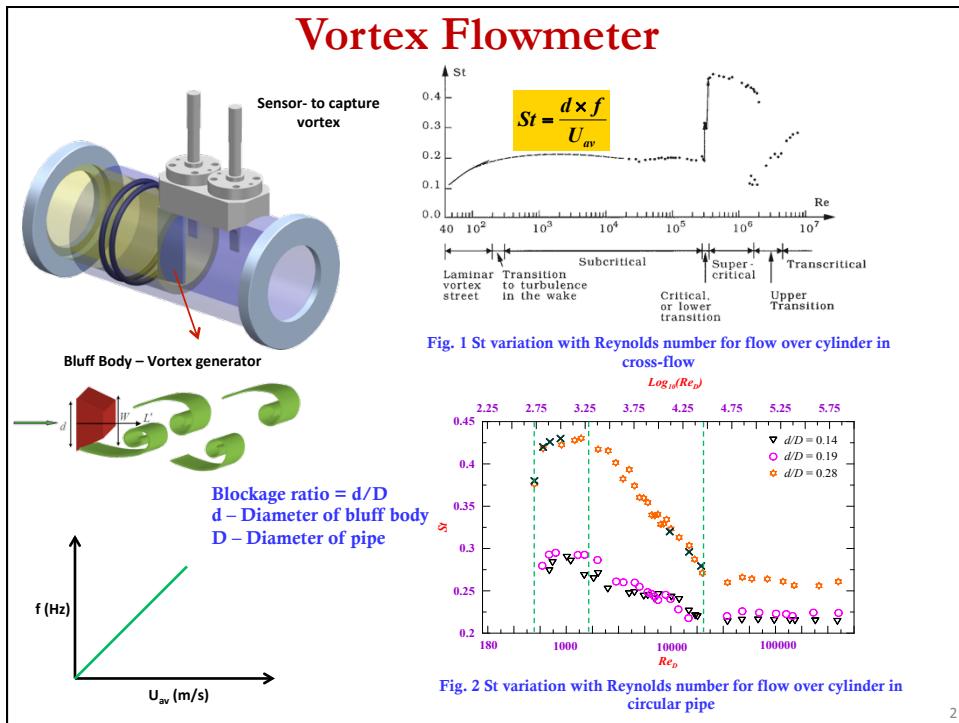


Vortex Flowmeter

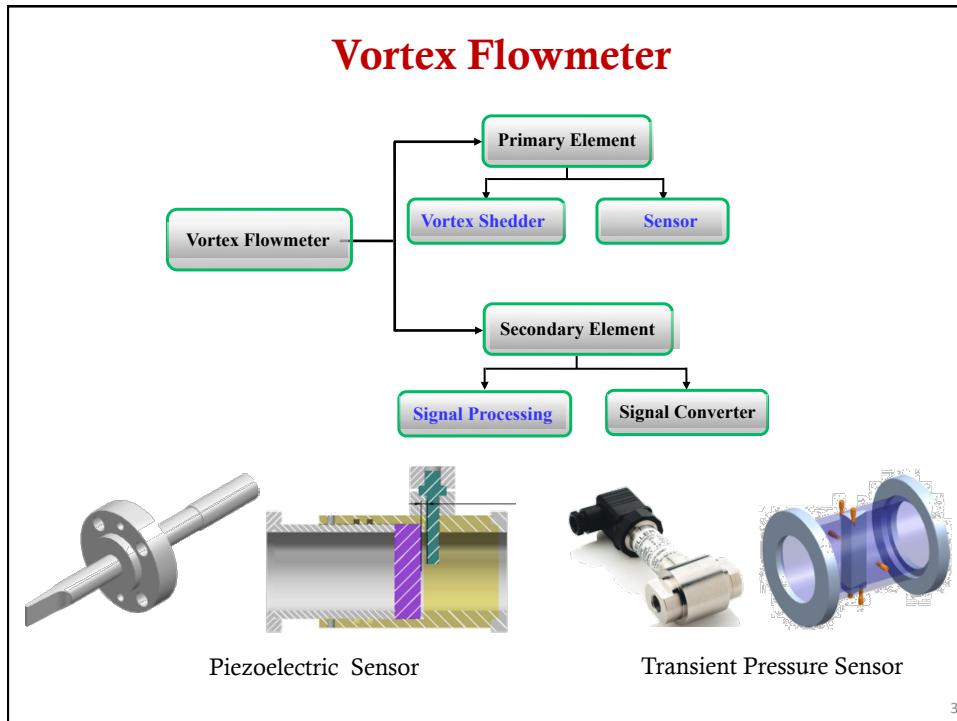
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➤ Advantages

- 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

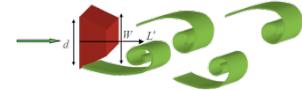
➤ Dis-Advantages

- Sensitivity to upstream flow conditions

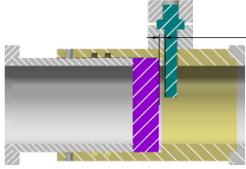
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Shape	x/d	Linearity (%)	K	L_{pm}/d	L_{rec}/d	W/d	L'/d	
Range of Re_D		$3.0 \times 10^4 - 3.0 \times 10^5$			$5.0 \times 10^4 - 1.8 \times 10^5$	10000		
Bullet $l/d = 1$	1.86 2.28	3.4 5.2	0.44	0.39 1.66	1.28 5.78	1.18 1.09	2.28 2.74	
Bullet $l/d = 1.5$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

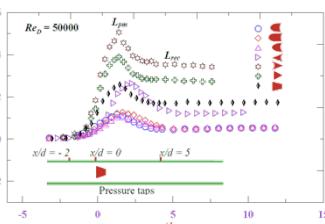
Bluff Body Optimization



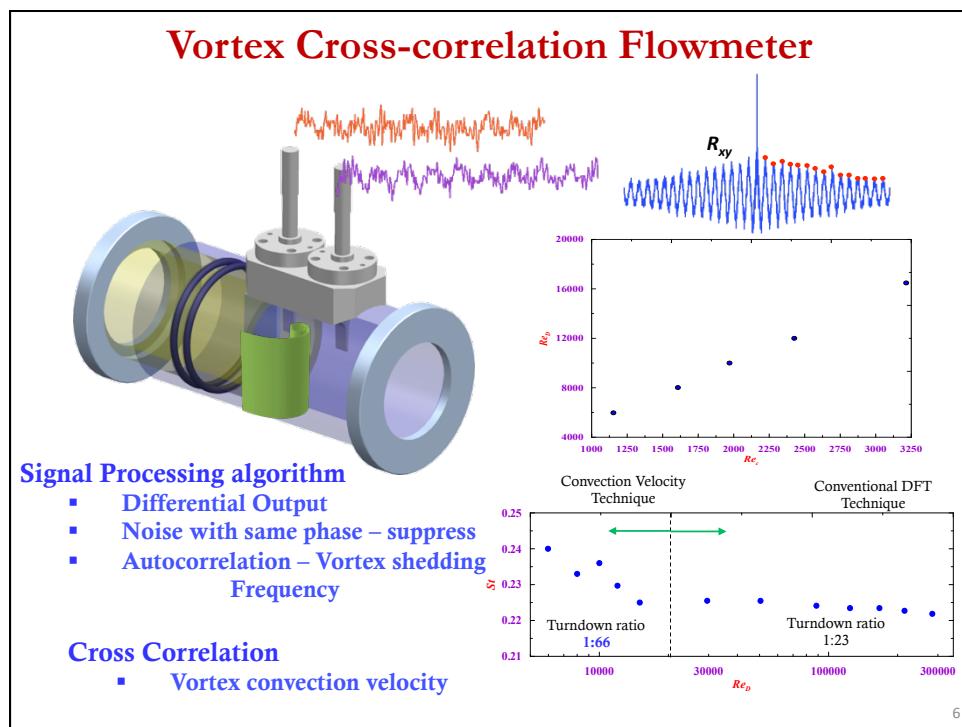
Wake Parameters

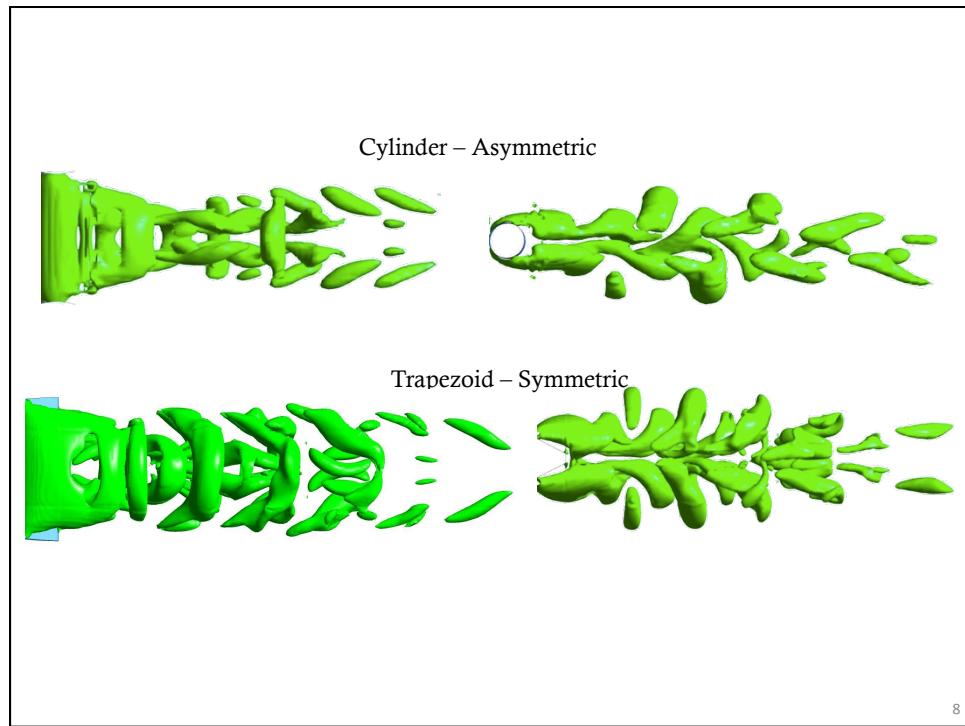
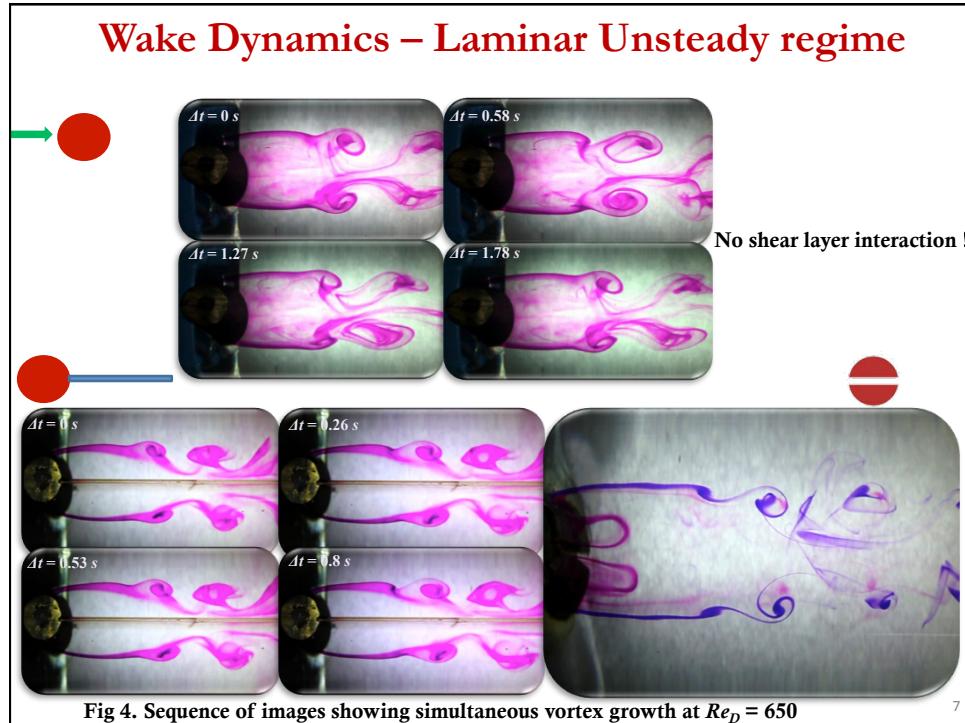


Location optimization

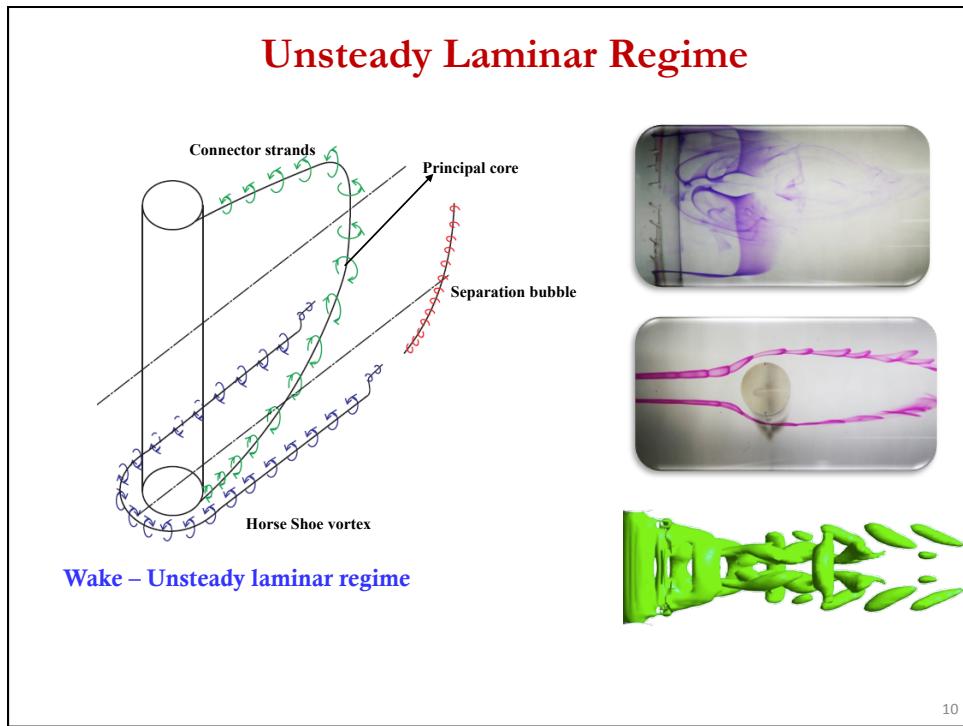
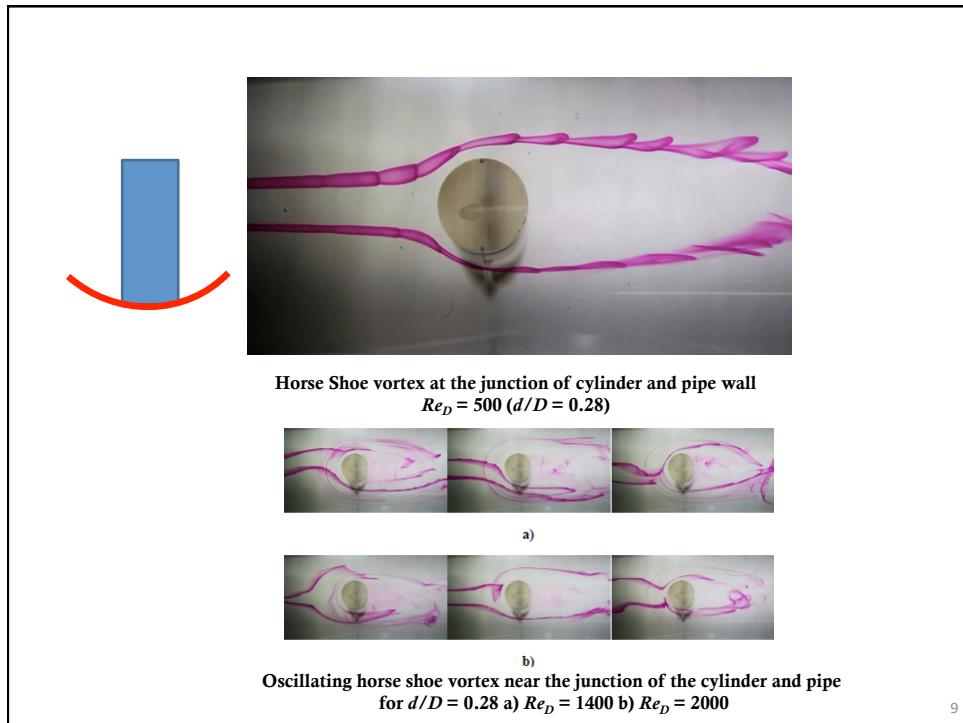


Permanent Pressure Loss

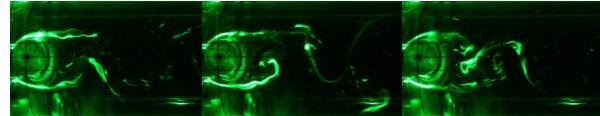




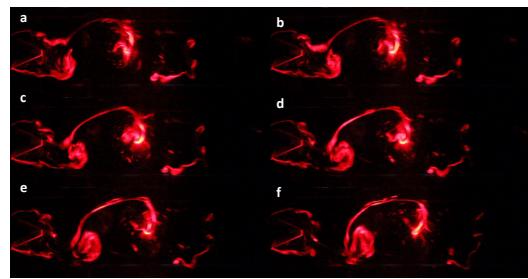
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Turbulent Regime



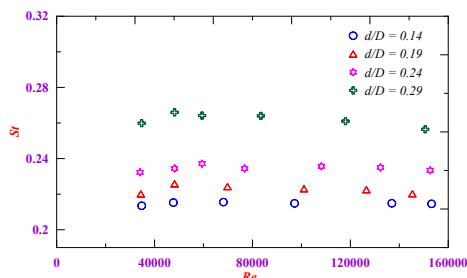
Sequence of images showing Vortex Shedding (circular cylinder)



Sequence of images showing Vortex Shedding (Trapezoid)

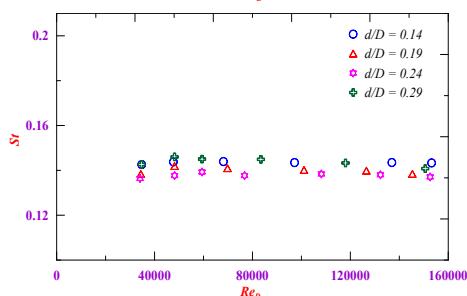
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Strouhal Number



$$St = \frac{d \times f}{U_{av}}$$

Blockage ratio = d/D
d – Diameter of bluff body
D – Diameter of pipe



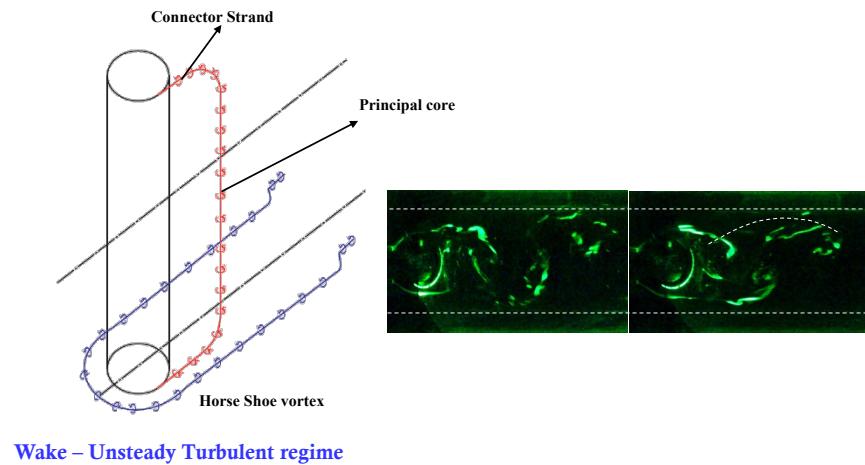
$$St^* = \frac{w \times f}{U_s} = 0.14$$

Scatter $\pm 2.3\%$

St variation with Reynolds number for various blockage ratio

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Unsteady Regime



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Acknowledgements

- Dr. A. Venugopal
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- Department of Science and Technology, New Delhi

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