Abstract FEM modelling for St. Petersburg Flood Barrier

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The construction of the St. Petersburg flood barrier will be completed in 2012. The design activities started in the Soviet era in the 1970's. Construction was started in the 1980's and was interrupted between 1991 and 2002. Prior to restarting construction Royal Haskoning was involved in project management and in design assessments. A couple of complicated technical issues were verified with FEM calculations with help of DIANA.

The large navigation opening of the flood barrier consists of two floating segment gates which have a stand by position in docking chambers on both sides of the navigation channel. Ball hinges allow the gates to be rotated to the position in the channel and to be lowered on the channel bottom with an immersion process.
The ball joints are relatively small. During operation under storm surge condition the ball joints need to transfer a 100 MN force.
A Diana simulation with contact elements was performed in order to verify the manual design calculations.

A second Diana simulation was performed to verify the stress distribution and safety levels of the massive concrete walls of the docking chambers. The docking chambers are mass concrete gravity structures resting capping beams on stiff clay layers. They were constructed in the dry. The soil-structure interaction was not sufficiently addressed in the original design calculations and the amount of applied rebar needed verification. A number of models were made, where the results of 2D and 3D element modelling were compared. Also the applied geometrical simplifications were verified with more accurate models where the actual curved geometry of the docking chambers was modelled.

The Diana modelling appeared a strong support in the verification process and the communication about the reliability of the design.