

Flow field in a liquid impinging jet confined by slopping plane walls

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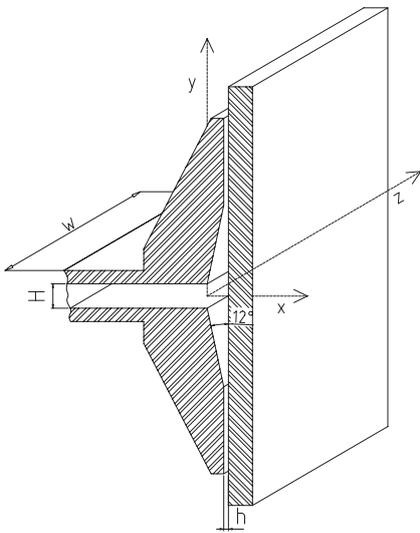
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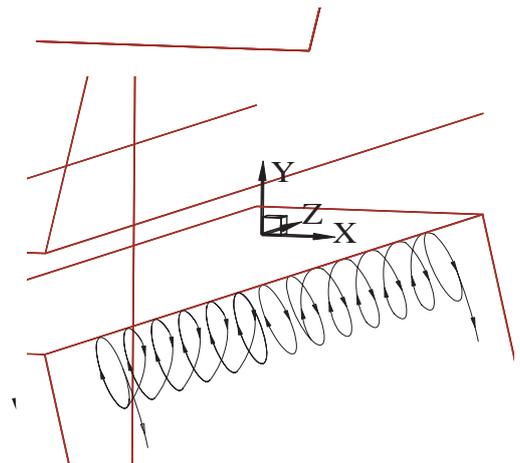
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An experimental investigation was carried out to characterize the flow field in a liquid impinging jet cell confined by slopping plane walls and emanating from a rectangular duct. The cell test section is schematically represented in Fig. 1.

**Fig. 1** Cell test section

The fluids are Newtonian flowing in the laminar ($Re = 136$ and 275) and turbulent regimes ($Re = 13,750$) and the two-dimensional rectangular cell has an aspect-ratio equal to 13. A 1-D laser-Doppler anemometer from Dantec was used to measure the mean and fluctuating velocity fields and pressure transducer measure pressure variations along the x-centre-plane. In the three cases the flow was fully developed in the rectangular duct. The fully-developed rectangular jet impinging the flat surface (plate) is confined by two slopping plane walls, each one making an angle of 12° relative to the plate. The presence of the impact plate is felt upstream at $y/H = -0.2$ in the laminar regime and at $y/H = -0.4$ in the turbulent regime. The flow was always and everywhere symmetric relative to the x-y and x-z center planes. Near the plane slopping wall there was separated flow for Reynolds numbers in excess of 208, as was observed in visualization studies and in velocity measurements parallel to the wall. The size and strength of this recirculation zone increases with Reynolds number: for $Re = 275$ its normalized length, $x_R/H = 0.25$ whereas for turbulent flow x_R/H is equal to 0.9. In the turbulent flow

regime the impact of the jet onto the plate produces turbulence by the strong fluid deceleration, but the maximum turbulence is observed within the cell, in the shear layer formed between the recirculation region on the sloping wall and the jet flowing along the impinging plate. We also report three-dimensional effects due to finite slenderness of the flow geometry: the absence of a recirculation next to the side walls, the existence there of a wall jet and an helical motion of the fluid in the separated flow region progressing from the centre-plane towards the side walls as sketched in Fig. 2

**Fig. 2** Sketch of the three-dimensional flow in the recirculation zone.