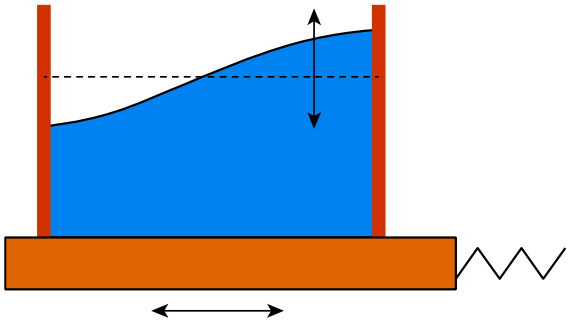
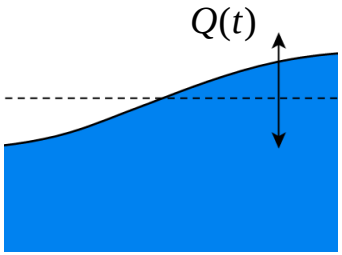
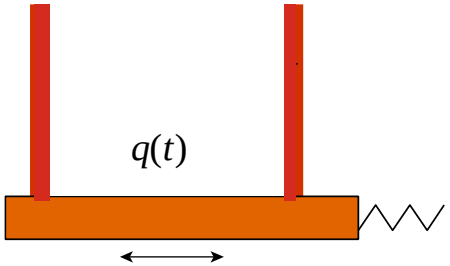
FLUID SLOSHING COUPLED WITH THE SOLID DYNAMICS



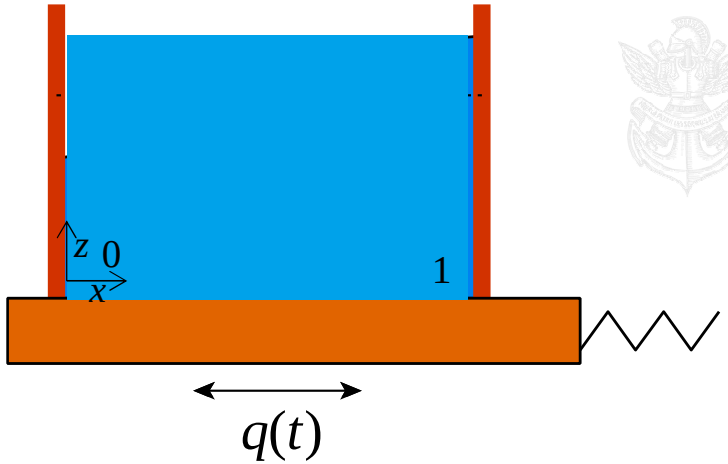




$$M_F\ddot{Q} + K_F Q = 0$$

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

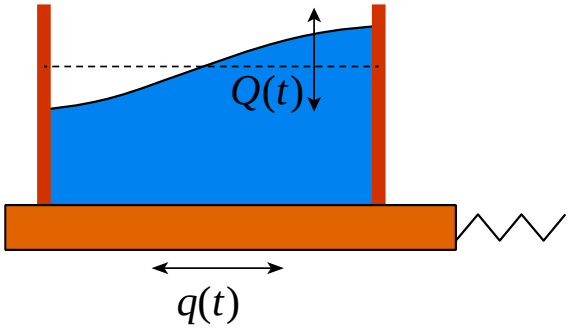
THE ADDED MASS PROBLEM



$$p(\underline{x},t) = \ddot{q}(t)\varphi_p(\underline{x})$$

$$\varphi_P = -x \qquad \underline{\varphi}_u = \underline{e}_X \qquad m_A = M$$

EFFECT OF THE SOLID MOTION ON SLOSHING

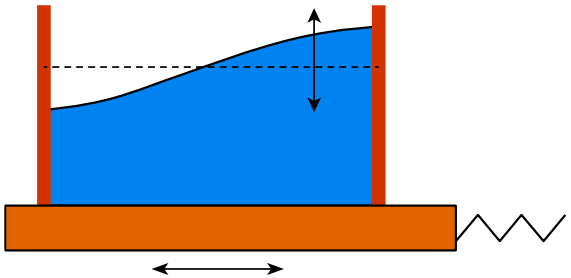


$$p(\underline{x},t) = \ddot{Q}(t)\phi_p(\underline{x}) + \ddot{q}(t)\varphi_p(\underline{x})$$

$$\int_{\text{free surface}} \left[\ddot{p} + \frac{1}{F_D^2} \underline{\nabla} p . \underline{e}_Z \right] \phi_P dS = 0$$

$$M_F \ddot{Q} + K_F Q + \left[\int_{\text{Free Surface}} \varphi_p \phi_p \, dS \right] \ddot{q} = 0$$

EFFECT OF THE SOLID MOTION ON SLOSHING



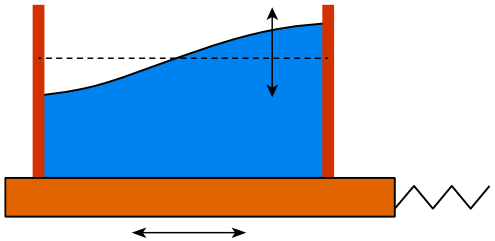
$$p(\underline{x},t) = \ddot{Q}(t)\phi_p(\underline{x}) + \ddot{q}(t)\varphi_p(\underline{x})$$

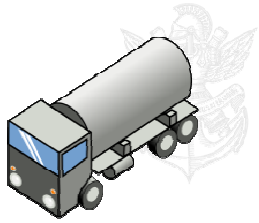
$$M_F\ddot{Q} + K_F Q = -m_{SF}\ddot{q}$$

Solid-to-fluid coupling mass

$$m_{SF} = \int_{\text{Free Surface}} \varphi_p \phi_p \, dS = \frac{2}{\pi^2}$$

EFFECT OF FLUID ON THE SOLID MOTION





$$f = M \int_{\text{interface}} -p\,\underline{n}.\underline{\varphi}\,dS$$

$$p = \ddot{Q}\phi_p + \ddot{q}\varphi_p$$

$$f = -\left[M \int_{\text{interface}} \phi_p\,\underline{n}.\underline{\varphi}\,dS\right]\ddot{Q} - \left[M \int_{\text{interface}} \varphi_p\,\underline{n}.\underline{\varphi}\,dS\right]\ddot{q}$$

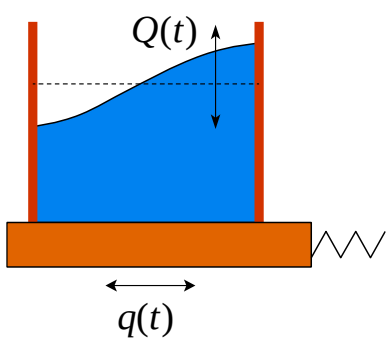
Fluid-to-solid coupling mass

m_{FS}

Added mass

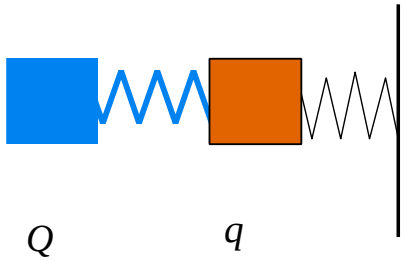
m_A

FLUID SLOSHING COUPLED WITH THE SOLID DYNAMICS

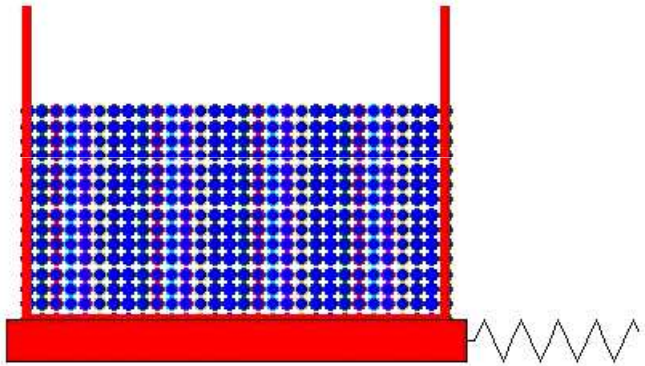


$$M_F \ddot{Q} + K_F Q = -m_{SF} \ddot{q}$$

$$\left(1 + m_A\right) \ddot{q} + q = -m_{FS} \ddot{Q}$$

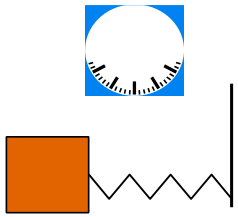


FLUID SLOSHING COUPLED WITH THE SOLID DYNAMICS



INTERNAL TIME SCALES OF THE FLUID

Diffusion

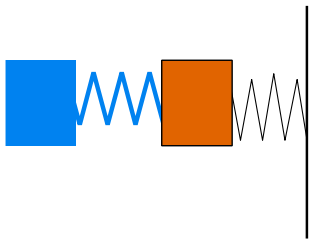


S_T

Oscillation

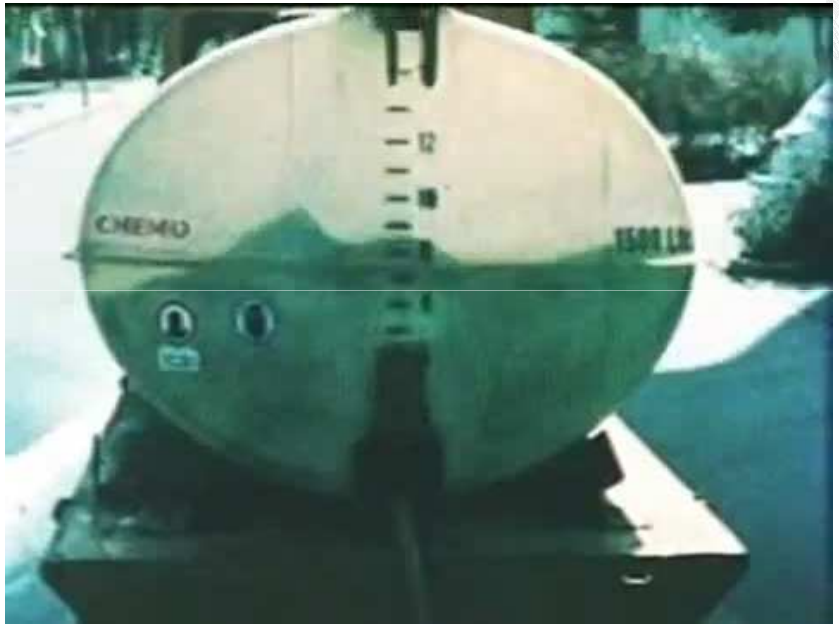
Fluid sloshing

Solid motion

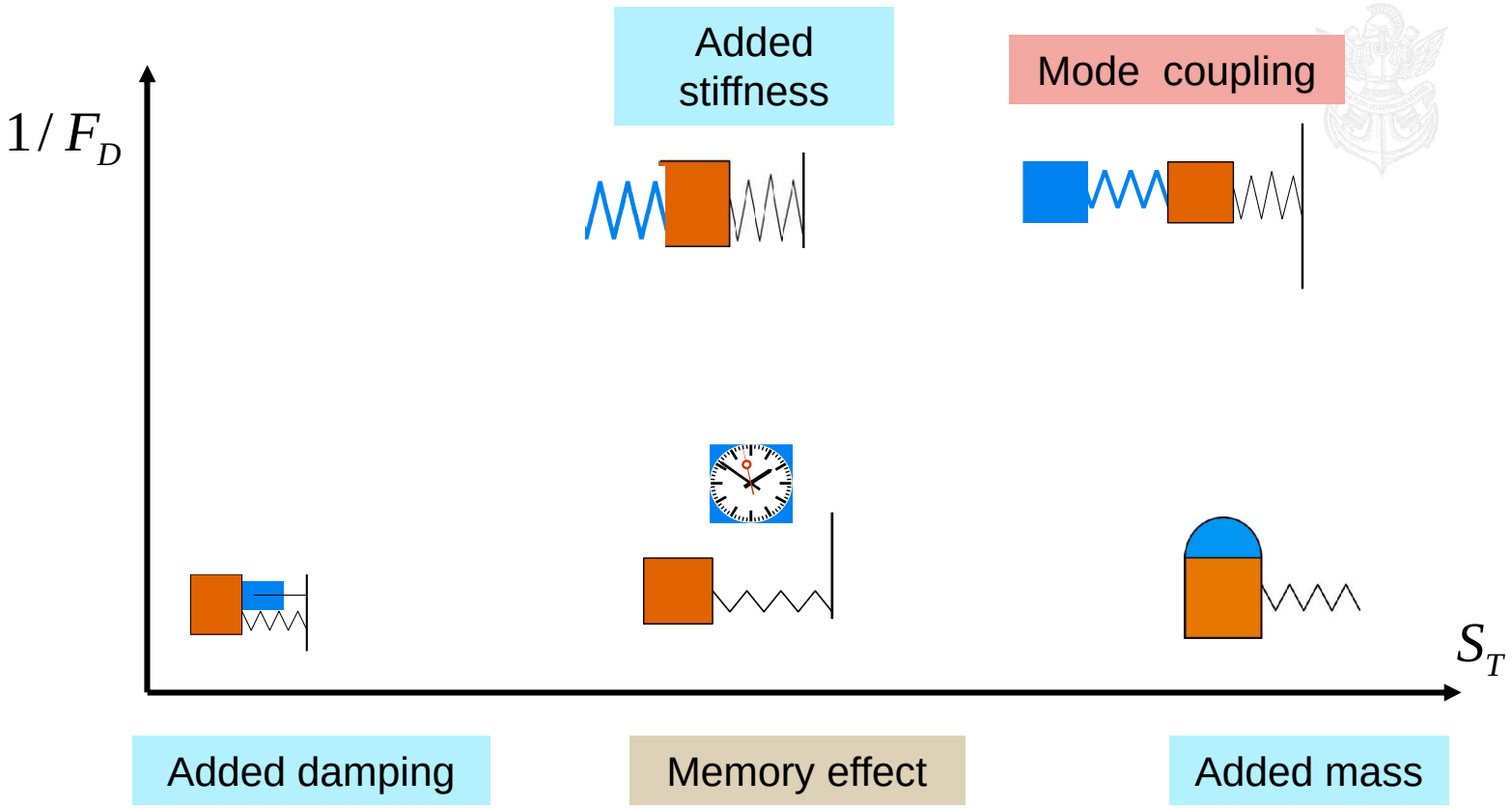


F_D

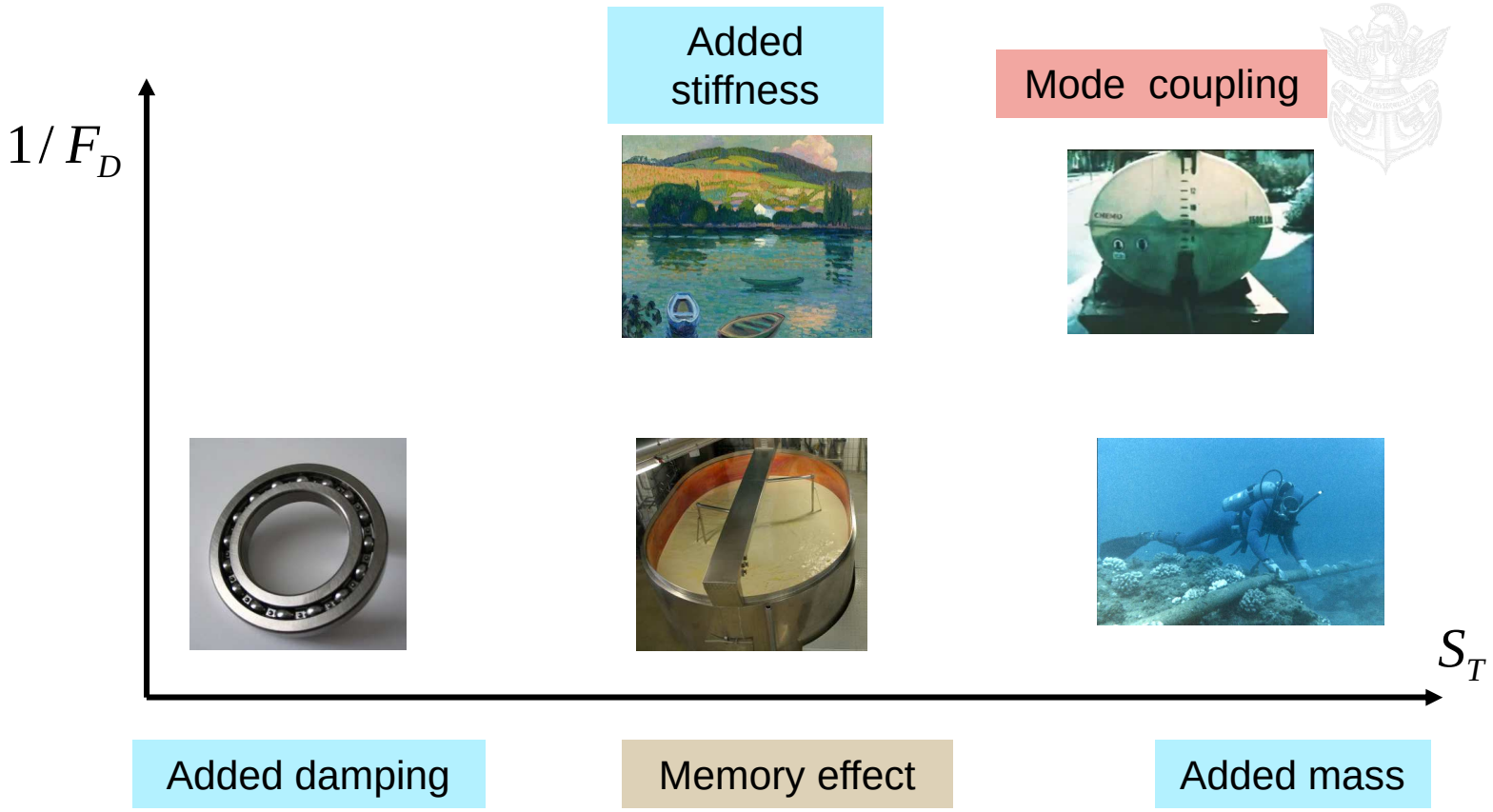
MULTIMODE DYNAMICS



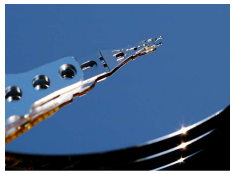
COUPLINGS AT LOW REDUCED VELCOTIES



COUPLINGS AT LOW REDUCED VELCOTIES



CLASSIFYING PROBLEMS USING DIMENSIONLESS NUMBERS



EFFECT OF THE REDUCED VELOCITY

$$U_R = \frac{T_{SOLID}}{T_{FLUID}}$$