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THE INFLUENCE OF WIND STRUCTURE AND ASPECT RATIO OF CIRCULAR CYLINDERS ON MEAN WIND PRESSURE COEFFICIENT

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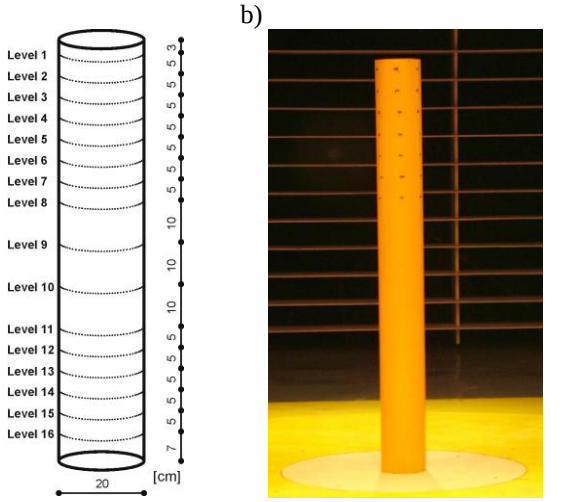
The paper presents analyses of the mean wind pressure coefficient distribution on the surface of circular cylinder. The experiment was performed in a boundary layer wind tunnel in the Wind Engineering Laboratory in Cracow, Poland. Three models were examined in the wind tunnel (Table 1). The following problems were considered during tests: the influence of aspect ratio and the influence of wind parameters on the mean wind pressure distribution. Each model was placed vertically on the rotational table in the center of working section. Pressure points were located at 16 circumferences in 6 vertical sections (Fig. 1). The rotation of the model in the angle range 0°-180° with 5° step was applied. The data from pressure taps was archiving with 500 Hz frequency in the time range equal to 30 sec.

a) b)



Model	H	D	λ
	[m]	[m]	[-]
C1	100	20	5
C2	99	11	9
C3	100	5	20

Table 1. Models characteristics.

c)

Figure 1. The experimental setup: a) distribution of pressure points along the height, b) model C1 in the wind tunnel, c) circumferential distribution of pressure points.

The flow in the wind tunnel was simulated by wooden barriers, spires and blocks. Detailed measurements allowed to choose six different wind structures characterized by mean wind speed profile, turbulence intensity profile and power spectral density functions for which further tests were conducted (Fig. 2). The mean wind static pressure coefficient C_p and its standard deviation were calculated according to the following equations:

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

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

Some results are presented in Figure 3. There are spatial (profile 1), circumferential (profiles 1-6) and vertical (for 0° and 180°, profiles 1-6) distributions of C_p. As it can be seen, the flow characteristics as well as the aspect ratio have strong influence on distribution of C_p.

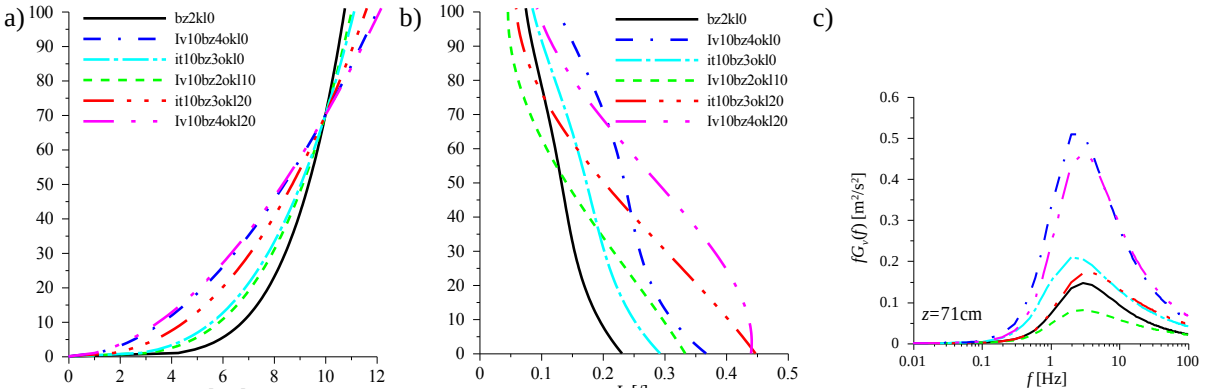


Figure 2. Wind characteristics: a) wind speed profiles, b) turbulence intensity profiles, c) power spectral density functions.

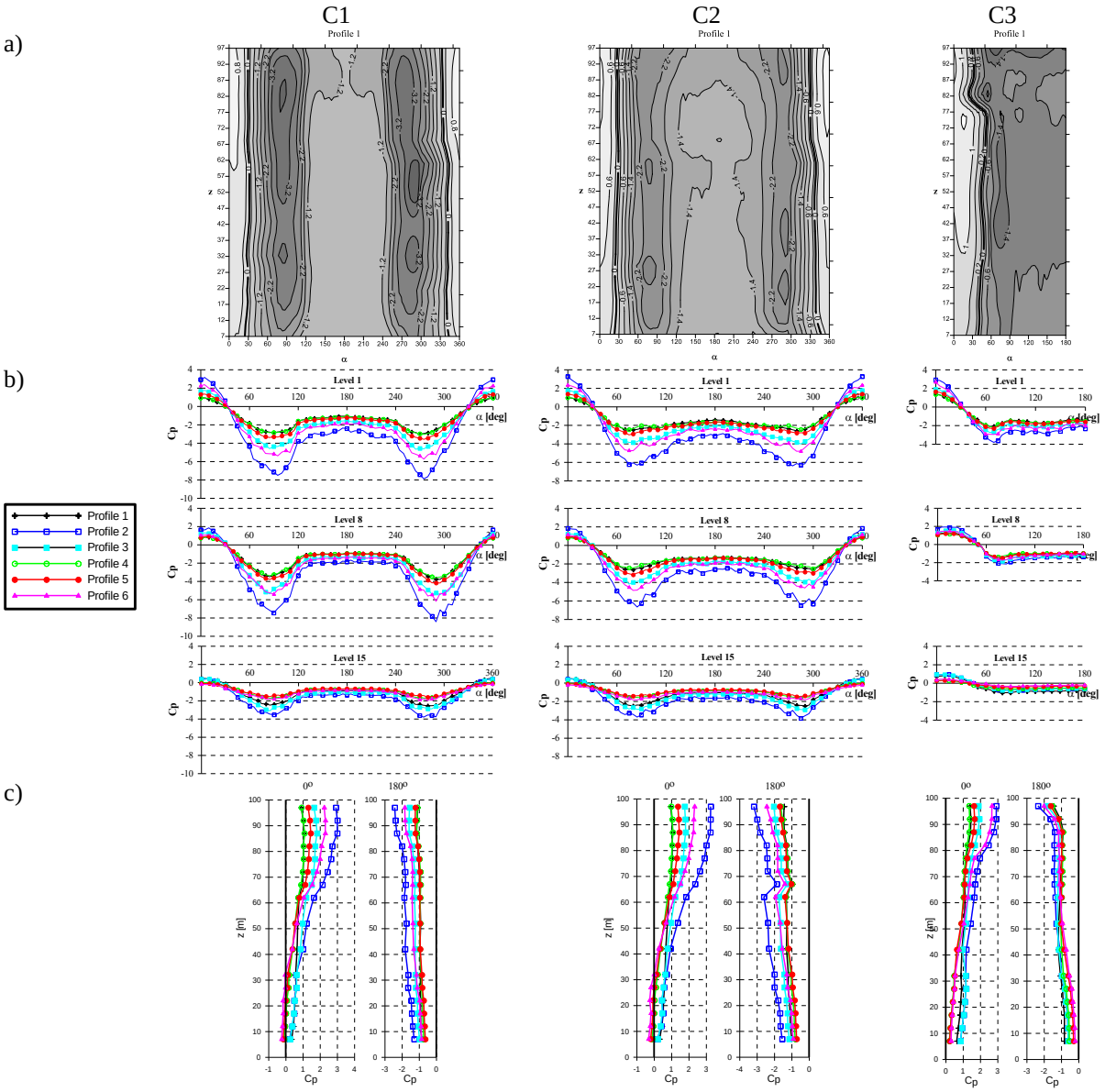


Figure 3. Distribution of C_p: a) spatial, b) circumferential, c) vertical.