Metacentric Height (GM) of a Barge or Any Hull

Centre of buoyancy, metacentric radius BM, metacentre height KM and metacentric height GM of a floating body for initial transverse stability, with the righting arm.

Method: Initial transverse stability: KM = KB + BM; BM = I_T/▯

Input parameters

Unit system: SI

Parameter	Value	Unit
Hull	Box-shaped barge (L × B × T)	
Length (barge)	60.000	m
Breadth (barge)	12.000	m
Draught (barge)	2.5000	m
Transverse second moment of the waterplane (any hull)	52,000	m^4
Displaced volume (any hull)	12,600	m^3
Height of the centre of buoyancy (any hull)	3.9000	m
Height of the centre of gravity above the keel	4.2000	m
Heel angle for the righting arm	5.0000	°

Calculated results

Parameter	Value	Unit
Centre of buoyancy above the keel	1.2500	m
Metacentric radius I_T/▯	4.8000	m
Metacentre above the keel	6.0500	m
Metacentric height KM − KG (positive = stable)	1.8500	m
Righting arm GM sin φ (small angles)	161.24	mm

Notes for this case

- Initial (small-angle) stability: GZ ≈ GM sin φ up to about 7–10°. Correct GM for free surfaces of slack tanks.

Formula and method

$$KM = KB + BM, \quad BM = \frac{I_T}{\nabla}, \quad GM = KM - KG, \quad GZ \approx GM \sin\phi$$

$$\text{box barge}: \quad KB = \frac{T}{2}, \quad BM = \frac{B^2}{12T}$$

Variables

shape	Hull	-
L	Length (barge)	m
B	Breadth (barge)	m
T	Draught (barge)	m
I_T	Transverse second moment of the waterplane (any hull)	m^4
∇	Displaced volume (any hull)	m^3
KB	Height of the centre of buoyancy (any hull)	m
KG	Height of the centre of gravity above the keel	m

ϕ	Heel angle for the righting arm	rad
BM	Metacentric radius I_T/▯	m
KM	Metacentre above the keel	m
GM	Metacentric height KM − KG (positive = stable)	m
GZ	Righting arm GM sin φ (small angles)	m

Method and standards

Initial stability of floating bodies.

Assumptions and limits

- Small heel angles, upright equilibrium, wall-sided near the waterline.

References

Initial transverse stability: KM = KB + BM, BM = I_T/▯

Report details

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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/metacentric-height-gm

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.