DIANA Users Association

Lecture evening DIANA Users Association

11 March 2026, Arcadis, Amersfoort

19:00 Opening - Ane de Boer, chairman Association

19:05 Welcome Arcadis, Coen van der Vliet

19:10 Concrete bridges with half-joints containing non-compliant reinforcement details: Ongoing research in The Netherlands
Ricky Tai, TNO and Delft University of Technology

In The Netherlands, a considerable number of concrete bridges with half-joints contain reinforcement detailing that no longer comply with current design codes, as these codes have been updated to reflect new insights and improved understanding of concrete mechanics. At present, no robust, accurate and validated assessment method is available for this type of structure. Moreover, the half-joint detail is particularly susceptible to reinforcement corrosion due to the use de-icing salts, while inspection is often impossible without disrupting the traffic. Altogether, these factors complicate the reassessment of such bridges.
To address these challenges, ongoing research is being conducted in The Netherlands. This presentation provides an overview of the collaborative research activities between Rijkswaterstaat, TNO and Delft University of Technology. It places the current activities performed by the engineering companies in context and offers insight into the related ongoing PhD projects at the Delft University of Technology.

19:35 Questions

19:40 2D Nonlinear finite element analysis of half joints in existing bridges and viaducts
Marcel Janssen, Witteveen+Bos

In the past half joints (dapped ends) have often been used in concrete bridges and viaducts. One of the reasons for using half joints is to shorten the span or to reduce the height of the construction. In practice these half joints have proven to be critical in terms of structural safety because of two reasons. On the one hand because they are very maintenance-sensitive, for example when expansion joints leak for prolonged periods. On the other hand because the force distribution in half joints was often insufficiently understood in the past, resulting in unfavourable detailing of the reinforcement which does not comply with modern standards. In order to determine the structural safety of half joints, Rijkswaterstaat has initiated a programme to reassess all half joints within their portfolio. In collaboration with TNO a temporary approach has been developed. An important part of this approach is a 2D non-linear finite element analysis to estimate the capacity of the half joints. Currently, six parties are using this approach to the determine the structural safety of these half joints. Experiments to validate the approach will be carried out at TU Delft in the near future (among others by Ricky Tai of TNO).
This presentation will illustrate the approach using an example of an existing bridge. In a number of cases the half joint turns out not to be critical, other parts of the construction are governing. This leads to model modifications to determine the capacity of the half joint. Finally, two other structures are shown with other notable aspects.

20:15 Questions

20:20 System behaviour in prestressed concrete T-beam bridges
Sebastiaan Ensink, Volker InfraDesign

About 70 prestressed concrete T-beam bridges, constructed in the Netherlands between 1953-1977, are still in use today with many located in the main highway network. This type of bridge consists of prefabricated

and prestressed T-shaped beams, with an integrated deck slab, cross-beams and transverse prestressing. Even if these bridges are well maintained, two important factors demand the current need for assessment: (1) increased traffic loading and (2) potential lack of shear resistance. Using traditional assessment methods it was concluded that about 50% of these bridges do not fulfil the current design code requirements. However, this does not automatically imply that these bridges are structurally unsafe, since some potentially significant additional load-transfer mechanisms are not taken into account in a traditional assessment. This is strengthened by the observation that, in general, these bridges do not show any signs of distress.
In previous research the integrated deck slab with transverse prestressing was investigated and a substantially higher load capacity was found due to the presence of compressive membrane action (CMA). For the current research, the focus is on the load capacity of the main T-beams. The main characteristics and shear-related deficiencies for the Dutch T-beam bridge stock are therefore investigated. The presence of 2--4 cross-beams in each span, as well as transverse prestressing, in both the integrated deck slab (CMA) as well as the T-beams, with the latter designated as compressive arch action (CAA).
The main part of this research is related to a case study of a typical Dutch T-beam bridge called the Vecht bridge. The Vecht bridge is a multispan T-beam bridge, constructed in 1962, located near the town of Muiden crossing the Vecht river. Using a single concentrated load at the centre of the T-beam at two different *a*/*d* positions, seven full-scale collapse tests are conducted on this bridge prior to its scheduled demolition. Three tests are conducted with the original structural system unchanged. On a separate span, four tests are conducted on individual T-beams, with the deck in-between the beams sawn in the longitudinal direction. The two types of tests allow for a direct comparison between the load capacity of an individual T-beam versus a connected T-beam. The individual beam tests resulted in a flexural shear failure, whereas the connected beam tests resulted in an explosive failure for both the bridge deck (punching failure) and the T-beam (shear failure).
The case study is extensively analysed with conventional cross-sectional evaluations for shear and bending and using nonlinear finite element analysis. In addition, a generic analytical model for arch action is derived, to investigate the effects of CMA and CAA. Following the conventional assessment, using a linear model for the load effect and a cross-sectional analysis for the verification, the governing failure mode for connected T-beams is shear tension. On the contrary, analysing an individual simply supported T-beam, the governing failure mode is either the ultimate bending moment at midpoint or flexural shear close to the support. Using a full 3D nonlinear finite element model of the complete span with 15 beams, the experimentally observed failure mode(s) are confirmed. In addition, the model allowed insight in the development of the mechanisms of CMA and CAA. With the exception of the stiffness of the elastomeric bearings, no other parameters needed to be calibrated. From the numerical parameter study, an optimal incremental-iterative solution method combined with an automatic adaptive step size method has been found resulting in nonlinear analyses in which all steps are converged, regardless of the size of the finite element model.
Using the experimental, numerical and analytical methods, it is demonstrated that for T-beam bridges a combination of compressive membrane action (CMA) and compressive arch action (CAA) contributes to the 'system behaviour', which differs significantly from the behaviour of an individual T-beam. Compressive membrane action (CMA), and the corresponding increased (punching) capacity, is found in the deck in case of a (concentrated) load at the centre of a T-beam. Compressive arch action (CAA), and the corresponding increased shear capacity, is found in the T-beam in case of a (concentrated) load positioned in-between the cross-beams. This research has explained and quantified the contribution of the aforementioned mechanisms resulting in an increased capacity for these types of bridges. These effects are not considered in a traditional assessment.

20:50 Questions

21:00 Closure