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a Lift Crisis in the Drag Crisis Regime - Physical Review Letters - Vol. 117, p.234501-1 à 5 - 2016

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## Supplemental material to “Lift crisis on non-symmetrical obstacles”

This supplemental material shows the results briefly given in the paper for three different sections.

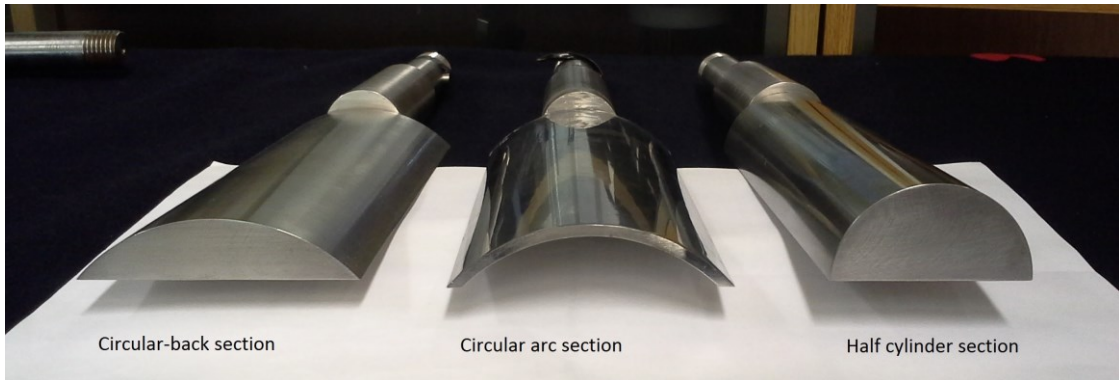


Figure SM1: The three sections tested (bodies 2, 1 and 3 from left to right).

As shown in Figures SM2 and SM3, the same behavior is evidenced on the 3 tested sections showing a simultaneous lift and drag crisis.

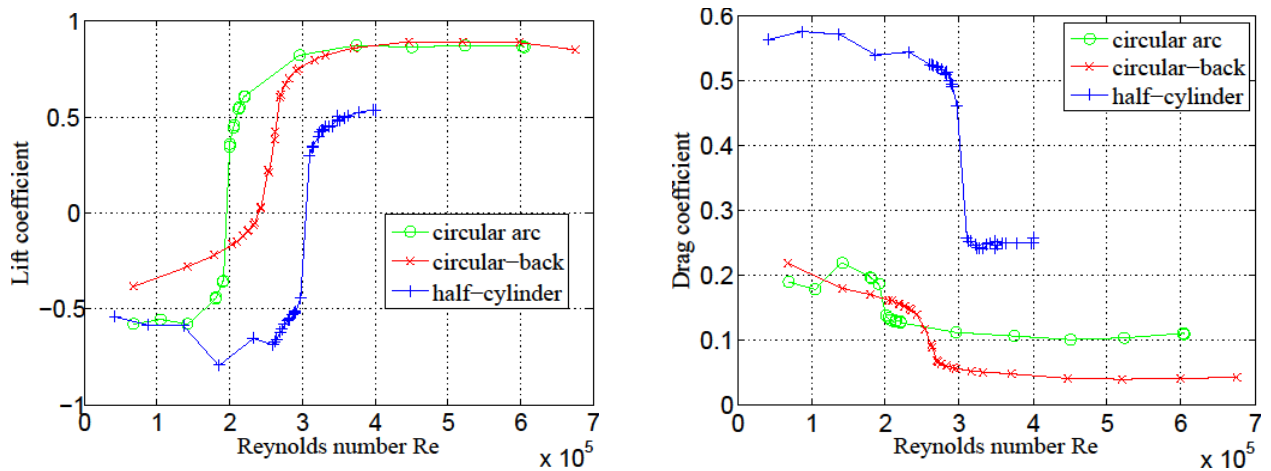


Figure SM2: Lift and drag crisis on the three sections tested. The crisis is less abrupt for the circular-back profile than for the other sections.

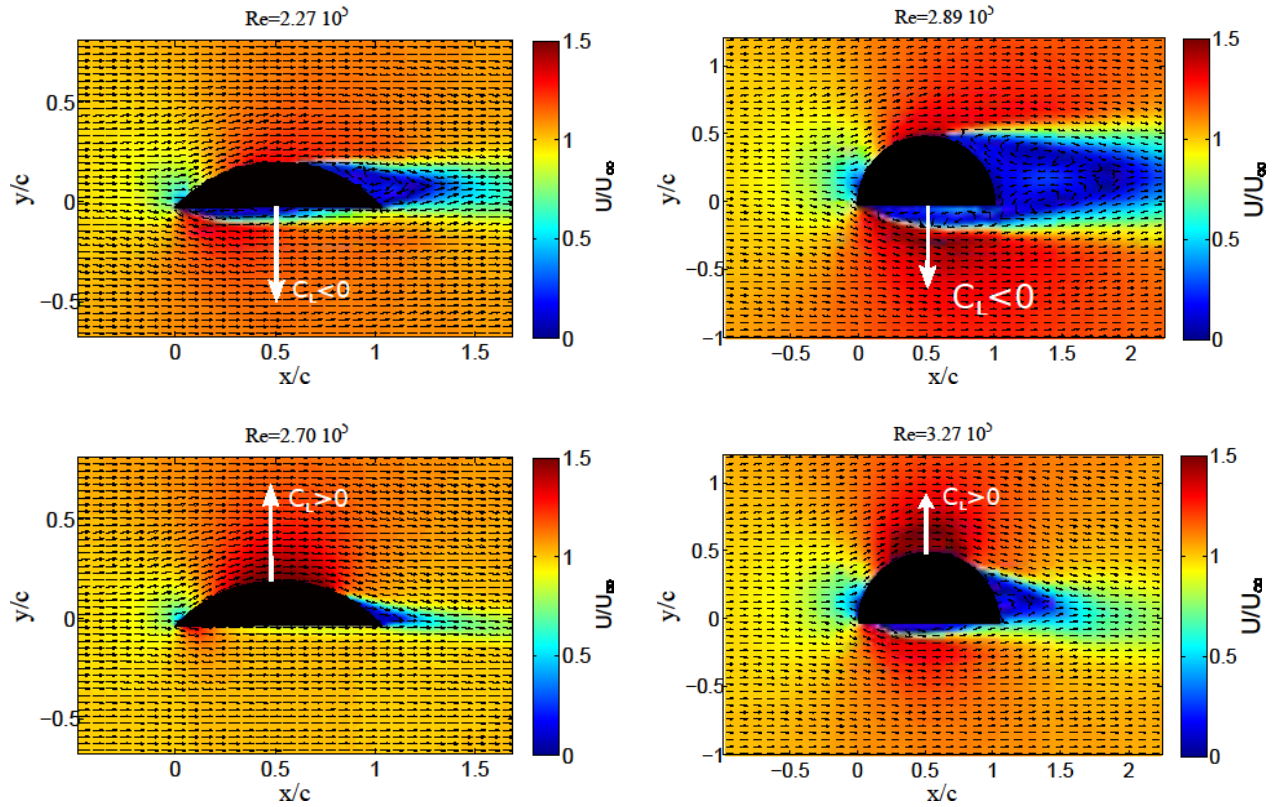


Figure SM3: Time-averaged velocity field below (top line) and above (bottom line) the critical Reynolds number, for the circular-back section (left column) and the half-cylinder section (right column).

The following table summarizes the results obtained on the three sections.

Profile	1	2	3
	Circular arc	Circular-back	Half-cylinder
$Re_c (10^5)$	2.0	2.5	3.0
$C_{L0}$	0.08	0.24	-0.103
$C_L$ below	-0.6	-0.3	-0.6
$C_L$ above	0.87	0.9	0.53
$C_D$ below	0.2	0.18	0.57
$C_D$ above	0.1	0.04	0.25
$\gamma$	0.2	0.5	0.2
$C_L/C_D$ below	-3	-0.2	-0.1
$C_L/C_D$ above (max)	8.5	22	2
$C_x$ below	0.9	0.81	1.14
$C_x$ above	0.45	0.18	0.5

Table SM1: Comparison between the 3 profiles.  $C_L$  and  $C_D$  are defined with the chord length  $c$  as the reference length  $C_x$  is defined with the section thickness as the reference length. Values below and above the transition are given far away from the threshold  $Re_c$ .

Comparing the circular-back section with the circular arc section:

- The critical Reynolds number  $Re_c$  is slightly higher:  $2.5 \cdot 10^5$  instead of  $2.0 \cdot 10^5$ ,
- The lift coefficient above  $Re_c$  is similar and the drag coefficient is about half;
- The lift coefficient below  $Re_c$  is about half and the drag coefficient is similar.

Comparing the half-cylinder section with the circular arc section:

- The critical Reynolds number  $Re_c$  is higher:  $3.0 \cdot 10^5$  instead of  $2.0 \cdot 10^5$ ,
- The lift coefficient above  $Re_c$  is lower;
- The lift coefficient below  $Re_c$  is similar;
- The drag coefficient  $C_D$  (defined with the chord length) is far higher for all  $Re$ ; the drag coefficient  $C_x$  defined with the frontal area is similar (of order 1 below  $Re_c$ , of order 0.5 above  $Re_c$ ).

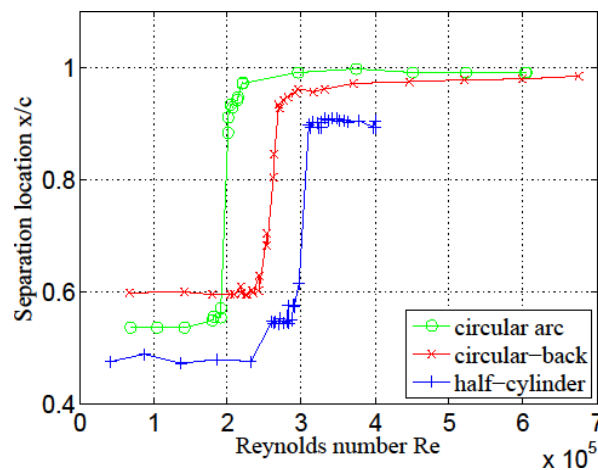


Figure SM4: Separation point location  $x/c$  for the 3 profiles.

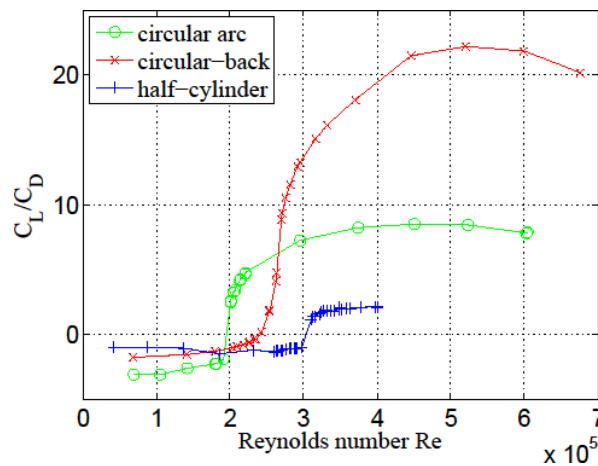


Figure SM5: Lift-to-drag ratio for the three different profiles. The circular-back profile has a large lift-to-drag ratio at high Reynolds numbers.