powerHull version 2.0

Quick user guide

1. System requirements

powerHull minimum system requirements are as follows:

- Processor: 1 GHz or faster
- RAM: 1 GB
- Display 800x600
- Operating system: Windows 10
- .NET Framework 4.7.2

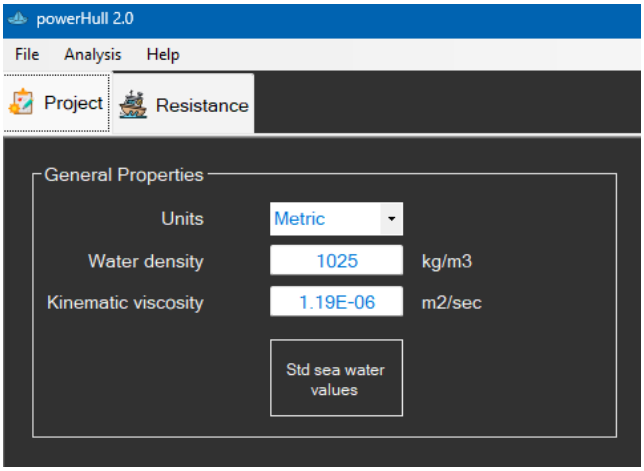
2. Available resistance methods

powerHull provides several parametric resistance prediction methods divided into two categories: prismatic semi-empirical and regression based. User is responsible for choosing the right method for the hull-form to be analyzed. A list of the available methods follows:

Method name	Typical applications	Type	Reference papers
Savitsky's method	Fully planing hulls with hard chine hull-forms and constant deadrise.	Prismatic semi-empirical	Savitksy D (1964) Hydrodynamic Design of Planing Hulls. Marine Technology, Vol 1.
Savitsky with M-Factor	Planing hull-forms at semi-planing speeds or running at "hump" region.	Prismatic semi-empirical	Blount D, Fox D (1976) Small – Craft Power Prediction. Marine Technology, Vol. 13
Series 62	High speed (Fnv=1-4), narrow stern, hard chine planing hull forms.	Regression	Radojčić D (1985) An approximate method for calculation of resistance and trim of the planing hulls. University of Southampton, Ship Science Report No. 23.
Series 65	High speed, hard chine planing hull forms.	Regression	
Mercier & Savitsky	Transom stern, semi displacement (Fnv=1-2) hull forms.	Regression	Mercier JA, Savitsky D (1973) Resistance of transom-stern craft in the pre-planing regime. Davidson Laboratory Report 1667
Lahtiharju (VTT)	Transom stern, hard chine semi displacement (Fnv=1.8-3.2) hull forms.	Regression	Lahtiharju E, Karppinen T, Hellevaara M, Aitta T (1991) Resistance and seakeeping characteristics of fast transom stern hulls with systematically varied form (trans: SNAME), vol 99
Crouch	Fully planing hulls.	Regression	Gerr D. (2001) Propeller Handbook. International Marine.
Wyman	Semi displacement hulls.	Regression	

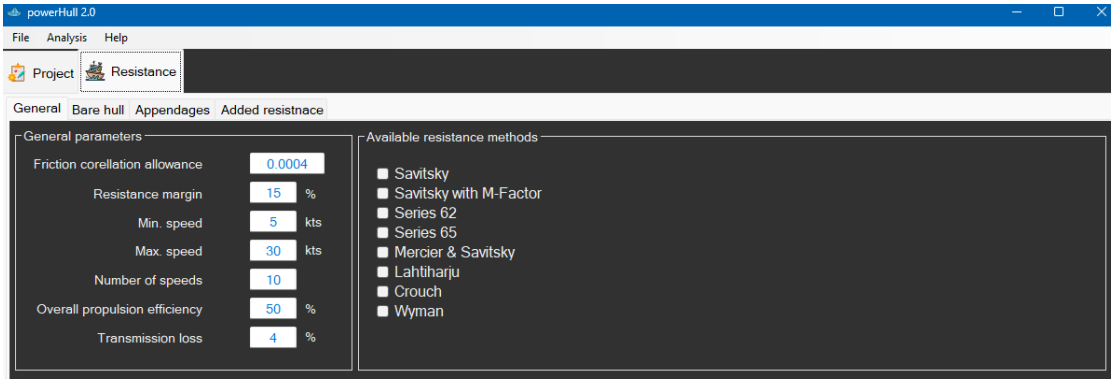
6. User input

Under the "Project" tab select the required units, the water density and viscosity. By clicking the button "Std sea water values" density and viscosity will be prefilled with default values for the units selected.



General project properties include units, water density and kinematic viscosity.

Under the "Resistance" tab fill the general parameters of the calculation and choose the desired resistance prediction methods:



Resistance prediction general parameters.

Resistance margin will add resistance to the total resistance according to the desired percentage in order to accommodate for rough weather, prediction errors, etc. User can use this value to correct the prediction for unaccounted parameters.

Min. and max. speed parameters define the range of speeds to be included in the calculation

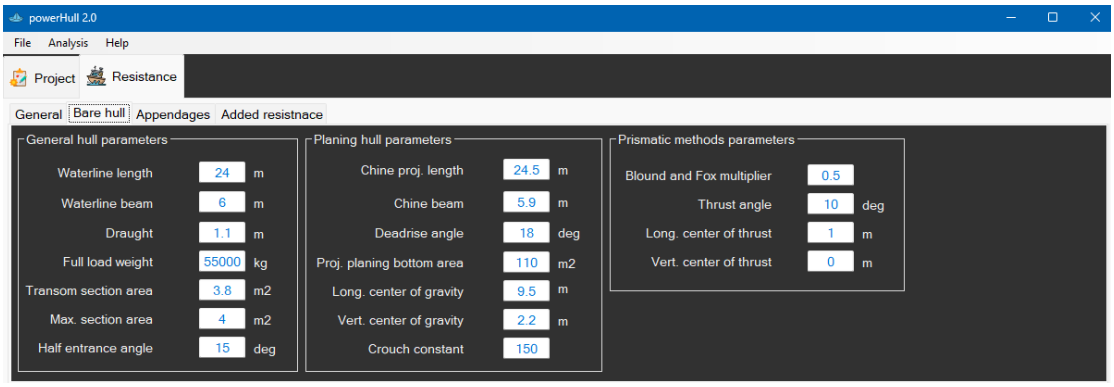
Number of speeds parameter define the number of speeds to be included in the calculation.

Overall propulsion efficiency is the total efficiency of the propulsion system required to calculate the shaft power.

Transmission loss is the percentage of power lost due to transmission gear efficiency. This parameter used to calculate total power.

Available methods is a list of all available methods. Multiple methods can be included in every calculation but at least one must be checked in order to calculate the resistance for a defined speed range.

Under the "Bare hull" tab the bare hull resistance prediction parameters are listed:



Bare hull resistance parameters.

Waterline length is only used to calculate the Froude number for each speed.

Waterline beam is the beam of waterline at displacement of choice. Required only for semi displacement regression methods.

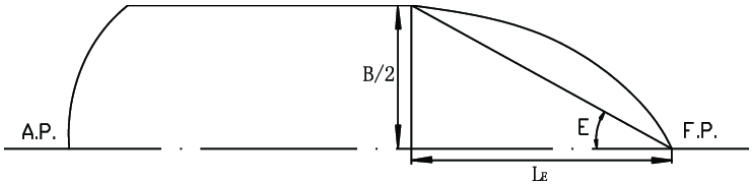
Draught is the draught of vessel at the displacement of choice. Required only for semi displacement regression methods.

Full load displacement is the displacement to be considered for the resistance prediction.

Transom section area The immersed portion is considered. Required only for semi displacement regression methods.

Max. section area The immersed portion is considered. Required only for semi displacement regression methods.

Half entrance angle As defined graphically bellow. Required only for semi displacement regression methods.



Chine proj. length is the projected length of chine, required only for planing hull methods.

Chine beam is the maximum breadth of the planing bottom excluding any external spray rails, required only for planing hull methods.

Deadrise angle is the angle between the bottom of the hull with the horizontal plane. It is measured at half chine length and required only for planing hull methods.

Proj. planing bottom area excludes external spray rails. Required only for planing hull methods.

Long. Center of gravity measured from transom. Required only for planing hull methods.

Vert. Center of gravity measured from hull center line. Required only for Savitsky based methods.

Crouch constant a coefficient within the range of 150 – 230 depending on hull/boat type. User can derive it from other similar designs or use a proper value as follows:

150 Average runabouts, cruisers, passenger vessels
190 High-speed runabouts, very light high-speed cruisers
210 Race boat types
220 Three-point hydroplanes, stepped hydroplanes
230 Racing power catamarans and sea sleds

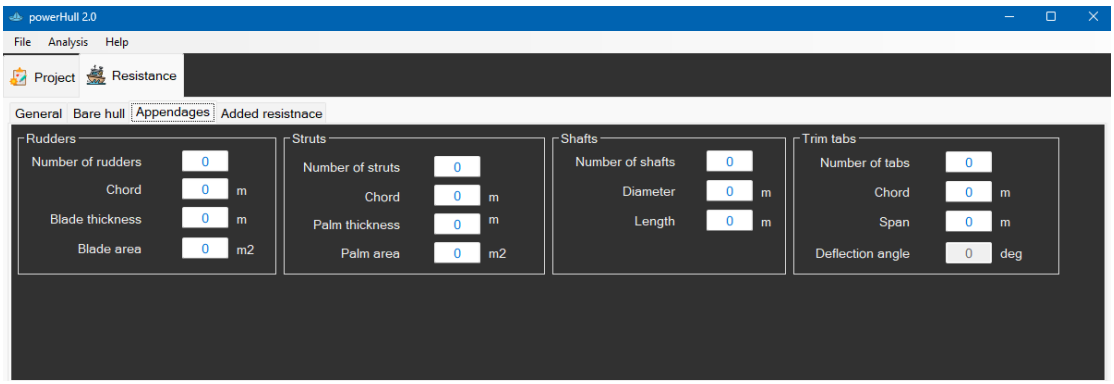
Blount & Fox multiplier A coefficient within the range of 0-1, affecting the Blount & Fox correction to the Savitsky's method for lower than true planing speeds. A typical value is 0.5. Required only for the Savitsky with M-Factor method.

Thrust angle required only for Savitsky based methods.

Long & vertical centers of thrust required only for Savitsky based methods. When unknown, the "simple" Savitsky method can be used by having the angle of thrust set to 0, and LCG = LCE, VCE = VCG where LCE is the long. Center of thrust and VCE the vertical center of thrust.

Note: Some parameters are used for specific methods only and will be available only if the user selects the appropriate method of resistance prediction.

Under the "Appendages" tab optionally fill the appendage parameters to include resistance of appendages to the results:



Appendage resistance parameters.

Rudder parameters: number of rudders, rudder chord, rudder span, blade thickness and blade area

Strut parameters: number of struts, chord, palm thickness, palm area.

Shaft parameters: number of shafts, shaft diameter, shaft length.

Trim tabs: number of tabs, tab chord, tab span and deflection angle.

Note: use can choose to define any of the appendages or none.

Under the "Added resistance" tab optionally fill the air- drag resistance prediction parameters:

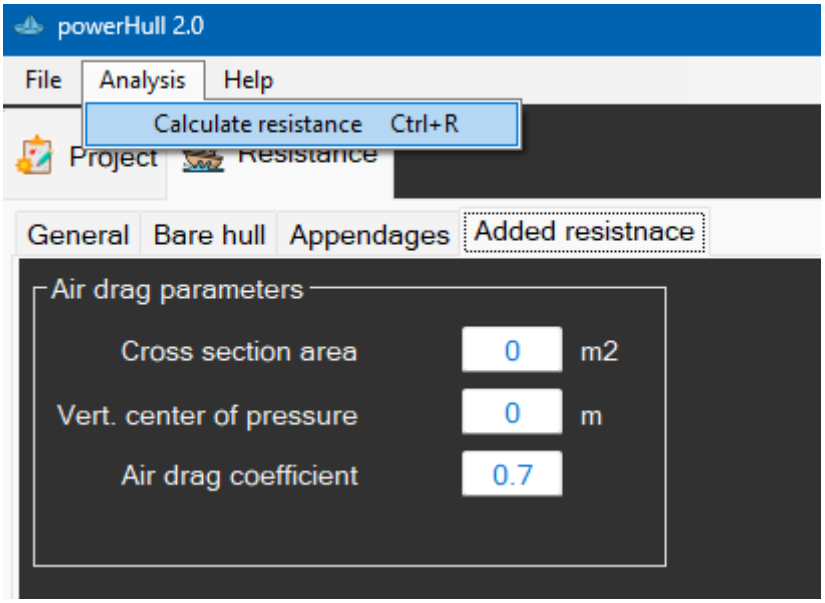
Cross section area is the cross-section area above water line including superstructures.

Vert. center of pressure measured from the base line

Note: If a vertical center of pressure value is given, the running trim angle calculated by Savitsky based methods will be corrected for air drag. If not, or if other methods are used only the air drag resistance will be added to the result.

6. Calculating resistance and power requirements

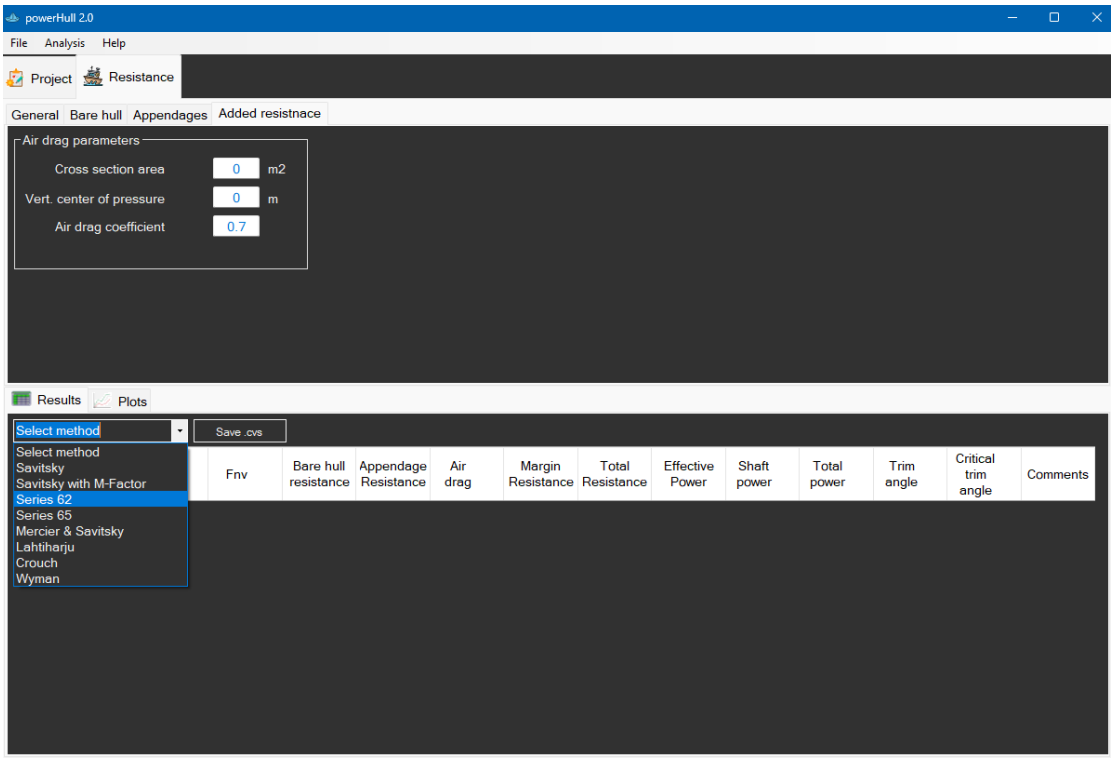
After filling all required parameters, user can perform resistance and power requirements calculations by clicking on the "Analysis" menu and choosing the "Calculate resistance" menu item. Alternatively the Ctr+R key combination can be used.



The “Calculate resistance” menu item.

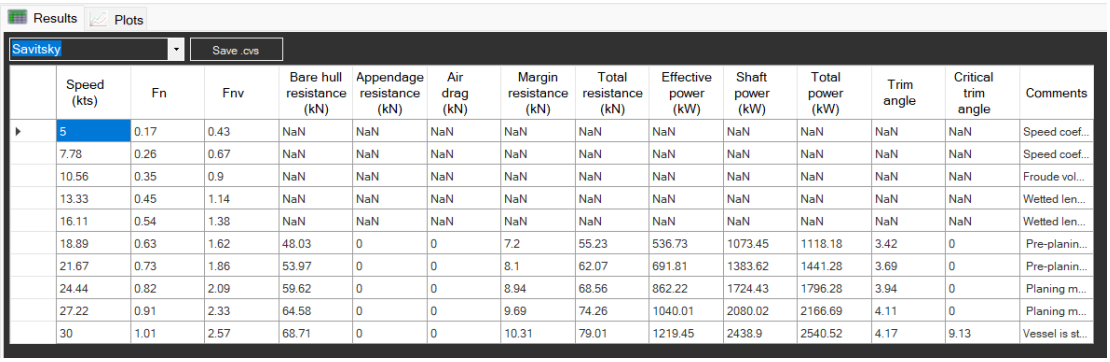
7. Results

For each chosen method, results can be viewed in a tabular form using the lower section of the application window.



“Select method” menu to switch between different method results.

The “Select method” menu can be used to switch between different method results.



	Speed (kts)	Fn	Fnv	Bare hull resistance (kN)	Appendage resistance (kN)	Air drag (kN)	Margin resistance (kN)	Total resistance (kN)	Effective power (kW)	Shaft power (kW)	Total power (kW)	Trim angle	Critical trim angle	Comments
▸	5	0.17	0.43	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Speed coef...
	7.78	0.26	0.67	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Speed coef...
	10.56	0.35	0.9	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Froude vol...
	13.33	0.45	1.14	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Wetted len...
	16.11	0.54	1.38	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Wetted len...
	18.89	0.63	1.62	48.03	0	0	7.2	55.23	536.73	1073.45	1118.18	3.42	0	Pre-planin...
	21.67	0.73	1.86	53.97	0	0	8.1	62.07	691.81	1383.62	1441.28	3.69	0	Pre-planin...
	24.44	0.82	2.09	59.62	0	0	8.94	68.56	862.22	1724.43	1796.28	3.94	0	Planing m...
	27.22	0.91	2.33	64.58	0	0	9.69	74.26	1040.01	2080.02	2166.69	4.11	0	Planing m...
	30	1.01	2.57	68.71	0	0	10.31	79.01	1219.45	2438.9	2540.52	4.17	9.13	Vessel is st...

Viewing results in a tabular form.

Results include the following data:

Speed of vessel in knots
Linear Froude number
Volumetric Froude number
Bare hull resistance in kN or Lbs
Appendage resistance in kN or Lbs
Air drag in kN or Lbs
Margin resistance in kN or Lbs
Total resistance as the sum of all resistance components in kN or Lbs
Effective power in kW or Hp
Shaft power in kW or Hp (if overall propulsion efficiency is given)
Total power in kW or Hp (if transmission loss is given)
Trim angle if selected method provides running trim prediction
Critical trim angle as an indicator for dynamic instability
Comments where *powerHull* will output errors, method applicability or other comments.

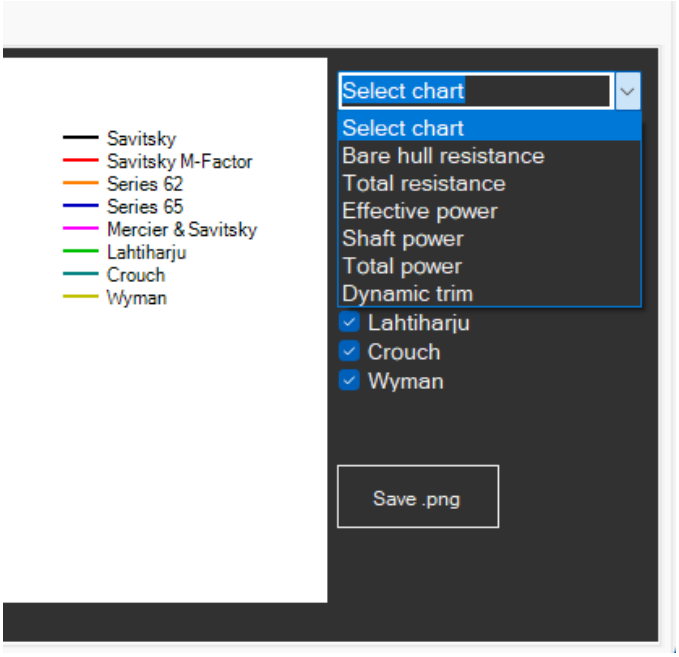
Clicking on “Save .csv” button, will save the current results into a “csv” file, editable in spreadsheet applications.

Note: User can copy the result’s data directly from the tabular formed area and paste them on a spreadsheet application. User can rearrange the column position or size.

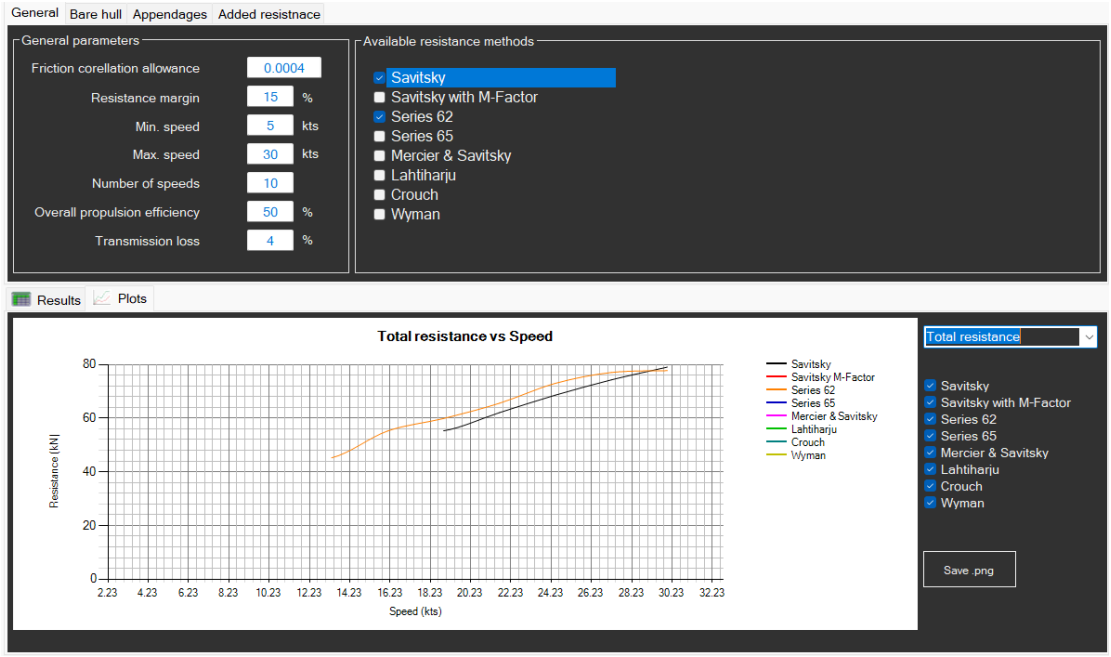
8. Plots

powerHull produces several plots using the results of the resistance/power prediction. Clicking on the “Plots” tab the user can view and save those plots:

Empty plots tab



In order to view a plot, the user must first select the type of plot using the “Select chart” menu. Using this menu, the user can switch between different plots.



The user can add multiple method results on a single plot or remove them using the list of methods next to the plot area. If a method is not previously included in the calculation, no data are available to be included in the plot.

The current plot can be saved as a PNG file by clicking on the “Save png” button.

Note: Plot’s size can be altered by changing the size of the window. The “Save .png” button, saves the current plot at its current size.