Floating Bridge Design and Optimization
Are We Modelling the Wave Loads Accurately?

Compared to a ferry, a bridge is a faster and more efficient means of transportation between islands or across fjords. The Øresund bridge between Denmark and Sweden has proven to benefit both countries by allowing increased transport of people and goods at lower expense. A floating bridge supported by pontoons is a good option when it is impossible to use conventional bridges.

Recent developments in floating bridge technology suggest that the use of a horizontal bottom flange in the pontoon design may reduce the costs of floating bridges significantly. This idea, supported by an existing simplified analysis method from the offshore industry, has however, not been validated for floating bridges under design wave conditions, which are very different from the typical conditions encountered by offshore structures. Important questions in this regard are what are the uncertainties of using such a method in bridge design, and how can we in general model the wave loads on bridge pontoons in an accurate and efficient manner?

In this project, we will:

1. Assess the existing simplified wave-load model by analyzing dedicated model test results for the bridge pontoons;
2. Perform a custom CFD analysis to understand the underlying mechanics when the existing simplified method becomes less reliable;
3. Propose improvement to the existing simplified method;
4. Investigate the scaling effects of the wave loads on the pontoons, which are important when extrapolating the findings from model scale to full scale.

To demonstrate the importance of the accurate wave-load model, this project will involve collaboration with the Norwegian University of Science and Technology (NTNU), on the global structural performance analysis of the Bjørna-fjord floating bridge design in Norway. The improved wave-load model from this project will be applied in a coupled hydrodynamics-structural model, recently developed at NTNU.

It is expected that this project will identify the limitations of the existing simplified method being used in floating bridge design, propose improvements to the method, and develop a deeper knowledge of the interaction between floating bridge pontoons and typical wave conditions in fjords. With the completion of the project, a seminar will be organized at DTU to communicate the results with industrial engineers concerned with the design and construction of floating bridges. This project will also involve two Master's theses on floating bridges in waves, with primary supervisors at DTU, and co-supervisors from NTNU, COWI and the Norwegian Public Road Administration (NPRA).