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A numerical study of the unfluence of wall effects on the onset of unsteadiness in the three dimensional flow over a backward-facing step NIKOLAOS MALAMATARIS, George Mason University - TEI of W.Macedonia — In three dimensional separated flows, a flow component is developed in the spanwise direction that permits the flow to laterally escape [1]. This work shows for the first time how this flow situation occurs in the three dimensional, backward-facing step flow in a numerical experiment that mimics actual laboratory conditions (expansion ratio 1:2, aspect ratio 1:40). To this purpose, the full three dimensional Navier Stokes equations are solved directly with finite elements up to the highest Reynolds number (Re = 950) where the flow is stable. The wall effects are studied thoroughly, by showing how the recirculation regions vary close to the lateral wall and how the limiting streamlines are related to the spanwise flow in terms of their direction depending on the magnitude of the Reynolds number. It is shown how this spanwise flow goes all the way to the lateral wall and bounces back in a manner that it is impossible to be sustained at Reynolds numbers higher than 950 [2]. It is argued that this flow is responsible for the early onset of unsteadiness for this flow as has been observed in laboratory experiments and never fully understood so far.

[1] J.Délery, Onera on-line lessons, Part I, 2011
[2] N.A.Malamataris, DOI: 10.1002/fld.3699

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