Liquid Sloshing Natural Frequency in a Tank

First sloshing natural frequency and period of liquid in a rectangular or upright cylindrical tank from size and liquid depth (linear potential-flow theory).

Method: Linear sloshing theory

Input parameters

Unit system: SI

Parameter	Value	Unit
Tank shape	Upright cylinder	
Length in motion direction, or diameter	10.000	m
Liquid depth	6.0000	m

Calculated results

Parameter	Value	Unit
First sloshing circular frequency	1.8775	rad/s
First sloshing frequency	0.29882	Hz
Sloshing period	3.3465	s

Notes for this case

• ω² = gk·tanh(kh), with k = π/L for a rectangular tank and k = 1.841/R for an upright cylinder (first root of J_1'). Large storage tanks slosh with periods of several seconds, close to long-period earthquake motion; seismic design uses this period for the convective (sloshing) pressure and freeboard.

Formula and method

$$\omega_1^2 = gk\tanh(kh), \quad k = \frac{\pi}{L}\ \text{(rectangular)}, \quad k = \frac{1.841}{R}\ \text{(cylinder)}$$

Variables

shape	Tank shape	-
L	Length in motion direction, or diameter	m
h	Liquid depth	m
ω_1	First sloshing circular frequency	rad/s
f_1	First sloshing frequency	1/s
T_1	Sloshing period	s

Method and standards

Sloshing.

Assumptions and limits

- Linear, inviscid, rigid tank; first mode.

References

Linear sloshing theory

Report details

Report reference	FCC-KVJR-RC39 (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/vessels/liquid-sloshing-frequency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.