



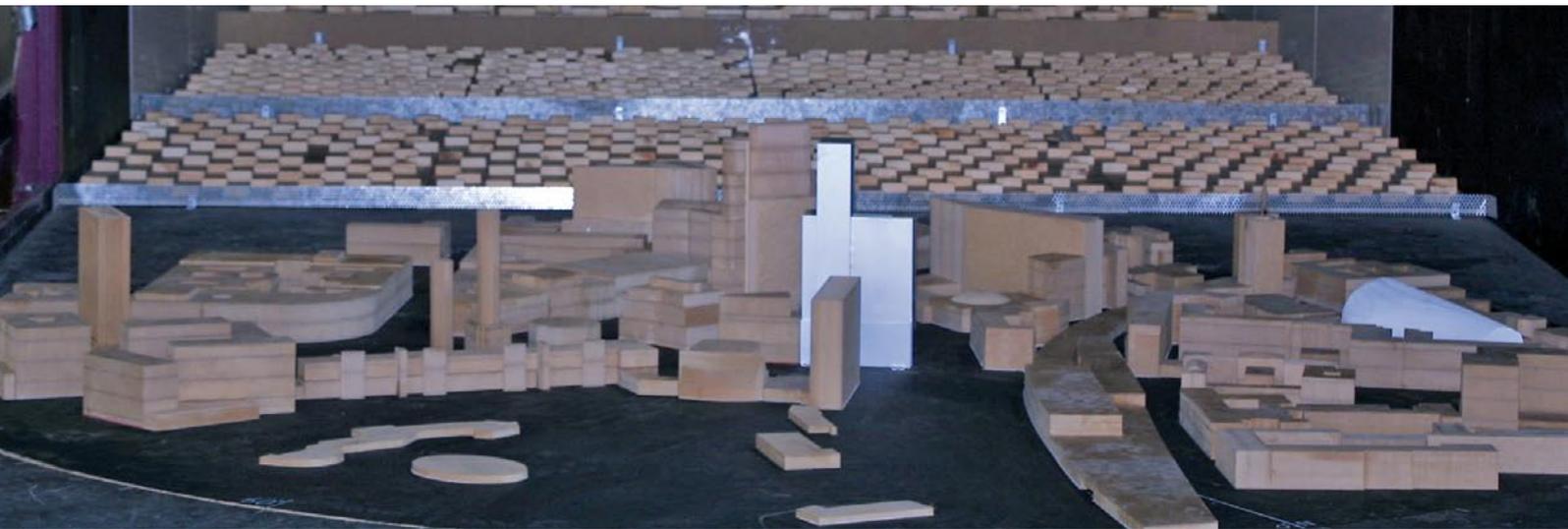
Wind tunnel tests

Simple, inexpensive, approved

Wind loads, wind comfort, immissions,
aero-acoustics

Reports, documentation, forecasts,
characteristic values

I.F.I. Institut für Industrieaerodynamik GmbH
Institut an der Fachhochschule Aachen



WE ARE THE SPECIALISTS |

WHEN IT COMES TO WIND LOADS, WIND COMFORT AND WIND ACTION

Whether it's advertising signs or skyscrapers, correct determination of wind loads ensures durability and economic construction. Knowledge of wind fields and differential pressures enables advance clarification and remedy of unwanted influences on apertures, smoke extraction mechanisms, air intakes and air outlets, etc.

Vibration-prone structures can be dynamically designed or equipped with more efficient damping, which is even better in many cases.

Analyses of emissions and immissions prevent exposure to unwanted odours and toxic substances, besides avoiding usage restrictions associated with re-infiltration.

Sand erosion images reveal surface wind velocities, besides enabling detection and remedy of critical groups of construction elements already during development planning. Local velocity measurements quantify the success of optimisation measures and allow economic assessments.

We plan and conceive wind controllers for ventilation, smoke extraction, sun shading and production conditions, determine optimum positions and required heights for

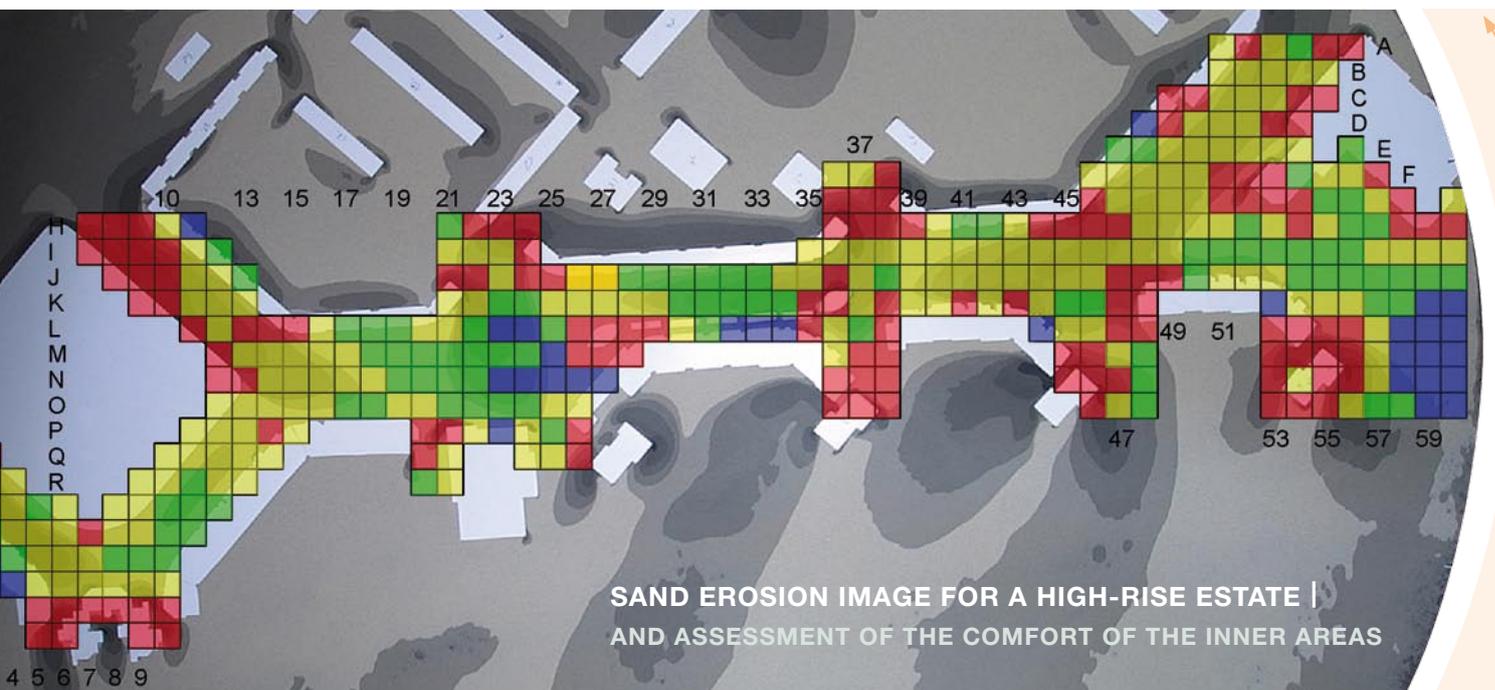
measuring poles as well as handling evaluations and correction of measurements.

Add-ons to a building, such as rooftop photovoltaic systems, extensions and back-ventilated cladding or double-skin facades, also require wind design parameters which are not yet usefully covered, or even mentioned, by standards. Our tests and the resulting characteristic values provide dependable help in such cases, even across borders.

Of course, we also offer information and assistance regarding wind standards in other countries, and design of your products in projects abroad, including technical translations into a number of languages.

Feel free to contact us!

Aero-acoustic effects can often be recognised and remedied through reviews of design details. If critical details cannot be dispensed with, closer examinations in our special aero-acoustics wind tunnel can be of assistance. Often, even just minimal changes to edges or pressure relief holes suffice to relocate acoustic effects to non-critical areas.



WIND TUNNEL TESTS AND FLOW SIMULATIONS |

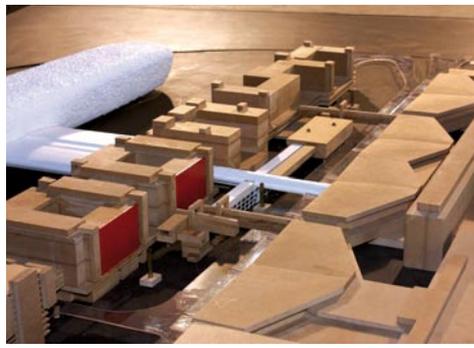
SERVE THE FOLLOWING PURPOSES:

- ▶ Proper static and dynamic determination of global and local pressure conditions, and consequential derivation of wind loads and wind actions.
- ▶ Appropriate design and arrangement of wind protection mechanisms, pressure relief elements, wind sensors and emission sites.
- ▶ Optimised arrangement of air intakes and inlets.
- ▶ Identification and avoidance of unwanted acoustic effects on walls, extensions and building elements with internal air flow.

Concerned specialists are thus provided with a solid foundation for static and, if necessary, dynamic dimensioning in order to achieve economical and functional solutions in general.

BY PARTICIPATING IN COMMITTEES FOR STANDARDS AND DIRECTIVES, I.F.I. NOT ONLY OPERATES IN ACCORDANCE WITH PREVAILING REGULATIONS, BUT IS ALSO ABLE TO TAKE FUTURE DEVELOPMENTS INTO CONSIDERATION.

Wind tunnel model for measuring immission levels: Frankfurt Airport Terminal 1 with Airrail Center and Airport City



RESULTS ARE PROCESSED ENTIRELY IN ACCORDANCE WITH FURTHER PLANNING OR APPROVAL STEPS:

WIND LOADS |

- ▶ Structural loads, tabulated per wind direction.
- ▶ Wall loading expressed in the form of load maps, maximised in all wind directions.
- ▶ Coefficients in tabular form or in graphs/sections as required.
- ▶ Calculations of dynamic reactions and quasi-static dynamically induced loads in general charts according to standard procedures.

WIND COMFORT |

- ▶ Visualisation by means of sand erosion images per wind direction.
- ▶ Quantification by local measurements of acceleration.
- ▶ Assignment to comfort classes via wind statistics and visualisation in the form of coloured grids on layout plans.

IMMISSION MEASUREMENT |

- ▶ Measurement of natural or mechanical exhaust air or motor-vehicle emissions.
- ▶ Immission points in accordance with requirements.
- ▶ Review of intake points for critical applications.
- ▶ Determination of dilution ratios, tabulated per wind direction.
- ▶ Assessment of probability of occurrence based on wind statistics.

I.F.I. IS NOTIFIED TESTING, INSPECTION AND CERTIFICATION BODY IN ACCORDANCE WITH THE CPD.

SPECIAL ADVANTAGES | OF I.F.I. WIND TUNNEL TESTS

- ▶ Realistic depictions of atmospheric flow in our boundary-layer wind tunnels with variable profiles and matching turbulence.
- ▶ Investigation zones with a diameter of more than 1 km can be set up in the large boundary-layer tunnel, e.g. for large, new housing developments such as Hamburg's Port City, or extensive facilities such as Terminal 1, Airrail Center and Airport City in Frankfurt.
- ▶ Visualisation of surface wind velocities in a sand erosion process.
- ▶ Determination of external pressure distribution in wind tunnel tests in terms of static and dynamic building elements, as well as characteristic values for flexible determination of wind action on entire buildings, local building elements, superstructures or extensions, etc.
- ▶ Determination of propagation variables with the help of highly accurate tracer gas measurements and a 16-channel flame ionisation spectrometer.
- ▶ Model tests allow quick investigation of multiple variants, e.g. to establish the minimum or optimum necessary measures.
- ▶ Precise and flexible acoustic measurements at speeds up to 180 km/h in our aero-acoustics wind tunnel.
- ▶ Analyses of the necessity or dispensability of wind deflectors and other wind protection measures.
- ▶ Maximum available nozzle area of 4 x 2.5 m for large models and original equipment.
- ▶ Computer simulations of interior flows allow 3D visualisation of relevant characteristic parameters.
- ▶ For simple cases, it is possible to directly generate reports including specification and verification of necessary measures based on the institute's four decades of practical experience.

The experience of I.F.I. specialists allows accurate determination of wind parameters, thus optimising selection of measures even in complex situations and yielding the appropriate documentation.

FURTHER SERVICES |

RELATED TO WIND TUNNEL APPLICATIONS:

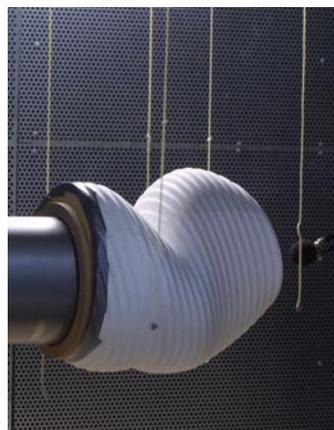
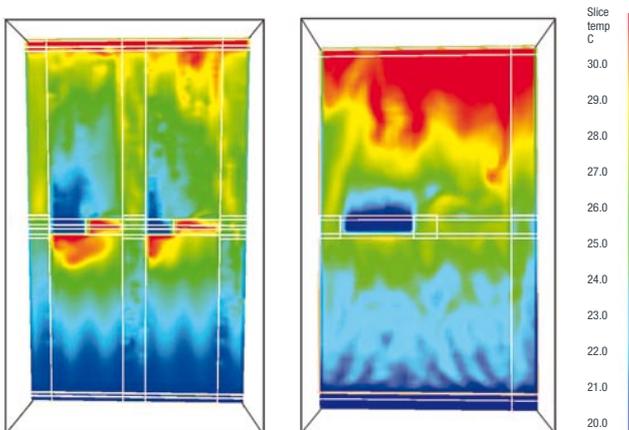
- ▶ Testing the aerodynamic efficiency of natural smoke and heat exhaust ventilators according to EN 12101-2 (I.F.I. is notified body for testing, inspection and certification for these products).
- ▶ Recording of characteristic curves for various aerodynamic parameters, e.g. lift and sliding loads on photovoltaic systems, wind resistance of poles with numerous attachments, properties of grilles, screens, panels, etc. with internal air flow.
- ▶ Calculation of building pressure conditions and verification of design sufficiency for pressure differential systems as well as operational behaviour (e.g. in high-rise buildings).
- ▶ Design of wind protection features and pressure relief mechanisms for building elements, industrial buildings, walls, roofs, terraces, superstructures.
- ▶ Design of special flow elements, e.g. for dilution/distribution of emissions or optimised suction of pollutants and smoke from confined spaces, planning of diverse, customised solutions for industrial flow applications, e.g. to prevent accumulation of dirt and optimise jet action and drying.

KNOW HOW |

IN OTHER AREAS OF RESPONSIBILITY

- ▶ Smoke extraction
- ▶ Real fire tests
- ▶ Industrial aerodynamics
- ▶ Room flow optimisation
- ▶ Leakage and thermography measurements

Temperatures in a double-skin facade



Your contacts for
wind tunnel tests:

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