Bridge Tips

A Closer Look at Small Cable Suspension Trail Bridges

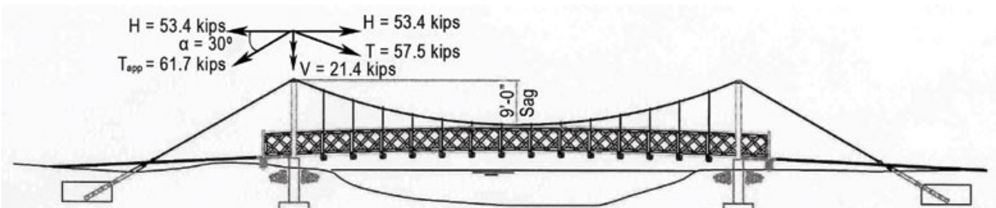
Before 1960, bridge design was done by hand using slide rules and simple methods whenever possible. Small suspension bridges were no exception. Fortunately, there are some simple, time-proven methods and guidelines that are still valid today for small cable suspension trail bridges.

Bridge geometry should be considered first. Cable sag should be 8 to 12 percent of the span length. Deck camber is for aesthetics only and should provide ADA accessibility. AASHTO Guide Specifications for Design of Pedestrian Bridges requires a load capacity of 85 psf with an allowable reduction for loaded areas over 400 square feet. This reduced load equals $85x[0.25+15/(A)^{1/2}]$, but not less than 65 psf, where A is the contributing load area for the member considered. Generally, secondary members are designed for 85 psf. The deck should also be designed for a 1,000-pound point load if there will be horse traffic. Snow load and small utility vehicles may be accommodated by the uniform live load and point load design, but should be checked to see if they control. Lateral bracing or sway cables should be designed for AASHTO wind load.

Hanger cable forces are calculated from the dead and live load on the contributing deck area for each hanger; in the case of the Rattlesnake Creek Bridge this was 2.25 kips. The factor of safety for cables and their connections must be greater than 3.0, therefore the minimum breaking strength for the hanger cables must be 6.75 kips or more. Standard galvanized steel bridge strand with a diameter of 1/2 inch and a minimum breaking strength of 30 kips is commonly used for the hangers because of aesthetics, and because smaller bridge strand and end connectors are not readily available. The hanger cable forces on the main cables may be approximated as a uniform load. This makes calculations simple and is usually close enough for small cable bridges. The horizontal cable force component is $H=wL^2/(8d)$, where w is the dead and live load weight per foot, L is the span length and d is the sag in the cable. For the Rattlesnake Creek Bridge, $H=0.475(90.0)^2/((8)(9.0))=53.4$ kips. The vertical force component is $V=(wL)/2$, or $V=0.475(90.0)/2=21.4$ kips. The maximum tension force, $T=(H^2+V^2)^{1/2}$ along the axis of the cable at the tower can then be calculated, in this case it was $T=(53.4^2+21.4^2)^{1/2}=57.5$ kips. The cable force on the approach span side of the tower must be checked since this varies with the angle of the cable on that side. This can be calculated from $T_{app}=H/\cos\alpha$, or $T_{app}=53.4/\cos 30=61.7$ kips (controls). The minimum breaking strength for the cable must be greater than $3(61.7)=185.1$ kips. In this case, a standard galvanized steel bridge strand 1 1/4 inches in diameter will provide a minimum breaking strength of 96 tons or 192 kips, which is greater than the required 185.1.

Common practice for cable anchors for small suspension bridges is to design them such that the total weight of each concrete anchor is greater than twice the vertical force component V of the main cable, and the earth pressure on the vertical surface of the concrete anchor caused by the horizontal force component H of the main cable does not exceed 2,000 psf.

Design of stiffening trusses is not covered by AASHTO, but a rule of thumb established by cable bridge pioneer John A. Roebling suggests designing the stiffening truss for an equivalent simple span equal to 40 percent of the actual span, for live load only, in order to achieve sufficient stiffness.



Rattlesnake Creek Pedestrian Bridge