Civil Engineering Structural Dynamics Group

Technical University of Denmark

DESIGN SPECIFICATIONS FOR A NOVEL CLIMATIC WIND TUNNEL FOR THE TESTING OF STRUCTURAL CABLES

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The newly proposed Femern fixed link between Denmark and Germany will push the limits in engineering design. The selection of a cable-stayed or suspension bridge will lead to one of the longest bridges of its type in the world. The challenges of designing a bridge are many and the prospects of cable vibrations already preoccupy both the owners and designers. In this connection, the Danish owners/operators Femern Bælt A/S, together with Storebælt A/S, are funding a collaborative research project to examine the ways of reducing the risk of cable vibrations on a bridge solution. A novel Climatic Wind Tunnel (CWT) facility, dedicated to the testing of structural cables under dry, rain and icing conditions, is being developed as part of this research project. Collaboration partners are the Technical University of Denmark (DTU) and FORCE Technology, on which premises the new wind tunnel will be erected.

The room housing the new CWT is located at the wind tunnel laboratory of FORCE Technology. Major reconstruction of the building and a significant expansion of the laboratory power supply were necessary.

ROOM

Min. upper airspeed limit……... 25m/s
Turbulence intensity…….. 1-20%
Temperature range……..... -5°C to 40°C
In-cloud air humidity……...0.4g/m^3
Test section dimensions…….. 2 x 2 x 5m

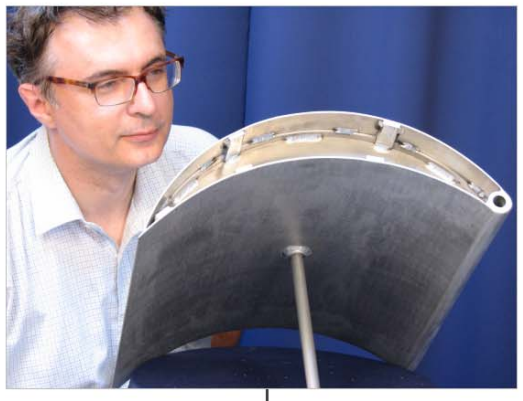
DIFFUSOR

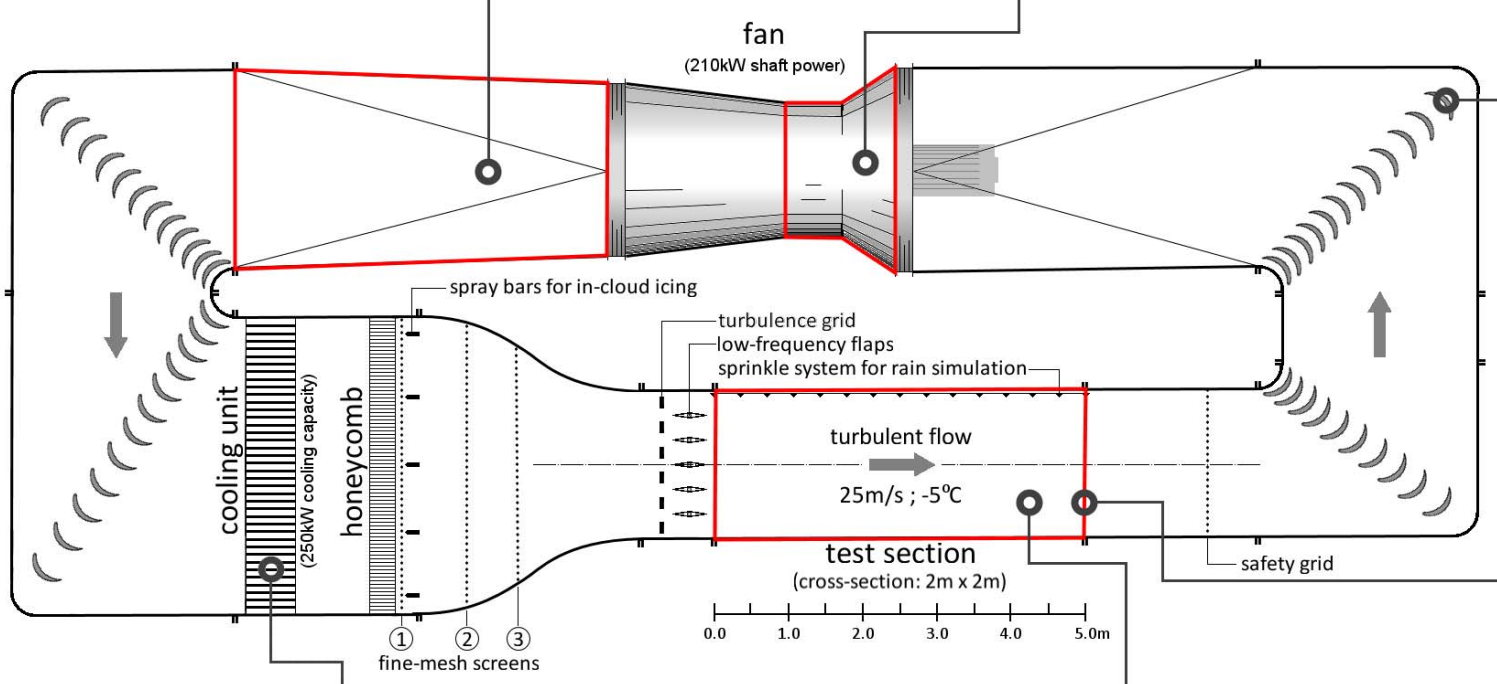
The CWT design requires a 210kW motor for the fan. This shaft power is needed to circulate the air with 100m^3/s at maximum drag configuration, i.e. all flow generating devices (turbulent flow) and model setup included.

FAN

A heating system shall prevent ice accreting on the turning vanes for long-term testing under icing conditions. For rain simulation the injected water is collected by a drainage system

HEATED TURNING VANE



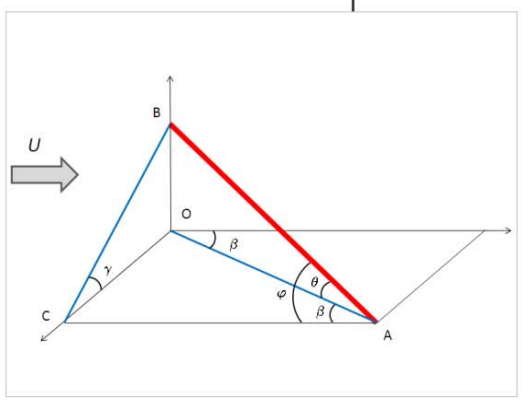


HEAT EXCHANGER

14 heat exchangers are located outside the building to release the thermal energy from the wind tunnel inside. The compressor station (shed in the background) is connected with a large piping system to the cooling unit inside the settling chamber.

COOLING UNIT

The 4m x 4m cooling unit has a capacity of 250kW to compensate for heat due to air friction and motor waste heat and to heat transmission from ambience. Located in the settling chamber the cooling unit contributes to the smoothening of the approaching airflow.



MODEL SETUP

In the static tests the inclination angle θ can vary from 19° to 90°, and the yaw angle β from 0° to 90°. The static setup allows pressure and force measurements
In passive dynamic setups the model is supported on springs. For a dry cable the inclination and yaw angles of the prototype can be combined into one single angle.

TEST SECTION

The CWT is specifically designed for testing of dry, wet or iced vertical and inclined/yawed cables. Furthermore, static, passive dynamic and active dynamic setups are envisaged. Interchangeable elements (panels) of the test section allow for numerous model support conditions, together with different geometric arrangements.

Follow the construction progress under www.cesdyn.byg.dtu.dk

DESIGN: December 2008 – March 2009 • **CONSTRUCTION:** April – October 2009

A COLLABORATION PROJECT BETWEEN

DTU Civil Engineering
Department of Civil Engineering

FORCE TECHNOLOGY

FEMERNBELT DEVELOPMENT