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The Environmental Contour Approach Is Used To Model the Buffeting Response of Long-Span Bridges with Unclear Turbulence Parameters

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Introduction

Long-span bridges are increasingly being used to cross longer passages in international bridge engineering. More daring bridge crossings, such as the Messina Strait and the Strait of Gibraltar, are being considered as experience and development progress. The Norwegian government intends to construct a continuous motorway along the country's west coast. A motorway like this would have to cross multiple fjords with extremely long-span bridges, displacing current ferry links. Many of the bridge concepts being considered are incredibly thin, such as floating bridges with spans up to 5500 metres and suspension bridges with major spans exceeding 3000 metres.

The design stresses for these sorts of structures are governed by the buffeting response from turbulent wind loading, hence uncertainties related to the description of the turbulent wind field must be adequately handled because it has a substantial impact on overall structural reliability. The Norwegian University of Science and Technology has been measuring the wind field characteristics and acceleration reactions of the Hardanger Bridge, Norway's longest suspension bridge, at full size since 2013. The measuring campaign's findings have been published in a series of papers. The measured dynamic response shows significant turbulenceinduced variability. Several full-scale measurement experiments on long-span bridges have been conducted around the world, and the measured response has shown similar variations.

Only the mean wind velocity is handled as a stochastic variable in traditional long-span bridge design approach since it is regarded a very dominant load characteristic. Following that, deterministic turbulence parameters are chosen based on design codes or site data. Long-term severe response simulations have long been the gold standard for designing wave-stressed offshore buildings [18]. The load parameters and the short-term extreme reaction can be considered as stochastic variables in such calculations. The environmental contour method is a useful tool for estimating the long-term extreme reaction using a shortterm extreme value analysis.Only the variability in the load parameters is directly evaluated in this method, which decouples the variability in the ambient parameters from the variability in the extreme reaction itself. Choosing a higher percentile of the short-term extreme response probability distribution as the design value frequently simplifies the effect of extreme value uncertainty. Several methods, including the inverse first order reliability method (FORM), inverse second order reliability method (SORM), highest density contour method (HDC), and Monte Carlo simulation, can be used to create environmental contours. The most popular method is the inverse FORM, which is used in this study.

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