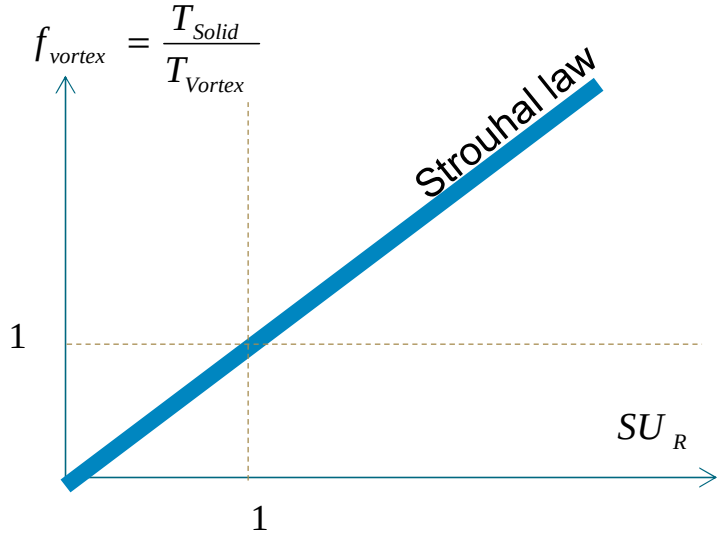
FREQUENCY OF VORTEX SHEDDING

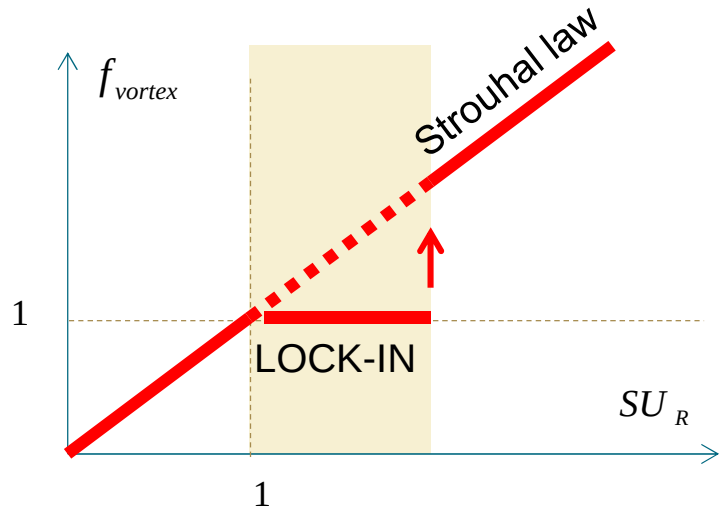
Fixed cylinder



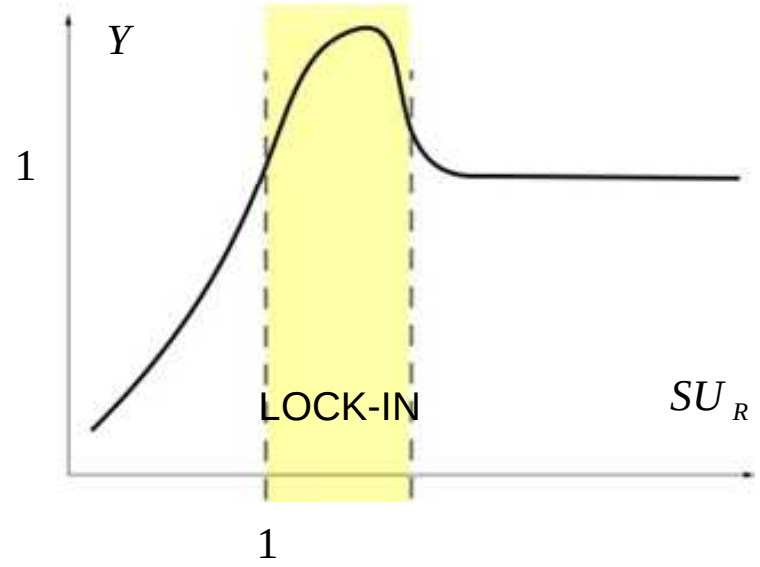
Strouhal law $$f_{Vortex} = \frac{T_{Solid}}{T_{Vortex}} = SU_R$$

LOCK-IN OF THE FREQUENCY OF VORTEX SHEDDING

Cylinder free to move



LOCK-IN OF THE FREQUENCY OF VORTEX SHEDDING



BASIC MODEL OF VIV

Wake

$$F = \frac{1}{2} M U_R^2 C_l \sin(S U_R t)$$

Solid

$$\ddot{Y} + Y = 0$$

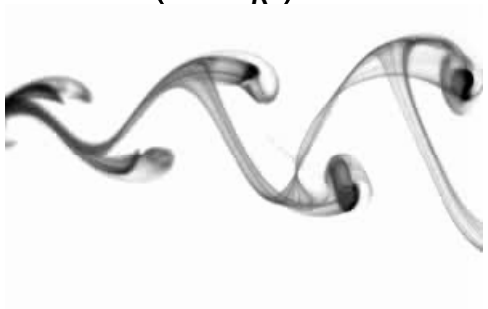
$$\ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l \sin(S U_R t)$$

Resonance curve

BASIC MODEL OF VIV

Wake

$$\ddot{F} + (SU_R)^2 F = 0$$



Solid

$$\ddot{Y} + Y = 0$$

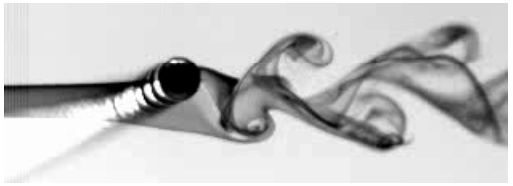
$$\ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l F(t)$$

Resonance curve

IMPROVED MODEL OF VIV

Wake

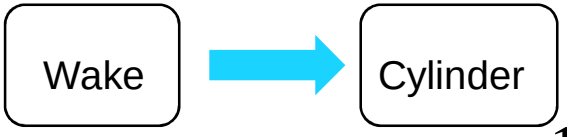
$$\ddot{F} + (SU_R)^2 F = A\ddot{Y}$$



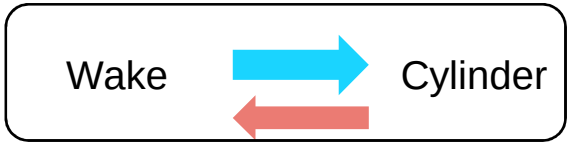
Solid

$$\ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l F$$

VORTEX-INDUCED VIBRATION

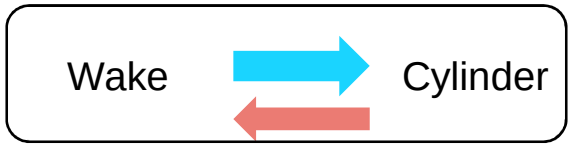


$$\ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l \sin\left(S U_R t\right)$$



$$\ddot{F} + \left(S U_R\right)^2 F = A\ddot{Y} \qquad \ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l F$$

COUPLED MODEL OF VIV

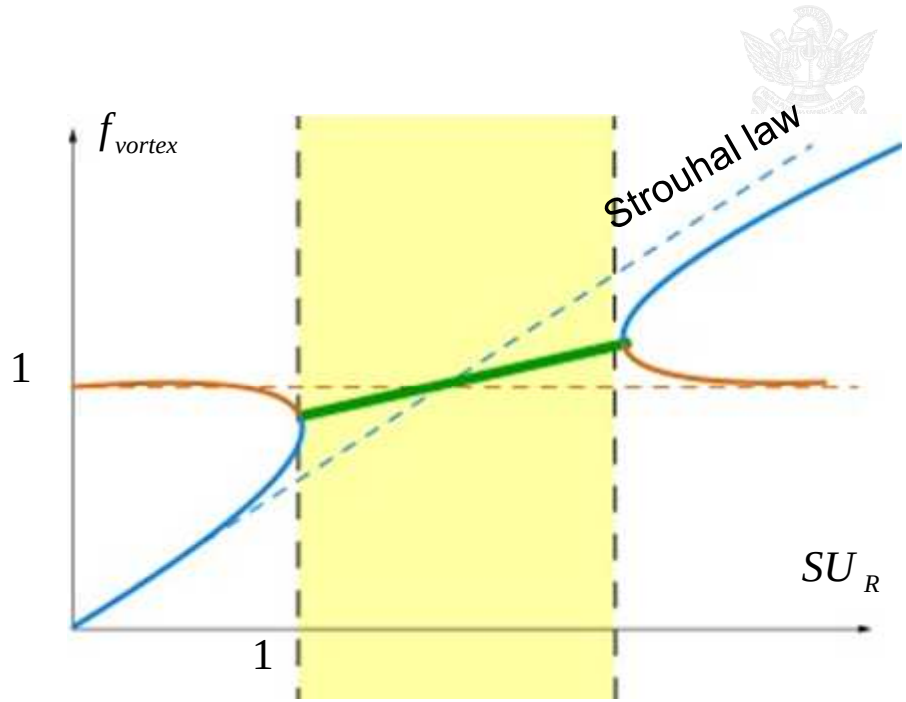


$$\ddot{F} + (SU_R)^2 F = A\ddot{Y} \qquad \ddot{Y} + Y = \frac{1}{2} M U_R^2 C_l F$$

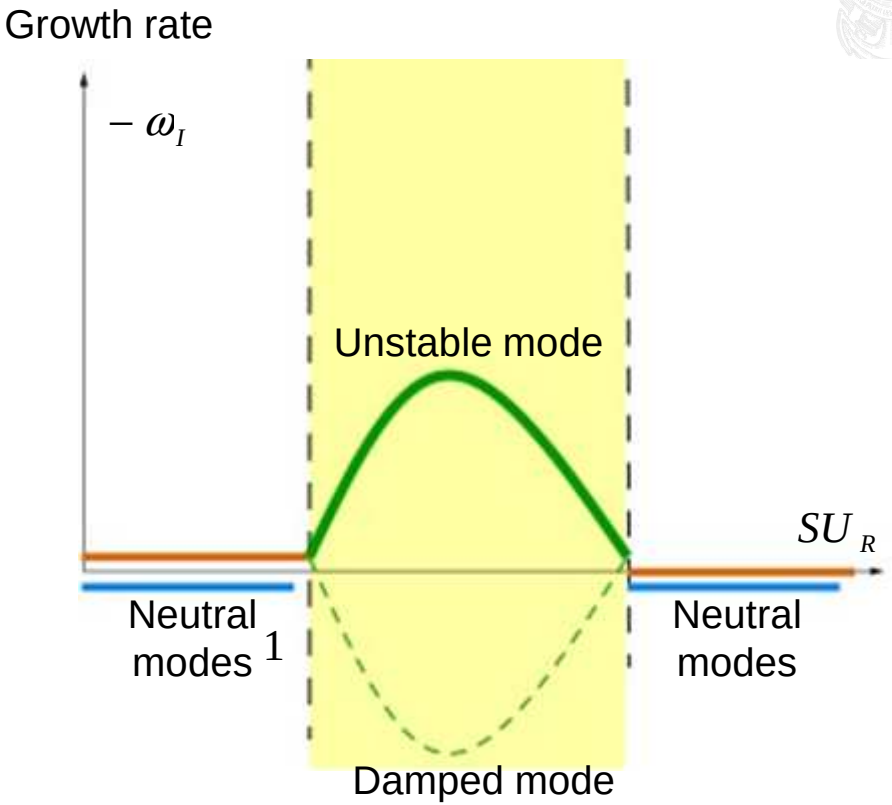
$$\begin{bmatrix} Y \\ F \end{bmatrix} = \begin{bmatrix} Y_0 \\ F_0 \end{bmatrix} e^{i\omega t}$$

$$\omega_1(U_R) \quad \omega_2(U_R)$$

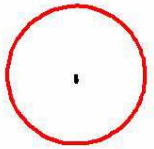
COUPLED MODEL OF VORTEX-INDUCED VIBRATION



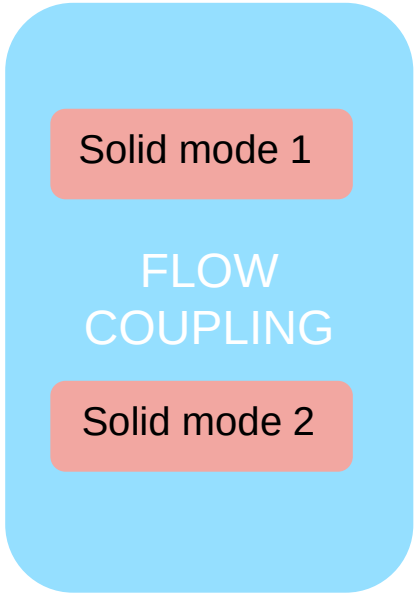
COUPLED MODEL OF VORTEX-INDUCED VIBRATION

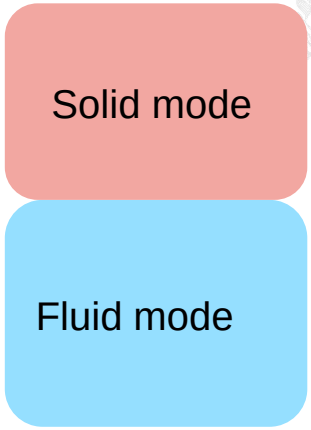


TIME SCALES



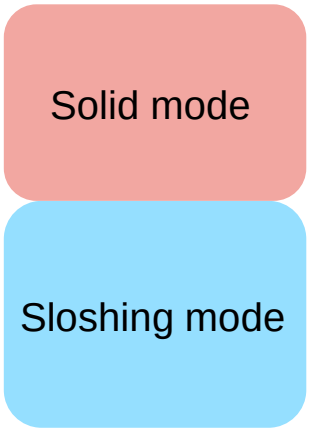
COUPLED-MODE INSTABILITIES





MODE COUPLING BETWEEN FLUID AND SOLID

Stable coupled mode



Unstable coupled mode
with lock-in