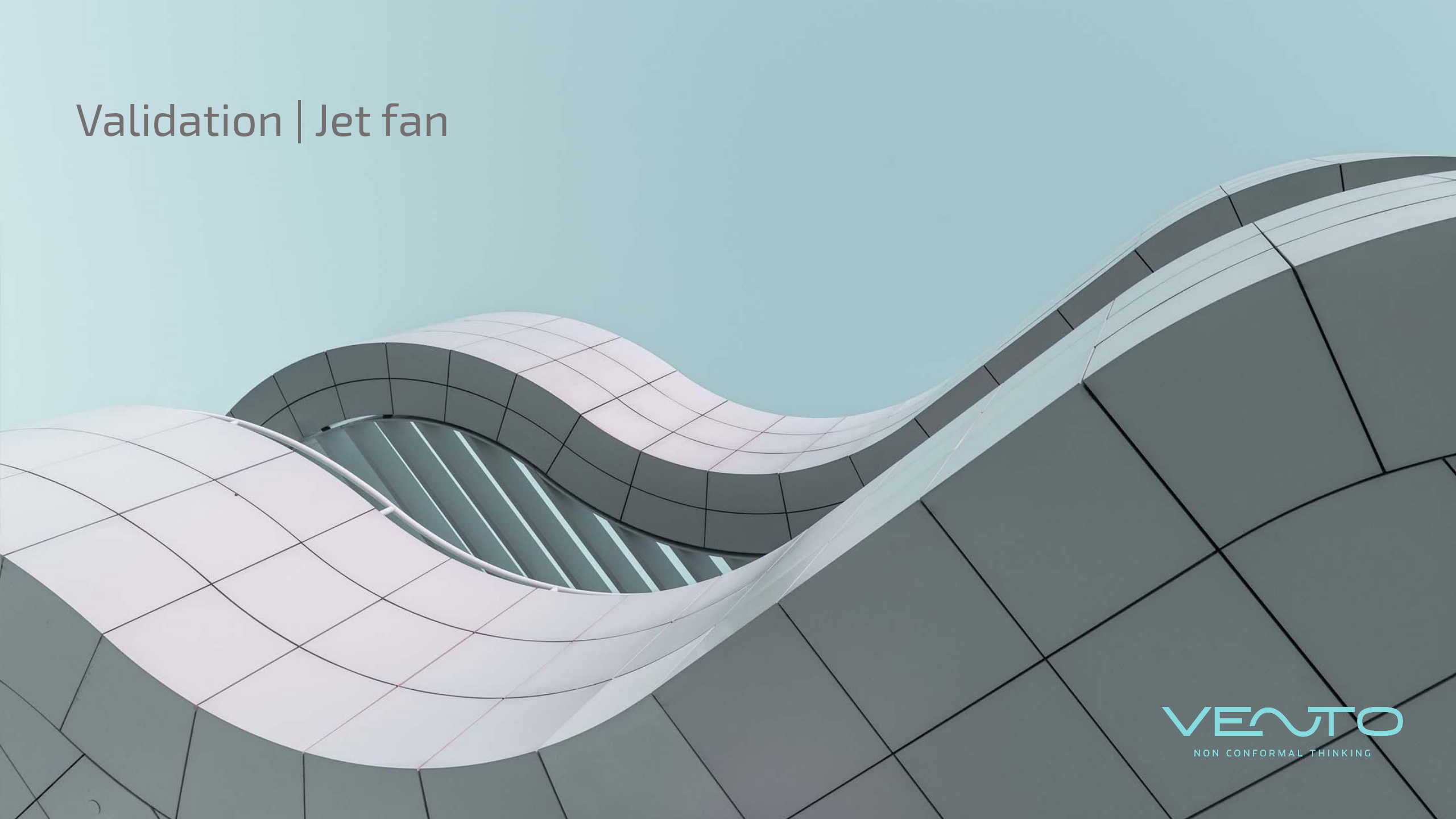
VENTO

NON CONFORMAL THINKING

Innovative CFD for the built environment

Validation | Jet fan



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Jet fan

Jet fan is a type of ventilation fan engineered to generate a high-velocity air jet. This jet increases the air momentum within a space, making them particularly effective in enclosed environments like underground car parks and tunnels.

The air velocity produced by a single, unidirectional jet fan was analyzed and compared to measurements and to CFD simulations carried out by other CFD sw.

foto by:
https://www.linkedin.com/posts/dragan-nikodinovic-6b653b146_in-july-of-last-year-we-signed-a-contract-activity-7220804623601729536-byGQ/

Reference (Measurement and CFD data)

SFT VOL. 55 ISSUE 1, 2020, PP. 6–14

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Results of Jet Fan Tests Using Experimental and Numerical Techniques

Wyniki badań wentylatorów strumieniowych z wykorzystaniem technik eksperymentalnych i numerycznych

DOI: 10.12845/sft.55.1.2020.1, pages: 6 – 14

Model and Conditions

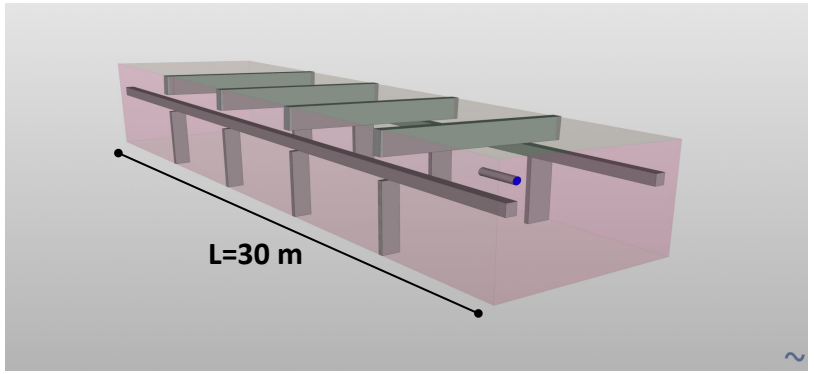
The paper did not provide the exact geometrical layout.

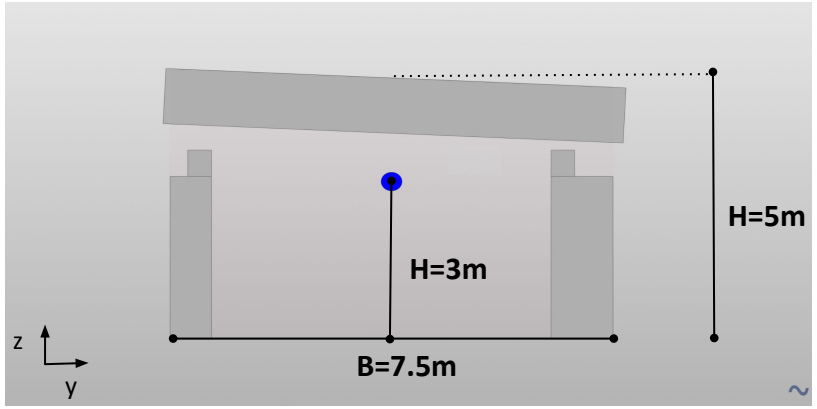
The fan's dimensions and position were known, however the size and the position of the nearby columns and bar joists were only approximately known.

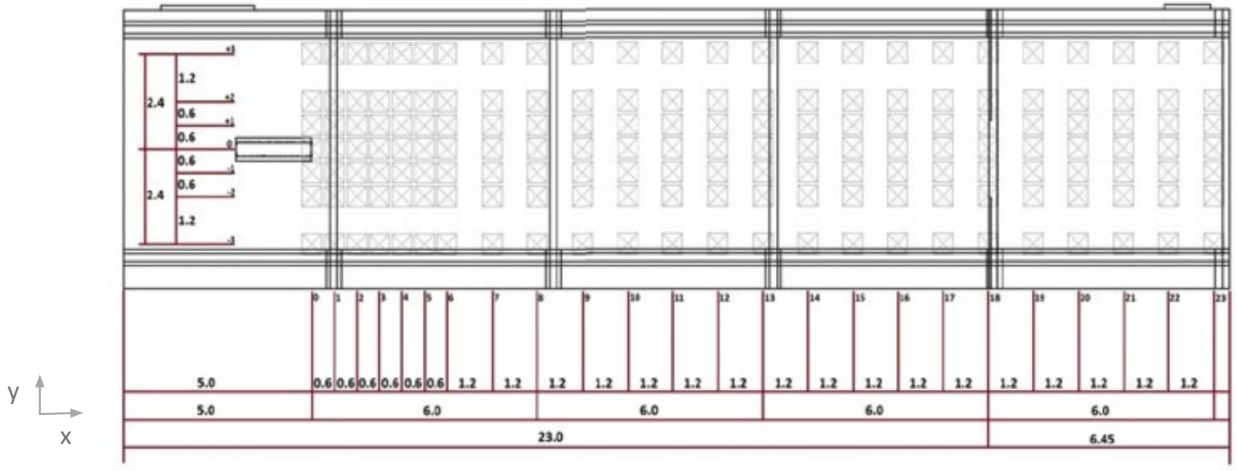
The jet mass flow rate was 2.20 m^3/s.

The measurement points are arranged along seven axes positioned at a fixed height of 3 meters from the ground.

The spacings among the 7 axis and the position of the measurement points are shown in the adjacent image.







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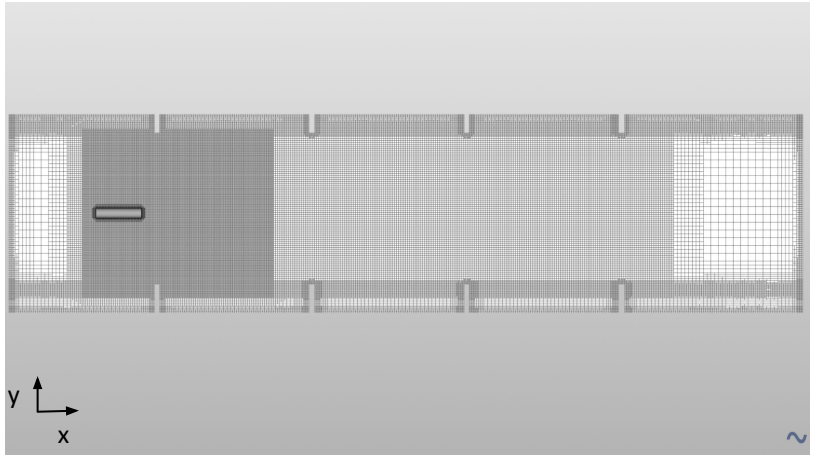
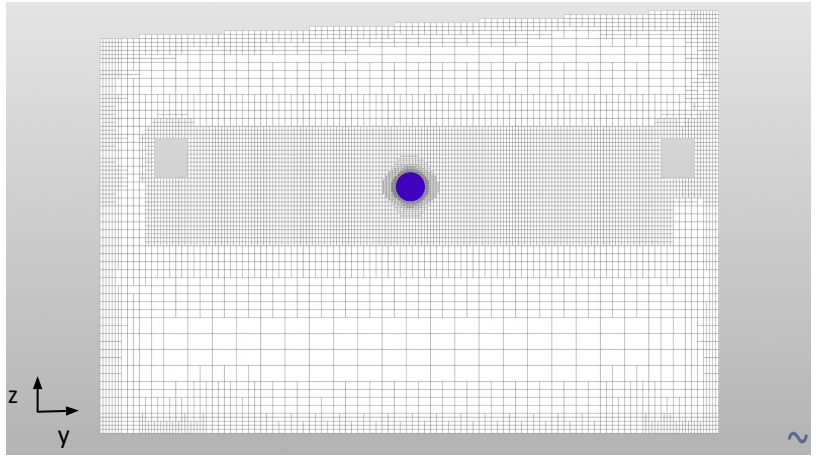
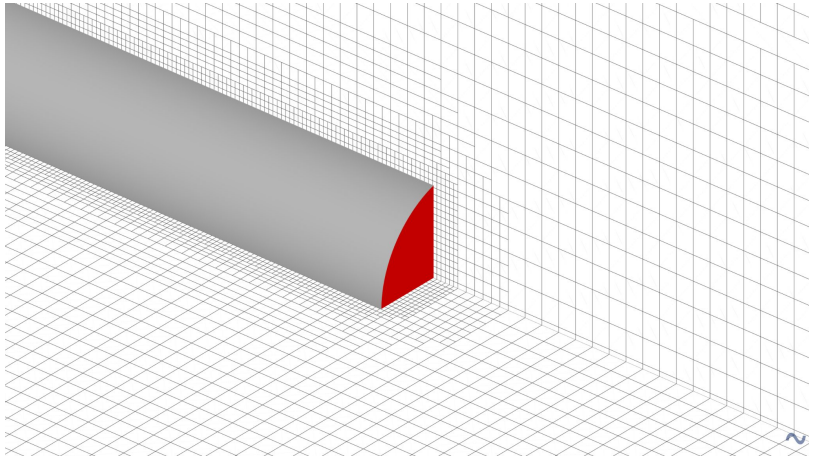
VENTO CFD simulation

VENTO AEC: 2.9 M cells, K & Epsilon turbulence model (RANS).

The convergence was reached in less than 2000 iterations, 6 seconds per iteration, on a 6-core desktop with CFL=1000.





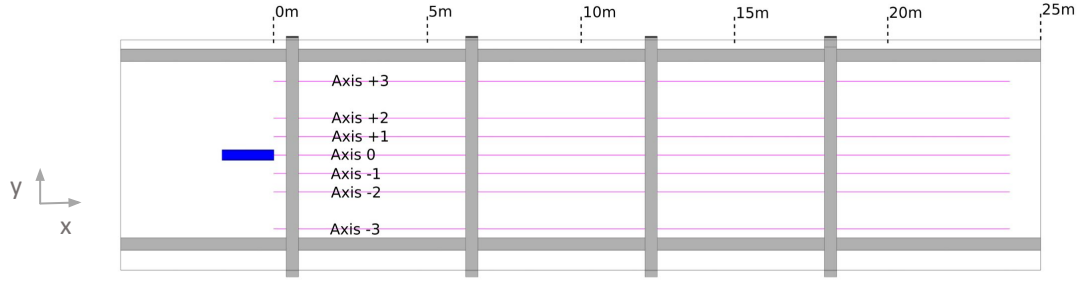


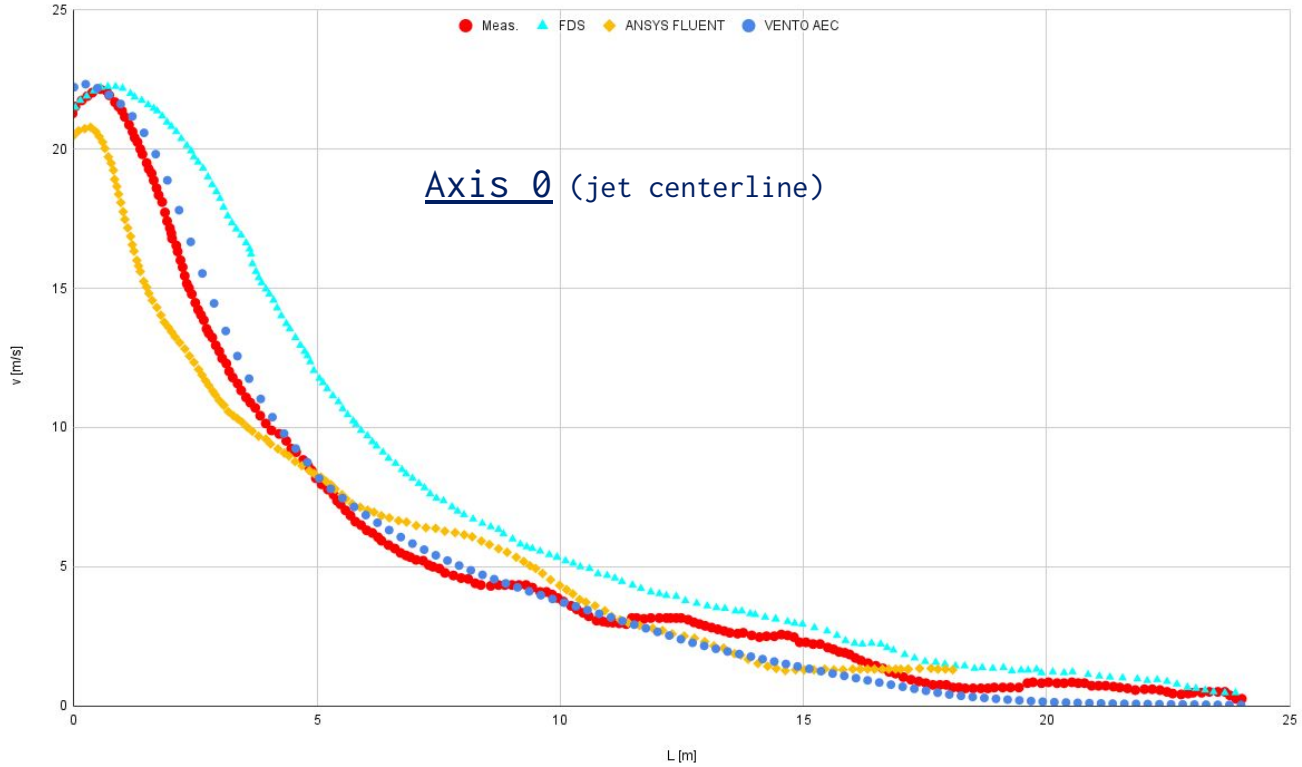
VENTO results vs reference

The reference presents experimental measurements and several CFD results:

- ANSYS Fluent (RANS model)
- FDS basic LES model
- FDS Smagorinsky model
- FDS Dynamic Smagorinsky model

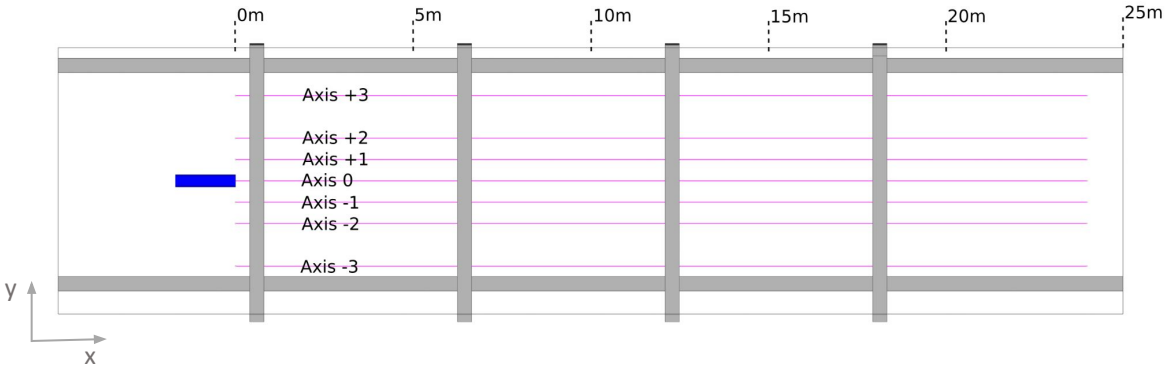
Only the best FDS result (the dynamic LES model) is used for the comparison (see image on the right).





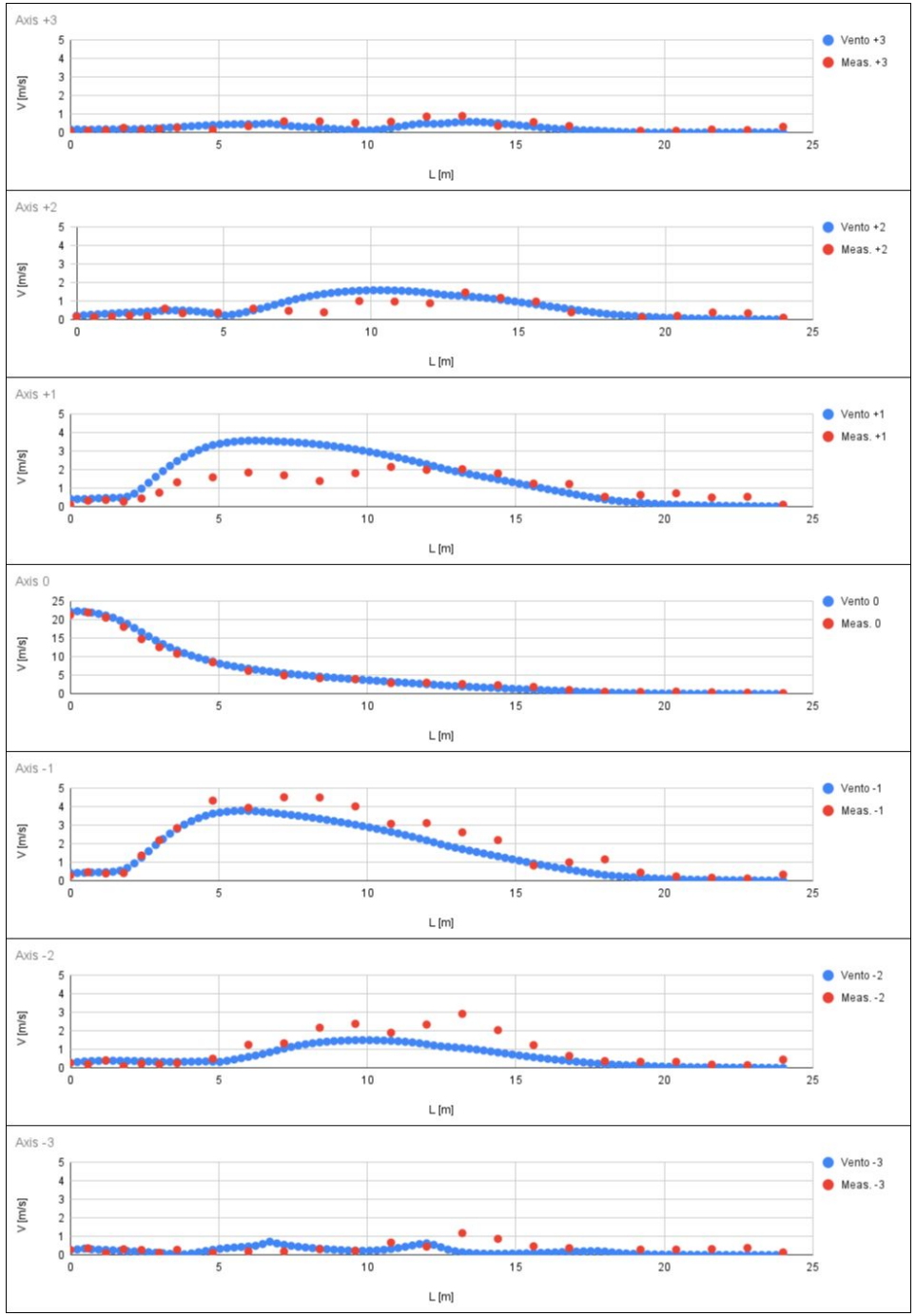
Comparison on axis 0 (jet centerline) between data measured using an ultrasonic anemometer-Windmaster Pro (blue dots), data obtained by VENTO AEC 2024 simulation (red dots), Ansys Fluent 13 simulation (black stars), FDS v 5.5.3. simulation with Dynamic Smagorinsky function (cyan triangles).

VENTO results vs reference



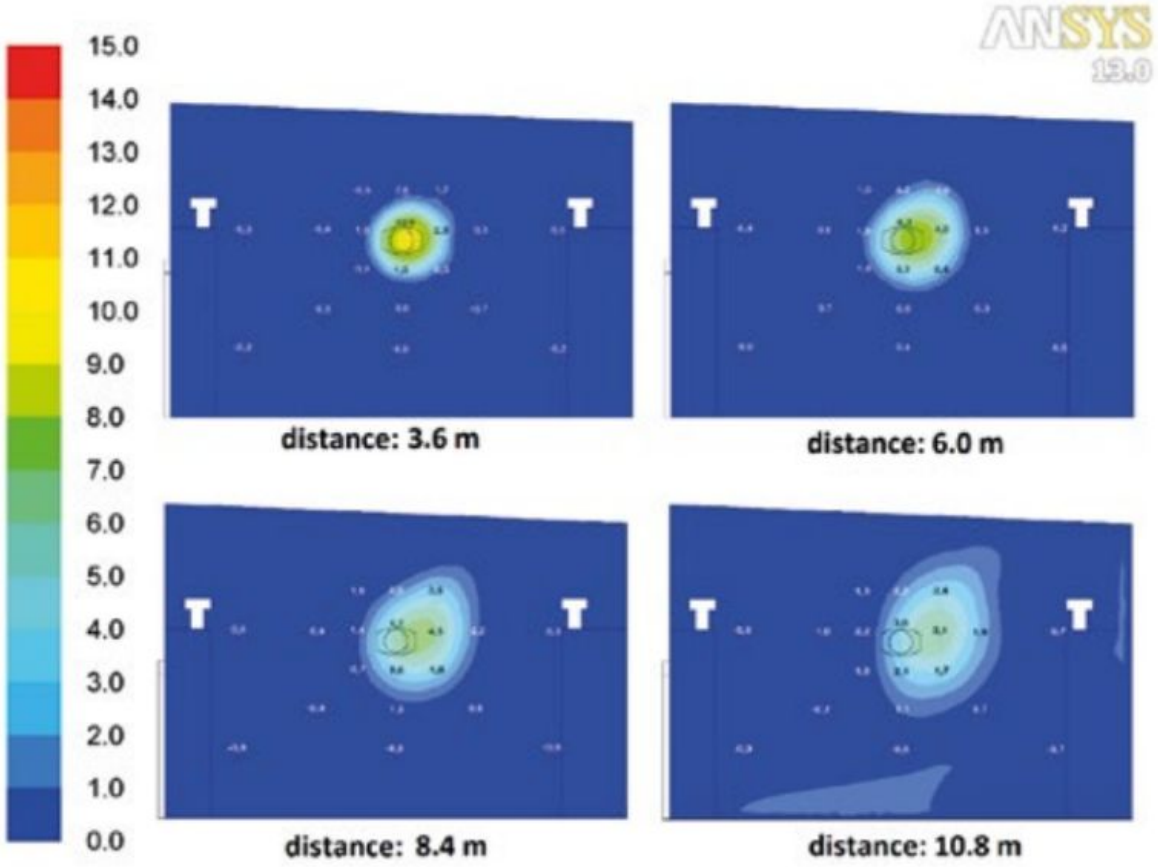
Data measured with an ultrasonic anemometer (Windmaster Pro, blue dots) are compared to simulation results (red dots) along seven axes.

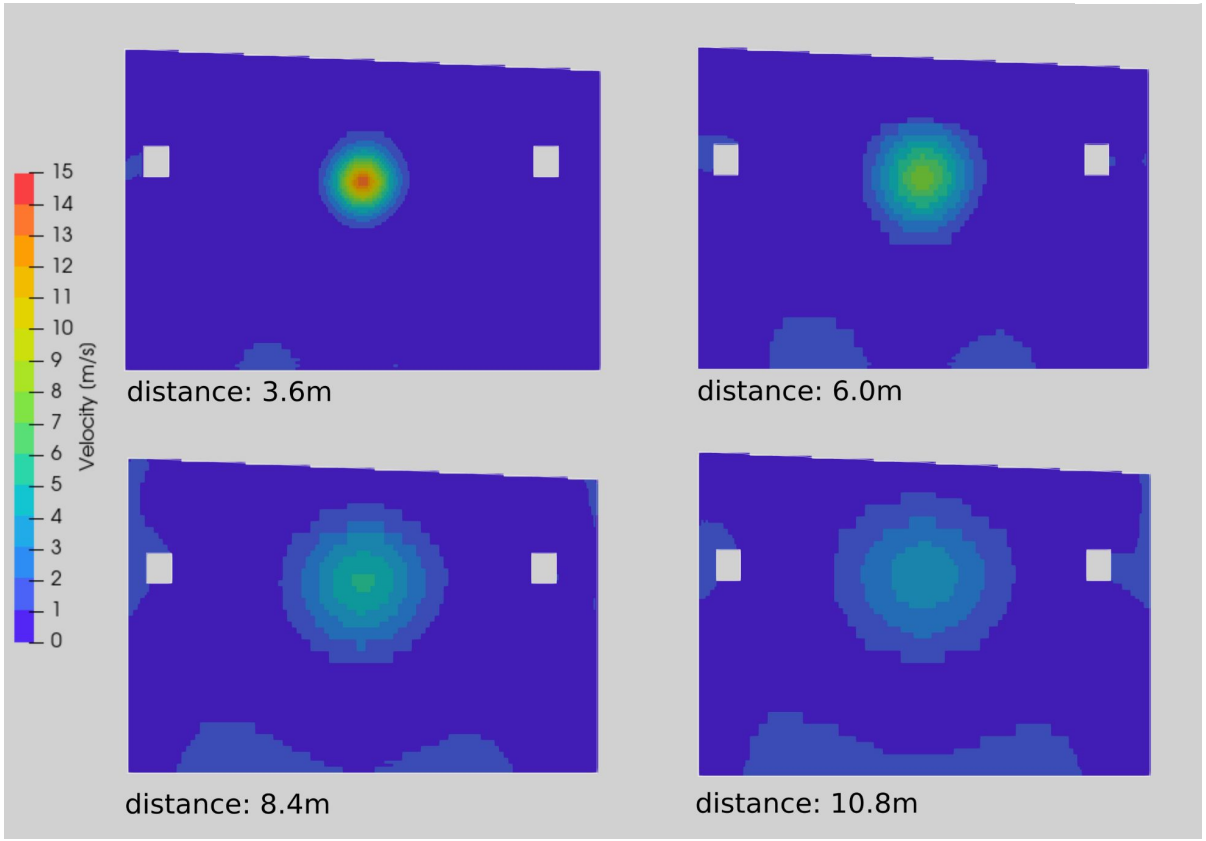
ANSYS Fluent and FDS results are only available for Axis 0 (centerline).



VENTO results vs reference

X-Y sections





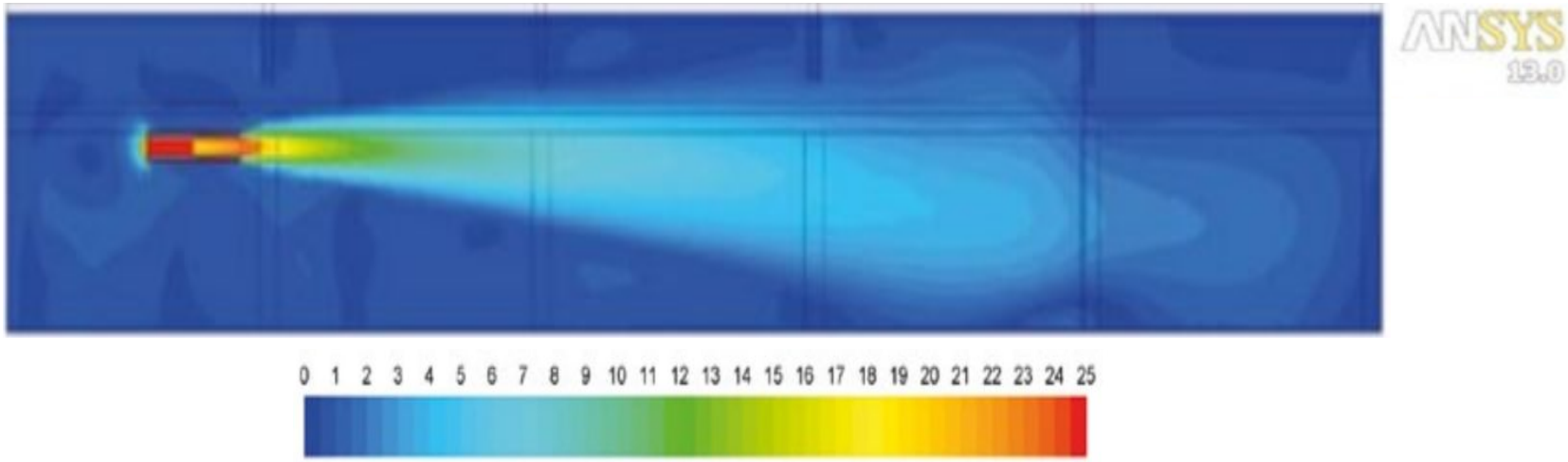
Speed distribution on vertical sections (z-y section) at different distances from the inlet of the jet fan.
ANSYS Fluent on the left, VENTO on the right. No similar images are available for the FDS simulations
Note: The scales used for the comparison differ slightly in color shade.

VENTO results vs reference

X-Z section

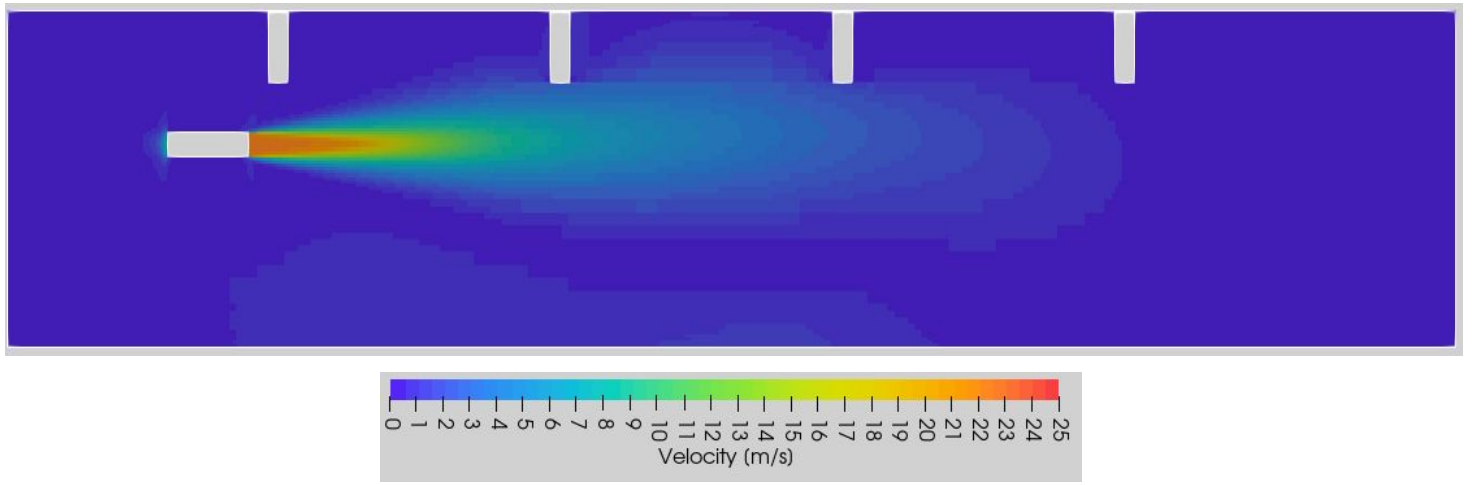
N.B. the images of the jet plume calculated by ANSYS Fluent in the horizontal sections (previous page) and on the vertical section (on the right) seem to be at odds.

The plume moves toward the right in the horizontal sections, while it moves downwards in the vertical section.



Speed distribution on vertical section (x-z section) through the center of the jet fan, ANSYS Fluent top, VENTO bottom.

Note: The scales used for the comparison differ slightly in color shade.

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