Slim-Floor Girder – Experimental tests and design rules for the deflection

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Summary

Slim-floor girders form an attractive alternative to usual reinforced concrete flat slabs. However their effective design suffers from assumptions concerning the effective width of the concrete chord which are not reflecting the real deflection behaviour. This paper reports on investigations concerning the deformation of slim-floor girders including experiments on single-span and two-span continuous girders as well as analytical evaluations. The test results promise the advantageous possibility to increase the assumed ratios of the effective width for the design of slim-floor girders in serviceability limit state (SLS) and thus to improve the calculation of realistic deflections.

Keywords: Slim-floor girder; single-span and two-span continuous girder; effective width

1. Introduction

Due to the shallow height of composite slim-floor girders the structural and even more the deflection behaviour differ decisively from normal composite girders.

The contribution of the concrete chord to the effective moment of inertia $I_{i,0}$ of the composite cross section and the bending moment M_c of the concrete chord are not negligible for the total bearing capacity of the composite section. The concrete is in cracked condition already under service loads also in regions of sagging bending moments. These two effects are not considered when calculating the deflections of composite girders based on the effective width given in the codes. Due to the higher stiffness of the cross-section the deflection of the girders is lower than calculated with the effective width according to the current codes [1]. Therefore single-span girder tests and two-span girders tests were executed to investigate the deflection and load bearing behaviour. The aim is to derivate a calculation model for the deflection.

2. Structural behaviour of slim-floor girders

Regarding the smooth strain distribution of a normal height composite girder it can be seen that the neutral axis normally lies in the steel section and the concrete chord is under pure pressure [2]. Thus, under service loads the concrete chord remains uncracked (Fig. 1). The difference of the concrete strain from the top to the bottom side of the concrete plate is very small; therefore the bending carrying capacity of the concrete can be neglected for the calculation of the total bending carrying capacity. Normally only the bending moment of the structural steel girder and the axial forces of the composite action are considered.

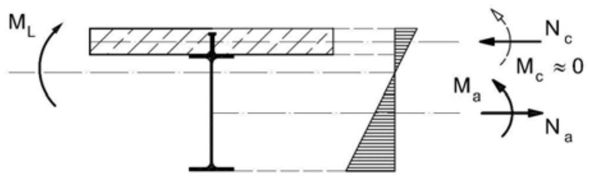

Fig. 1: Structural behaviour of a normal height composite girder

For the calculation of the deflection of a single-span girder linear-elastic calculation approaches can be used. For two or multi-span girders and due to the hogging moment at the mid supports the concrete chord cracks and the girder stiffness has to be reduced (Fig. 2).

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