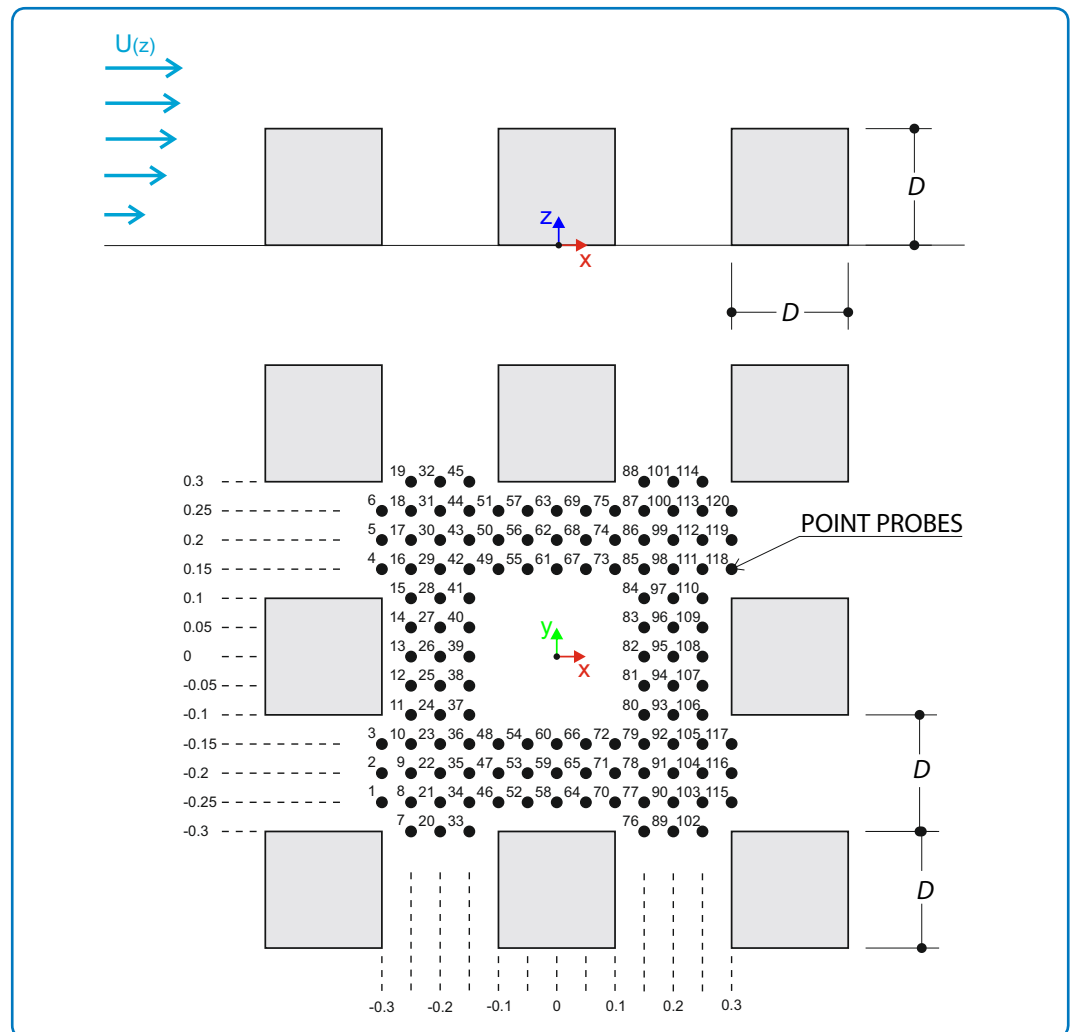


## 0306 – Flow Around a Simple Group of Buildings

### Description

The verification example describes the wind loads in several wind directions on a model of a group of buildings. The model consists of eight cuboids, the setup of which is presented in **Figure 1**. The experimental data and calculation parameters are taken from AIJ Benchmarks [1]. The data are measured using a thermistor anemometer in a wind tunnel. The velocity field obtained by RWIND Simulation is compared with the experimental data, the velocity values are measured in points, called point probes in the RWIND Simulation, and can be seen in **Figure 1**.

Fluid Properties	Kinematic Viscosity	$\nu$	$1.5 \cdot 10^{-5}$	$\text{m}^2/\text{s}$
	Density	$\rho$	1.250	$\text{kg}/\text{m}^3$
Model Parameters	Width and height of buildings	$D$	20.000	mm
	Width of street	$D$	20.000	mm



**Figure 1:** Problem sketch

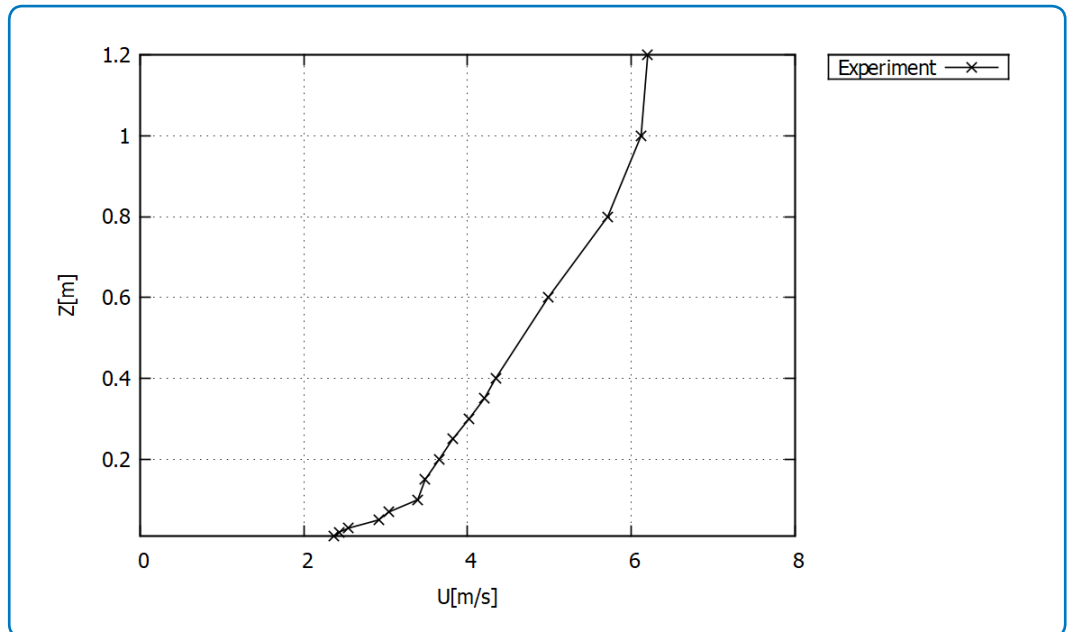
## Verification Example: 0306 – Flow Around a Simple Group of Buildings

The velocity was measured at 120 point probes placed at the measurement height  $0.1D$  (0.02m), the location of the points can be seen in **Figure 1**.

### RWIND Simulation Settings

- Modeled in RWIND Simulation 1.26
- Model of turbulence:  $k - \epsilon$ , intensity of turbulence  $I = 1$
- Finite volume mesh density 30%

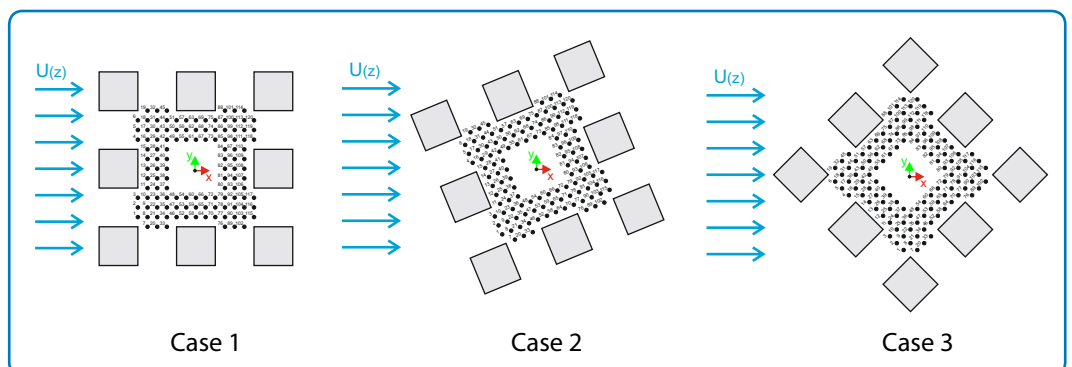
The vertical mean wind flow velocity profile was set to be in agreement with the wind tunnel experiment values, which can be seen in **Figure 2**.



**Figure 2:** Velocity profile

The calculation was performed for the different wind directions given in the following table.

Computed case	Wind directions
1	$0^\circ$
2	$22.5^\circ$
3	$45^\circ$

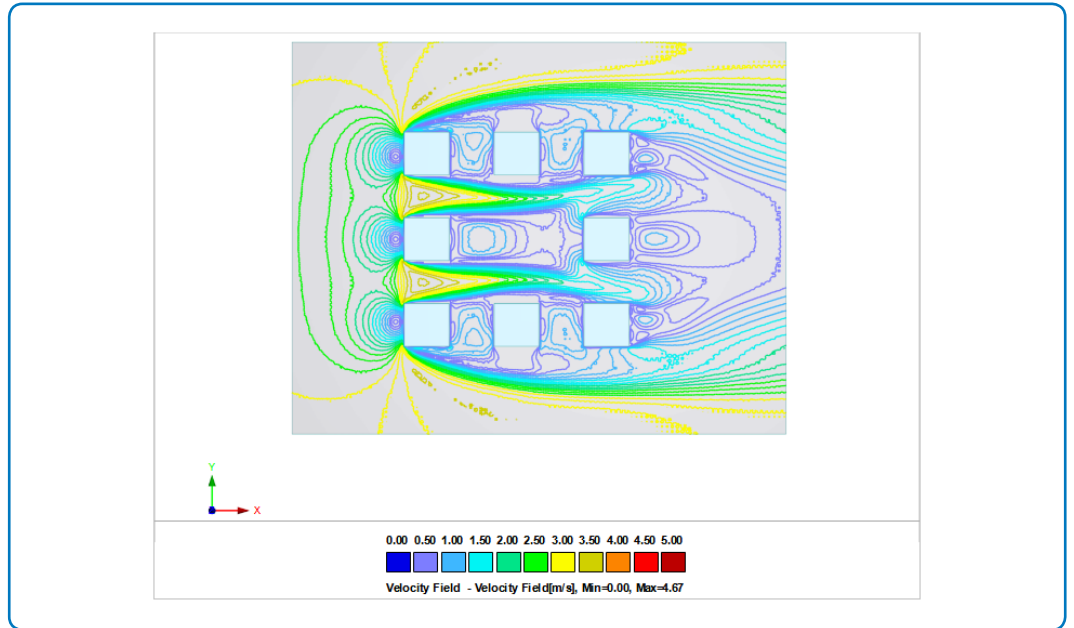


**Figure 3:** Wind directions

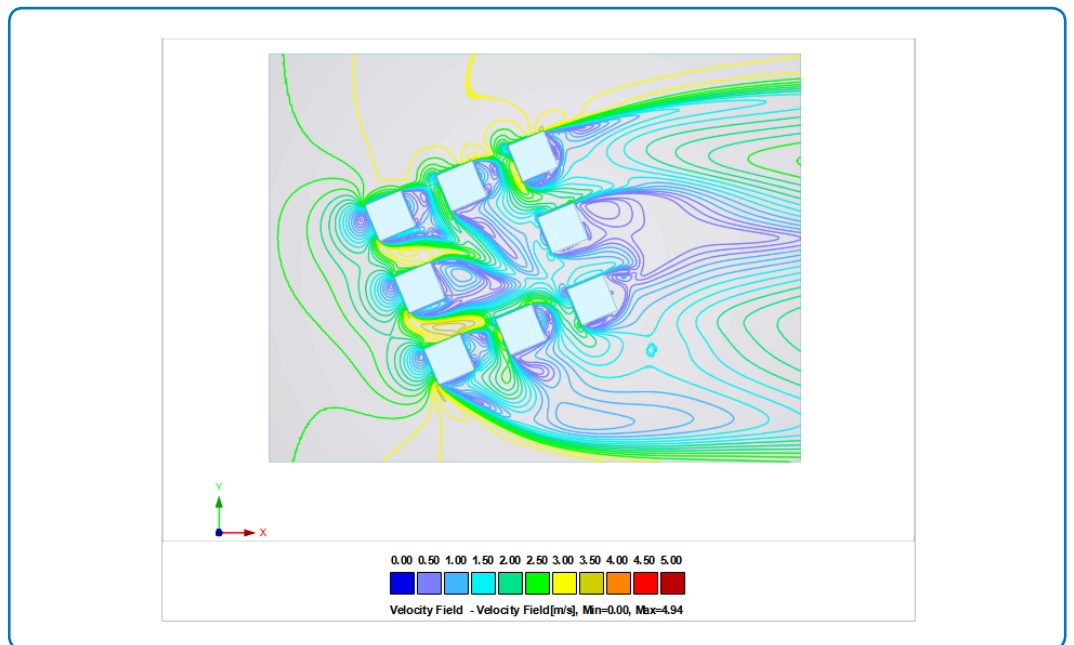
**Results**

Structure Files	Computed case	Program
0306.01	1	RWIND Simulation
0306.02	2	
0306.03	3	

The following figures show the results of the velocity field around the buildings for the computed cases.



**Figure 4:** Case 1, wind direction 0°



**Figure 5:** Case 2, wind direction 22.5°

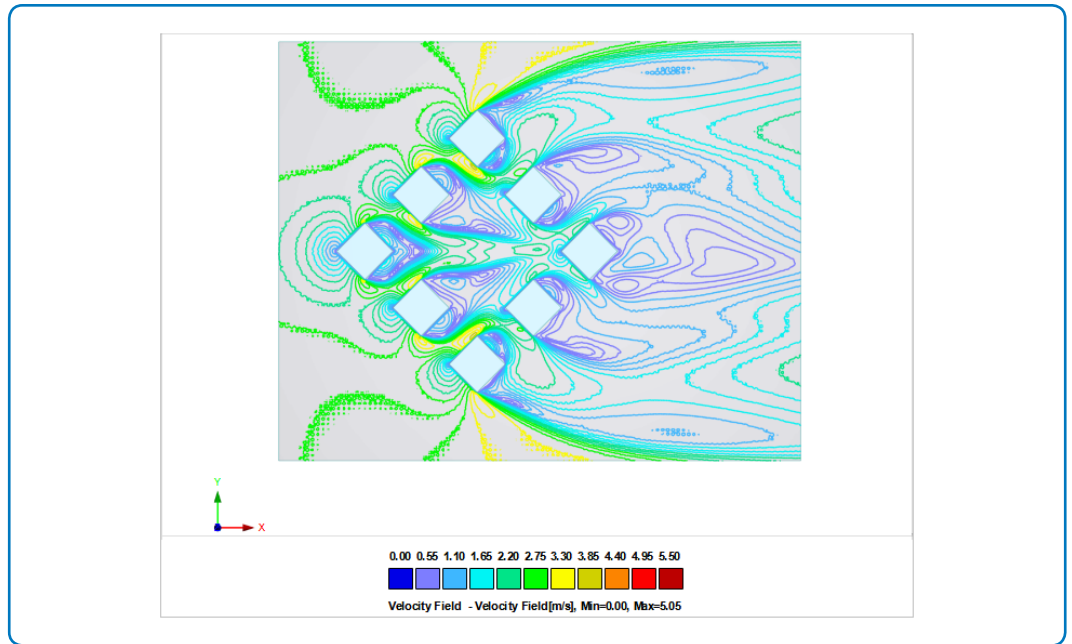


Figure 6: Case 3, wind direction 45°

The following figures show the comparison of a wind speed ratio obtained by RWIND Simulation and wind-tunnel experiments in measuring points for different wind directions, the experimental data are available in [1]. The wind speed ratio was the velocity value normalized by the inflow velocity at the same height ( $U = 2,434\text{m/s}$ ).

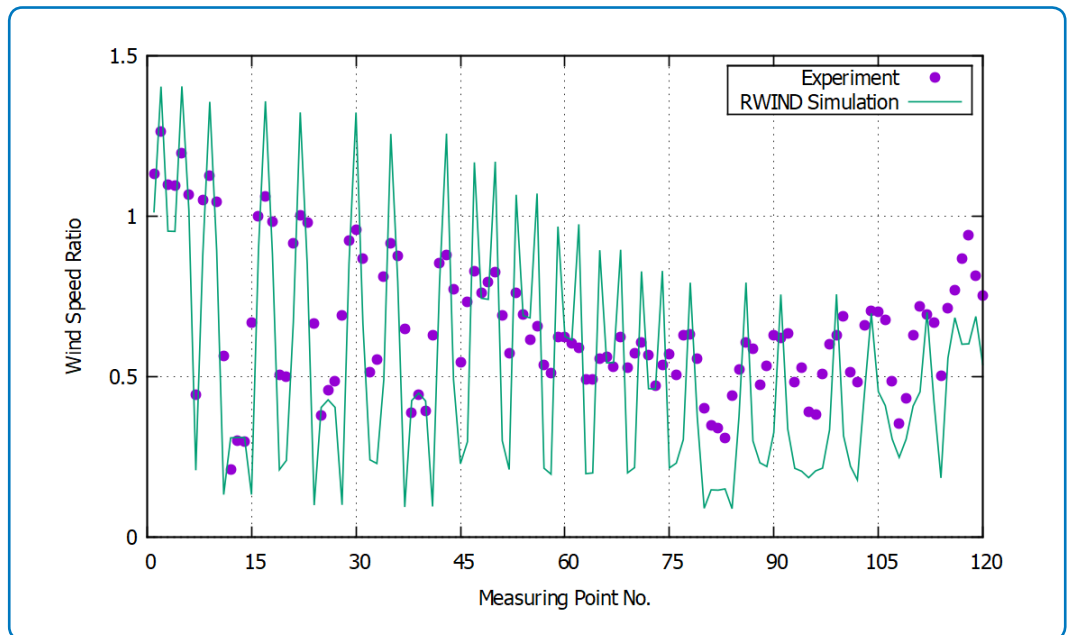


Figure 7: Case 1, wind direction 0°

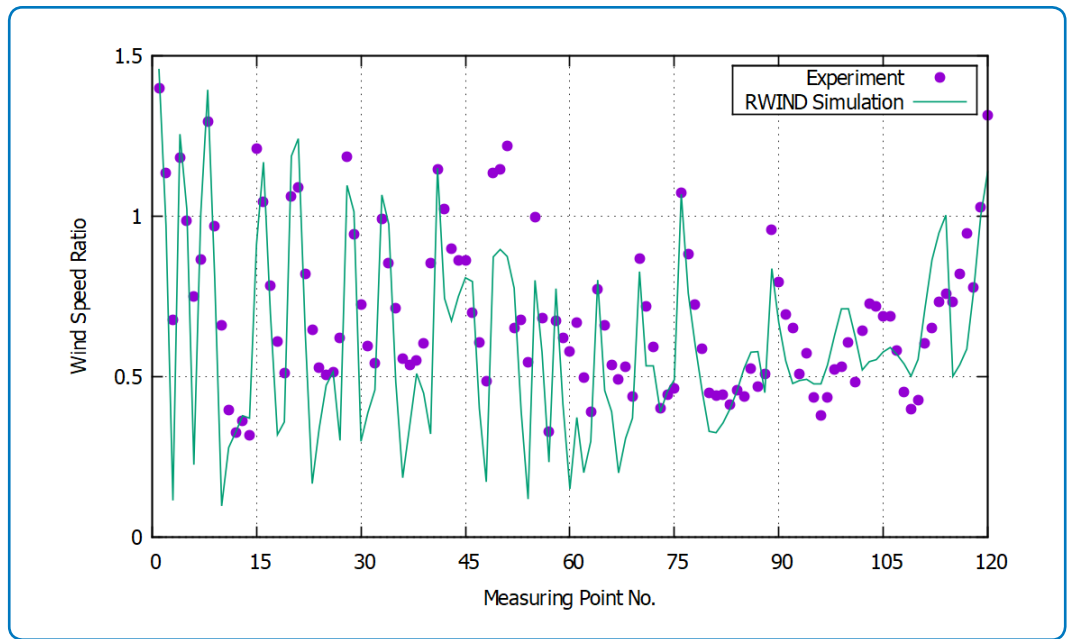


Figure 8: Case 2, wind direction 22.5°

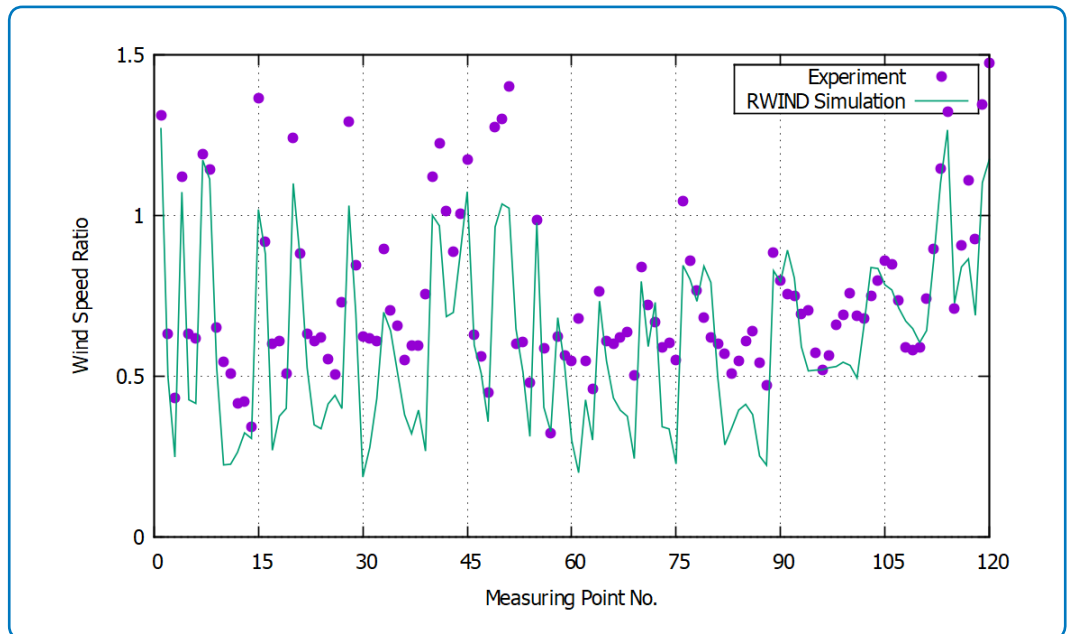


Figure 9: Case 3, wind direction 45°

## **References**

- [1] TOMINAGA, Y. and MOCHIDA, A. *AIJ Benchmarks for Validation of CFD Simulations Applied to Pedestrian Wind Environment around Buildings*. 2016.