Indirectly Supported Bridges – Large-Scale Experiment

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Summary

For concrete bridge structures, the currently valid Swiss code, SIA 262:2003 [1], stipulates that in case of indirect support conditions, force transfers need to be checked utilizing stress fields. This is necessary to guarantee that sufficient hanger reinforcement is provided in load application areas. If the total shear force is supported by hanger reinforcement, it is possible to investigate static actions in the longitudinal and transverse beams independently of each other; otherwise, the load bearing capacity depends on the interaction between the longitudinal and transverse beam [2].

In order to investigate the influence of insufficient hanger reinforcement on the strength of indirectly supported beams, a large-scale experiment was conducted at the University of Applied Sciences and Arts, Lucerne [3]. The prestressed test specimen reflected a continuous, single celled box girder in the region of continuous support. The experiment clearly illustrated that the ultimate load and the failure mechanism of an indirectly supported concrete structure strongly depend on the reinforcement arrangement and the detailing. Furthermore, the deformation capacity of the plastic hinge also largely depends on the reinforcement arrangement.

Keywords: Bridge, Indirect support, Brittle failure, Strength reserve, Plasticity theory, Stress field models.

1. Research Significance

For concrete bridge structures, current structural codes, like the SIA 262 [1], require that in cases of indirect support conditions, force transfers need to be checked utilizing stress field models. This is necessary to guarantee that sufficient hanger reinforcement is provided at cross-section discontinuities. If the total shear force is supported by hanger reinforcement, it is possible to investigate the load path in the longitudinal and transverse girders independently of each other.

Many existing, older, indirectly supported reinforced concrete bridge structures were designed with insufficient hanger reinforcement. Thus, for these older bridges, it is necessary that the interactions between the longitudinal and the transverse force flows be considered. The strength of the entire system is largely dependent on the arrangement of the reinforcement in the transverse beam and the resulting stress fields in the longitudinal and transverse beams. To avoid or minimize expensive strengthening a better understanding of the statics taking into account the reinforcement arrangement is necessary.

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