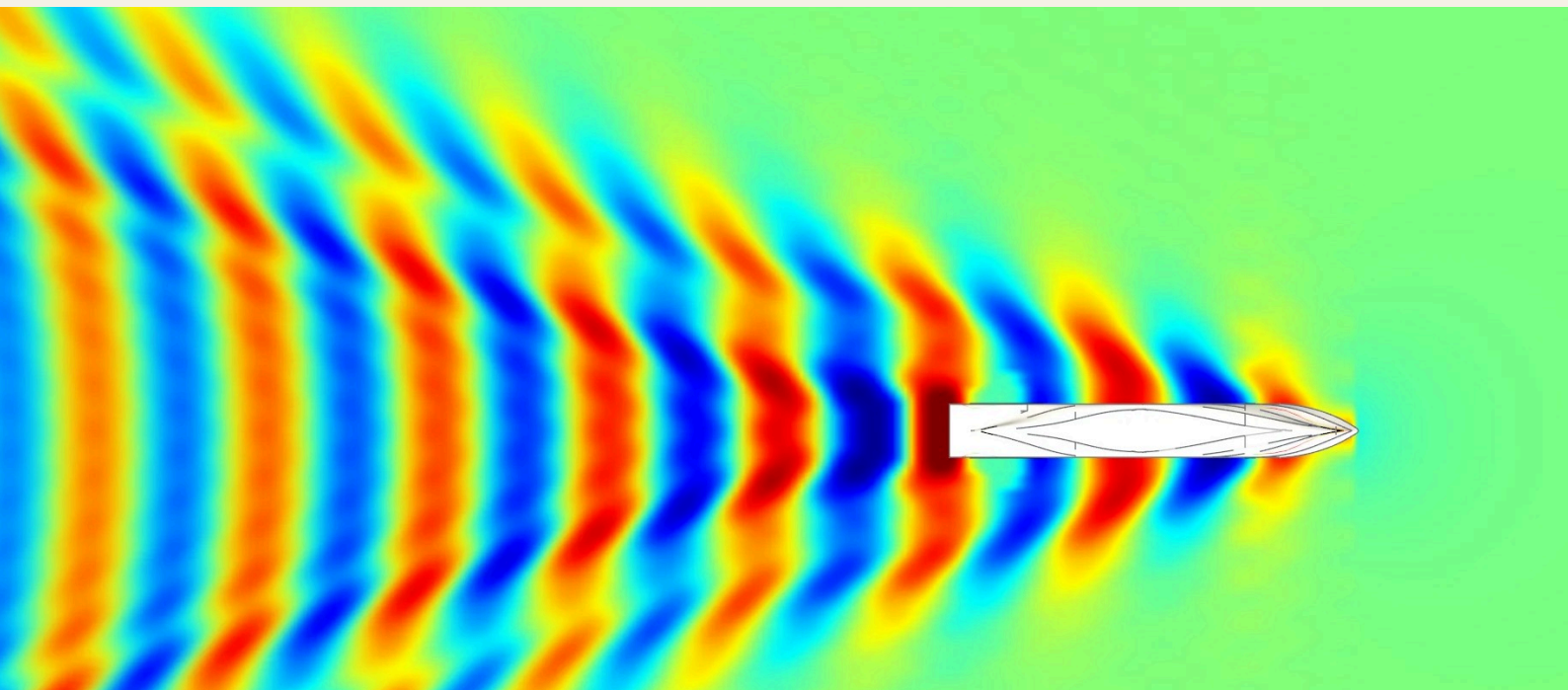


Hull resistance, attitude and stability in Rhino

A calm-water speed sweep of any hull you model, in seconds, with its waves, trim, stability and propeller.



The Kelvin wave pattern of the KCS container ship, as QuickWake draws it.

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This guide is for QuickWake 0.2.5 in Rhino 8 for Windows. The latest copy is always at quickwake.app/guide, and the panel's **Guide** link opens it.

01 What QuickWake does

QuickWake predicts how a hull modelled in Rhino behaves in calm water across a range of speeds. For each speed it gives:

- the total resistance and its parts;
- the effective power;
- the running trim and heave;
- what carries the weight: buoyancy and dynamic lift.

It covers displacement hulls and planing hulls, through the transition between them, in one method. For the selected speed it also shows the hull at its running attitude, the free surface around it and the flow along the hull. Separately, it computes the hull's static stability curve (GZ) at rest.

The predictions come from a reduced-order method: Michell thin-ship wave theory, with closures for friction, form drag, transom flow, planing lift and spray. A sweep of twenty speeds takes seconds, not the hours of a CFD run. That makes QuickWake a design-stage tool for comparing hull forms, loadings and speeds. It does not replace model tests or CFD for final numbers. The method's validation and its limits are summarised in [Validity and accuracy](#).

02 Getting started

QuickWake runs in Rhino 8 for Windows (8.20 or later).

- 1 **Install.** In Rhino, run `PackageManager`, search for **QuickWake**, click **Install** and restart Rhino. Rhino keeps it up to date from then on.
- 2 **Open the panel.** Type `QuickWake`, or click the **W** on the QuickWake toolbar. The QuickWake panel opens, and the command line shows the version.
- 3 **Enter your licence key.** Click **Licence** at the top right of the panel and paste the key from your e-mail (see [Licence](#)).
- 4 **Choose the hull.** Select the hull object in the viewport and click **Use selected object** on the Setup tab. The **Hull report** shows its hydrostatics, and any problem with the mesh, before you run anything.
- 5 **Set the loading.** Enter the mass and the centre of gravity, then check the speeds.
- 6 **Run.** Click **Run sweep**. The Results tab opens and fills as the speeds finish.

The rest of this guide goes through each step in detail.

Once QuickWake has loaded, Rhino shows its floating **QuickWake toolbar**: the **W** opens the panel, the **book** opens this guide, the **key** opens the licence and the **speech bubble** opens a new mail to support@quickwake.app. Dock it like any other toolbar.

Tip: the **Guide** link at the top of the panel, the toolbar's book and the `QuickWakeGuide` command all open the latest copy of this guide at quickwake.app/guide.

03 Licence

QuickWake needs a licence key to run a sweep. The key comes by e-mail when you buy a licence at quickwake.app. It is one line of text starting with `QW-`, and it carries your e-mail address, the kind of licence (perpetual or yearly) and, for a yearly licence, the month it runs to.

- **To enter it**, click **Licence** at the top right of the QuickWake panel, paste the key and click **Save**. The dialog closes when the key is accepted. The `QuickWakeLicense` command does the same from the command line.
- **To see your licence**, hover over **Licence**, or open it: the dialog says whom it is licensed to and, for a yearly licence, how many days are left.
- **Without a valid key** a line under the panel's header says why, for example that no key has been entered or that a yearly licence has expired. Click it to enter a key. **Run sweep** opens the dialog instead of running.
- **To move it** to another computer, enter the same key there, and click **Remove key** on the old one.

The key is checked on your computer, with no internet connection needed. It is stored for your Windows user account, so each account on a shared computer enters it once.

Note: a key works only if it was copied in full. If it is not accepted, paste it again from the e-mail. The **Buy a licence** link in the dialog opens the pricing at quickwake.app; for any question about your licence, write to support@quickwake.app.

04 Preparing the hull model

QuickWake reads the hull's geometry directly: a polysurface, surface, SubD or mesh, closed or open.

- **Orientation.** World +Z must point up, and the calm water surface is horizontal. Choose which way the bow points with **Forward axis** (+X by default).
- **Units.** The document's units are used. Lengths are converted to metres internally, and coordinates you type are in document units.
- **Full or half hull.** Model the whole hull, or one half on its centreplane; a half is mirrored. A full hull must be symmetric port to starboard: QuickWake refuses one whose sides differ by more than 1 % in area. A full hull modelled away from the world origin is found from its bounding box.
- **One skin.** Seen from the side, the hull must be a single sheet. An internal surface, a duplicated skin or a second layer adds volume that isn't there, so QuickWake rejects it. Seams between panels are welded automatically.
- **Deck and transom.** Neither needs closing. The hull is assumed watertight up to its sheer line wherever that matters (for stability).
- **Catamarans.** You can give one demihull plus its spacing, one demihull placed at its position off the centreline, or both demihulls in one object. In the last case QuickWake measures the spacing itself. The two demihulls must be mirror images of each other, and each must be symmetric about its own centreplane.

05 The Setup tab

Begović planing hull · monohull · 14 of 14 speeds [1 note](#)

Setup Results Sailing

Hull

Use selected object Highlight

Begović planing hull: mesh, layer Default, units Meters

Forward axis (bow direction) +X

Hull form Automatic

Attitude Free: solve trim and sinkage

Heel (deg, to starboard) 0.0

Configuration Monohull

Loading

☒ By mass ☐ By waterline

Full-hull mass (kg) 32.60

Centre of gravity

☐ Assumed: LCG = LCB, VCG at the waterline

☒ Specified below

CG, world X / Y / Z (m)

0.6970 0.0000 0.1430

Speeds

From 1.00 To 7.50

Step 0.50 Unit m/s

14 speeds, 1.00 to 7.50 m/s.

Water ρ 999.2 kg/m³, ν 0.903×10⁻⁶ m²/s (custom)

Hull report

Hull: the hull mesh has 2 unconnected pieces after welding. Check the mesh before relying on the results.

Hydrostatics in the solver frame (metres, +x forward, +z up):
 QuickWake hull: 1243 vertices, 2190 triangles, full hull (sides differ by 0.00 %), 0 centreplane faces removed
 the hull mesh has 2 unconnected pieces after welding
 waterline z 0.0754 m, displacement 0.032626 m³, mass 32.60 kg
 Lwl 1.8990 m, Bwl 0.4240 m, T 0.0754 m, S 0.8495 m², Cb 0.5377
 LCB x 0.8866 m, LCG x 0.6970 m, VCG z 0.1430 m, deadrise 16.7 deg, planing form, transom beam 0.424 m
 Rhino check: not available (the object is not a closed solid)

Advanced 47 threads

Figure 1 The Setup tab with a planing hull chosen, loaded by mass with its centre of gravity given.

Hull. **Use selected object** takes the selected object as the hull, and **Highlight** selects it again in the viewport (Figure 1). The settings below it are:

- **Forward axis.** Which way the bow points.
- **Hull form.** Automatic, Planing or Displacement. Automatic calls a hull planing when its chine is at or below the waterline at rest. A planing hull whose chine sits above the static waterline (Series 62, and many round-bilge-to-chine forms) needs Planing set by hand. The hull report says which form was used.
- **Attitude.** *Free* solves the trim and sinkage at every speed. *Fixed at rest* holds the hull at its static flotation, as in a captive model test; the trim and heave columns then read zero.
- **Configuration.** Monohull or Catamaran. For a catamaran, the hull spacing is centre to centre; 0 means “from the model”. A spacing you type in overrides the modelled one, and the hull report says so.

Hull report. A moment after you choose the hull or change an input that shapes it, QuickWake prepares the hull in the background and reports what it found: the mesh, the hydrostatics in the solver frame, the form used, and any notes (unconnected pieces, port and starboard differing, a hull outside the method’s range). It opens by itself when a note appears. An input still to be given, such as the mass, is said there without opening it.

Loading.

- **By mass.** The full-boat mass in kilograms; QuickWake floats the hull to it.
- **By waterline.** The waterline height in world Z; the mass follows from the displaced volume.

Centre of gravity.

- **Assumed.** LCG above the LCB, VCG at the waterline.
- **Specified.** Give the CG in world coordinates. The transverse coordinate is ignored, since no heel is modelled underway.

The running attitude depends strongly on the LCG. The stability curve depends on the VCG (KG). Give both whenever you know them.

Water. Density and kinematic viscosity. The defaults are fresh water at about 15 °C (999.1 kg/m^3 , $1.139 \times 10^{-6} \text{ m}^2/\text{s}$). Enter your own for a towing tank or for sea water.

Speeds. From, to and step, in knots or m/s, up to 500 speeds. **Advanced** sets how many speeds are solved in parallel.

Heel

Heel (deg, to starboard) imposes a heel on the sweep, as a sailing yacht sails. The default, 0, is upright. At a heel:

- **Flotation.** The hull floats at that heel, free to sink and trim. The panel shows the static heeled trim and the running trim and heave on top of it.
- **Method.** The solver takes the heeled hull's symmetric *thickness part*: at each station and height, half the heeled hull's horizontal breadth. Linear theory gives the waves and resistance from this part.
- **Resistance.** The heeled resistance is your upright result plus the change from heeling. The change is computed between two such hulls, built the same way, at the heel and upright, so a mesh's own bias cancels. At 0° it is exactly the upright result.
- **Friction** is taken on the heeled hull's own wetted area.
- **The Speed sub-tab** shows the heel effect, split into friction and the rest. Beside it is the Delft Systematic Yacht Hull Series regression for the change with heel (Keuning and Katgert 2010, fitted at 20°), for F_n 0.15–0.45. QuickWake shows it only for canoe bodies inside the series' range, and otherwise says why. It compares the regression with QuickWake's change split the same way: ITTC-57 friction on the change in wetted area.
- **Static trim.** Heel is refused where the hull would trim so much at rest that the method loses more than 1 % of its displacement (about 6° of trim).
- **The viewport** shows the real hull heeled at its running attitude.

Not modelled:

- the side force, the induced drag and leeway (the *camber* part of the heeled hull, with the keel and rudder; the Sailing tab estimates them for the keel and rudder);
- the waves the camber part makes;
- appendages and waves at sea.

At a heel the free surface shows the waves of the equivalent symmetric hull, the field that carries the heeled resistance, fitted to the heeled hull's waterline on each side. The asymmetric waves of heel and leeway (the side force) are not modelled. Streamlines, C_p and the propeller inflow are off at a heel, because on the heeled hull they would be the symmetric hull's. A heel is not available for catamarans. On a planing hull it is outside the method's range.

06 Running a sweep

Run sweep solves the speeds in parallel; **Cancel** stops after the speeds already running. The Results tab fills as each speed finishes, with progress at the bottom of the panel.

The results stay tied to the inputs and the hull geometry they were computed from. If you then change an input, edit or move the hull, change the document's units or choose another hull, a line under the header says the results are stale, and why. Run the sweep again to update them.

The header. Above the tabs, the header names what the shown results are for: the hull, monohull or catamaran (with its spacing), the heel, and how many speeds were solved. It describes the last sweep, not the inputs as edited since. **! n notes** counts the hull's notes from that sweep; hover over it to read them, or click it for the hull report.

07 The Results tab

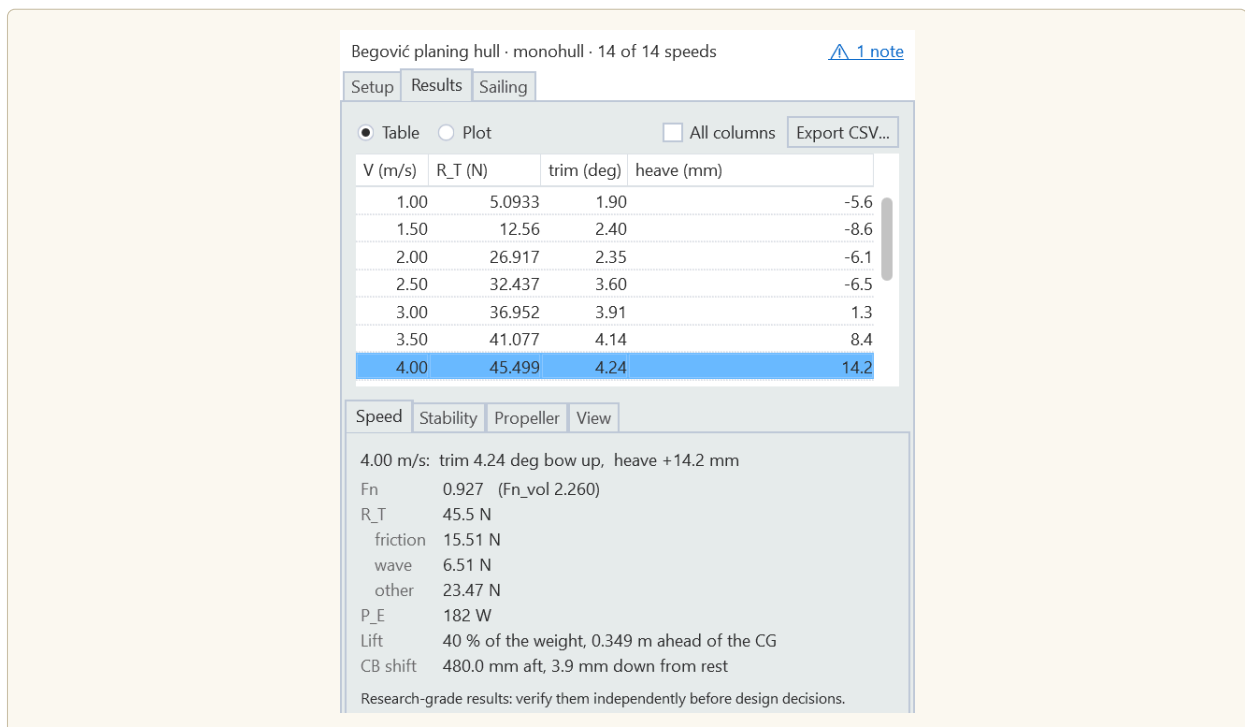


Figure 2 The Results tab: the speed table, with 4 m/s selected, and the Speed sub-tab below it.

The sweep stays at the top of the tab: the table, or the plot when **Plot** is chosen. Below a splitter you can drag, four sub-tabs show the selected speed: **Speed**, **Stability**, **Propeller** and **View**. Each scrolls on its own, so the table stays in view while you move between them. The panel remembers the view, the sub-tab and the splitter's position (one for the table, one for the plot) between sessions. **Export CSV...** sits at the top right.

Speeds

The table lists each speed with its total resistance R_T , trim (degrees, bow up positive) and heave (mm, the rise of the CG, up positive) (Figure 2). **All columns** adds the effective power P_E , the Froude numbers on length and volume, and the friction, wave and other resistance.

A row in plain text is solved with no notes. An **amber** row is solved but has validity notes, listed on the Speed sub-tab. A **red** row failed: R_T reads "failed", and selecting it gives the reason.

Click a row, or a point on a plot, to select that speed. Throughout the panel, hovering over a label or control gives its explanation.

Speed

The Speed sub-tab gives the selected speed's details as a short table: the Froude numbers, R_T and its split into friction, wave and other, then the rest listed below. Hover over a row for what it means; hovering over "other" lists its smaller terms, and hovering over the title gives the sign conventions. The table also gives:

- the effective power;
- the vertical support: weight = buoyancy + dynamic lift, with the dynamic lift's share and its position relative to the CG;
- the centre of buoyancy at the running attitude;

Any validity notes for that speed appear below it as  lines.

Plot

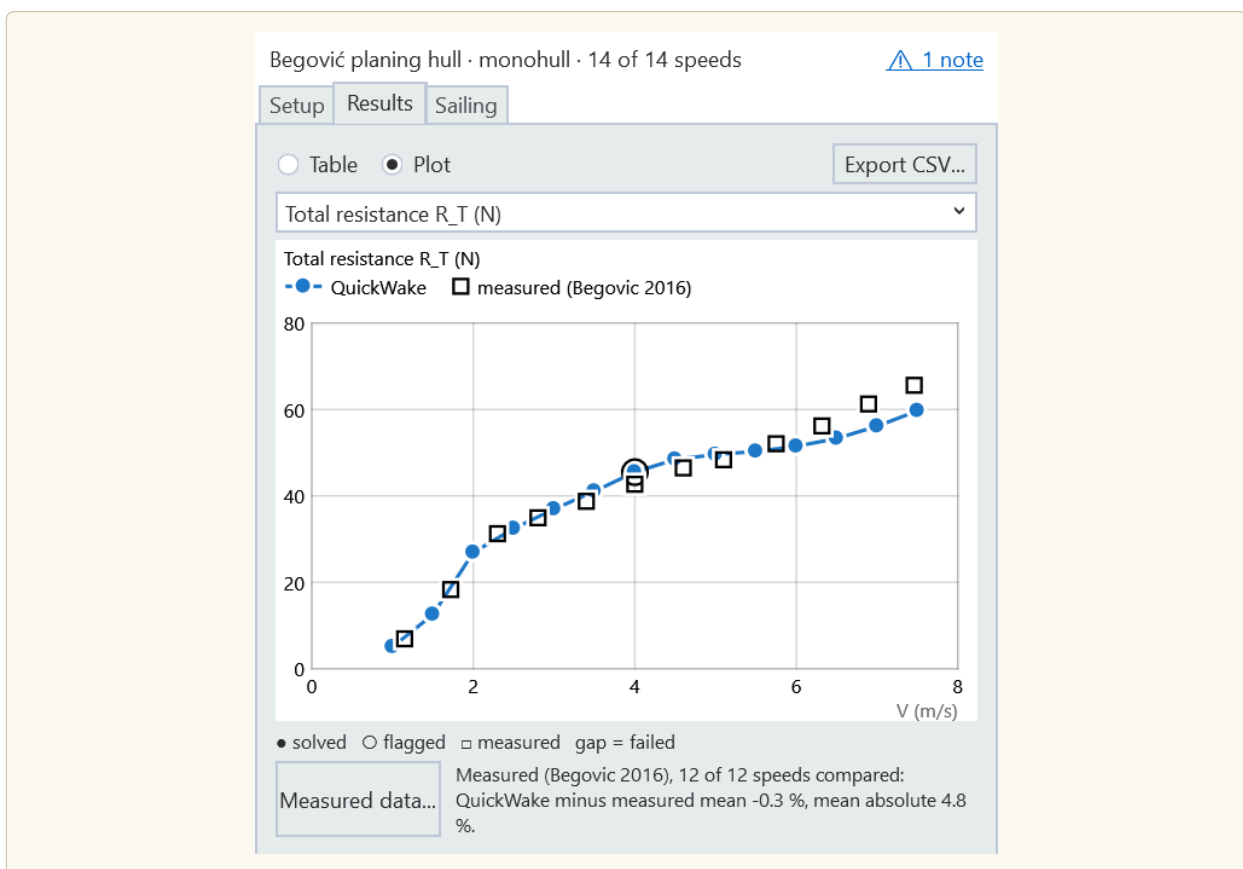


Figure 3 The resistance plot with tank measurements loaded as measured data.

Choose **Plot** at the top of the Results tab for one quantity against speed (Figure 3). The plot takes the table's place, with its own splitter position. The available quantities are:

- total resistance;
- effective power;
- trim;
- heave of the CG;
- resistance over weight;
- the experimental propeller inflow w_n at the checked propeller's virtual disk;
- the dynamic lift's share of the weight;

- after a propeller check: the propeller's rpm, the brake power and the open-water efficiency.

How points are drawn:

- A filled point is solved.
- A hollow point is flagged: the heave balance was not met, or the trim sits at its search limit. Such a point is not joined to the line.
- A gap marks a failed speed.

Hover over the plot for values; the arrow keys step through the speeds and Enter selects one.

Measured data... adds your own tank or trial points to every plot as hollow squares. Paste them from a spreadsheet or load a CSV or text file. Each line holds V, R_T, trim, heave and w_n, in that order; leave a column blank or put “-” where it wasn't measured. Tabs, semicolons and decimal commas are accepted.

The points are stored on the hull object, so they are saved in the .3dm file. Under the plot, QuickWake reports its prediction minus your measurement: the mean and the mean absolute difference. Predictions are interpolated between solved speeds, never across a failed or flagged one. Compare like with like: the same model scale, water and loading.

Export CSV... writes every speed with its full resistance breakdown, attitude and vertical support. The file is headed by the inputs, the validity notes, the stability results and the measured data.

08 Viewport preview

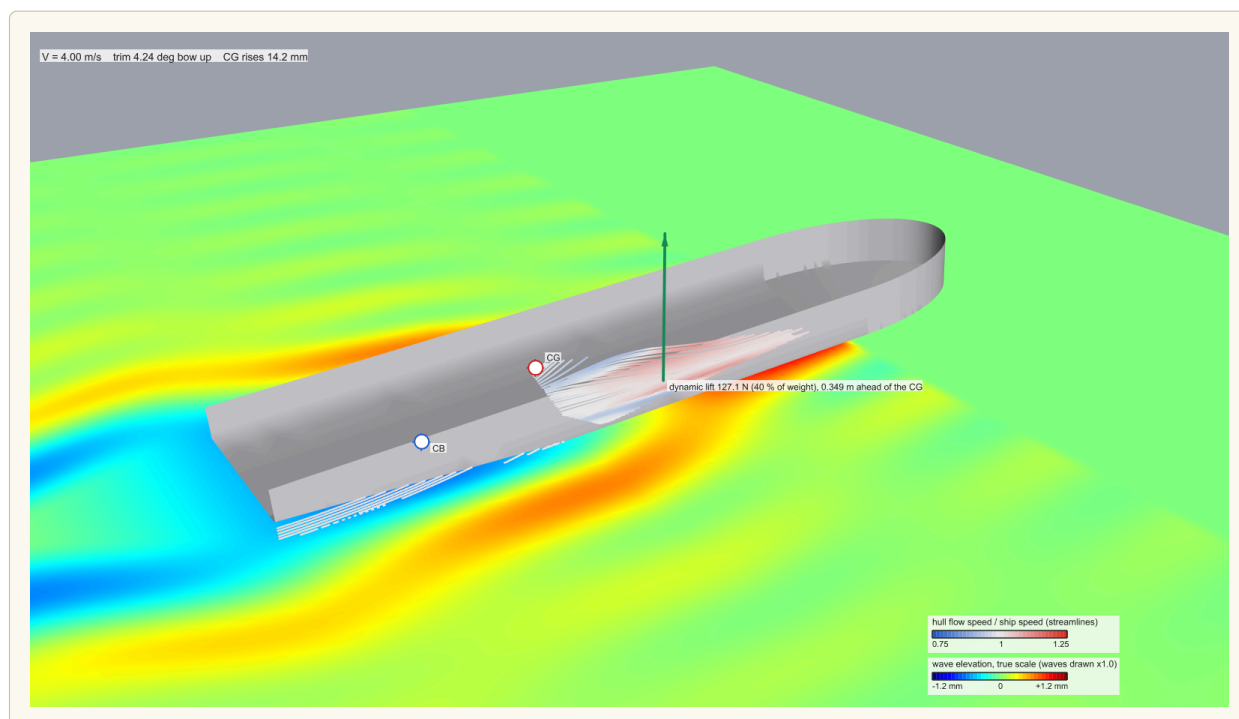


Figure 4 The selected speed in the viewport: the hull at its running trim and heave, the free surface, the dynamic lift arrow, the CG and the CB.

Selecting a speed shows the hull at its running attitude in the viewport, in place of the model (Figure 4). The **View** sub-tab switches each element on or off (Figure 5). **Show the preview in the viewport** hides or shows all of them at once, and the selected speed stays selected. The elements are:

- **Running hull.** The hull at its solved trim and heave, with the calm waterline drawn around it.
- **CG and CB.** The centre of gravity, and the centre of buoyancy at that attitude.

- **Dynamic lift.** A green arrow from the hull bottom at the dynamic lift's centre of pressure, marked CL and labelled with its value and share of the weight. It points in the direction of the force: up for lift, down for suction. Below 5 % of the weight its position is not meaningful, so the arrow is drawn at the CG. Once the hull starts to plane, the planing bottom pressure (Morabito's, as the planing blend weights it) hangs below the keel as a load diagram: its depth is the load per metre of length, on one scale for all speeds. The arrow is the whole dynamic lift, placed where the balance puts it (the planing part at Savitsky's centre of pressure), so it need not pass through the diagram's centroid. A warped hull's planing lift comes from a sectional model instead, and has no diagram.
- **Free surface.** The linear thin-ship wave elevation around the hull, coloured by height. The waves can be drawn exaggerated ($\times 0.5$ to 2) while the colours stay at true scale. Behind a transom the surface stays as wide as the transom: the band between the two sides is the hollow behind it, at the wave height on the centreline. Jet is the default colour scheme; Crest / trough, Ocean and Monochrome are the others.
- **Streamlines.** The potential flow along the wetted hull, coloured by speed relative to the ship. **Streamline density** sets roughly how many lines cross the midship girth on each side: 16, 32 (the default) or 64. Lines start evenly spaced near the bow; where they spread apart further aft, more are started to keep the spacing even, so the whole wetted hull is covered. Denser settings take a little longer and draw thinner lines.
- **Pressure (Cp).** The running hull coloured by the pressure coefficient $C_p = 1 - (v/V)^2$ of the same flow as the streamlines: red above the free-stream pressure, blue below it (where the flow runs faster than the ship). It is the hydrodynamic part only; the hydrostatic pressure is not included. The colours cover the wetted hull up to the model's wave profile and fade into the hull over 1 % of the length below it; the hull's panels are split along the profile, so the edge follows it. The scale is symmetric, and its ends are the 98th percentile of $|C_p|$ over the wetted area, so the stagnation at a bulb or the stem doesn't wash out the rest. Values beyond the ends take the end colours: the legend marks them $\leq$ and $\geq$ and gives the hull's own smallest and largest C_p . Panels facing forward or aft read the undisturbed stream itself, $C_p = n_x^2$ for a panel whose normal has a fore-and-aft component n_x . So a bulb nose or a sonar dome shows red whatever the flow, and a fine stem shows little. A transom face is left grey: the linear flow gives it the same free-stream value, while the solver treats the transom by its head release. With C_p shown, the streamlines are drawn in plain ink, because their colours would mean the opposite (red is fast there). C_p is provisional: it includes the solver's local-flow term, whose sign is under review. Like the streamlines, it is a preview of the linear model, not a measured or validated pressure field.

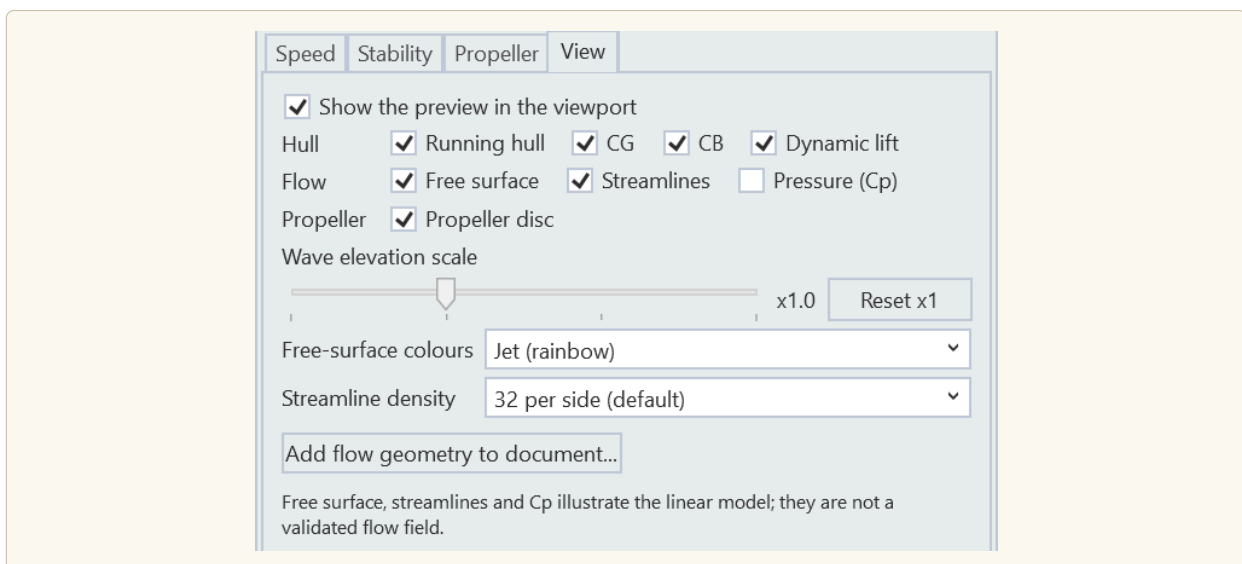


Figure 5 The View sub-tab: the preview's elements grouped by hull, flow and propeller.

The free surface, streamlines and C_p illustrate the model's solution; they are not a validated flow field. For a catamaran they add the two demihulls' linear fields: the surface between the hulls, and the streamlines and C_p

on both sides of each hull. There is no reflection or blockage between the hulls, and the running attitude is one demihull's, so treat the inner side as indicative. The propeller inflow is not available for catamarans.

Add flow geometry to document... (or the command `QuickWakeAddFlow`) adds what the preview shows to a layer as ordinary geometry, in one undoable step: the hull at its running attitude (coloured by C_p when Pressure (C_p) is ticked), and the free surface and the streamlines when they are ticked.

09 Stability



Figure 6 The Stability sub-tab: a downflooding point, the GZ curves at rest (grey) and at the selected speed (blue) with the flooding angle marked, and their measures side by side.

The Stability sub-tab starts with its **Inputs**: the downflooding points and the criteria. Folded, they read as one line, such as “automatic criteria · 1 opening”. **Compute GZ curve** gives the hull's static transverse stability (Figure 6): the curve at rest, in grey, and the curve at the speed selected in the results table, in blue over it. The hull is heeled to starboard from 0° to 90°, and further until the curve crosses zero. At rest, it sinks and trims freely at each heel at constant displacement, with the CG from the Setup tab.

At the selected speed. The curve at rest stays, and the criteria check it. The blue curve belongs to the speed selected in the results table and follows the selection; the measures of both curves stand side by side below the plot, and hovering shows the hull heeled on the blue curve. At that speed (running trim, hydrostatic):

- The hull is held at that speed's running trim.
- At each heel it sinks to the buoyant volume it has at that speed. That volume is the displacement times the share of the weight on the buoyancy, from the solver's vertical balance.
- The dynamic lift carries the rest of the weight and is taken to act through G, so it adds no roll moment. GZ is the buoyancy's lever about G, scaled to the whole weight.

The curve shows how the running trim and rise change the waterplane: on a planing hull GM falls as the lift takes over. It is hydrostatic. The flow's own roll moment, which governs planing-hull roll stability and chine walking, is not modelled, so this is not a dynamic stability assessment. The intact-stability criteria are not applied at speed. Where the buoyancy carries almost none of the weight (2 % or less), a hydrostatic curve says nothing, so only the curve at rest is shown. With no speed selected, the curve at rest is shown alone and hovering follows it.

The curve comes from transverse sections of the hull as modelled. Each section is the hull's outer breadth at each height, closed at the sheer line. That means:

- the deck is taken as watertight at the sheer;
- superstructure, appendages and the free surfaces of liquids in tanks are not included.

Measures reported, as a table under the curve:

- GM, from the initial slope;
- the maximum GZ and its angle;
- the angle of vanishing stability;
- the areas under the curve to 30° and 40°, and between them;
- KG;
- a check of the displacement against the resistance solver's.

Downflooding. Pick downflooding points... (the command `QuickWakeDownflooding`) picks openings, such as hatches and vents, through which water would get in. Pick each opening's lowest edge, on either side: it is taken on both. The points are stored on the hull. The curve then marks the flooding angle, and the summary gives the lowest opening's height above the water at rest.

Criteria. A second table checks the curve against a set of intact-stability criteria, one by one (met, NOT met or n/a, with the curve's value), *for reference*. Choose the set under **Criteria**:

- **Automatic** (the default) picks by hull type: the HSC Code multihull criteria for a catamaran, the HSC Code monohull criteria for a planing hull, and the IS Code general criteria for a displacement hull. The table's heading names the set used and why.
- **IMO IS Code 2008, general criteria** (Part A 2.2), for ships of 24 m and over. As the code requires, the areas to 40° and from 30° to 40° stop at the flooding angle.
- **IMO HSC Code 2000, monohull** (annex 8, 1.2 to 1.6). The required area depends on where GZ peaks: 0.07 m·rad to 15° if the maximum is at 15°, 0.055 m·rad to 30° if it is at 30° or beyond, and $0.055 + 0.001 (30^\circ - \theta_{\text{max}})$ to θ_{max} in between.
- **IMO HSC Code 2000, multihull** (annex 7, 1.1 and 1.2): an area of at least $0.055 \times 30^\circ / \theta$ m·rad up to θ , the least of the flooding angle, the angle of maximum GZ and 30°, with the maximum GZ at 10° or more.
- **Custom:** your own limits, typed one per line under **Edit custom criteria...** — `area A B MIN` (the area from A° to B°, stopping at flooding), `gz A MIN` (GZ at a heel of A° or more), `maxangle MIN`, `gzmax MIN`, `gm MIN` and `vanishing MIN`. Use it for ISO 12217 at your design category, or for class rules.
- **None:** the curve and its measures only.

The choice, and any custom limits, are stored on the hull and saved in the .3dm file. The weather criterion of the IS Code and HSC Code, and the HSC Code's passenger-crowding and high-speed-turning heel, need the windage area, the passengers and the turn, so they are not checked. Small craft are assessed under ISO 12217; its limits

depend on the design category and the boat type and are not built in, but the CSV export carries the quantities it works from, such as downflooding height and angle, vanishing angle and maximum GZ.

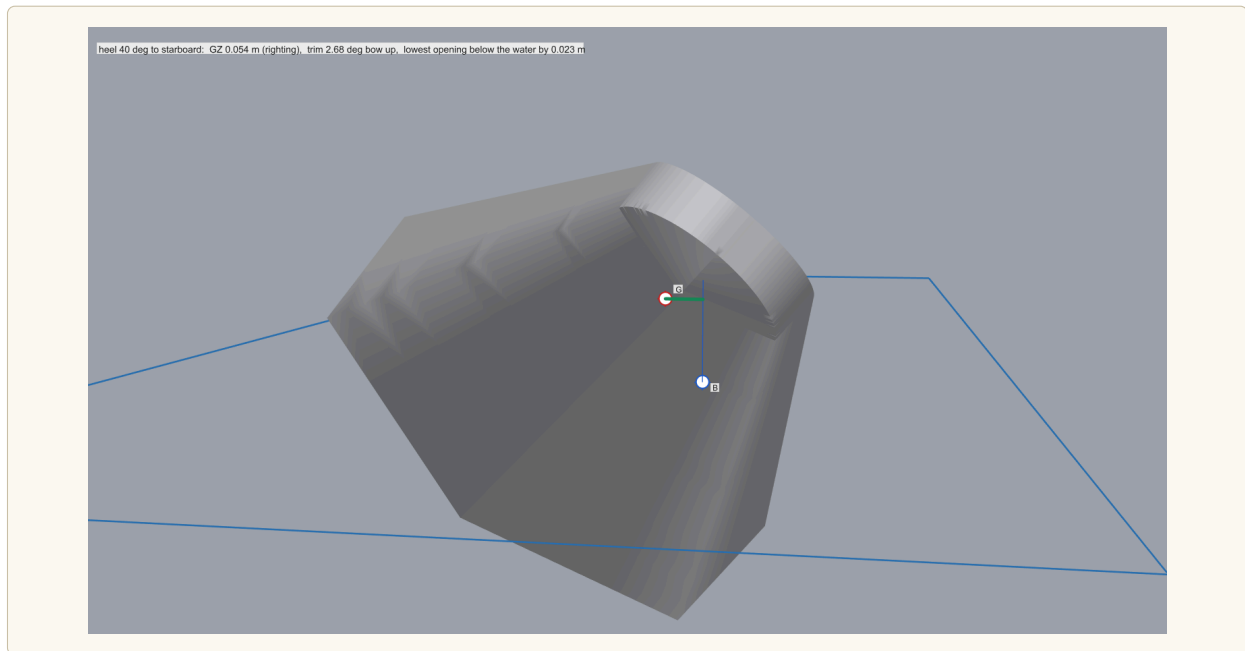


Figure 7 Hovering over the GZ curve at 40°: the hull heeled and trimmed onto its waterplane, with G, B, B's vertical and the righting lever GZ in green.

Heeled view. Hovering over the GZ curve shows the hull heeled to that angle in the viewport, at its free trim and sinkage, with G, B and the righting lever (Figure 7). The label gives GZ, the trim and how far the lowest opening is above or below the water. Moving off the plot returns to the running view.

10 Propeller (B-series)

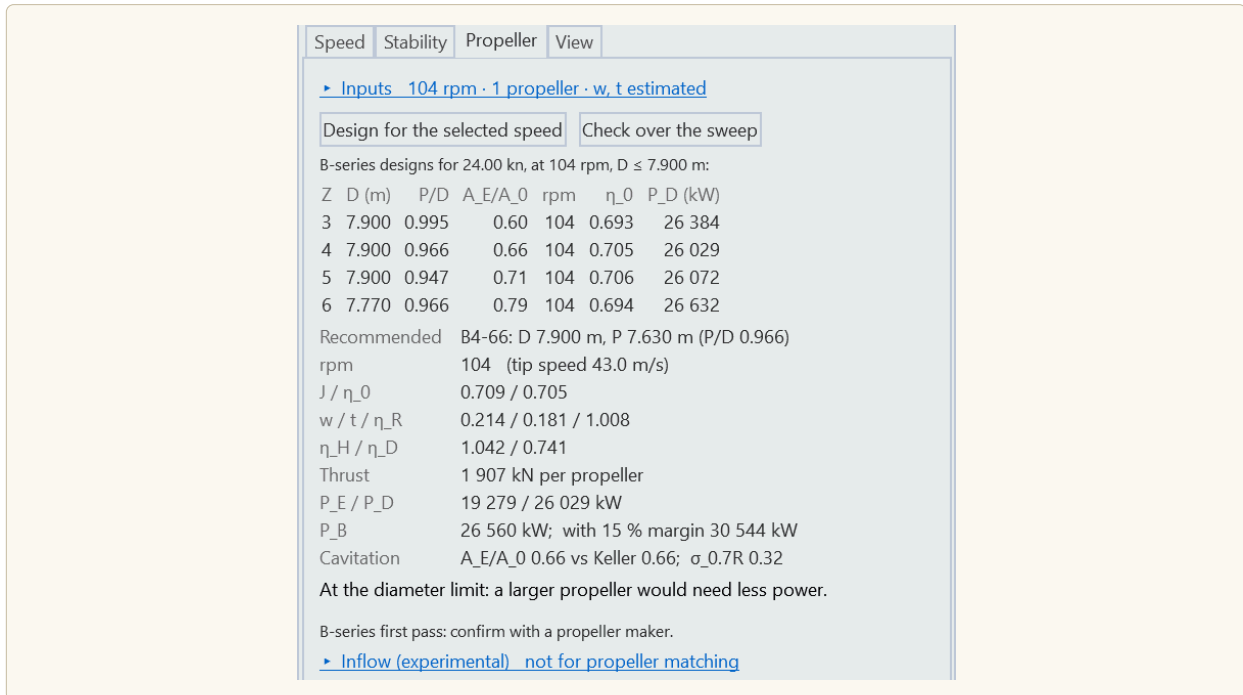


Figure 8 The Propeller sub-tab: a fixed-rpm design for the KCS at full scale (104 rpm, $D \leq 7.9$ m) with the inputs folded, one design per blade count and the recommendation.

The **Propeller** sub-tab recommends a Wageningen B-series propeller for the selected speed, and runs a propeller over the whole sweep (Figure 8). Click **Inputs** to fold them to one line, such as “104 rpm · 1 propeller · w, t estimated”. Choose the **Problem**:

- **Fixed rpm: find the diameter.** The engine and gearbox are chosen. QuickWake finds, for each blade count, the diameter and pitch that need the least power at that shaft rpm. **Largest diameter** limits the diameter to what the aperture takes, tip clearance included; 0 means no limit.
- **Diameter limit: find the rpm.** The aperture sets the largest diameter. QuickWake finds the diameter (usually the limit), rpm and pitch that need the least power.
- **Given propeller: check it.** Enter the blade count, diameter, pitch ratio P/D and blade-area ratio A_E/A_0 of a propeller you have.

Design for the selected speed gives one design per blade count in **Blades, from / to**, in a table, and recommends the one needing the least delivered power. Under the table are:

- the recommendation’s geometry and rpm;
- the hull–propeller factors;
- thrust, effective, delivered and brake power;
- the cavitation checks.

Check over the sweep runs the given propeller, or the recommended one, at every solved speed. The plot can then show its rpm, brake power and open-water efficiency against speed.

The bookkeeping.

- Each propeller delivers a thrust $T = R / ((1 - t) n)$, where R is the total resistance plus any **Added resistance** (appendages, roughness; the solver models the bare hull).
- The propeller advances at $V_A = (1 - w) V$.
- The delivered power P_D is that of all propellers, with the relative rotative efficiency η_R applied.

- The brake power is $P_B = P_D / \eta_S$, where η_S is the **shaft efficiency** (shaft line and gearbox).
- The installed power adds the **Power margin** for sea, fouling and engine.

Hull–propeller factors. w , t and η_R are estimated, or you enter them under **Given**.

- **Displacement hulls:**
 - Holtrop (1984) for one propeller per hull behind a conventional stern;
 - Holtrop and Mennen (1982) for an **Open stern** (a shaft on brackets, no skeg) and for two or more propellers per hull.
- **Planing hulls:** the mean twin-screw data of Blount and Fox (1976), against the volume Froude number from 1 to 4. Their thrust deduction already includes the effect of the inclined shaft.
- **Catamarans:** each demihull is treated as a hull of its own.

These are statistical estimates for a first design pass; measured or CFD values are better. The experimental propeller inflow (below) is a different quantity and is not used here.

t from a virtual disk. The third choice, **Estimate, t from a virtual disk**, keeps the estimated w and η_R and computes the thrust deduction t instead.

- **What it computes.** The propeller is a linear actuator disk: a pressure jump with the Hough–Ordway radial loading. Its suction acts on the wetted hull, at the solved trim and heave, and raises the resistance by $t \cdot T$.
 - This is only the unreflected potential part of t . There is no viscous part, so on a displacement hull it reads low: about 70–80 % of a measured t .
 - The transom is taken as dry, as in the resistance.
 - The free surface is a rigid lid on a displacement hull and a zero-pressure surface on a planing hull. The tooltip of $w / t / \eta_R$ gives both values.
- **The shaft angle.** With the shaft at an angle to the flow (its angle to the baseline plus the running trim), only $T \cos(\text{angle})$ pushes the boat. t therefore gains $1 - \cos(\text{angle})$.
- **Where the disk sits.** By default it goes at the generic position for the hull form. D is the given diameter or the diameter limit.
 - **Planing:** 0.5 D aft of the transom, with the centre 0.6 D below the keel, on a 12° shaft.
 - **Displacement:** the centre 0.55 D above the keel, 0.2 D aft of the stern at that height, with the shaft level.
 - **Twin screws:** 0.3 B off the centreplane.

Untick **Generic position for the hull form** to place it as designed. t depends strongly on how close the disk is to the hull. An aperture in the stern is not modelled, so the disk must sit outside the hull.

- **The shaft depth.** In this mode it comes from the disk centre.
- **Designs.** A design keeps the centre where it is and varies the diameter. A propeller that would cut the hull or break the surface is ruled out, and the reason is given.
- **Planing hulls.** The disk mainly takes lift off the bottom. A re-balanced attitude would turn that into resistance, but the attitude is held here, so t is mostly the shaft-angle part.
- **The viewport.** It shows the disk, with its tip and hub rings, at the selected speed.
- **The plot. Thrust deduction t** is one of the quantities for the check over the sweep.

Cavitation.

- The blade-area ratio of a design is Keller’s minimum for its thrust and **Shaft depth** (the shaft centreline below the water, running).
- Keller’s constant K is 0.2 for a single screw and 0.1 for twin screws, and 0 can be entered for fast twin-screw craft.
- A blade count that would need more blade area than the series has gets no design.
- A design whose blade area is the series’ largest for its blade count is flagged. Cavitation, not efficiency, has set its diameter.
- A cavitation number at 0.7 R below 0.25 is flagged: cavitation is then likely to cut the thrust, and the series’ non-cavitating data are optimistic. This threshold is a guide, not a criterion.

- The recommendation passes over a flagged design if one without flags needs at most 2 % more power.

Limits.

- The B-series polynomials of Oosterveld and van Oossanen (1975) are used within their tested ranges: 2 to 7 blades, P/D 0.5 to 1.4, and each blade count's blade-area range. Their Reynolds-number correction applies above 2×10^6 ; model-scale propellers below that are flagged.
- Thrust breakdown by cavitation, Burrill's criterion, blade strength, ventilation and engine matching are not modelled.
- Confirm the propeller with its maker.

The section's settings are stored on the hull and saved in the .3dm file. The CSV export lists the designs and the sweep check.

11 Sailing (VPP)

The **Sailing** tab predicts a sailing yacht's speed polar for the swept hull, taking its waterline, loading and water. It is for displacement monohulls.

Inputs (metres, as ORC measures them):

- **Rig:** I, J, P, E, BAS, LPG, the mainsail roach, HBI (the sheer's height above the water at the mast), the mast diameter, and ORC's low or high coefficient set.
- **Downwind sails:** a symmetric spinnaker (SL, SFL, SHW, ISP, SPL) and an asymmetric gennaker (SLU, SLE, SFL, SHW, TPS, on a bowsprit or a pole). Leave a dimension at 0 for ORC's default sail.
- **Keel and rudder:** span, root and tip chords, and thickness ratio.
- **Crew and wind:** the crew's mass (already in the boat's mass), how far to windward they sit, and the true wind speeds at 10 m height.
- **Hull resistance:**
 - **QuickWake** (the default): its own solver, heeled as in the Heel section.
 - **DSYHS:** the Delft series' regressions (Keuning and Katgert 2008, 2010), only for canoe bodies inside the series' range.
 - For a hull inside that range, the notes compare the two upright.

QuickWake fills in defaults from the hull's size when you first choose a hull. Your settings are saved with the hull object.

Compute polar.

- **The first run** with QuickWake's resistance solves the hull over speeds F_n 0.10–0.60 and heels 0, 10, 20 and 30° (see Heel), and its GZ curve. This takes about a minute for a typical hull. With the DSYHS resistance it only solves the hull upright, for the comparison. The table is kept while the hull, loading, water and source stay the same.
- **Each polar** then takes seconds.
- **At each true wind angle**, QuickWake finds the speed and heel where:
 - the sails' drive equals the hull's resistance plus the keel and rudder's friction and induced drag;
 - the heeling moment equals the righting moment (the GZ curve and the crew).
- **Depowering.** It flattens and reefs the sails for the most speed.
- **Sail choice.** It sails each angle on the fastest of the jib, the spinnaker and the gennaker.

Results:

- **The polar plot:** boat speed against true wind angle per wind speed. Dots mark spinnaker or gennaker points, and rings mark the best VMG.

- **The table:** the beat angle and VMG, speeds at 52–150°, and the run VMG and gybe angle. Hover a cell or a point for its heel, leeway, sails, flat and reef.
- **Export CSV** writes every angle, set and force.
- **Amber cells** reached the top of the resistance table: the boat may be faster there.
- **Jumps.** Where the hull's resistance has a hump, the speed can jump between neighbouring angles. The polar shows the faster equilibrium, past the hump.

Method:

- **Sails:** the ORC VPP sail model (ORC VPP Documentation 2026): its lift and drag coefficients, effective rig height, flat and twist; the reef is Kerwin's.
- **Keel and rudder:** the Delft Systematic Yacht Hull Series effective draft and side force (Keuning and Sonnenberg 1998).
- **Hull:** the heeled resistance of the Heel section, or the DSYHS regressions.
- **Righting moment:** the GZ curve; the heel is held to 30° or the GZ maximum.

Not modelled: yaw balance and the rudder angle, the keel's residuary resistance, rigging and crew windage, and waves.

The heeled resistance has not yet been validated against the DSYHS tank data, so treat the polar as a design comparison, not a rating.

12 Experimental: propeller inflow

With **Estimate, t from a virtual disk**, the propeller's disk in the viewport is coloured by the nominal potential inflow V_A/V of the bare hull at its running attitude. The disk label adds w_n and its V_A .

A check over the sweep also records w_n for each speed. It is plotted as **Nominal potential wake w_n at the propeller**, and it goes into the CSV.

This inflow has no boundary layer, transom jet or appendages. It is **not** the effective wake w_T , and it is not used for the powering: the operating point uses Holtrop's or Blount & Fox's w , shown on the label as w and V_A . It is shown to illustrate how the running attitude and the waves change the inflow, and it is labelled experimental.

13 Validity and accuracy

The method was validated on model-scale, bare-hull, calm-water experiments. Appendages, roughness, propulsion interaction, full-scale correlation and dynamic stability (porpoising, broaching) are outside the model.

Monohulls with tank data. Eleven hulls, displacement and planing, were run through the plug-in itself and compared with their published tank tests. The resistance came within a mean absolute error of 5 to 10 % per hull (Figure 9). With the measured attitude imposed, as in the method's paper, the displacement hulls pooled to 7.2 % over 143 points.

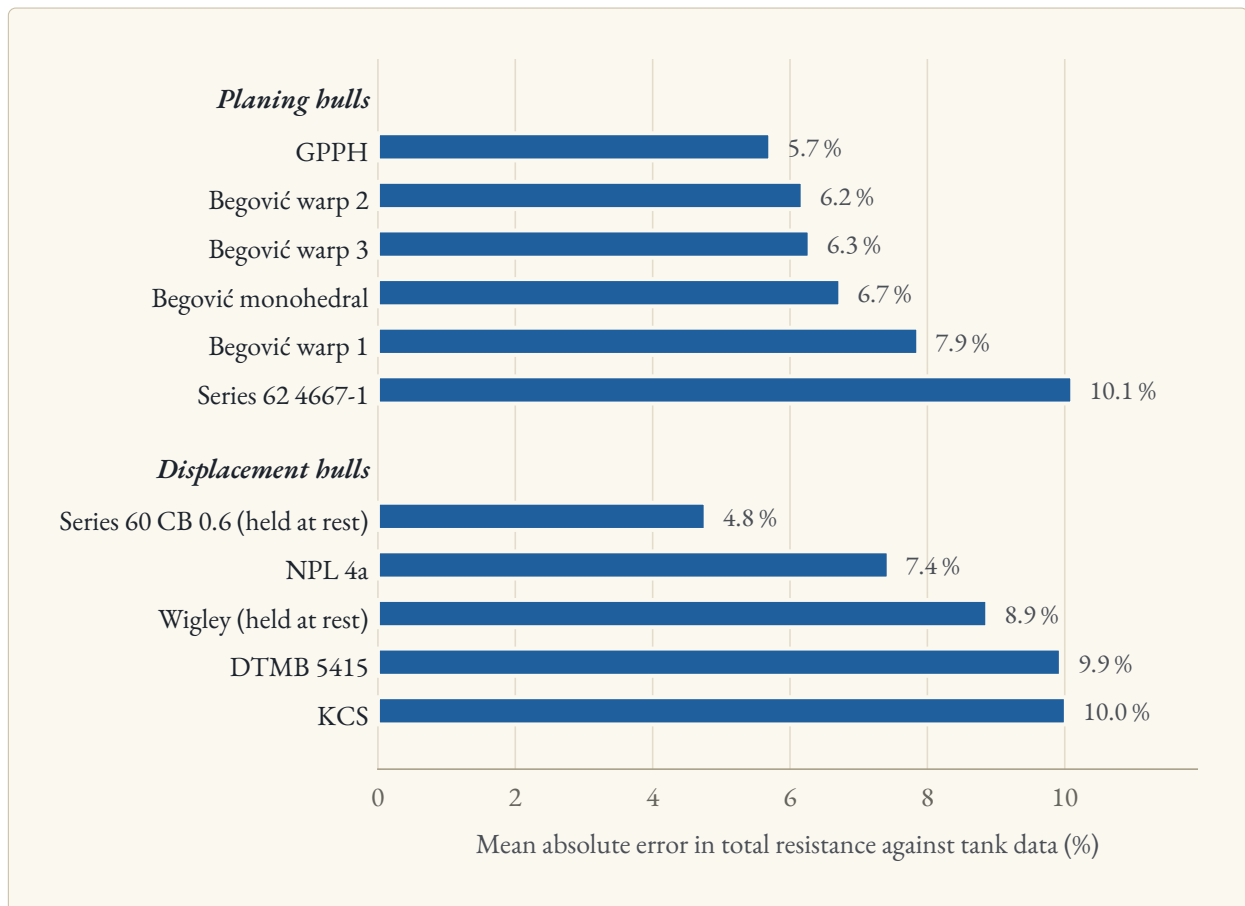


Figure 9 The mean absolute error in total resistance of each hull, over all its tank speeds. The hulls are free to trim and sink, except the two held at rest as they were towed. Data: the plug-in's validation run of 8 October 2026.

Planing hulls. On the Begović hull family, trim came within $0.15\text{--}0.7^\circ$ on average and heave within 4–15 mm. Figure 10 shows the monohedral hull across its speed range.

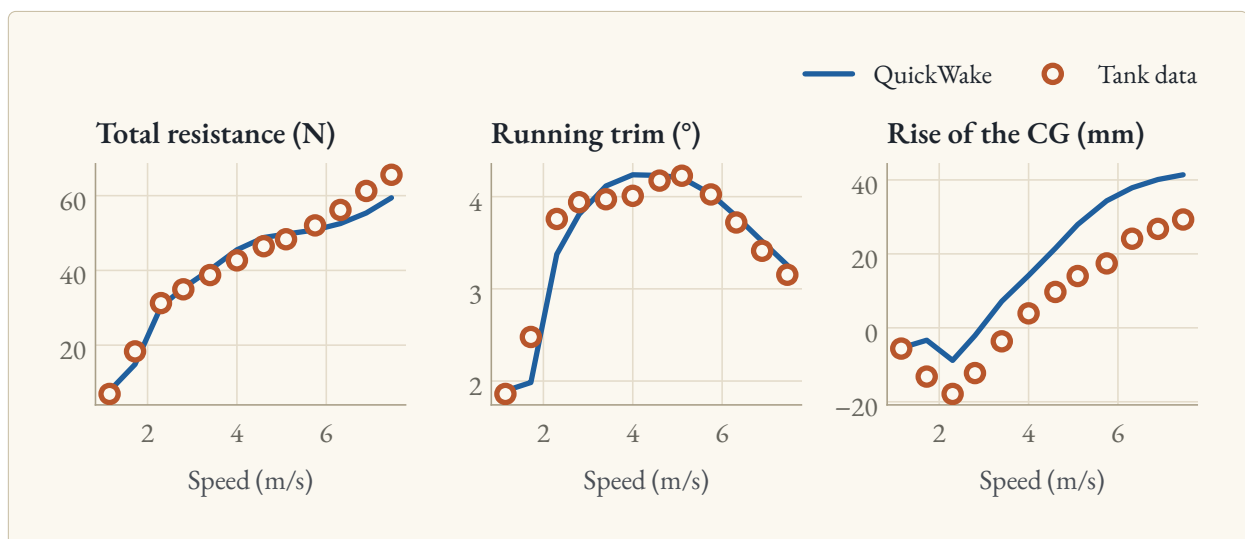


Figure 10 The Begović monohedral planing hull, free to trim and sink: QuickWake (line) against the tank (rings), from displacement speeds to full planing.

Displacement hulls. Figure 11 shows two of them, free to trim and sink, from low speed to past the hump.

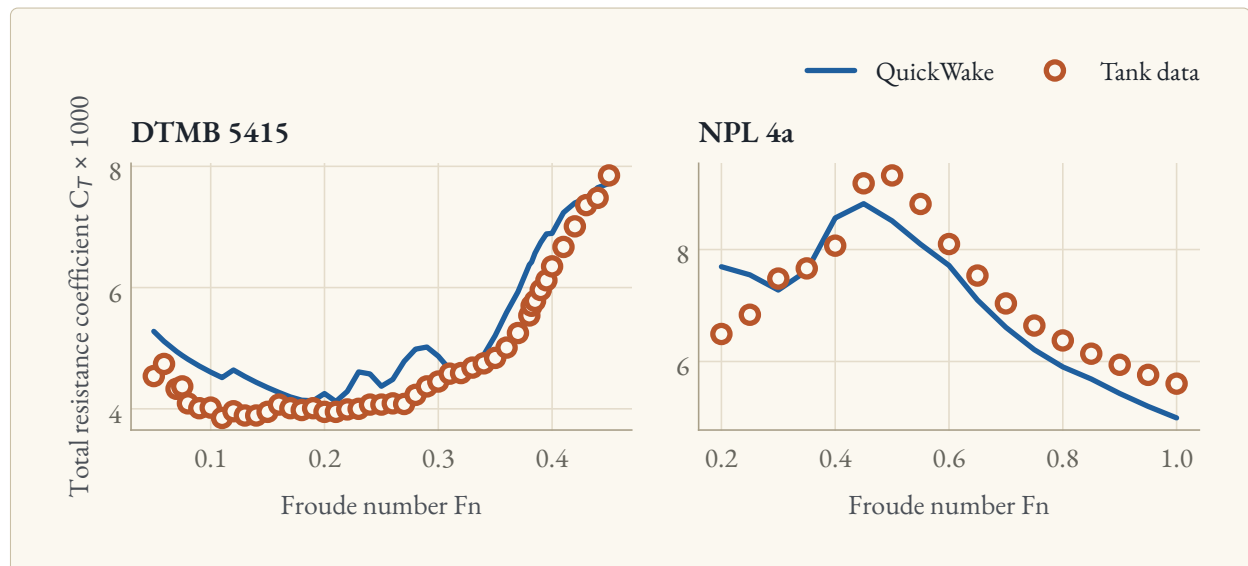


Figure 11 The total resistance coefficient of the DTMB 5415 frigate and the NPL 4a round-bilge hull: QuickWake (line) against the tank (rings).

Catamarans. These are less validated. Wigley and NPL 4a catamarans read 8–12 % low in resistance, Series 60 catamarans 3–16 % high. A catamaran’s free running attitude is one demihull’s, with no lift interaction between the hulls. Treat catamaran results as indicative.

QuickWake flags results that fall outside the validated range:

- **full-scale:** a hull longer than the largest validation model (7.3 m);
- **deadrise:** planing deadrise outside 10–30°;
- **$F_n > 1$:** a displacement form above $F_{n_L} = 1.0$;
- **$F_{nv} > 8$:** a planing form above $F_{nv_vol} = 8$;
- **low trim:** planing at under 2° of trim, where trim was over-predicted by about 1°;
- **heave:** a heave balance not met;
- **trim limit:** trim at its search limit, -1° or 8° .

Note: a flag is a coverage warning, not an error estimate.

14 Troubleshooting

Message	What to do
No licence key: enter one to run sweeps	Click Licence and paste the key from your e-mail.
This licence key is not valid	Paste the key again, in full, from the e-mail. A key from another product or an edited key is rejected.
Licence for ... expired	Renew the yearly licence and enter the new key.
This licence is not valid yet	The computer's clock is earlier than the key's issue date: check the date.
michell_capi.dll was not found	Reinstall QuickWake from the Package Manager; <code>michell_capi.dll</code> must stay in the folder with <code>QuickWake.rhp</code> .
the hull is not symmetric about its centreplane	Check the forward axis, or model one half on its centreplane.
the half hull does not reach the centreplane	Move the hull, or its centreplane, onto the world origin's plane.
more than one surface layer along y	Remove internal, duplicated or nested surfaces: seen from the side, the hull must be one skin.
the two demihulls differ	Both demihulls must be mirror images, side by side.
set the full-hull mass, or give a waterline	Enter the mass (Loading, by mass) or a waterline height.
set the catamaran spacing	Give the spacing, place the demihull off the centreline, or model both.
 heave / trim limit on some speeds	No proper equilibrium at that speed. Check the CG (LCG especially) and the hull form setting.
The CG height was assumed	Set the real VCG under Centre of gravity: the GZ curve depends on it.

For anything this table does not cover, and for feedback, click **Feedback** at the top of the panel or the toolbar's speech bubble: a new mail to support@quickwake.app opens in your mail program, with the QuickWake and Rhino versions on its last line. Without a mail program, write to that address from any mail account.

15 Commands

Command	Does
<code>QuickWake</code>	Opens the QuickWake panel and prints the version and, if there is a problem, the licence state.
<code>QuickWakeLicense</code>	Shows the licence, and enters, replaces or removes the key.
<code>QuickWakeGuide</code>	Opens this guide at quickwake.app/guide in the browser.
<code>QuickWakeFeedback</code>	Opens a new mail to support@quickwake.app in your mail program, with the versions filled in.
<code>QuickWakeHull</code>	Sets up a hull from the command line and prints its hydrostatics report.
<code>QuickWakeAddFlow</code>	Adds the shown flow to the document, in one undoable step.
<code>QuickWakeDownflooding</code>	Picks the downflooding points for the GZ curve.