Optimization of continuous post-tensioned bridge decks of prescribed lengths

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Abstract

Two or three span continuous post-tensioned beam type members are used occasionally in buildings and more often in bridges as psuedo slab-type decks. The minimum cost optimization of such a member involves basically a search for the optimum depth and the corresponding optimum cable layout which would yield minimum prestressing steel. The design procedure faces difficulty, due to two intrinsic problems: (1) the required prestressing force depends upon the secondary moments which however are caused by the primary moments from prestressing and (2) the requirements of the maximum positive and negative moments due to load effects dictate, in general, different prestressing forces leading to different number of tendons for an economical designs.

In this thesis, the constrained optimization problem is solved by using a linear programming in conjunctin with the 'gradient technique'. A combination of two types of tendons, full length and short length, are considered in seeking the best tendon arrangement. The constraints include the limits of permissible stresses both at the initial stage of prestressing and at the final stage, which must be satisfied at all sections throughout the beam. The variables are the depth of the member, the prestressing force (hence the area of prestressing steel) and the geometry of the rendon profile which is taken as segments of parabolas. While the approach is general to accommodate any imposed loading, uniformly distributed superimposed loading is considered for illustration and presentation of some data.