Influence of detailing on shear in existing concrete viaducts

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Summary

For a lot of existing concrete bridges and viaducts a sufficient safety against shear failure can be proved with an in depth structural assessment based on the present design regulations and taking into account hidden capacities, such as an increase in strength in time in the actual structure in regard to the design strength. However some structures still have a lower reliability value. As an example of this, in this paper a few bridges and viaducts, on which the road-capacity had to be increased, are presented. It is illustrated that, with the knowledge of today, the detailing of prestressing or reinforcement and changes of cross-sections in these structures causes lower reliability values as designed.

Keywords: Shear; detailing; concrete bridges; assessment; recalculation.

1. Introduction

Because of the large traffic-jam problems in the Netherlands the road capacity of motorways will be increased in the next years by creating rush-hour lanes. Therefore many existing structures in these motorways are structural assessed by the taskforce for Rijkswaterstaat program “Widening of the roads” ZSM (Dutch abbreviation of visible, smart, measurable). These assessments proves that in the Netherlands the design regulations for reinforced concrete before approximately 1975, often results in far less reliability values on shear then required nowadays. [1, 2]

This was the reason for Rijkswaterstaat Centre for Infrastructure of the Dutch Ministry of Transport, Public Works and Water Management, to start an extensive shear-program. One of the main tasks of this program was to quantify possible hidden capacity in these structures. The following hidden capacities were found:

- Actual concrete compressive and tensile splitting strengths measured on drilled cylinders can be up to or even more then two times as high as accounted for in the design;
- Improving modelling of the dispersion of especially the concentrated mobile loads gives shear force reductions up to 20%;
- Allowing decreased partial safety factors on loads, if actual concrete strengths and dead weights are measured; (up to 10% reduction)
- Allowing for a reduction factor on mobile loads if remaining life-span (reference period) is less then 100 years. (shear force reduction 3-17%)

Using these refinements in combination with the Dutch design regulations in an in-depth structural assessment often a sufficient safety against collapse on shear can be proved. However some structures still have too less reliability values.

As an example of this, in this paper a few bridges and viaducts, on which the road-capacity had to be increased in the ZSM program of Rijkswaterstaat, are presented.

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