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Fully automated global analyses of long-span bridges at a detail design level

Tor Martin Lystad
tor.martin.lystad@norconsult.com
Norconsult AS
Sandvika, Norway

ABSTRACT

Long-span bridges require special analyses when addressing the global forces in the system. For cable-supported bridges, geometric nonlinearities become crucial for the structural behaviour and must be treated with care. The slender structural systems make them prone to dynamic actions from wind and wave loading. In this paper, a framework for an automated system that addresses these specific needs of long-span bridges is presented. The system covers structures such as suspension bridges, cable-stayed bridges, and floating bridges. It employs commercial tools like ABAQUS as a FEM calculator, while handling traffic loads and load combinations directly within the system. Results reporting is automated, and the results can be accessed interactively through a web page interface. The framework also includes links to special design tools and BIM models. The system also includes a state-of-the-art software named DynNO, developed by the author, to handle stochastic dynamic analyses including both wind and wave loading. The system performs fully automated analyses at a detail design level, providing a unique basis for optimization. The proposed framework offers flexibility and agility in demanding detail design processes, as well as the possibility of performing high-level analyses in early phase projects.

Keywords: Automated analyses, Global analyses, Long-span bridge, Dynamic analyses

1 INTRODUCTION AND BACKGROUND

Norconsult AS is Norway's largest multidisciplinary engineering consultant company, and it has a well-renowned department that specializes in the design of bridges. The bridge department has been working on long-span bridges for many years, with the design of the Hardanger Bridge, Norway's longest suspension bridge with a main span of 1310 m, being one of the most famous projects. Norway is a country with a long tradition of long bridges due to the complexity of the Norwegian landscape. Suspension bridges has been a particular specialty in Norway. According to the database established by bridgemeister.com [1], Norway is by far the country with the most suspension bridges per capita among the countries with more than 100 suspension bridges (small and large, See Figure 1).

Several long-span bridges have been designed, and built, in recent years, and more are in the planning stages for coming years. Norconsult is heavily involved in many of these projects. Two of Norconsult's key strategic pillars are digitalization and sustainability. This has driven the development of digital working methods with the aim of automation and optimization. For the design of long-span bridges, we have built automated systems based on the methods and experience we have developed over many years of designing large bridges. The system presented

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