# Inclining Experiment: GM and KG from a Weight Shift

Metacentric height and height of the centre of gravity of a ship from an inclining test: a known mass shifted across the deck and the pendulum deflection.

**Method:** Inclining experiment

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Displacement at the test | 8,000.0 | t |
| Inclining mass shifted | 40.000 | t |
| Transverse distance moved | 12.000 | m |
| Pendulum length | 6.0000 | m |
| Pendulum deflection (mean of both sides) | 180.00 | mm |
| KM from the hydrostatic tables at the test draught | 8.6000 | m |
| Free surface correction at the test (0 if all tanks pressed or empty) | 0.050000 | m |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Tangent of the heel angle a/ℓ | 0.030000 | |
| Heel angle | 1.7184 | ° |
| Measured (fluid) metacentric height | 2.0000 | m |
| Solid metacentric height (fluid + free surface correction) | 2.0500 | m |
| Centre of gravity of the ship as inclined | 6.5500 | m |

**Notes for this case**

• GM = w d/(Δ tan φ). Use the mean of several shifts to both sides, keep the angle small (1–3°), and correct the KG for items to be added or removed to reach the lightship condition.

## Formula and method

$$GM = \frac{w\,d}{\Delta \tan\phi}, \quad \tan\phi = \frac{a}{\ell}, \quad KG = KM - GM_{fluid} - FSC$$

### Variables

| | | |
|---|---|---|
| $\Delta$ | Displacement at the test | kg |
| $w$ | Inclining mass shifted | kg |
| $d$ | Transverse distance moved | m |
| $\ell$ | Pendulum length | m |
| $a$ | Pendulum deflection (mean of both sides) | m |
| $KM$ | KM from the hydrostatic tables at the test draught | m |
| $FSC$ | Free surface correction at the test (0 if all tanks pressed or empty) | m |
| $\tan\phi$ | Tangent of the heel angle a/ℓ | - |
| $\phi$ | Heel angle | rad |
| $GM_{fluid}$ | Measured (fluid) metacentric height | m |
| $GM_{solid}$ | Solid metacentric height (fluid + free surface correction) | m |
| $KG$ | Centre of gravity of the ship as inclined | m |

### Method and standards

Inclining experiment.

### Assumptions and limits

- Small angles, calm water, mooring lines slack.

### References

Inclining experiment

## Report details

| | |
|---|---|
| Report reference | FCC-VDKW-AZRT (the same inputs always give the same reference) |
| Generated | 23 November 2026, 18:00 UTC |
| Calculator | Inclining Experiment: GM and KG from a Weight Shift |
| Method last reviewed | 17 November 2026 |
| Software release | FireCAD Calc, release of 22 November 2026 |
| 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/inclining-experiment-gm

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.