

Lecture evening DIANA Users Association

22 October 2026, Haskoning, Amersfoort

16:00 General Meeting of Members

17:00 Meal

18:00 Opening Technical Lecture Evening & Welcome Haskoning.

18:00 Modelling indirect supported diaphragms in existing concrete box-girder bridges

Johan van Dam, Haskoning

The assessment of existing post-tensioned concrete box-girder bridges with diaphragms with indirect support of deck webs remains a challenging task. Especially when assessing the suspension reinforcement. In original design approaches a verification of the principal tensile stresses was deemed sufficient and no suspension reinforcement was applied in indirect supported diaphragms. Nowadays suspension reinforcement is designed for by strut and tie models, and thus the question arises whether existing bridges without suspension reinforcement can be considered safe. A comparative study is being undertaken on a representative two-cell box-girder bridge, focussing on the middle support, which is supported centrally.

The study evaluates four numerical modelling strategies with increasing levels of sophistication. The first model consists of a model using 2D shell elements with prestressing represented as external loads and linear-elastic material behaviour. This approach reflects current engineering practice and provides a computationally efficient benchmark. The second model uses a linear-elastic, 3D solid model of solely the diaphragm, in which the transverse post-tensioning cables are modelled physically and all the other loads are modelled as external loads. The third model combines the first and second model, such that the global bridge is modelled with 2D shell elements with the localized 3D-solid region around the diaphragms. The fourth model extends the third approach by incorporating nonlinear material behaviour and cracking for the 3D-solid zone, enabling the influence of tensile fracture and stiffness degradation to be assessed.

The main objective of the study is to quantify the differences in principal tensile stresses in the diaphragm and at the diaphragm-web interfaces between the four modelling approaches. The results are expected to establish the level of modelling complexity required for reliable assessment, identify situations where simplified shell models remain acceptable, and provide the basis for a practical and technically justified assessment methodology for existing concrete box-girder bridges.

18:35 Questions

18:40 Structural Reinforcement of Masonry Quay Walls

Stan den Hartog, Witteveen+Bos

Many historic quay walls in Amsterdam are founded on timber piles and are increasingly affected by ageing, deterioration and changing loading conditions. Rather than replacing these structures entirely, strengthening measures can be used to extend their service life while preserving as much of the existing structure as possible.

This presentation discusses several quay wall projects in which steel tube piles are installed as a replacement or supplementary foundation system. The piles are connected to the existing masonry through mortar, allowing loads to be transferred from the historic structure to the new foundation. Over the past years, this strengthening concept has been applied and further developed for a range of quay wall configurations and project-specific conditions.

The introduction of the new foundation system significantly changes the load transfer within the quay wall. Whereas the existing masonry originally functions primarily as a gravity wall, the strengthened structure is subjected to additional forces and bending moments introduced by the steel tube piles. As a result, the masonry must fulfil a more active structural role than in the original configuration.

DIANA FEA is used to investigate whether the existing masonry can safely resist these additional actions and to assess the interaction between the masonry and the strengthening system. Nonlinear finite element analyses are applied to evaluate the resulting stress distribution, load transfer and potential failure mechanisms. The presented case studies

demonstrate how this approach can be used to verify strengthening measures and support the safe extension of the service life of existing quay wall structures.

19:15 Questions

19:20 Case study of microseismicity near salt-production caverns in the Netherlands

León González Acosta, TNO

Salt-production caverns play an increasingly important role in the Dutch economy, and maintaining their mechanical integrity is essential for safe operations. Microseismic monitoring provides valuable information on cavern integrity and damage evolution within the surrounding salt; however, the physical mechanisms responsible for the recorded events remain poorly understood. This study investigates the origin of microseismicity at the Zuidwending salt cavern field in the Netherlands, which comprises a series of solution-mining caverns. An integrated analysis combining microseismic observations, operational data, and numerical geomechanical modelling was conducted to identify the processes governing event occurrence. This involved evaluating spatio-temporal correlations between microseismicity and cavern operations, investigating stress evolution around the caverns, and assessing the influence of geological heterogeneities. The results show that microseismicity is predominantly concentrated near the cavern bottoms. Numerical simulations indicate that stress concentrations in these areas are sufficient to promote shear failure, while nearby anhydrite layers and contrasts in creep behaviour can further localise these stress concentrations. Together, the observations and numerical results indicate that shear failure within the salt and anhydrite layers is the most likely mechanism driving the observed microseismicity.

19:55 Questions

20:00 Closure