THREE DIMENSIONAL FEM CALCULATION OF STRESS RIBBONS ON SADDLES

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Summary

Stress ribbon bridges are light and slender footbridges. Only two tension elements, so-called stress ribbons, are needed for the main load-bearing structure of the deck. Stress ribbon bridges fit our needs for resource-conserving structures, in respect of material savings and the reduced impact on the landscape. The stress ribbons are mounted on saddles to reduce the additional bending moments at the anchorage and on intermediate supports. The main objective of this paper is to discuss whether simple 2D calculations of stress ribbons on saddles will provide results for a safe design of stress ribbon footbridges. This investigation was carried out using different numerical models for a two-span stress ribbon bridge with intermediate supports. This paper compares the results of 2D FE models with those of full 3D FE models and provides conclusions for the practical design. It can be shown, that there are some typical 3D effects of the steel stress ribbons which are mainly caused by the Poisson's ratio. Those effects can only be found using a 3D FE model. The results of 3D FE calculations suggest that the effects for the chosen example spans and stress ribbons, particularly when made of steel, are of minor importance. It is therefore sufficient for a safe design of steel stress ribbons to calculate their behaviour at saddle supports with a simple 2D FE model.

Fig. 1. Stress ribbon bridge Slinky Springs to Fame in Oberhausen / Germany (photo: Christoph Hasler)

Keywords: stress ribbon bridge; saddle; contact pressure; detachment point; sag; fatigue; FEM; 3D model.

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