

Steel Cable Creates Novel Structural Space Systems

Paper presented by LEV ZETLIN (January, 1964 Issue)

THE PORTION of the article dealing with "Elimination of Flutter—Double Layers of Cables," namely equations (11), (12), (13) and (14), seems to be sufficient to accomplish Step (c) on page 7, viz., to show that the natural frequencies of the two cables tend to diverge with the application of superimposed loading. However, the equations seem to be incomplete since they are given in terms of q_b where q_b is the weight of the cable only. The actual q that controls the natural frequency for a given T on a cable is dependent on the strut force and the cable weight. If the tension T_b is increased by ΔT_b , it seems that the q term in the denominator will also be increased. Likewise, if T_u decreases by ΔT_u , the q term will be decreased. Although $\Delta T/\Delta q$ is not equal to T/q due to the change in f_b and f_u , the fact that the q values change along with the T values tends to obscure the divergence of W_b and W_u .

If equation (10) is written independent of T and q , the divergence of natural frequencies may be shown more clearly. The writing of equation (10) independent of T and q is, of course, subject to the same limitations set forth in the article and only serves as a medium of explanation.

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Equation (10) as given:

$$W_n = n \frac{\pi}{L} \sqrt{T/(q/g)}$$

Equation 10 in terms of f/L ratio:

$$\frac{T}{q} = \frac{L^2}{8f} \sqrt{1.0 + 16 \left(\frac{f}{L}\right)^2}$$

Equation (10a):

$$W_n = \frac{n \pi}{L} \sqrt{\frac{gL^2}{8f}} \sqrt{1.0 + 16 \left(\frac{f}{L}\right)^2}$$

The term $16(f/L)^2$ will control so that as f is increased, W_n is increased. Conversely, as f is decreased, W_n is decreased.

If the cables are originally erected so that $f_u = f_b$ as shown in the example, the two cable systems will have the same natural frequency; however, any downward incremental load will tend to increase f_b and decrease f_u thereby increasing W_{nb} and decreasing W_{nu} and causing the natural frequencies of the two systems to diverge.

It also appears that if $f_u > f_b$ at the time of erection, a certain loading would make $f_u = f_b$, thereby equalizing the natural frequencies. Therefore, $f_u \leq f_b$ at erection.

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