

Cable design for continuous prestressed concrete bridges

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This extension to the published theory on this topic is to be welcomed, and I have one comment. Fig. 10 shows the limits on prestressing force along the 3-span bridge example. The maximum force shown is calculated from the extremity of the Magnel diagram. This could be called $P_{1\max}$. What is missing is the maximum force limits imposed by case 3, $P_{3\max}$. Following arguments similar to those in § 8 of the Paper and in §§ 15–20 of reference 4, it can be shown that for an internal span

$$P_{3\max} = f_{cw} A - \frac{\bar{M}_{LH} A}{Z_B} = \frac{Z_2 f_{cw} - \bar{M}_a}{Z_2/A} \quad (49)$$

84. From Fig. 7, it may be judged that for the centre span $\bar{M}_{LH} \approx 0.5 \times \bar{M}_{LS}$. Hence $P_{3\max} \approx 6.616 \times 16.5 - 0.5 \times 51.82 = 83.3$ MN. This is much less than the values of $P_{\max}$ plotted in Fig. 10. A similar derivation is possible for the end spans.

85. Introducing the concept of maximum cable force in continuous spans raises some interesting questions. Are cases 1 and 3 the only cases to impose maximum limits? Cases 2 and 4 are both governed by the limit on the cable profile amplitude. When there is an excess of force this will not govern. Hence cases 2 and 4 govern $P_{\min}$ but not $P_{\max}$. Are there complementary cases 5 and 6 which govern $P_{\max}$ but not $P_{\min}$?

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It is quite correct to state that other criteria could be derived. In the Paper, equation (19) was derived on the assumption that $e_{\min}$ is the limiting position of the line of thrust, and that this condition is governed by tensile stresses in the bottom fibre under the action of the maximum applied moment M_b . Mr Low's condition (49) is derived on the assumption that $e_{\max}$ is the limiting position, and that this is governed by compressive stresses in the bottom fibre under the action of the minimum applied moment M_a .

87. Clearly, there are many other similar relationships that could be derived, but this should not be allowed to detract from the main point of the argument: the prestressing force must be chosen such that a cable placed at $e_{\min}$ would give rise to hogging secondary moments, while one placed at $e_{\max}$ would give rise to sagging secondary moments. Under those circumstances, a concordant line of thrust between $e_{\max}$ and $e_{\min}$ can exist.

DISCUSSION

88. Mr Low raises the possibility that upper limits might exist on the cable force that correspond to the lower limits imposed by P_2 and P_4 . This is not the case, however, since P_2 and P_4 are limited by the maximum eccentricity determined by the section dimensions. Increasing the cable force decreases the eccentricity, and there are no corresponding lower limits on eccentricity that need to be introduced. There is no need to worry about possible limits on P_5 and P_6 .