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ANALYSIS OF WIND PRESSURE DISTRIBUTION ON THE SURFACE OF 2:1 RECTANGULAR CYLINDER

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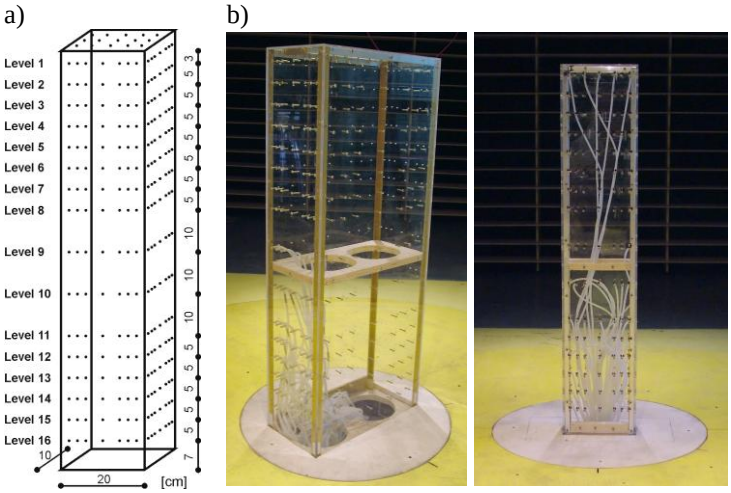
The paper presents a study on the mean wind pressure coefficient distribution on surfaces of rectangular cylinders. The experiment was conducted in a closed-circuit boundary layer wind tunnel in the Wind Engineering Laboratory in Cracow, Poland. Several models were examined during tests (Table 1). This paper focuses on two models with the same side ratio – 1:2 (R1, R3), and on the influence of aspect ratio, wind parameters, and the angle of wind attack on the wind pressure surface distribution. The model was placed vertically on the rotational table in the center of measuring section. The distribution of pressure points on vertical walls and wind tunnel views are presented in Figure 1. Moreover, 15 points were located on the roof of the model to examine 3D flow around its free end. The data from pressure taps was archiving with 500 Hz frequency in the time range equal to 30 sec.

a) b)



Model	*H*	*B*	*D*	*H/B*	*B/D*
	[cm]	[cm]	[cm]	[-]	[-]
R1	100	40	20	2.5	2
R2	100	40	10	2.5	4
R3	100	20	10	5	2
R4	100	20	5	5	4
R5	100	10	5	10	2

Table 1. Model characteristics.

c)

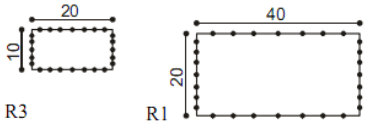


Figure 1. The experimental setup: a) distribution of pressure points along the height, b) models in the wind tunnel (R1, R3), c) circumferential distribution of pressure points.

The flow in the wind tunnel was simulated by wooden barriers, spires and blocks. All tests were performed in six different cases of wind structures characterized by mean wind speed profile, turbulence intensity profile and power spectral density functions (Fig. 2). The angle of the wind attack was changing every 15° in the range 0°-90°. The mean pressure coefficient was calculated according to the following equation:

$$C_p = p / \left(0.5 \cdot \rho \cdot v_0^2\right), \qquad (1)$$

where: p – mean dynamic pressure in the given point of the model, ρ – air density, v_0 – wind speed in undisturbed flow in reference point, at the front of the model, at height z = 70 cm.

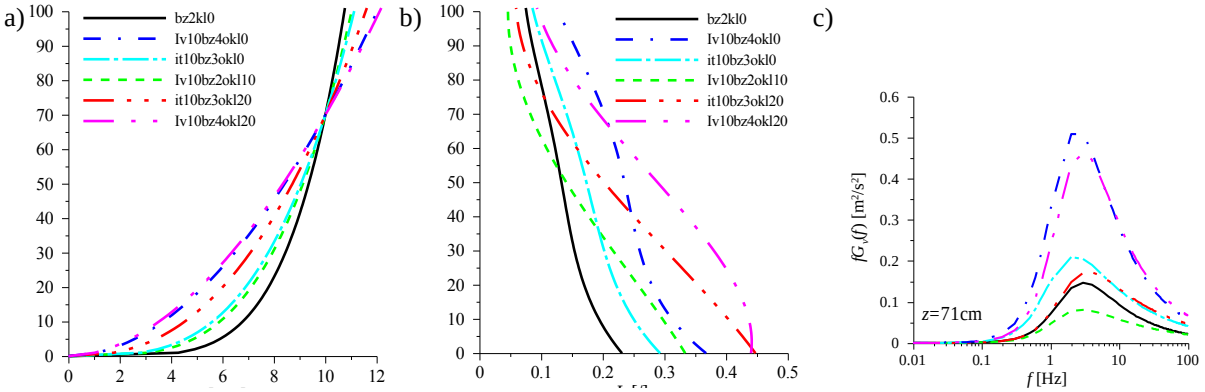


Figure 2. The wind characteristics: a) wind speed profiles, b) turbulence intensity profiles, c) power spectral density functions [1].

Some results of wind tunnel tests are presented in Figure 3. There is spatial distribution of C_p for angle of wind attack equal to 0° in the case of Profile 1 (wall A is a windward wall, C – leeward wall). Examples of circumferential distribution and vertical in the middle lines of each wall (point 4 – windward wall, 18 – leeward wall, 11, 25 – side walls) distribution of C_p, for the model R3, the angle of wind attack 0°, for different profiles are enclosed in Figure 3, as well. As it can be seen, the pattern of C_p is similar but wind parameters strongly influence the C_p values. Aspect ratio of the models are very important for 3-D distribution of C_p mainly near the top of the model (Fig. 3c).

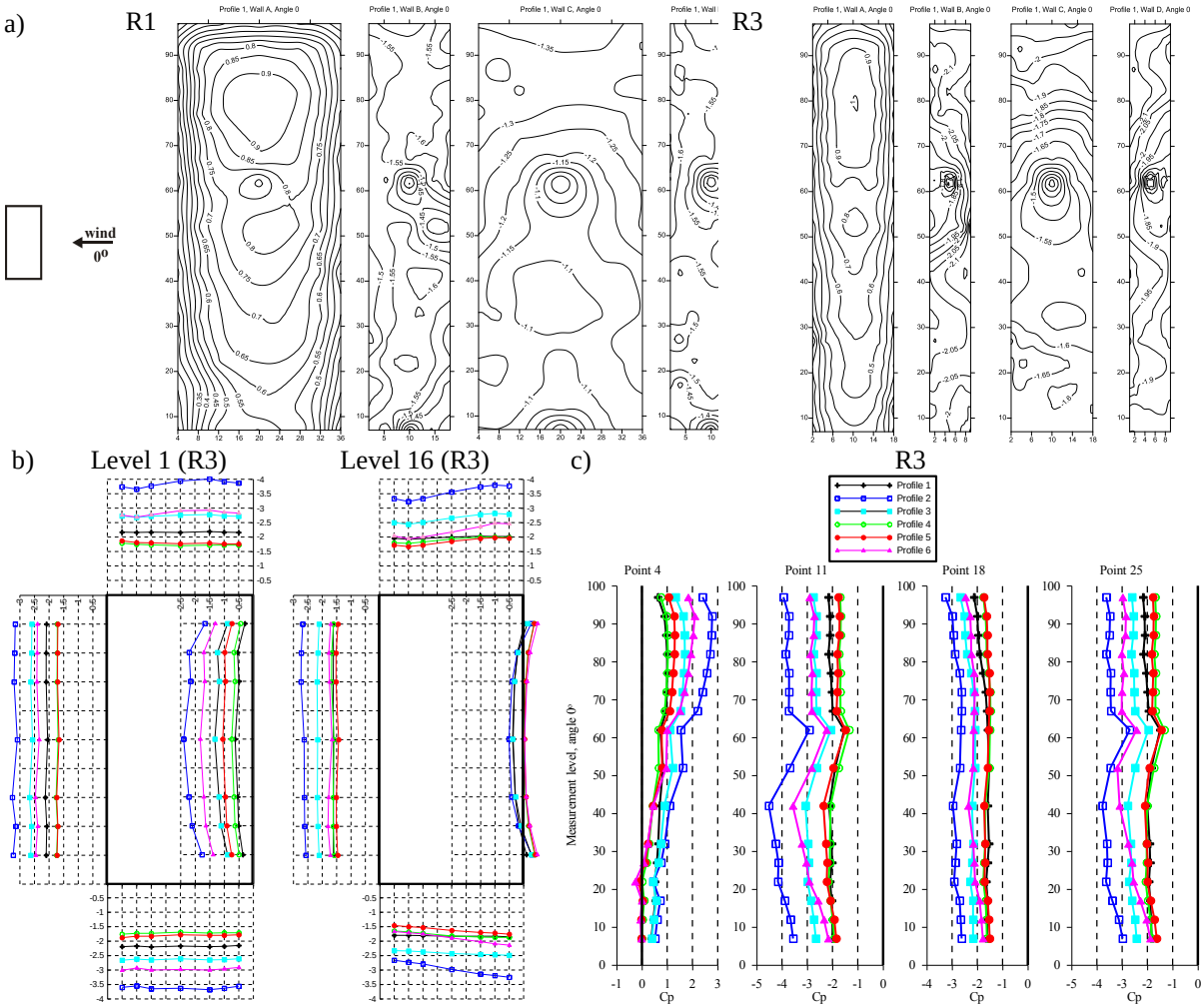


Figure 3. Distribution pf C_p: a) spatial, b) circumferential, c) vertical.