

Innovative design of steel girders for cable-stayed bridges

This industrial PhD project is a cooperation between DTU Civil Engineering, DTU Mechanical Engineering and COWI's department of Major Bridges International. The project will furthermore involve COWI's bridge experts from COWI UK and COWI North America. This way, we will draw on COWI's worldwide, leading expert knowledge in orthotropic bridge decks. The three-year project will run from 2017 to 2019. The main purpose of the project is to study and develop new innovative design concept for steel girders for large cable-stayed bridges.

Since the 1950s, the design concept for steel girders has remained more or less the same for cable-stayed bridges. This conventional design in the shape of orthotropic steel decks has been widespread, but the past decades have seen the potential of the design practically exhausted. In other words, with the current design, the possibilities of further reducing the weight and increasing the span considerably are exhausted. Consequently, it is in COWI's interest to learn of new design possibilities.

The project's objectives are, by developing a new innovative design of steel girders for cable-stayed bridges, to reduce the weight, increase the span, reduce/eliminate fatigue issues and reduce the total costs. By reducing the weight of the bridge girder, it will in turn be possible to reduce the volume of materials for the other parts of the bridge (cables, pylons and anchor blocks), which will benefit both the total costs and the environment.

The focus area of this project is to optimise and develop innovative design concepts for steel girders in order to meet the objectives above. The focus area is methodically supported by knowledge of optimum structural principles, practical knowhow and state-of-the-art optimisation tools that are able to handle the complex task of developing a design concept that utilises new/alternative materials, considers stability and secures an optimum design as regards production, supervision and maintenance. Therefore, it is in DTU Civil Engineering's and DTU Mechanical Engineering's interest to demonstrate how developing and applying optimisation methods can be used to develop and strengthen a specific structural concept.

Major cable-stayed bridges are vital for COWI's strategy to remain the world's largest bridge consultant. The new design concept is expected to lead to a reduction in material use and fatigue problems as well as lower production costs, without increasing the costs of operation and maintenance. All above aspects and expected results are essential to the continued technical and innovative development of both COWI's bridge expertise and COWI as a whole.

One of the project's massive strengths is that it combines COWI's vast experience gained through years of work on the largest bridges in the world with joint insight into optimum structural principles and the knowledge held by DTU Civil Engineering and DTU Mechanical Engineering on new numerical modelling tools for optimisation of structures.