> **MAJOR STRUCTURES**

Bridges

30 years of expertise in aerodynamics

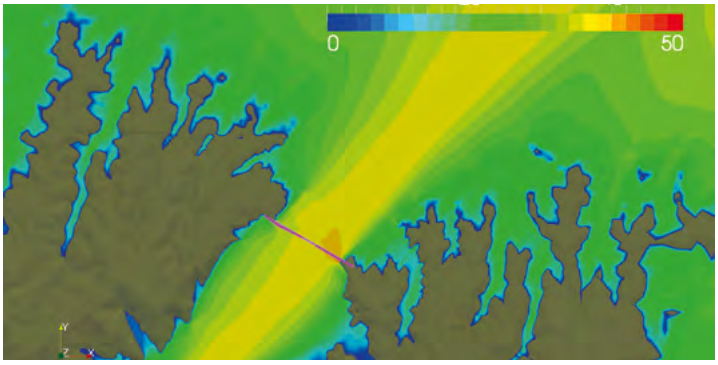
A complete and tailored service.
An integrated physical and numerical approach.
Exceptional experimental facilities.

www.cstb.fr

CSTB
le futur en construction

The wind behaviour is an essential component in the design of modern long-span bridges. Modifications and optimisation are key to meeting enhanced safety standards. For more than 30 years the CSTB have applied the latest techniques with high-tech facilities, becoming the partner of choice for constructors and designers around the world. They provide advice from the earliest conceptual design phase through construction and throughout the design life, monitoring the structure and ensuring ongoing reliability.

A COMPLETE AND TAILORED SERVICE



› Simulation numérique par CFD.

› Essai à la tenue au vent dans la soufflerie Jules Verne.

The CSTBs engineers expertly combine numerical and experimental simulation techniques across multiple scales to find the optimum solution, whether it be to guarantee stability, wind resistance, project lifetime or to guarantee comfort and safety.

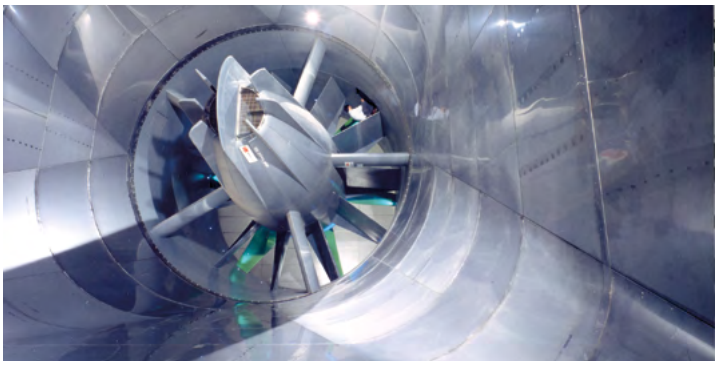
CLIMATOLOGY

Measurement, quality control and analysis of meteorological conditions across the project site, including wind, solar radiation, temperature and precipitation.

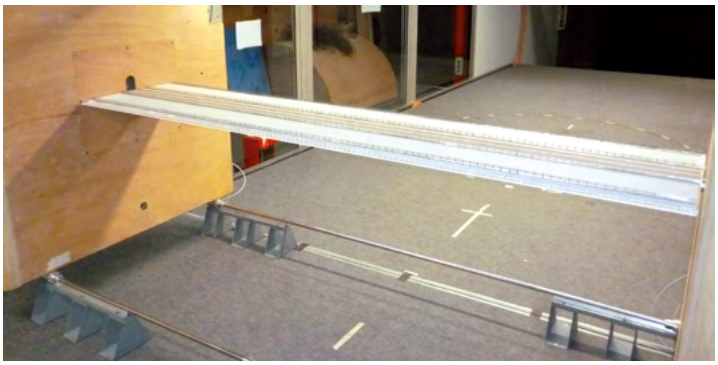
WIND LOADING

– Preliminary load estimates.
– Detailed load studies (static and dynamic loads).
– Dynamic response studies via detailed aeroelastic models.
– Full-scale testing.
– Aeroacoustic studies, advice and testing.
– Comfort and safety for bridge users, wind screen design and optimisation.

EXCEPTIONAL EXPERIMENTAL FACILITIES



› Jules Verne wind tunnel.



› Dynamic deck model in the atmospheric boundary layer wind tunnel.

JULES VERNE CLIMATIC WIND TUNNEL

Components are tested at up to full-scale in the very large Jules Verne climatic wind tunnel. Wind, snow, rain, sand and extremes of temperature, humidity and wind can all be produced and tested in combination.

ATMOSPHERIC WIND TUNNELS

Two atmospheric boundary layer wind tunnels reproduce all aspects of wind storms; the wind speed gradient, turbulence intensity and length scales are accurately replicated at reduced scale, allowing the dynamic response of the bridge to be measured and assessed.

THE 3rd BOSPHORUS BRIDGE, TURKEY
A TOTAL SERVICE: PRACTICAL, NUMERICAL AND EXPERIMENTAL EXPERTISE

A unique structure with exceptional overall dimensions,
it is the bridge with the largest suspended area in the world.

1,875
metres total length

60
metres deck width

10
road and rail lanes

AN INTEGRATED PHYSICAL AND NUMERICAL APPROACH

01 **Conceptual design advice.
Global responsibility for the wind design.**

02 **Deck design optimisation: stability, vortex-shedding, wind-screen design and validation at high Reynolds numbers.**

03 **Site wind speed measurements and statistical analysis of over 30 years of local wind speed data.**

04 **3D modelling of the regional wind climate.**

05 **Pylon stability and site safety during construction.**

"The tests were conducted in parallel with work on site, and the results confirmed the assumptions made during inspections of the structure. These studies helped us to confirm, predict and refine this project. Few laboratories offer both the large-scale technical resources and climatic wind tunnel of the CSTB, backed up by a very high level of expertise."

Jean-François Klein, CEO and engineering partner at T Engineering

More than 70 references worldwide

Simone de Beauvoir footbridge
France

Millau viaduct
France

Vasco da Gama bridge
Portugal

Rion-Antirion bridge
Greece

Russky bridge
Russia

Design: Nadège Theil – Photo credits: Millau viaduct (cover), Eiffage CEVM, Foster+Partners, D. Jamme – Bosphorus bridge, T Engineering – Fotolia – September 2016

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