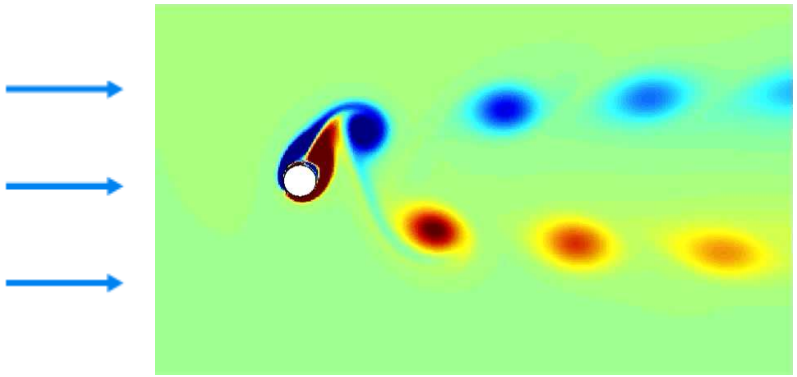
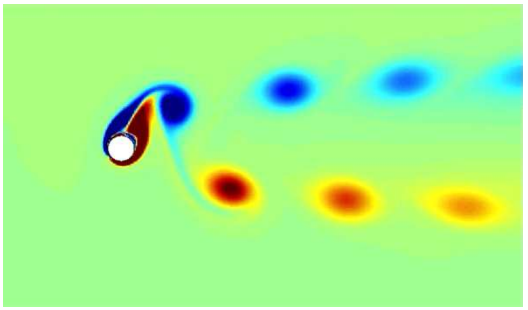
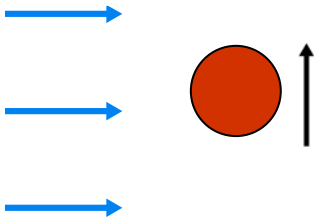
VORTEX-INDUCED VIBRATION

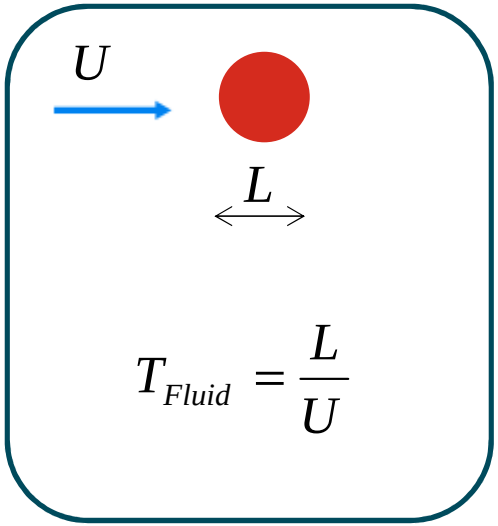


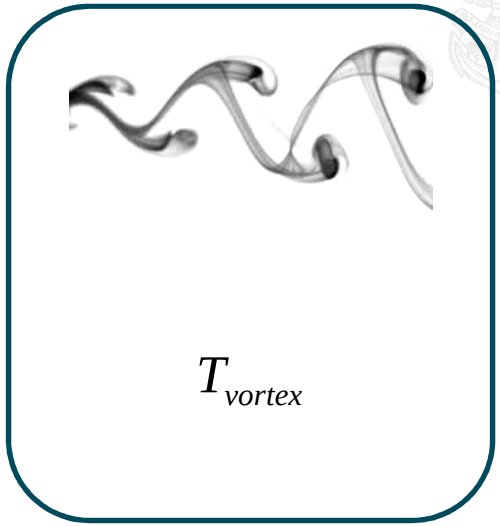
VORTEX-INDUCED VIBRATION





TIME SCALES

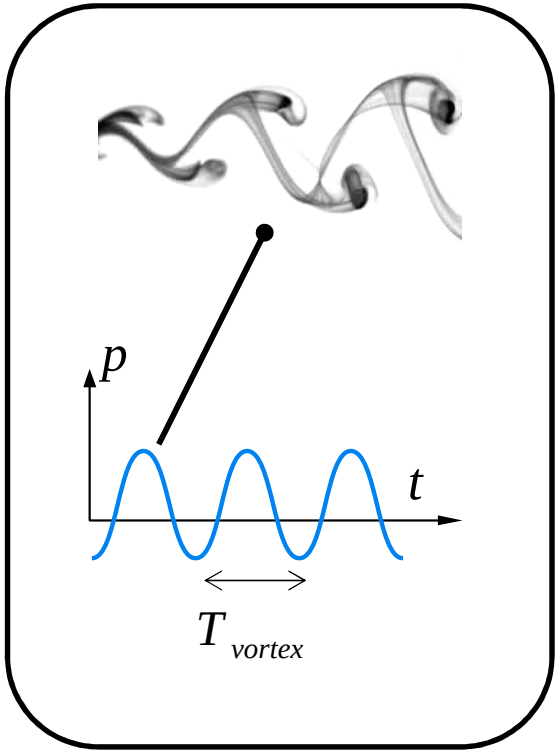


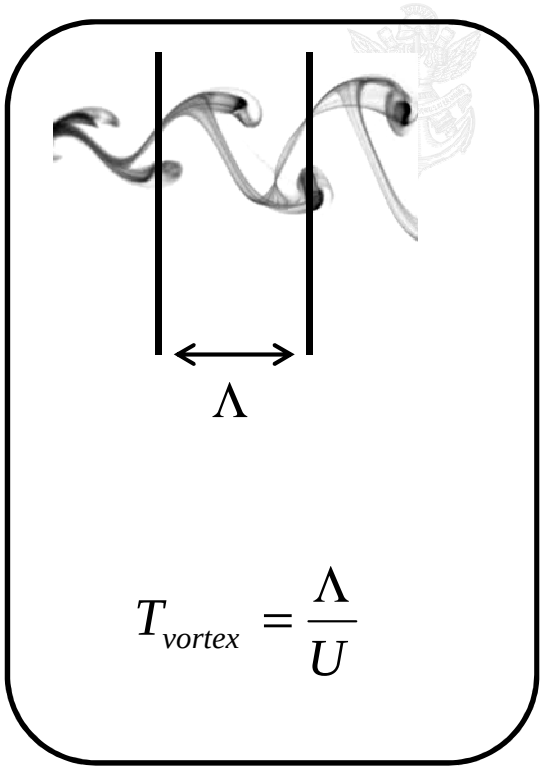


$$U_R = \frac{T_{Solid}}{T_{Fluid}}$$

?

TIME SCALE OF VORTEX SHEDDING





STROUHAL LAW

Strouhal law

$$T_{vortex} = \frac{1}{S} T_{Fluid}$$

Strouhal number S

$S \approx 0.2$

STROUHAL LAW

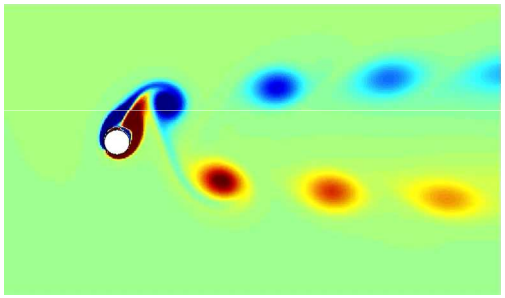
$$\frac{T_{Solid}}{T_{Fluid}} = U_R$$

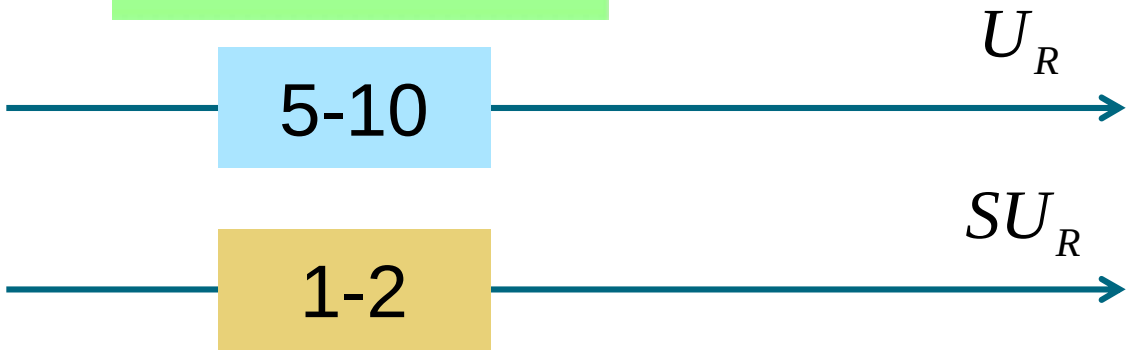
$$U_R = 1 \quad \Leftrightarrow \quad T_{Solid} = T_{Fluid}$$

$$\frac{T_{Solid}}{T_{Vortex}} = \frac{T_{Solid}}{\left(\frac{1}{S}\right) T_{Fluid}} = S \frac{T_{Solid}}{T_{Fluid}} = SU_R$$

$$SU_R = 1 \quad \Leftrightarrow \quad T_{Solid} = T_{Vortex}$$

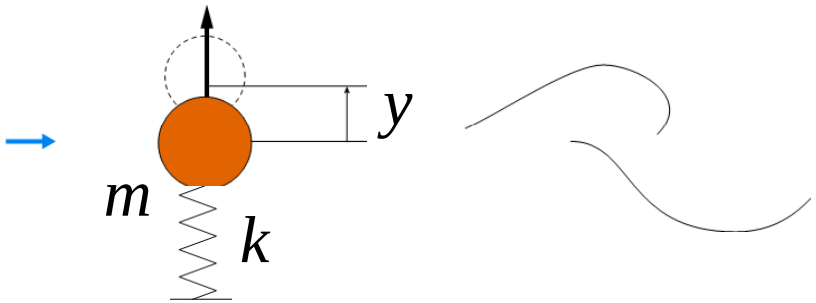
VORTEX-INDUCED VIBRATION





VORTEX-INDUCED VIBRATION AS A RESONANCE

$$F_{vortex}(t) = \frac{1}{2}\rho U^2 L C_l \sin\left(2\pi \frac{t}{T_{vortex}}\right)$$



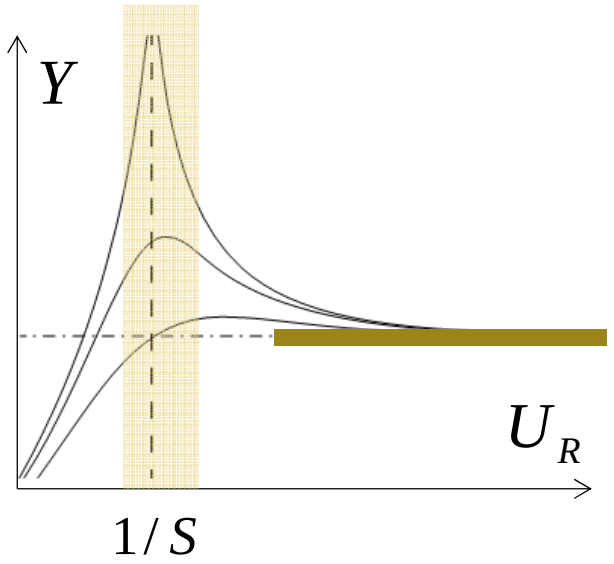
$$m\ddot{y} + ky = \frac{1}{2}\rho U^2 L C_l \sin\left(2\pi \frac{t}{T_{vortex}}\right)$$

VORTEX-INDUCED VIBRATION AS A RESONANCE

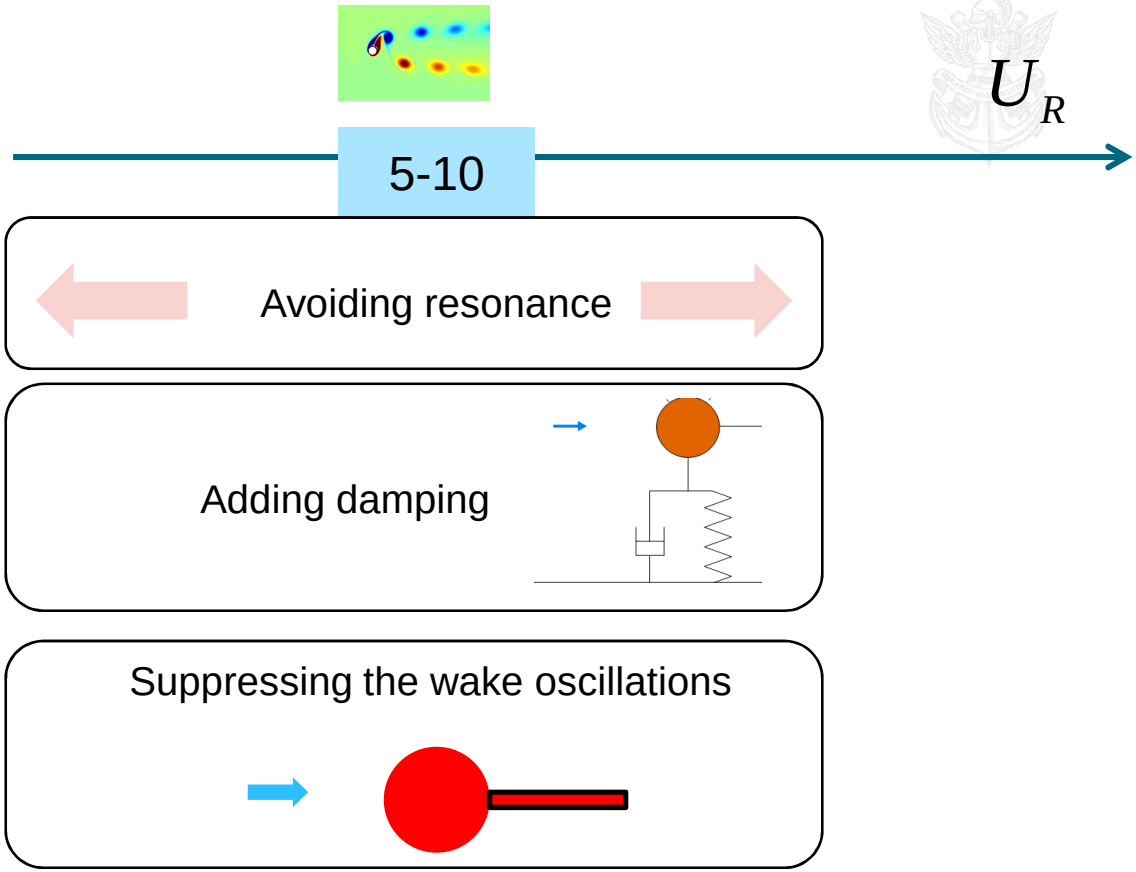
$$Y = \frac{MC_l}{2\pi^3}\frac{U_R^2}{\left(1 - S^2U_R^2\right)}$$

$$Y = y / L$$

$$M = \frac{\rho\pi L^2}{4m}$$



AVOIDING VORTEX-INDUCED VIBRATIONS



WAKE AND SOLID DYNAMICS