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Flow of a jet depositing on a moving wall near channel exit at moderate Reynolds number

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ABSTRACT

The steady flow of a moderately inertial moving wall jet is examined theoretically near channel exit. The free surface jet emerges from a channel and adheres to a wall, which may move in the same or opposite direction to the acting channel pressure gradient. The problem is solved using the method of matched asymptotic expansions. The small parameter involved in the expansions is the inverse Reynolds number. The flow field is obtained as a composite expansion by matching the flow in the boundary layer regions near the free surface and the moving wall, with the flow in the core region. The influence of inertia and wall velocity on the shape of the free surface, the velocity and stress is emphasized. It is found that the viscous relaxation length is essentially uninfluenced by the velocity of a forward moving wall. In contrast, it diminishes rapidly with the velocity of a backward moving wall. For a stationary wall, the flow is matched to Watsons (1964) similarity solution far downstream from the channel exit, thus allowing the prediction of the entire near and far fields of flow and free surface shape.

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