DIANA Users Association - Lecture Meeting 7 February 2024

NDC Den Hommel, Kennedylaan 9, 3533 KH UTRECHT

19.00 Approach Fib/TU Delft - BEAM BLIND PREDICTION CONTEST

ABT

The research over the past decades in the field of concrete structures has greatly expanded the modelling techniques of concrete structures in terms of both numerical and analytical models. Blind prediction contests using complex experiments have been recognized as a useful tool to verify the various models and to possible improvements. For that reason, at TU Delft, we have been organizing a series of blind prediction contests since 2014. The selection of the experiments for the contests is based on the principle that they should have the configurations that can reflect a typical construction type, and, at the same time, the type of experiments should not be commonly reported in literature. The past four contests were very well received and were used as valuable inputs of applications such as improving the modelling strategies in the Dutch guidelines for non-linear analysis of concrete structures.

As the newest edition of the blind prediction contest, we are proposing **to predict two upcoming experiments on two full scale precast continuous concrete inverted T beams**. This is a part of the research program on safety assessment of existing precast concrete bridges, financially sponsored by Rijkswaterstaat, Dutch Ministry of Infrastructure and Watermanagement. The specimens are designed to represent typical multi-span precast girder bridges. They were made by precast inverted T beams and made continuous on-site using a cast-in-situ topping layer. Many detailings of this type of structures do not fulfill the requirements of the modern design codes anymore and are often seen in the existing structures in many countries in the world, like having very low shear reinforcement ratio. And because of the complex construction process, it is challenging to predict their resistance with generally available models (both analytically and numerically). The details of the two experiments can be find at the experiments description page.

19.20 Discussion

19.25 Nonlinear analysis of concrete bridges and viaducts with dapped-ends

TNO

Existing concrete bridges and viaducts with dapped-ends (tanden en nokken) in the Netherlands have gained attention in the recent past over their structural performance. A distinctive feature of these structures is that the main suspension reinforcement (ophangwapening) is bent away from the dapped-end. This detail has sparked discussions about whether the traditional assessment methods based on static equilibrium could reliably predict a potential brittle shear failure. For this instance, Nonlinear Finite element Analyses (NLFEA) can be used to gain insight on the structural behaviour, and potentially offer an alternative to the traditional assessment methods. However, given the impact of modelling choices on the predicted failure mechanism, there is a need for a robust and validated modelling strategy specifically for dapped-end beams in the Dutch context. To this end, initial steps have been taken through the assessment of two benchmark experiments representative of the Dutch dapped-end beams using NLFEA in DIANA. The findings of this study shall be presented and they reaffirm the importance of a robust and validated modelling strategy.

19.45 Discussion

19.50 Nonlinear reassessment of prestressed T-girder bridge with surprising outcomes

Arcadis

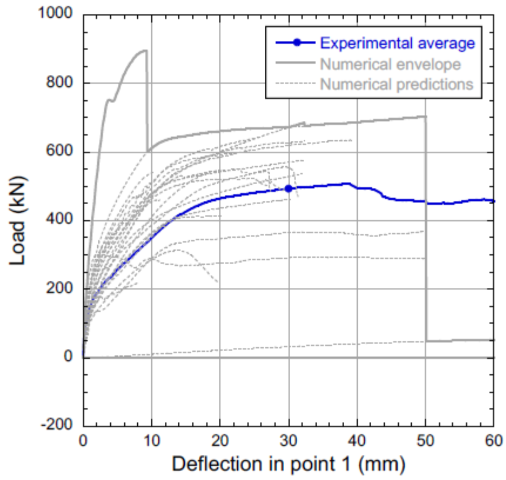
The Amsterdamsebrug is a steel tied arch bridge crossing the Amsterdam-Rijnkanaal. The concrete approaches of the bridge consist of multiple statically indeterminate sections, each composed of prestressed T-shaped girders with cast-ins. A Quick scan assessment of the approach proved insufficient bearing capacity in shear, with tension-shear as governing mechanism. A nonlinear reassessment was carried out to analyse the structural behaviour prior to and after the development of the critical shear crack. The governing girder was modelled with solid elements, all other parts with shell elements. The calculations started with a creep and shrinkage analysis under SLS loads, followed by a failure analysis in which the loads were incremented up to failure. The results of the analysis (including the sensitivity study) provide useful insights in the behaviour of such a structure. The lecture gives an overview of the model and the most relevant results. In addition, it will evaluate the added value of model choices such as the decision to do a full creep and shrinkage analysis and the choice for solid elements.

20.10 Discussion

20.15 Approach fib 3RD BLIND SIMULATION COMPETITION, "Simulation of slabs reinforced with conventional flexural reinforcement and fibres subjected to punching loading configuration"

ABT

This benchmark and the rules of the competition were announced in Februray 2023. Information about the properties of the materials at the age of 22 days was communicated at 10th April 2023. A total of 25 teams submitted 29 proposals, from which 25 proposals were considered in the final classification of the competition, corresponding to those submitted in proper time and format. Experiments were conducted at 18th and 27th of July 2023 on two slab prototypes for the appraisal of the predictive performance of the simulation proposals. The last test was transmitted in real time through a youTube channel. The videos of the tests can be found in the following links: https://youtu.be/Ru0szbEXWCo,
https://youtube.com/live/d6kIRS6_tPQ. The experimental results and those of the simulations were then analysed. The final classification was communicated to the participants on 29th September 2023.
The following sections of the current report present the name of the participants, the experimental results, the numerical results, and the performance of the numerical predictions.
Predictive results of the teams



(a)

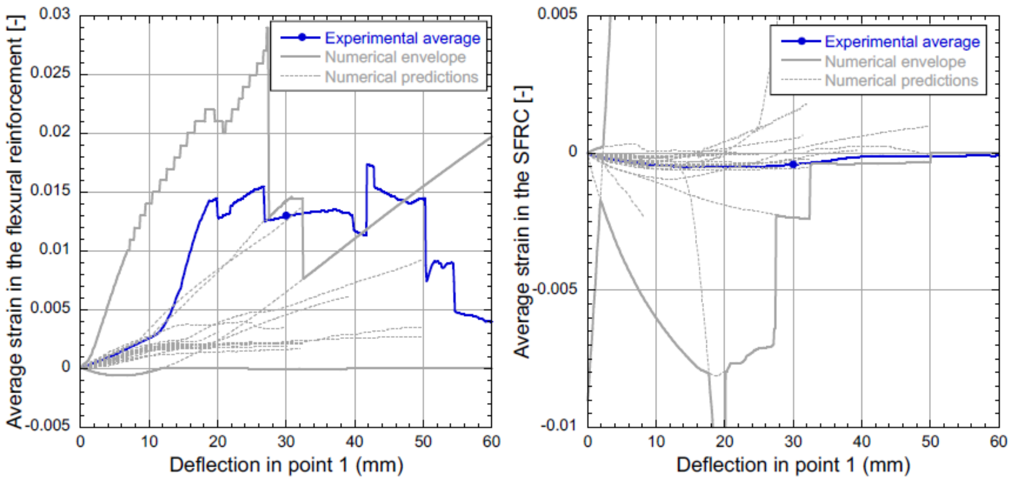


Figure 1. Experimental average, numerical envelope, and numerical predictions of all participants regarding the: load versus deflection in point 1 (a), average strain in the flexural reinforcement versus deflection in point 1 (b), and average strain in the SFRC versus deflection in point 1 (c)

20.35 Discussion

20.40 Closure + Refreshment