Wind Load Reduction for Light-Weight Heliostats

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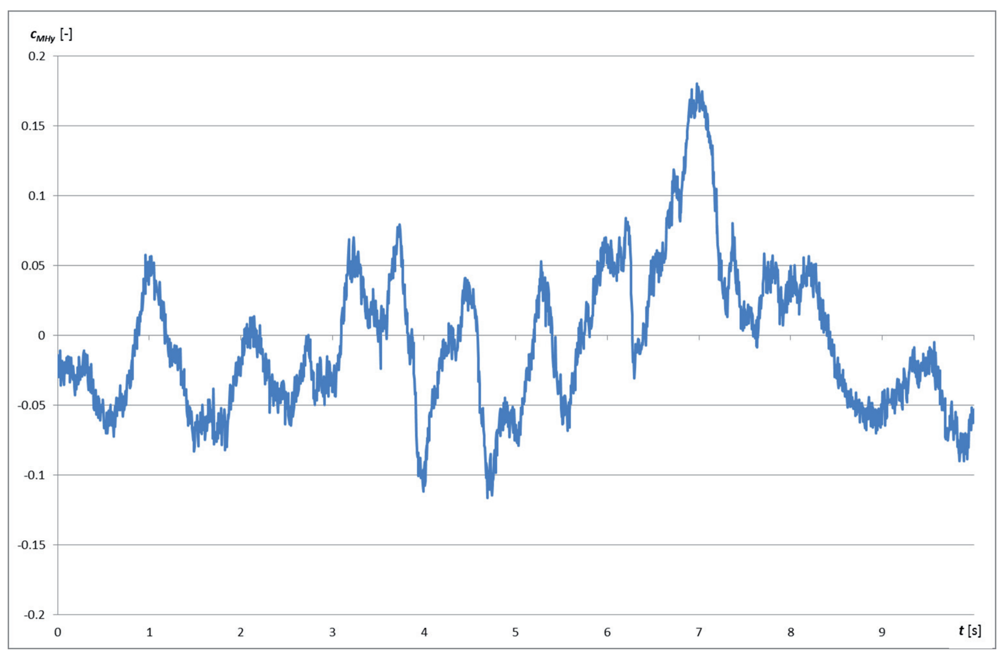
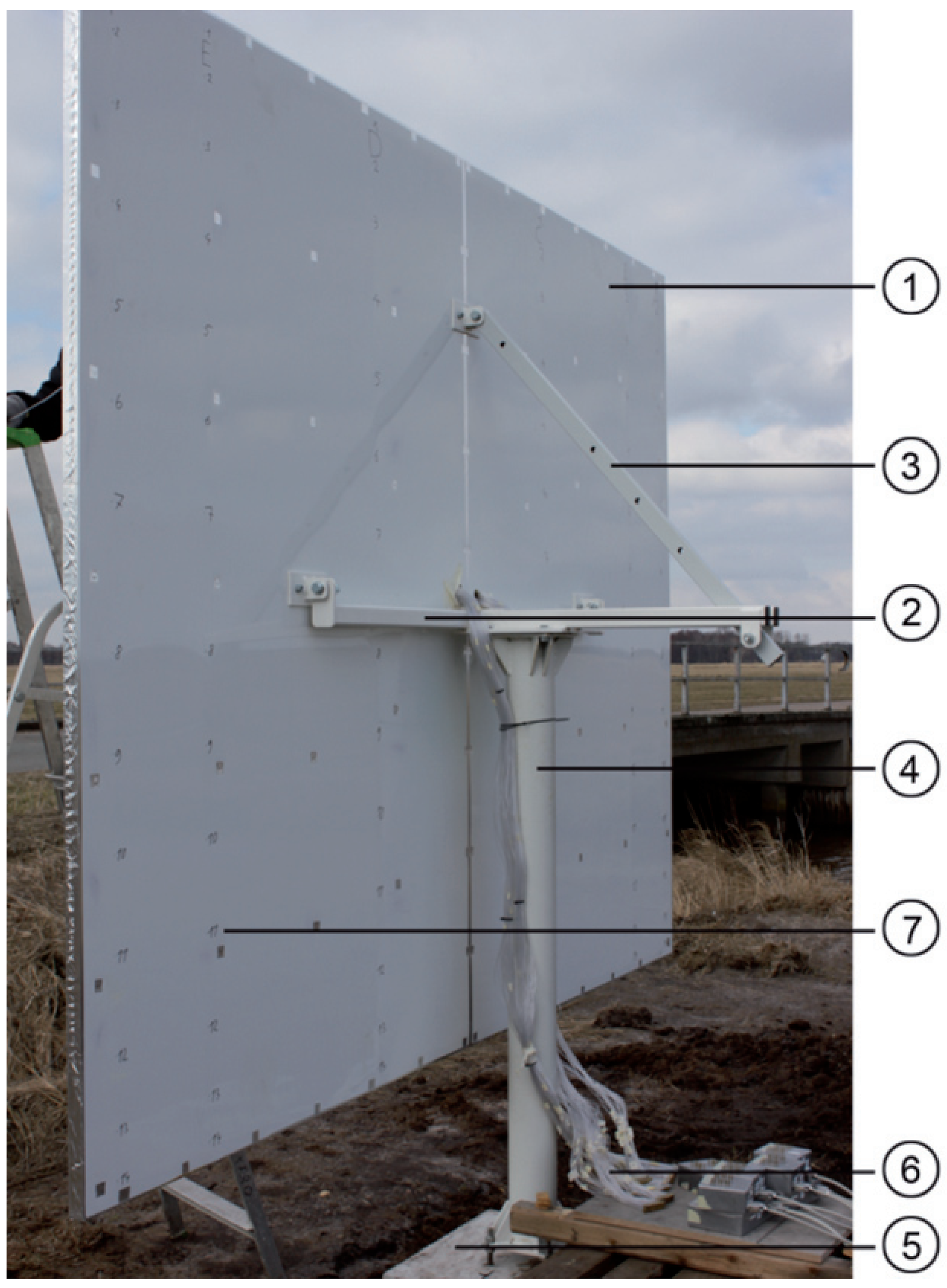
Wind protection devices

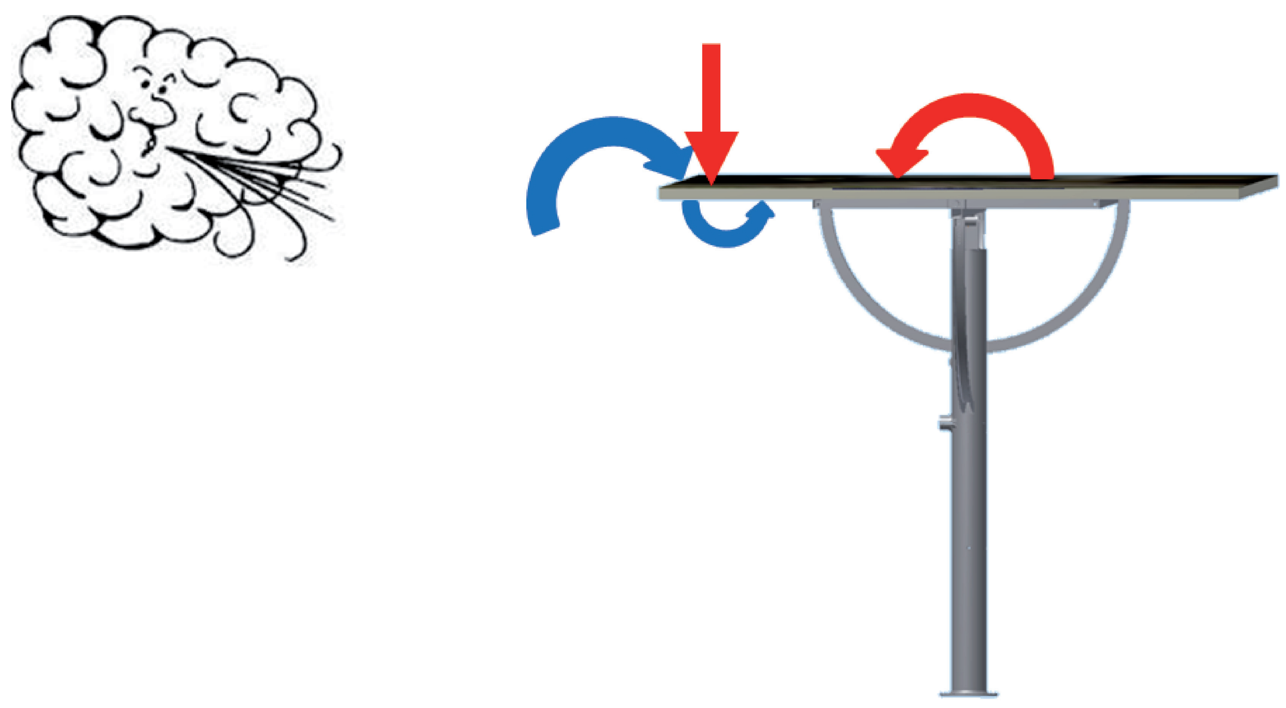
The high overturning moments in stow position are caused by the turbulence level of the natural wind. Turbulent wind has velocity components in all three axis directions. This signifies that the heliostats are attacked by the wind lengthwise and instantaneously also normal to the mirror plane. The incident flow with vertical velocity component separates at the frontal edge causing suction on the other side of the mirror. The resulting pressure difference between top and bottom of the facet leads to high pressure coefficients (cp-values) near the frontal edge which leads to the peak overturning moment.

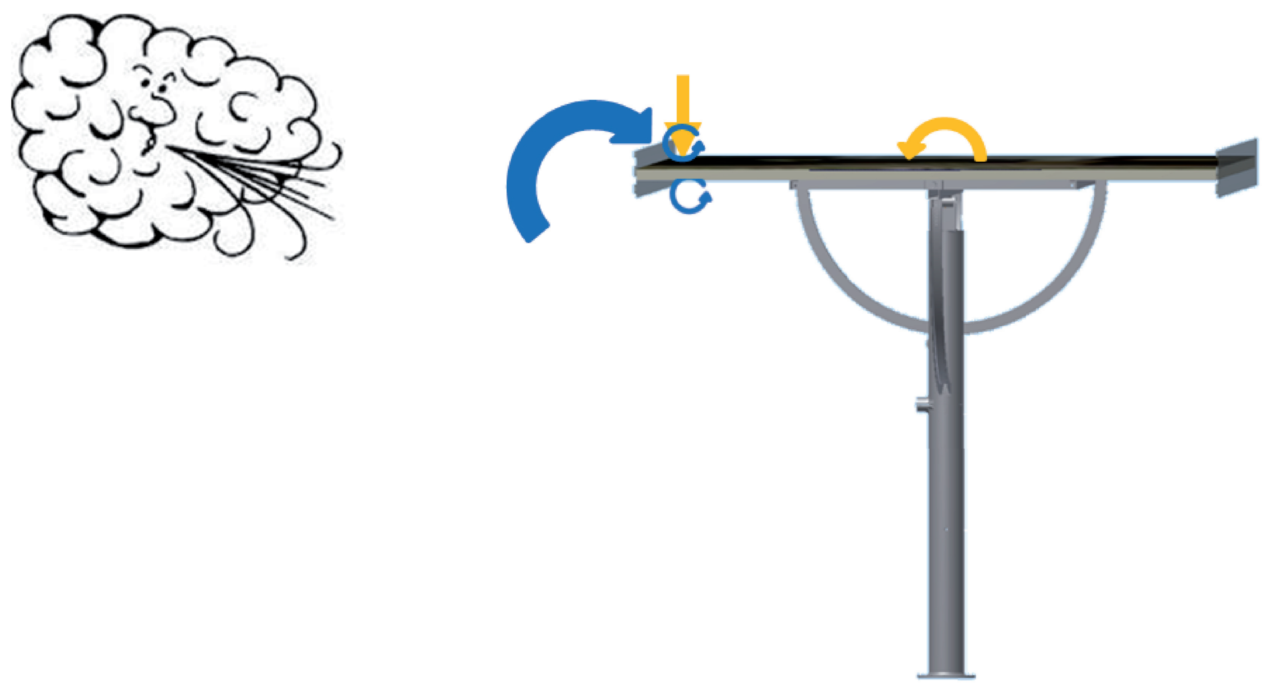
By a fence like structure at the frontal edge separation and thus suction is reduced. To measure the effects under boundary layer conditions of atmospheric flows typical at solar power plant sites, a sophisticated simulation technique has been developed using a specific set-up of the blocks and baffles on the wind tunnel floor. By the tests a reduction of 40% in the overturning moment was measured.





(1) Facet
(2) Supporting structure
(3) Adjustment of elevation
(4) Pylon
(5) Pedestal
(6) Pressure tubing and instrumentation boxes
(7) Pressure ports

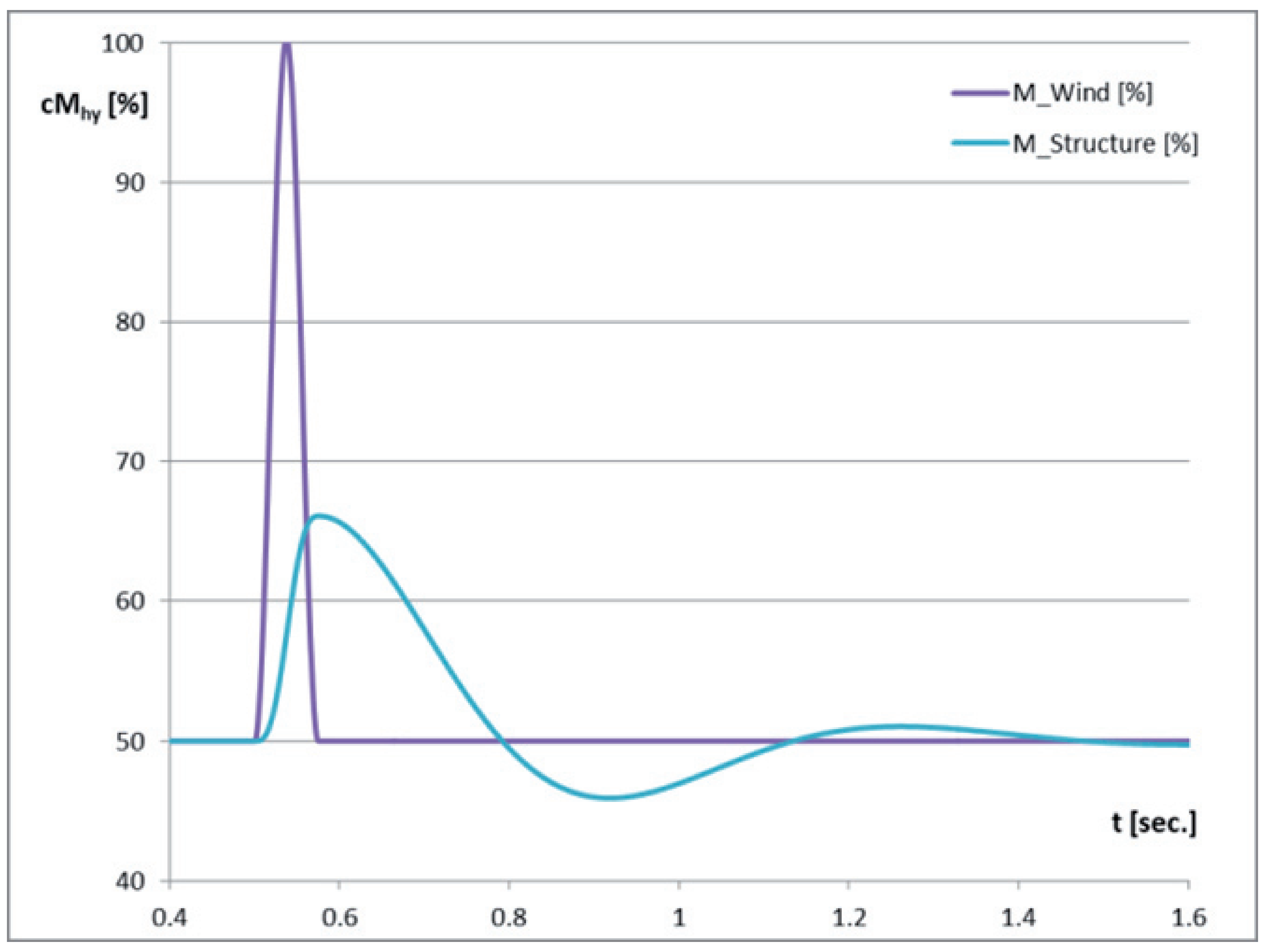




Shock-absorber system

In-field measurements were performed on an isolated full-scale heliostat set up in an area which complies with typical roughness area category II. The single, isolated 8 m² (2.5m x 3.2m) heliostat was equipped with 84 differential pressure gauges to collect direct information of the local pressure distribution. With the pressure distribution of the horizontal stow position the time depended behavior of the hinge moment coefficient cMHy (moment about horizontal primary axis) was calculated.

Because of the relative short duration of the gusts causing the peak values of the hinge moment the loading of the structure can be reduced by more than 30% thru simple shock absorbers as first simulations showed. These results will be verified by long-term tests.



Acknowledgement
The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) financed partly the wind tunnel investigations by the project HydroHelioTM (code 0325123B).

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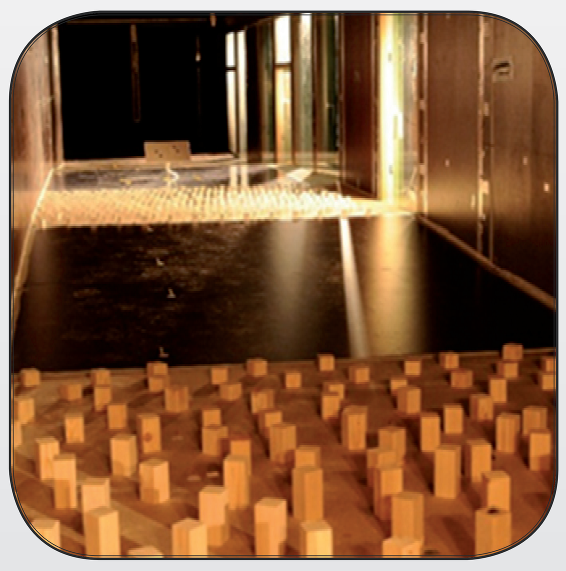
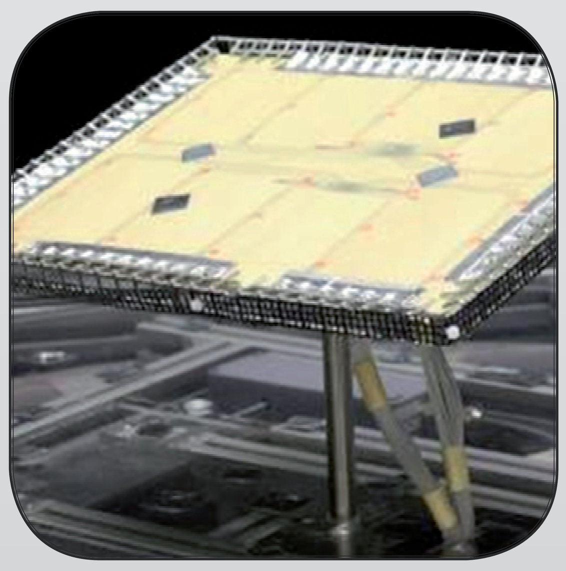
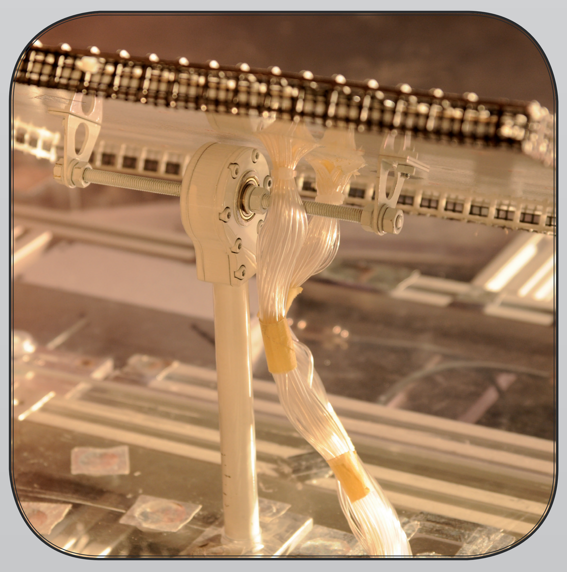


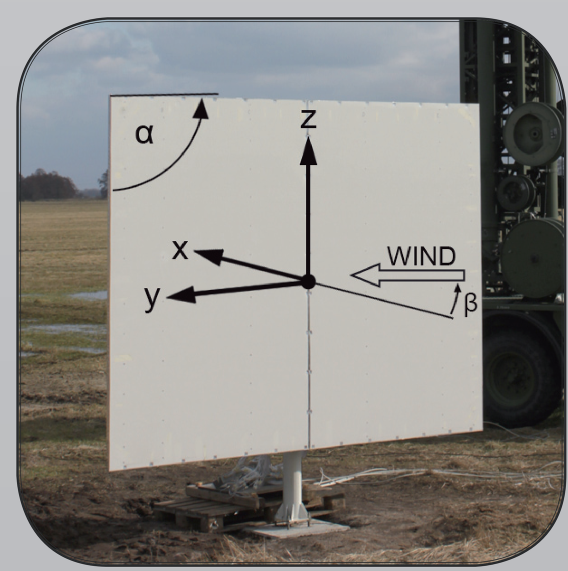
Test section of boundary layer in wind tunnel



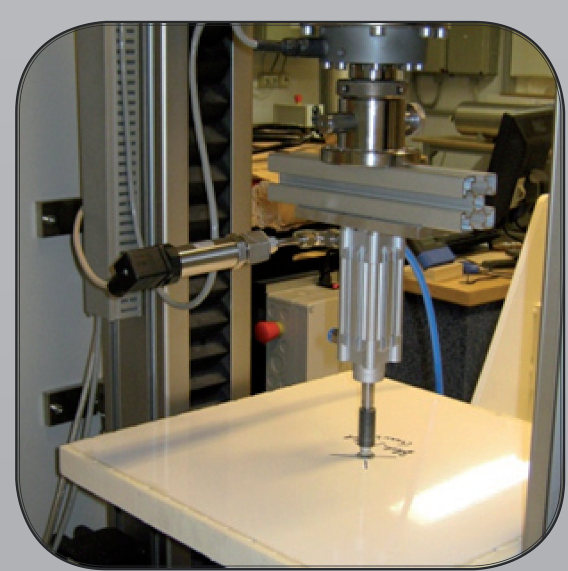
Heliostat with wind protection device



Rear side of wind tunnel model



Full-scale heliostat in field test



Test facility – shock absorber

Light-weight heliostat with wind load reduction