Bauhaus-Universität Weimar

Institute of Structural Engineering
Chair of Modelling and Simulation of Structures
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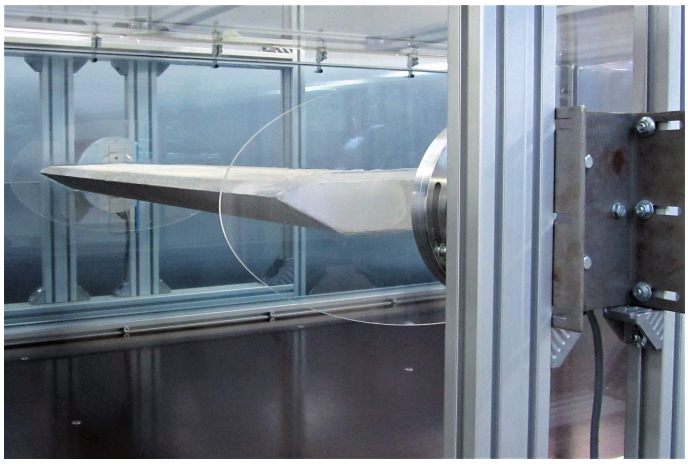
Experimental procedures for validation of non-linear aeroelastic models of bridges

Motivation

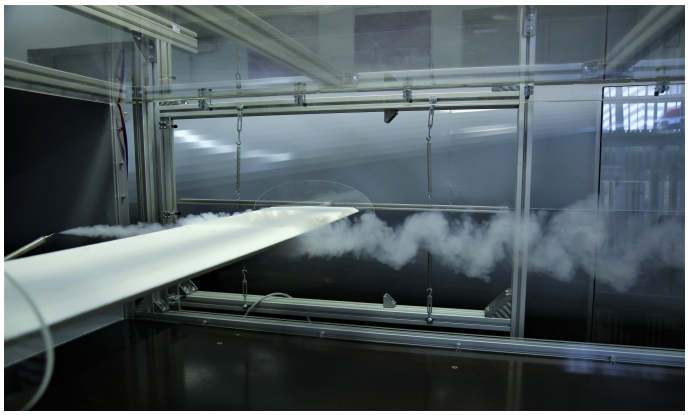
As structures evolve becoming more slender and consequently more flexible, the conventional linear models that describe their interaction with wind flows have gradually become less accurate. This is clearly seen in the non-linear nature of their input-response force correspondence.
Because of this, studying the manifestation of non-linear states through its associated forces and phenomena has become of increasing importance. It is from this premise that the development of predictive methodologies and models of non-linearity, and the procedures for their validation, are substantiated. All of which is done with the aim of aiding in the conception and design of slender wind susceptible structures such as cable-supported bridges.



Static model of the Great Belt Bridge in Denmark with load cells at both ends, Bauhaus-Universität Weimar wind tunnel.

Research goal

In non-linear scenarios, due to the intricate correlation of input-output forces, experimental models are the most direct and accurate approach to force-mapping. Due to the prohibitive cost and time requirements of experimental set-ups, alternative numerical and analytical options are under development by many institutions, the Chair of Modelling and Simulation of Structures of the Bauhaus Universität Weimar being one of them.
Despite the many advantages non-experimental approaches bring time and cost wise, they do ultimately have to rely on experimental validation. It is precisely here that the establishing of procedures for validation of non-linear models ensues.



Dynamic model of the Great Belt Bridge in Denmark, Bauhaus-Universität Weimar wind tunnel.

Current work focuses on procedures at non-linear states such as those found at large oscillations and separated flows. Namely static experimental set-ups at high angles of attack and free vibration analyses oriented to explore limit cycle oscillations are addressed. The study of the resulting force response and any perceived characteristic behaviour between fluid and structure will be identified and used to analogize with modelled equivalent results.

Outlook

The aim of the research is to pursue studying the input-output relationship of the forces in a more encompassing manner. This means going beyond static analyses and uniform wind excitation into experimental scenarios with a much more specific configurations of sectional motion and harmonic excitation. For this the implementation of experimental dynamic set-ups such as forced motion rigs and active turbulence generators will prove crucial.

Contact

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