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Experimental analysis of the floor inclination effect on the turbulent wake developing behind a wall mounted cube

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Abstract

The present study aims at investigating turbulence characteristics in high flow velocity areas like those suitable for marine energy application. The Reynolds number, based on the rugosity height and mean flow velocity, is rather high: $R_e = 2.5 \times 10^7$. For that purpose, experiments are carried out in a flume tank with R_e as high as achievable in Froude similitude (in the tank: $Re = 2.5 \times 10^5$ and $Fr = 0.23$). Obstacles are canonical wall-mounted elements chosen to be representative of averaged bathymetric variations: a cube and a cube followed by an inclined floor. First, the wake topology past a canonical wall-mounted cube is illustrated from PIV measurements. Results show a flow behaviour already observed in the literature but for different upstream conditions (R_e and turbulence intensity). Second, the impact of the addition of an inclined floor is studied. It is shown that the inclination causes a squeezing of the cube wake that strongly impacts the shape and intensity of the shear layer (up to 10% more intense with the inclined floor). To fully grasp the turbulence organization in the wake for both test cases, an analysis using both complementary Proper Orthogonal Decomposition and quadrant method is performed. POD acts as a turbulent noise filter and quadrant method decomposes turbulent events. Results show the predominance of ejection (Q2) and sweep (Q4) events in the flow Reynolds shear stress. Q2 events are more energetic although Q4 events prevail. It is observed that the inclined floor causes a persistence of Q2 and Q4 events higher into the water column, more than the impulsion given by the floor altitude variations. The rise of the cube wake due to the inclined

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