



LUND UNIVERSITY

Flow Around a Rectangular Cylinder of Critical Side Ratio

Norberg, Christoffer

Published in:
Album of Flow Visualization

1993

[Link to publication](#)

Citation for published version (APA):
Norberg, C. (1993). Flow Around a Rectangular Cylinder of Critical Side Ratio. *Album of Flow Visualization*, (10), 25-26.

Total number of authors:
1

General rights

Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

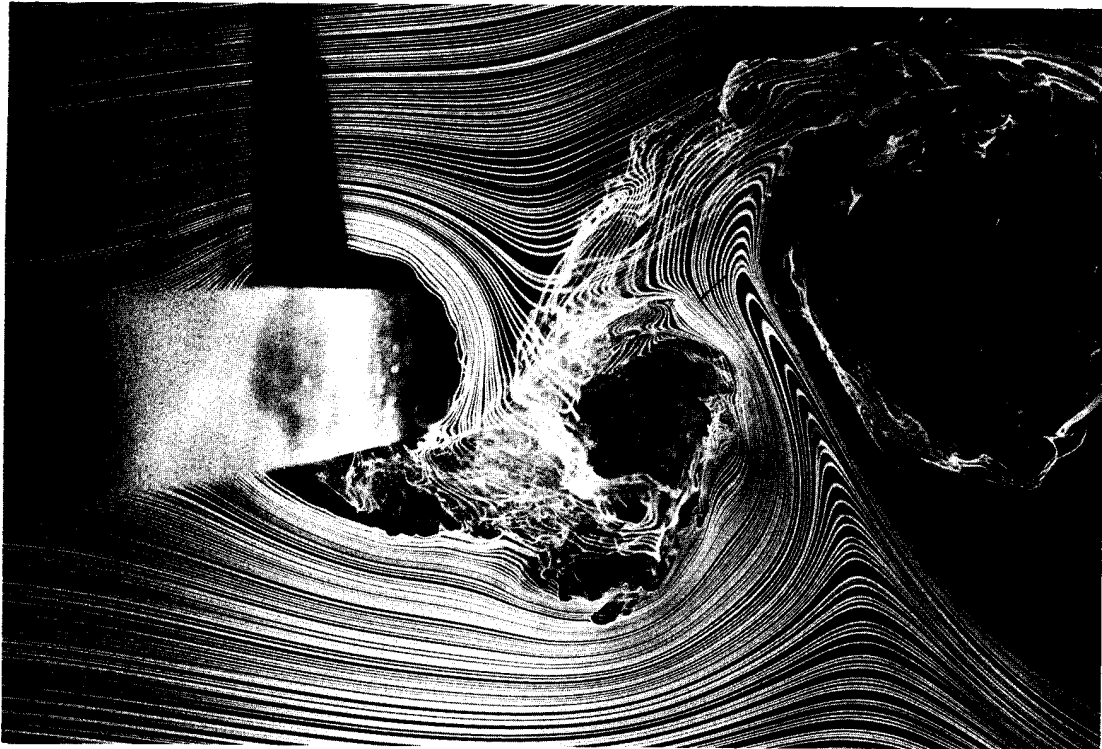
Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Album of Flow Visualization No. 10 (1993)



25. Flow Around a Rectangular Cylinder of Critical Side Ratio

25. Flow Around a Rectangular Cylinder of Critical Side Ratio

Christoffer Norberg (Chalmers Univ of Technology)

Keywords: Rectangular cylinder, vortex shedding, critical section, smoke-wire method

The photograph shows a snap-shot of the cross flow around a rectangular cylinder. The streaklines were made visible by using the smoke-wire method in a wind tunnel. The ratio between the side aligned with the flow and the side normal to the flow is $H/D=0.62$. The Reynolds number (based on D) is 8000 and the free stream turbulence intensity is 0.06%. The photograph reveals that the turbulent vortex shedding flow at this parameter combination is extremely powerful. The Strouhal number is 0.13 (aspect ratio $L/D=32$, blockage 2.5%). Experimental data at Reynolds numbers of the order 10000 show that the drag coefficient reaches a local maximum of about 2.8-3.0 at around this "Golden Section" side ratio [C.Norberg, *J. Wind Eng. and Industrial Aerodynamics*, 1993 (to appear)]. However, the critical side ratio is reduced by the addition of small-scale free stream turbulence as well as by transverse vibration especially at resonant conditions [Y.Nakamura, K.Hirata, *J. Fluid Mechanics*, Vol. 208, pp. 375-393, 1989]. With an increase in H/D (at constant D) and for a given Reynolds number in the turbulent regime the vortex formation moves upstream towards the cylinder, the cavity shrinks and consequently the base pressure decreases. Probably, the associated increase in vortex strength is accelerated due to e.g. progressive interactions between the two shear layers as well as by an increased importance of shear layer/edge interactions. At the critical side ratio the size of the base cavity has been reduced to a minimum. Indeed, the photograph shows that the shear layer springing from the upper left corner of the cylinder, at that particular instant, is tightly wrapped around the section and confronts, at the diagonal corner, with the shear layer from the other side. Beyond the critical ratio the interactions between the shear layers and the rear corners forces the vortices to again develop further downstream with the result of an increase in base pressure i.e. a decrease in drag.