Ship Natural Rolling Period from GM and Beam

Natural rolling period of a ship from its metacentric height and radius of gyration (as a fraction of beam), and the GM implied by a measured rolling period.

Method: Small-angle free rolling of a ship

Input parameters

Unit system: SI

Parameter	Value	Unit
Beam	32.000	m
Metacentric height	1.8000	m
Roll radius of gyration as a fraction of beam (0.35–0.45)	0.40000	
Measured rolling period (for the GM estimate)	18.000	s

Calculated results

Parameter	Value	Unit
Radius of gyration	12.800	m
Natural rolling period	19.142	s
GM from the measured period	2.0357	m
Rolling coefficient T√GM/B (IMO form)	0.80256	

Notes for this case

• T = 2πk/√(g GM) for small undamped roll; added mass of water is included in an effective k. A long period (tender ship) is comfortable but may mean low GM; a short, jerky period means a stiff ship.

Formula and method

$$T_\phi = \frac{2\pi k}{\sqrt{g\,GM}}, \quad GM_{est} = \frac{1}{g}\left(\frac{2\pi k}{T_{meas}}\right)^2, \quad k = (k/B)\,B$$

Variables

B	Beam	m
GM	Metacentric height	m
k/B	Roll radius of gyration as a fraction of beam (0.35–0.45)	-
T_{meas}	Measured rolling period (for the GM estimate)	s
k	Radius of gyration	m
T_ϕ	Natural rolling period	s
GM_{est}	GM from the measured period	m
C	Rolling coefficient T√GM/B (IMO form)	-

Method and standards

Simple harmonic roll.

Assumptions and limits

- Small angles, no damping, constant GM.

References

Small-angle free rolling of a ship

Report details

Report reference	FCC-S9AX-TZVE (the same inputs always give the same reference)
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Calculator	Ship Natural Rolling Period from GM and Beam
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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/marine/ship-rolling-period

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.