UNDERSTANDING THE USE OF WEIGHT SPANS

This technical note was prepared to help you understand why it is much more efficient to describe the vertical capacity of Method 1 structures with three separate allowable weight spans rather than with a single allowable weight span as often done in traditional designs.

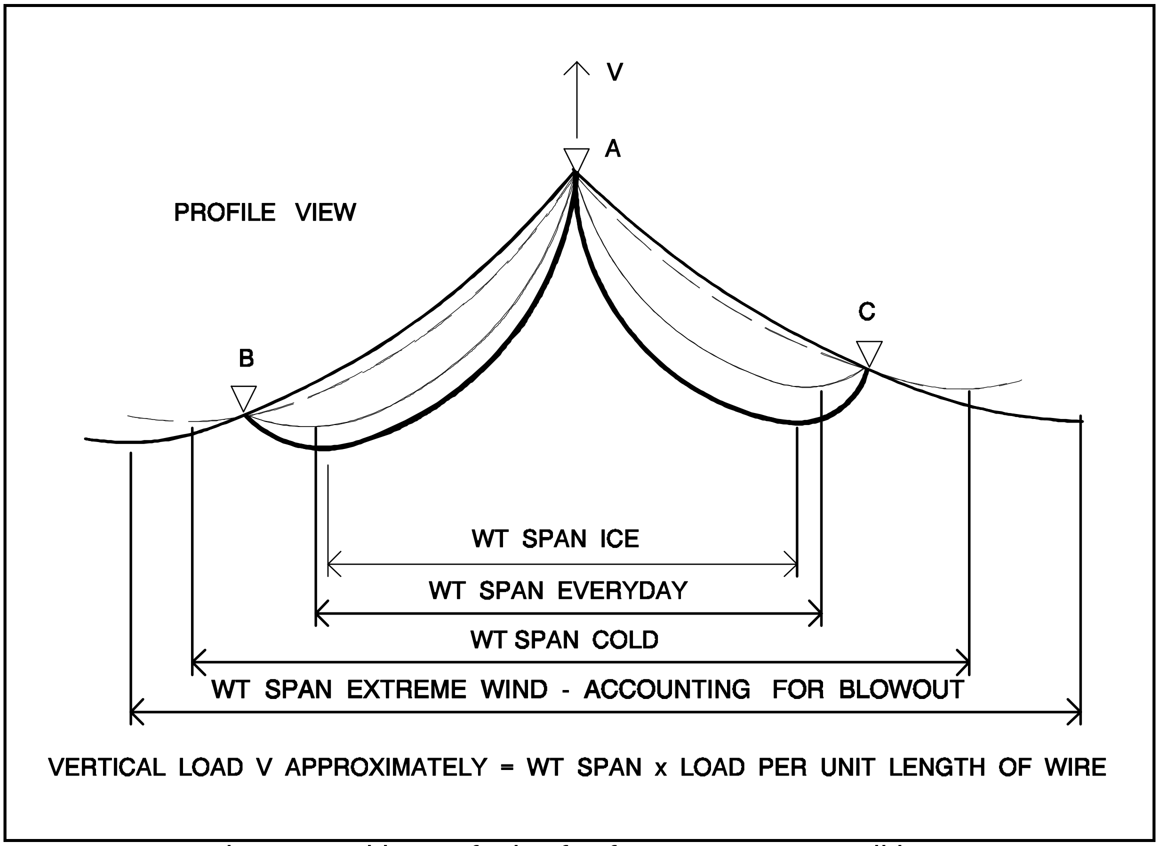

Fig. 1 Positions of wire for four separate conditions

In general, controlling vertical loads occur on structures located higher than those immediately to the left and to the right. Fig. 1 shows a profile view of such a structure supporting a single wire subjected to different weather conditions. The wire is represented for an everyday condition (say 60 degree F and no wind), an iced condition (say 1 inch of ice at 30 deg. F w/o wind), a cold condition (say -30 deg. F w/o wind) and an extreme wind condition (say 90 mph at 60 deg. F w/o ice).

V in Fig. 1 represents the vertical load applied to the structure at Point A by the wire which starts at Point B in the left span and terminates at Point C in the right span. For each weather case, the vertical load V is exactly equal to the vertical load per unit length of wire for the load case times the length of wire between the low point in the left span and the low point in the right span (that length of wire is the true weight span). This is the way PLS-CADD determines vertical loads, i.e. it uses an exact weight span. The low points may be imaginary points beyond the end of the spans as illustrated for the cold and extreme wind cases in Fig. 1. However, as an approximation, many designers assume that the length of wire between the low points is equal to the horizontal distance between these low points, i.e. they assume that the weight spans are the distances labeled WT SPAN in Fig. 1. This is a good approximation unless you are in steep hilly terrains.

For a situation like that depicted in Fig. 1, the physics of the behavior of a wire guaranties that: 1) the weight span under ice is smaller than the everyday weight span and 2) the cold and extreme wind weight spans are larger than the everyday weight span. For an inclined span, the position of the low point moves away from the higher attachment point as the span blows out under wind. This is why a blown-out span under extreme wind looks like a span under cold weather in the profile view.

For the wind, cold and ice cases, respectively, the vertical load V is equal to:

Bare wire weight x weight span for the wind case (Eq. 1)

Bare wire weight x weight span for the cold case (Eq. 2)

Weight of unit length of iced wire x weight span for the ice case (Eq. 3)

In Equations 1 to 3 and for the situation in Fig. 1, the unit weight of the iced wire is always larger than that of the bare wire but the weight span under ice is always smaller than those for cold and wind. Therefore, the largest vertical load can come from any one of the three equations and one cannot tell which of the three load cases (wind, cold or ice) controls the design in the vertical direction without checking the structure for these three load cases.

An indirect way of checking a structure for its ability to resist the vertical loads of Eqs. 1 to 3 is check the following:

Weight span for the wind case < Allowable weight span for wind case (Eq. 4)

Weight span for the cold case < Allowable weight span for cold case (Eq. 5)

Weight span for the ice case < Allowable weight span for ice case (Eq. 6)

In Eqs. 4 to 6 and for the situation in Fig. 1, the actual weight span under ice is always smaller than those for cold or wind, but the allowable weight span for ice is also always smaller than those for cold and wind. Therefore, again, there is no way to tell which condition controls without checking all three equations.

If someone were to use only one single value of allowable weight span to characterize the vertical capacity of a structure (which is unfortunately done quite often), that allowable weight span would be that of ice and it would also be used in Eqs. 4 and 5. Since the actual weight spans in Eqs. 4 and 5 are larger than that for Eq. 6, this would be too conservative. This is why it is generally wasteful of structure material to describe a structure by a single pair of allowable wind and weight spans. You should be aware of this issue (i.e. avoid the pitfall of using a single allowable weight span or a single interaction diagram between allowable wind and weight spans) when you model structures in **PLS-CADD** with Method 1 or Method 2.

Method 1 structure models:

For Method 1 models, you are asked, for each line angle, to enter maximum allowable weight spans for three weather conditions in the Structure Allowable Span table (see Section F.1.2.1 of the **PLS-CADD** manual). While it is not imperative that you do so, these conditions are normally Extreme Wind, Cold and Ice so that the checks of Eqs. 4, 5 and 6 above can be made separately.

Method 2 structure models:

For Method 2 models, you should generally provide separate interaction diagrams between allowable wind and weight spans for a minimum of three weather cases (load cases in Fig. F-12 of the **PLS-CADD** manual). These weather cases are normally Extreme Wind, Cold and Ice.

Automatic generation of Method 1 or Method 2 structure files from **PLS-POLE** or **TOWER**

Both **PLS-POLE** and **TOWER** have the ability to generate Method 1 or Method 2 structure files automatically from detailed Method 4 models.

In order to generate Method 1 structures, you will have to declare the three weather cases (usually wind, cold and ice) for which you will want allowable weight spans to be determined. This is now done in the top part of the **Wire Load Cases** table which you reach with **Loads/ Wire Loads** (see Fig. 1).

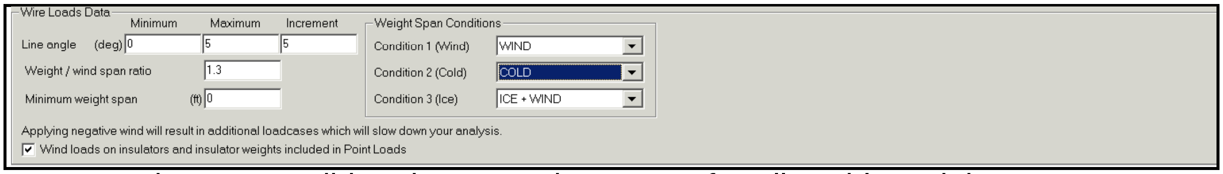

Fig. 1 Describing three weather cases for allowable weight spans

Data in the **Wire Load Cases** table can be generated automatically from **PLS-CADD** by using the **Structures/ Loads/ Write LIC File** command. You will be prompted for the three weather cases for which the allowable weight spans should be determined as shown in Fig. 2

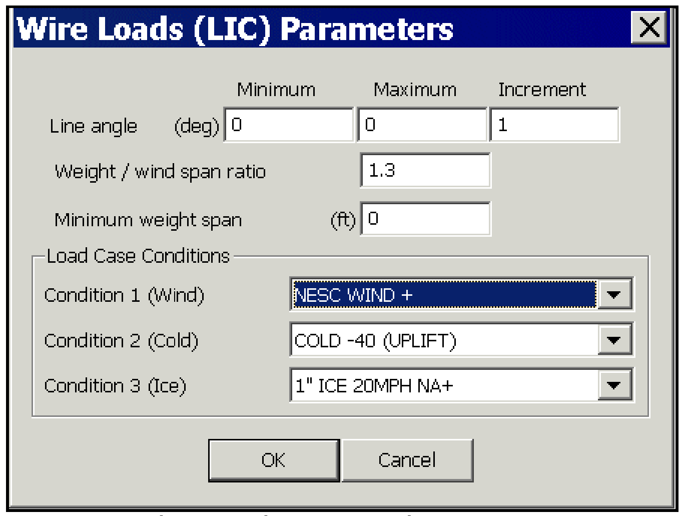

Fig. 2 Three weather cases

