

Vortex Flowmeter

Amit Agrawal

Department of Mechanical
Engineering, IIT Bombay

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Principle of Operation

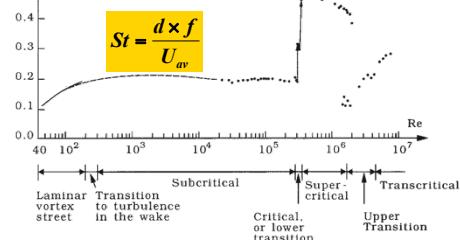
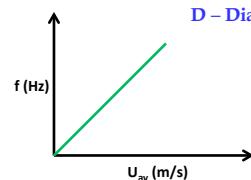
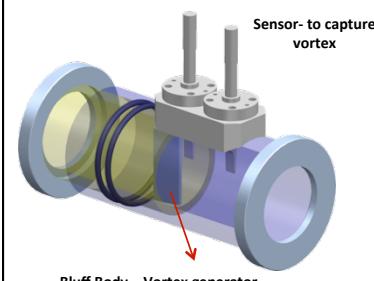


Fig. 1 St variation with Reynolds number for flow over cylinder in cross-flow

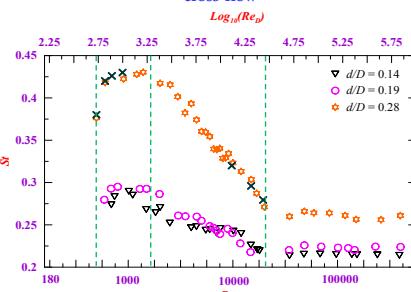
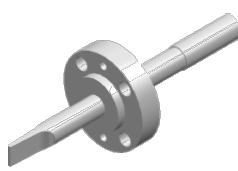
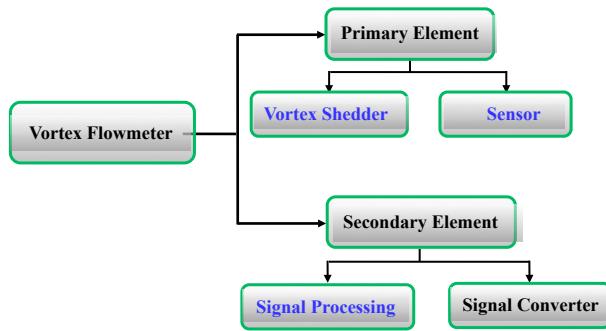


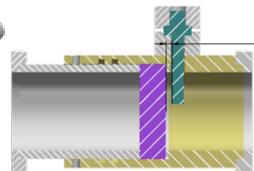
Fig. 2 St variation with Reynolds number for flow over cylinder in circular pipe

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Construction



Piezoelectric Sensor



Transient Pressure Sensor

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Advantages & Limitations

➤ Advantages

- Low pressure loss (One order lower than orifice flowmeter)
- Large turn-down ratio : Theoretically 1:100 (Practically 1:70)
 - Differential pressure devices 1: 10
- Low cost : compared to Coriolis and Ultrasonic flowmeter
- Wide operating Pressure and Temperature range
- Suitable for various fluids: Air, water, Steam, etc.
- No moving parts
- Linear output – Frequency \propto Velocity

➤ Dis-Advantages

- Sensitivity to upstream flow conditions

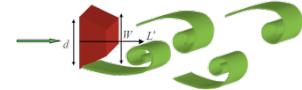
➤ Questions

- How to increase the range of operation of vortex flowmeter?
- What is the best location to place the sensor?
- ..

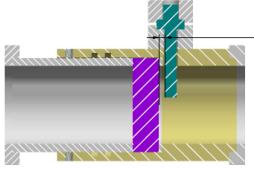
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Shape	x/d	Linearity (%)	K	L_{pm}/d	L_{rec}/d	W/d	L'/d
Range of Re_D		$3.0 \times 10^4 - 3.0 \times 10^5$			$5.0 \times 10^4 - 1.8 \times 10^5$	10000	
Bullet $l/d = 1$	1.86	3.4	0.39	1.28	5.78	1.18	2.28
	2.28	5.2					
	2.07	27					
Bullet $l/d = 1.5$	2.36	18.5	0.44	1.66	5.78	1.09	2.74
	2.78	7					
		l		d			
Elliptic $l/d = 1.5$	No regular vortex		0.41	2.24	6.74	1.43	2.30
							
	shedding is observed for $Re_D > 30000$						
Triangle apex $l/d = 1.2$	2.48	1.5	1.15	2.29	6.0	1.31	2.69
							
	2.77	5.6					
Triangle $l/d = 1.2$	2.48	3	2.76	1.41	3.88	1.70	1.45
							
	2.06	3.1					
Triangle blunt $l/d = 1.2$	1.77	27	3.45	1.41	3.88	1.54	1.40
							
	2.48	2.5					
Trapezoid $l/d = 1.25$	1.81	5.25	1.69	1.46	5.96	1.47	2.2
		2.1 2.25					
	1.14 1.68						

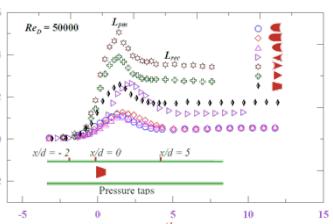
Bluff Body Optimization



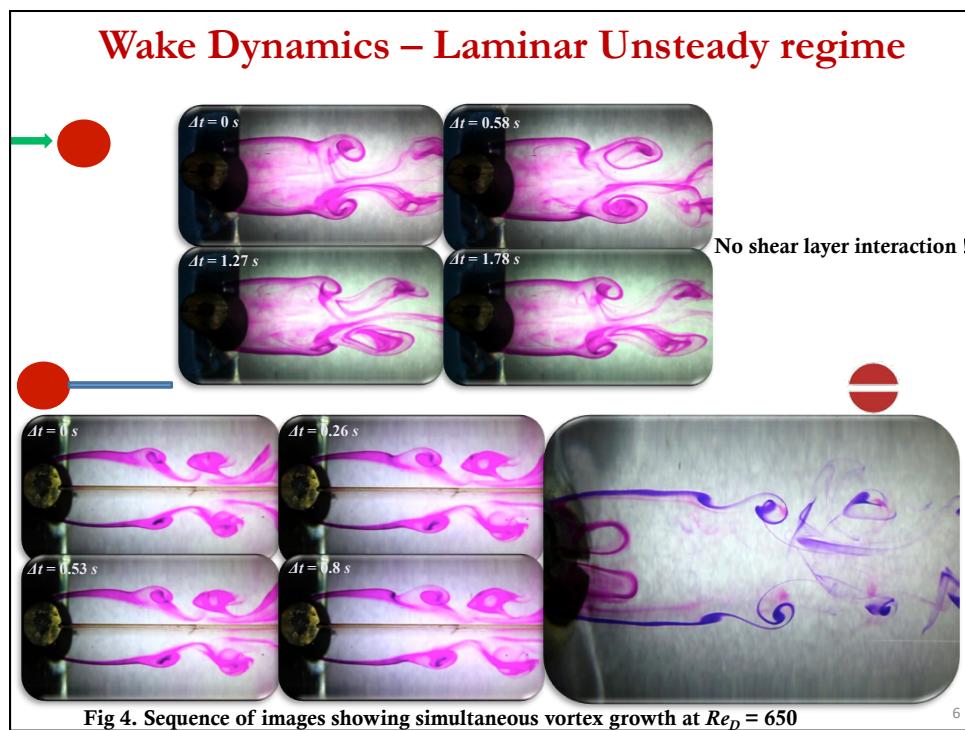
Wake Parameters

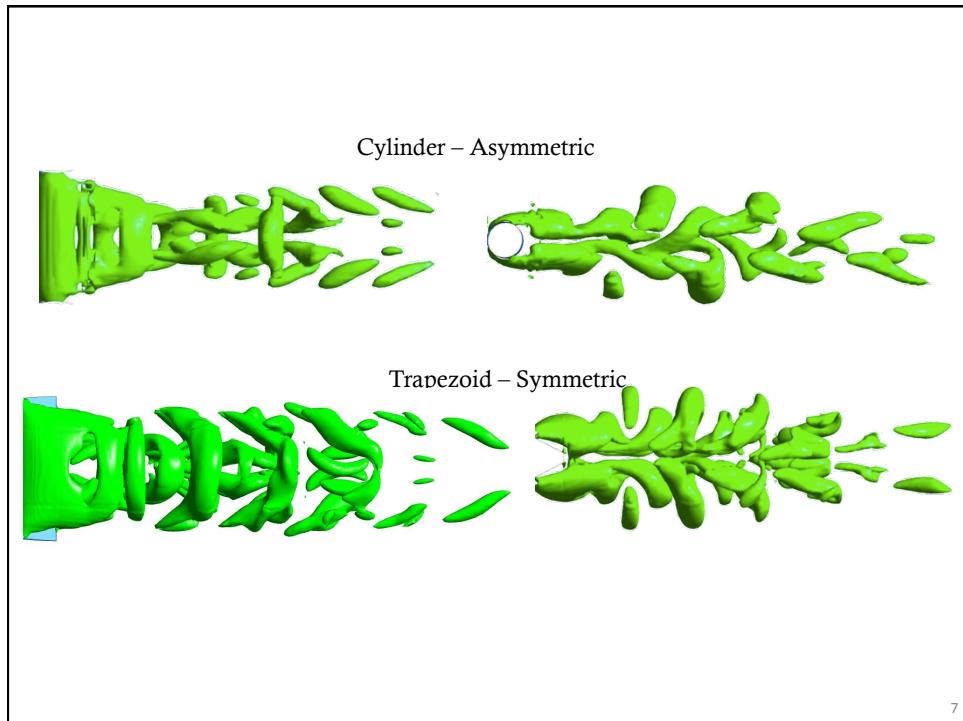


Location optimization

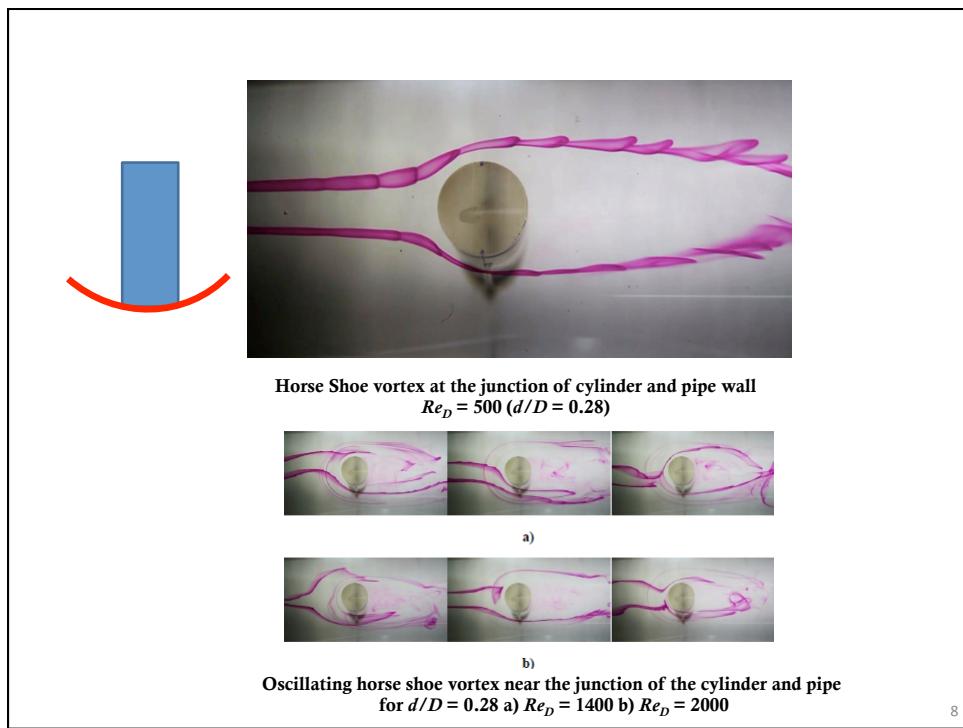


Permanent Pressure Loss



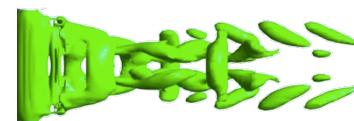
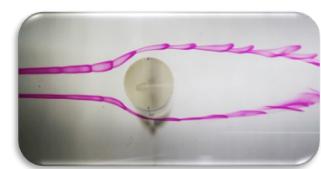
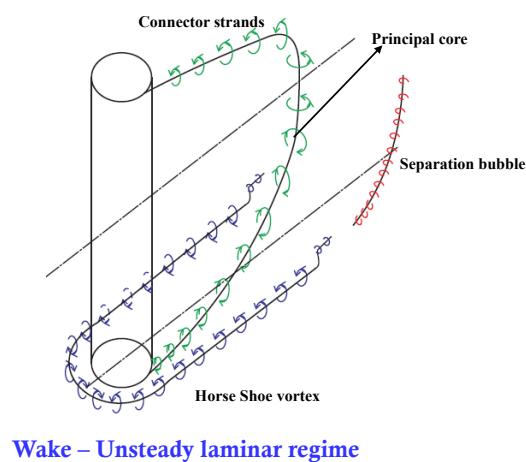


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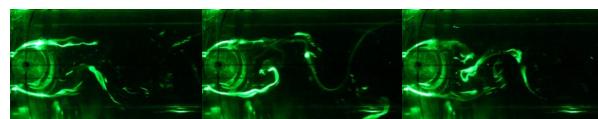
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Unsteady Laminar Regime

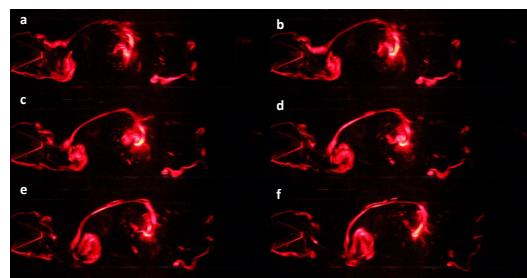


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Turbulent Regime

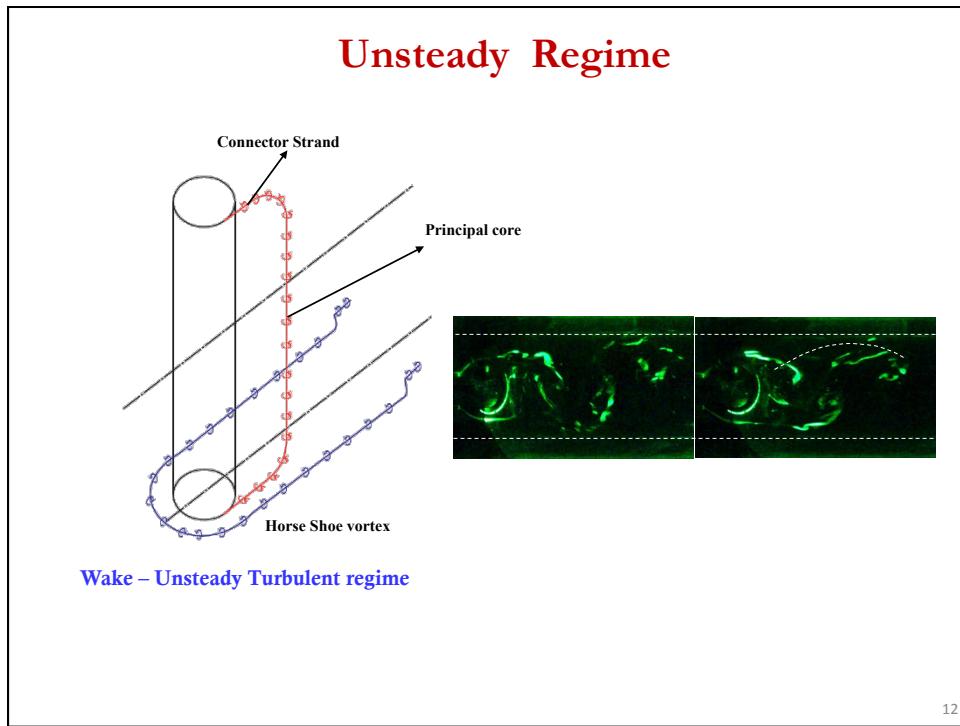
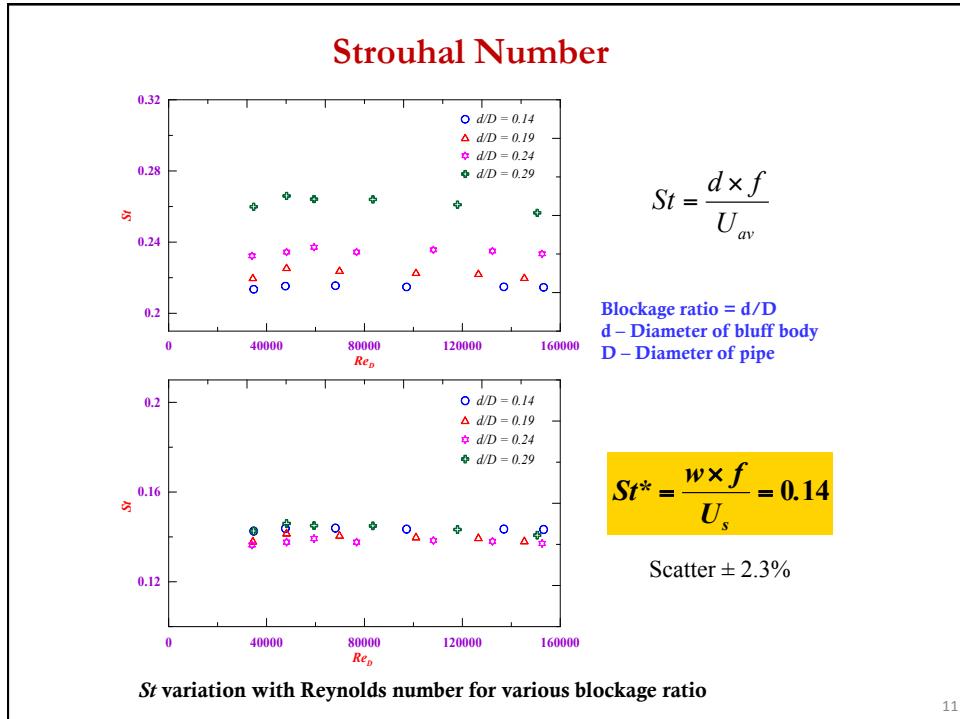


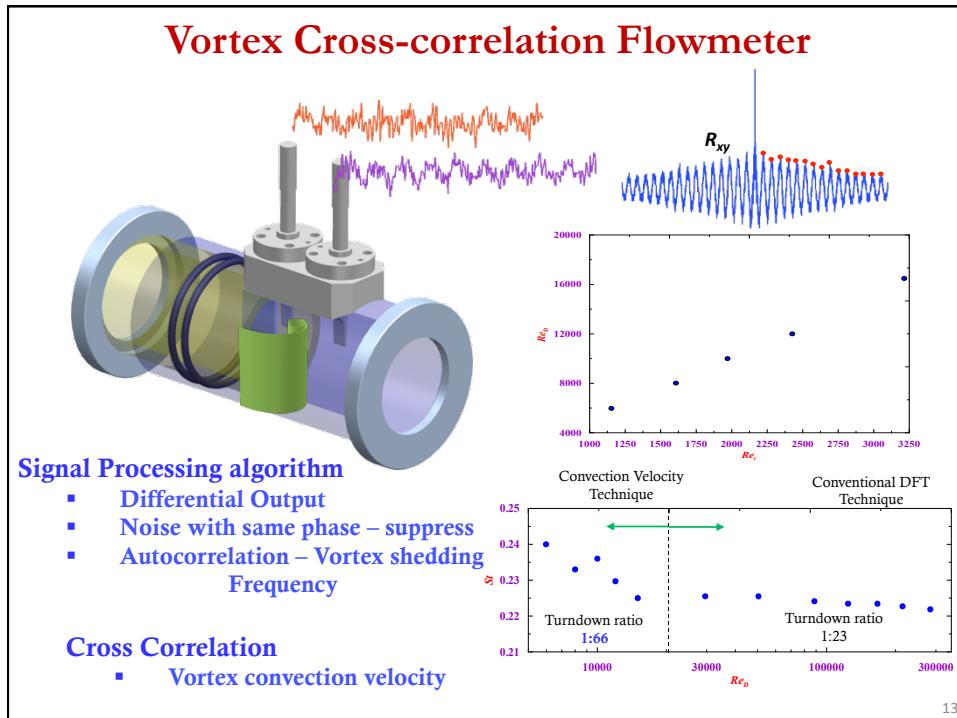
Sequence of images showing Vortex Shedding (circular cylinder)



Sequence of images showing Vortex Shedding (Trapezoid)

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Acknowledgements

- Dr. A. Venugopal
- Prof. S.V. Prabhu
- Department of Science and Technology, New Delhi