

Advantages of Utilizing Post-Tensioned Stress Ribbon Systems in Long Span Roofs

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Abstract : The stress ribbon system has numerous advantages that include but are not limited to increasing overall stiffness, control deflections, and reduction of materials consumption, which in turn, reduces the load and the cost. Nevertheless, its use is usually limited to bridges, in particular, pedestrian bridges; this can be attributed to the insufficient space that buildings' usually have for end supports, and/or back- stayed cables, that can accommodate the expected high pull-out forces occurring at the cables' ends. In this work, the roof of Västerås Travel Center, which will become one of the longest cable suspended roofs in the world, was chosen as a case study. The aim was to investigate the optimal technique to model the post-tensioned stress ribbon system for the roof structure using the FEM software SAP2000 and to assess any possible reduction in the pull-out forces, deflections, and concrete stresses. Subsequently, a conventional cable suspended roof was simulated using SAP2000, and compared to the post-tension stress ribbon system in order to examine the potential of the latter. Moreover, the effects of temperature loads and support movements on the final design loads were examined. Based on the study, a few practical recommendations concerning the construction method and the iterative design process, required to meet the architectural geometrical demands, are stated by the authors. The results showed that the post-tensioned stress ribbon system reduces the concrete stresses, overall deflections, and more importantly, reduces the pull-out forces and the vertical reactions at both ends by up to 16% and 11%, respectively, which substantially reduces the design forces for the support structures. The magnitude of these reductions was found to be highly correlated to the applied prestressing force, making the size of the prestressing force a key factor in the design.

Keywords : cable suspended, post-tension, roof structure, SAP2000, stress ribbon

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