Coherent structures in wave boundary layers. Part 1. Oscillatory motion - DTU Orbit

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This work concerns oscillatory boundary layers over smooth beds. It comprises combined visual and quantitative
techniques including bed shear stress measurements. The experiments were carried out in an oscillating water tunnel.
The experiments reveal two significant coherent flow structures: (i) Vortex tubes, essentially two-dimensional vortices
close to the bed extending across the width of the boundary-layer flow, caused by an inflectional-point shear layer
instability. The imprint of these vortices in the bed shear stress is a series of small, insignificant kinks and dips. (ii)
Turbulent spots, isolated arrowhead-shaped areas close to the bed in an otherwise laminar boundary layer where the flow
‘bursts’ with violent oscillations. The emergence of the turbulent spots marks the onset of turbulence. Turbulent spots
cause single or multiple violent spikes in the bed shear stress signal, which has profound implications for sediment
transport (in both the laboratory and the field). The experiments also show that similar coherent flow structures exist in the
case of combined oscillatory flow and current.

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