

**quickPlaning**

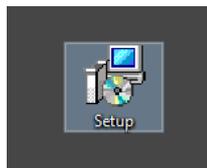
Planing Craft Resistance and Propulsion Analysis

# **Manual**

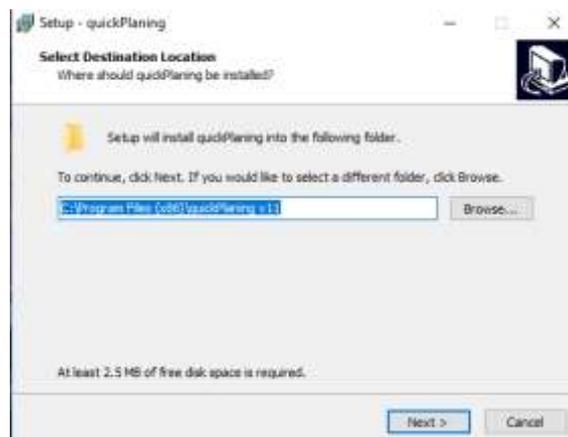
**(Version 1.1 / Windows Version)**

# Installing *quickPlaning* for Windows

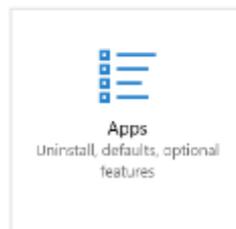
1. Download your own copy at [www.boatdesignlab.com](http://www.boatdesignlab.com). You can try all the plugin features for 20 days for free. After the trial period you need to purchase a valid license from boat-design-lab website.
2. After you download the setup application, double click its icon:



3. The installer's main window will appear. Follow the simple instructions presented to install your copy of *quickPlaning*:



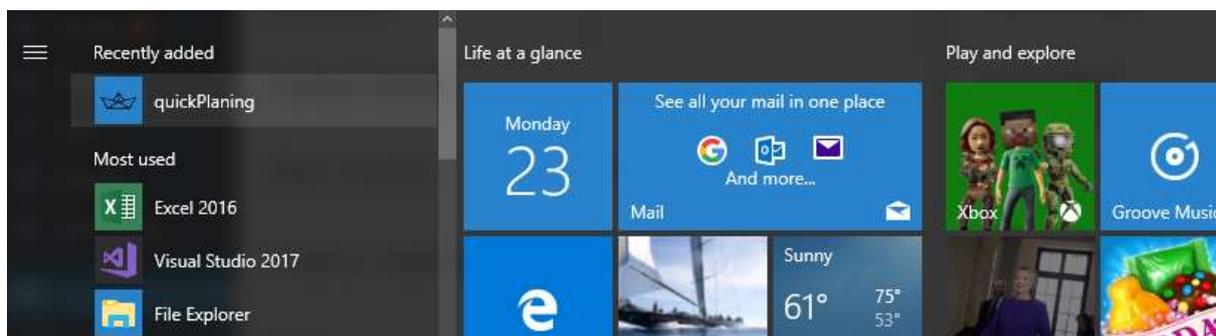
4. You are now ready to run *quickPlaning* for first time. You can double click the desktop application icon or use the Windows Start Menu where a new application is added.
  
5. In case you need to ***uninstall*** *quickPlaning*, select ‘Settings’ from Windows Start menu.
  
6. Then, select the ‘Apps’ option:



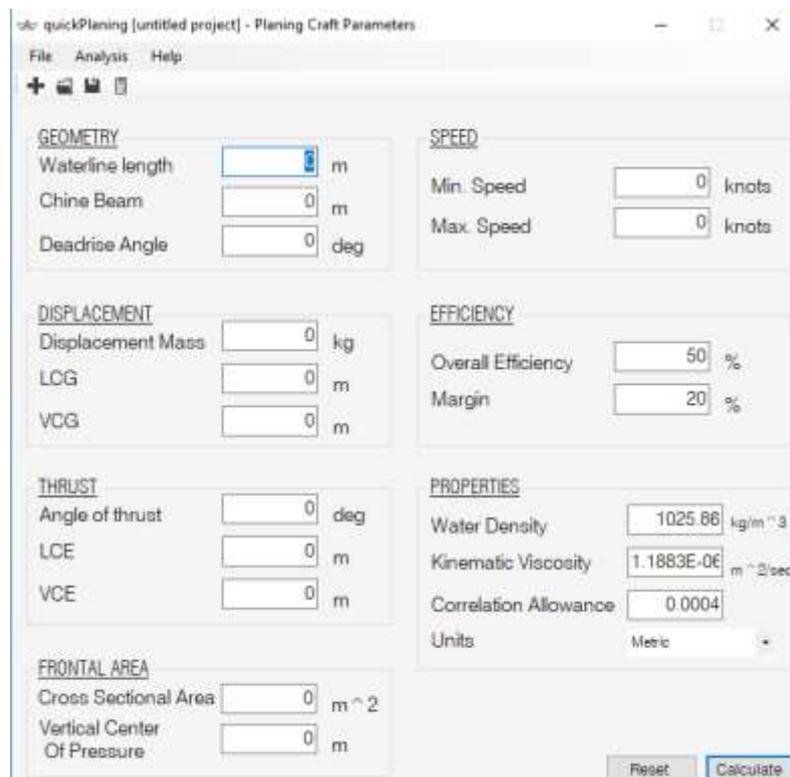
7. A new window will appear with a list of installed applications. Locate *quickPlaning* and click ‘uninstall’. Follow the simple instructions to uninstall *quickPlaning* from your PC.

## Using quickPlaning for Windows

After successful installation you can run quickPlaning by either double-clicking on the application's icon located on your desktop or by using the Windows Start menu:



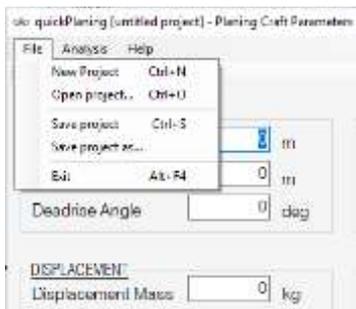
The quickPlaning main window (Planing Craft Parameters window) will appear after running the software:



The main window consists of the following sections:

- A title bar where the current file name appears
- A menu-bar with several user options
- A button strip with four common user options
- A parameter input area where user types the required parameters

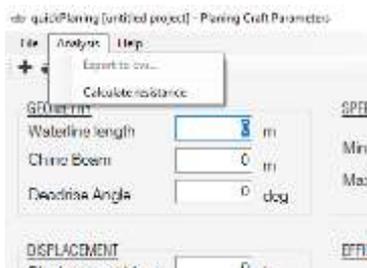
## File Menu



File menu contains the following user options:

- New Project. Creates a new empty project. User has option to save the parameters of current project before creating a new one.
- Open Project. Loads the parameters of a previously saved project
- Save Project. Saves any changes to the current loaded project.
- Save Project as. Saves current parameters to a new file.
- Exit. Exits the application. User has option to save the parameters of current project before exiting.

## Analysis Menu

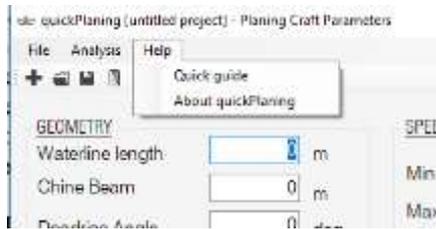


Analysis menu contains the following user options:

- Export to cvs. Exports current resistance data to a cvs file.

- Calculate resistance. Attempts to predict resistance using the current planing craft parameters.

## Help Menu



Help menu contains the following user options:

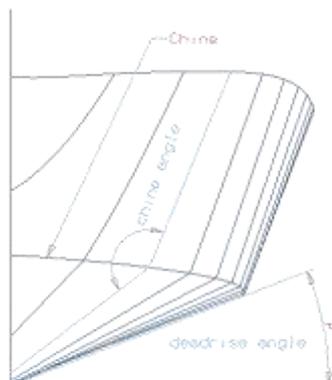
- Quick guide. Loads a pdf formatted quick guide of the application.
- About *quickPlaning*. Shows information about the application and its license status.

## User Input

User is required to input several parameters in order *quickPlaning* to estimate resistance. Parameters are grouped into seven (7) sections:

### GEOMETRY

- Waterline Length (optional)  
The intersection line of the free water surface with the moulded surface of the hull. It is used to compute a Froude number for each speed to be evaluated. *quickPlaning* will compute resistance in case Waterline Length is not defined by the user but will not check for minimum speed validity.
- Chine Beam (mandatory)  
Maximum breadth over chines, excluding external spray strips.
- Deadrise Angle (mandatory)  
Angle between a straight line approximating the bottom part of a body section and the intersection between basis plane and section plane



## DISPLACEMENT

- *Displacement Mass* (mandatory)  
The total displacement mass of the vessel to be used for resistance calculations.
- *Longitudinal Center of Gravity - LCG* (mandatory)  
Longitudinal distance between the center of gravity of the vessel and the trailing edge of the planing surface.
- *Vertical Center of Gravity - VCG* (mandatory)  
Vertical distance between the center of gravity of the vessel and the keel.

## THRUST

- *Angle of thrust* (optional)  
The angle of thrust line relative to base line or world-plane.
- *Longitudinal Center of Thrust Effort- LCG* (optional)  
Longitudinal distance between the propeller and the trailing edge of the planing surface.
- *Vertical Center of Thrust Effort- VCG* (optional)  
Vertical distance between the propeller and the keel.

In case the thrust passes through the boat's center of gravity or the thrust angle, LCE and VCE are unknowns, the user can 'emulate' the Savitsky's short form resistance prediction method. In such a case, the user can set angle of thrust equal to zero (0), set LCE equal to LCG and VCE equal to VCG.

## FRONTAL AREA

- *Cross Sectional Area* (optional)  
The cross-sectional area of the superstructure and hull above waterline. When provided, *quickPlaning* will estimate the aerodynamic resistance.
- *Vertical Center of pressure* (optional)  
The vertical distance of the cross-sectional area's centroid (center of pressure) to keel. If a cross sectional area is provided but not a vertical center of pressure, *quickPlaning* will add aerodynamic resistance to results but will not calculate the effect of air drag to the running trim angle.

## SPEED

*quickPlaning* will attempt to predict resistance for ten (10) speeds. User is required to define a minimum speed and a maximum speed to be evaluated. Minimum speed is checked so Froude number is greater than 0.5 (hull is at least at pre-planing mode). In case user defined minimum speed is less than required, minimum speed will be automatically overridden at the results. Maximum speed is the maximum speed to be evaluated. In case maximum speed is

less than minimum speed, it will automatically set to be two times the minimum speed to predict resistance.

## EFFICIENCY

*quickPlaning* will predict resistance (bare-hull and total) as well as effective power for each speed (maximum 10 speeds). The user can define the propulsive efficiency to be used for the application to estimate the total required power for each evaluated speed. In addition, the user can define an efficiency margin to be included in the final result. Efficiency margin could include non-calculated resistance such as hull roughness, appendages and rough weather.

Effective Power is calculated simply by multiplying total resistance times speed.

$$P_E = E_T \times V$$

In order to estimate required engine (brake) power the overall propulsive efficiency must be provided. OPC includes losses (efficiency factors) such as Hull Efficiency, Propeller Efficiency, Shaft mechanical efficiency and Transmission efficiency.

Typical values for Overall Propulsive Efficiency for planing crafts are within the range of 50-65%.

## PROPERTIES

It is required the user to define the water density, water kinematic viscosity and friction correlation allowance. By default, *quickPlaning* will use salt water density, and typical values for kinematic viscosity and correlation allowance. User can override default values.

## UNITS

User can select Metric or Imperial units.

### **Metric**

Length: Meters (m)

Area: Meters squared (m<sup>2</sup>)

Angles: Degrees (deg)

Mass: Kilograms (kg)

Density: Kilograms per cubic meters (kg/m<sup>3</sup>)

Kinematic Viscosity: Meters squared per seconds (m<sup>2</sup>/sec)

Force: Kilo Newtons (kN)

Power: Kilo Watts (kW)

### **Imperial**

Length: Feet (ft)

Area: Feet squared (ft<sup>2</sup>)

Angles: Degrees (deg)

Mass: Pounds (lbs)

Density: Slugs per cubic feet (slug/ft<sup>3</sup>)

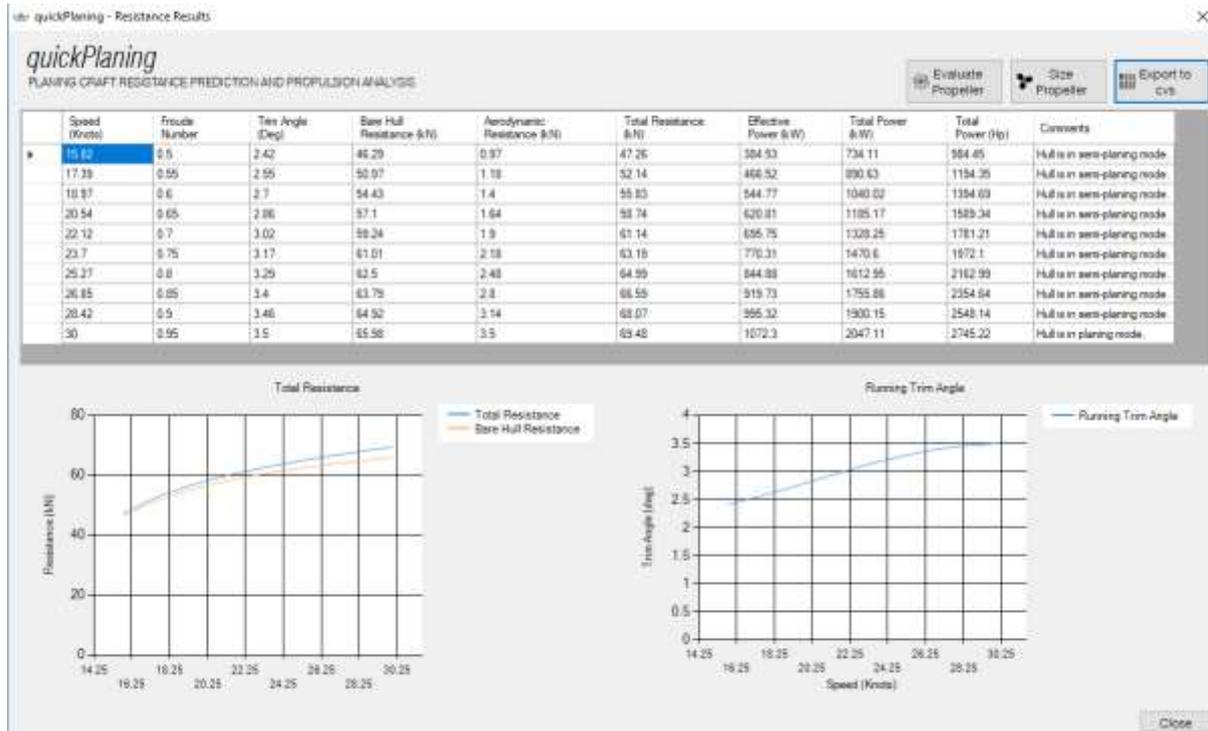
Kinematic Viscosity: Feet squared per seconds (ft<sup>2</sup>/sec)

Force: Pounds (lbs)  
 Power: Horsepower (hp)

**Speed is always in knots (kts).**

## RESULTS

After providing all the required data, user can click on 'Calculate' button to view the results. Results are shown on a separate window.



Results window contains a spreadsheet-like area where results are shown on a tabular form. User can copy and paste data to other software as usual. Results contain the following for each speed *quickPlaning* evaluated:

- Speed in knots
- Froude number (if waterline length was provided)
- Trim Angle in deg. (Dynamic trim angle - angle of keel relative to static waterline)
- Bare Hull Resistance in kN or lbs
- Aerodynamic Resistance in kN or lbs
- Total Resistance in kN or lbs
- Effective Power in kW or Hp
- Total Power in kW or Hp (Metric results contain total power in both kW and hp)
- Comments including the 'speed mode' of the hull and warnings about the validity of the result. Generally *quickPlaning* will attempt to calculate resistance with any input provided. However, if input or calculated data are out of method boundary limits, a comment is shown.

Results window contains two graphs. A speed to resistance curve and a speed to trim-angle curve.

## EXPORTING RESULTS

User can export results to a .cvs file to be viewed or processes in spreadsheet or other software. In order to export results, user can click on the 'Export cvs' button. A dialog will appear to save the .cvs file.

## PROPULSION ANALYSIS

quickPlaning offers to functions that help users to perform a preliminary propulsion analysis based on the provided planing craft parameters and the previously predicted resistance data:

1. Sizing a propeller: *quickPlaning* will estimate a propeller with maximum efficiency for a given condition and engine characteristics. Propeller diameter, pitch, EAR, efficiency, thrust, torque are predicted. For the defined engine power and RPM, the vessel speed is estimated as well as an overall propulsive efficiency (OPC).
2. Evaluating a propeller: *quickPlaning* will estimate vessel speed, engine RPM as well as propeller and overall efficiency for a given vessel condition, engine characteristics and propeller data.

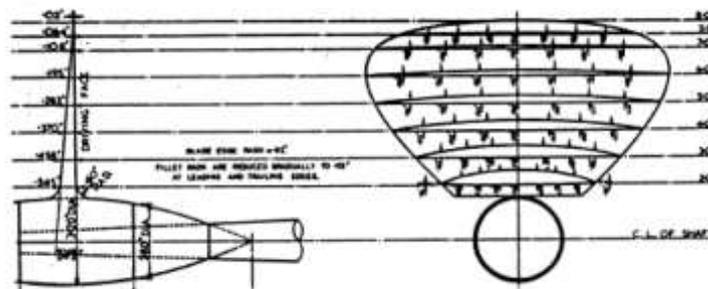
User can therefore estimate an optimum propeller for a specific load condition and then check the performance for other conditions or engine speeds.

In order to perform the above functions, *quickPlaning* is using data from a series of propellers known as Gawn-AEW series. The series is chosen as a representative of commercial available propellers for small craft performing at moderate planing speeds where little or no cavitation exists. GAWN-AEW series has the following data boundaries and typical geometry:

Number of blades: 3,4,5

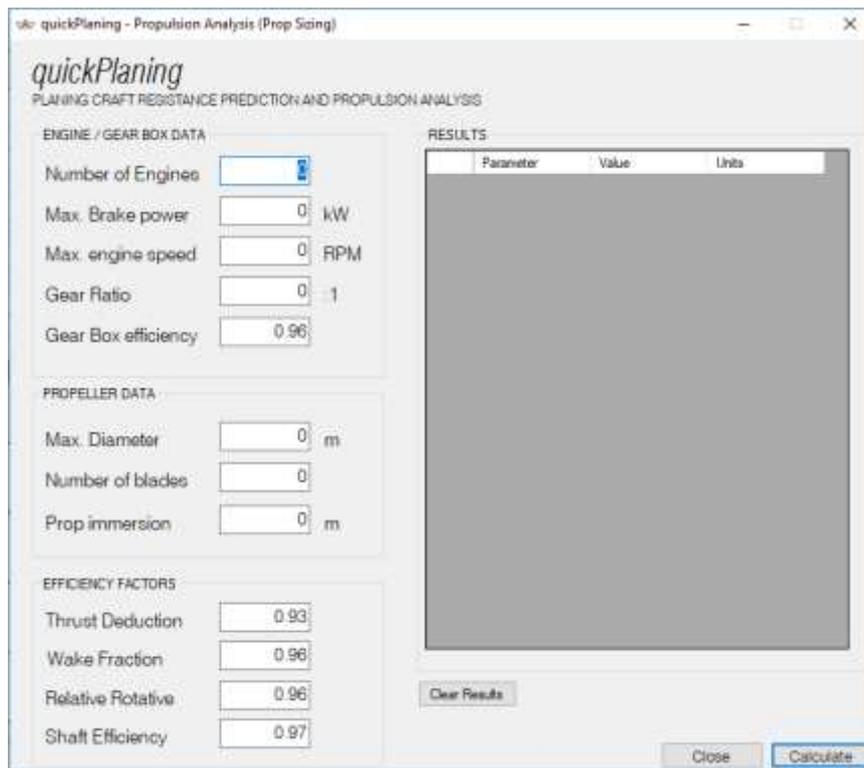
Blade Area ratio: 0.5 – 1.1

Pitch / Diameter ratio: 0.6 – 1.6



## SIZING A PROPELLER

User can estimate the basic sizing parameters of a propeller for given planing craft parameters (geometry, loading condition, etc), and given propulsion engine characteristics (max. power and RPM). Moreover, *quickPlaning* will estimate the maximum speed that the vessel can reach with given engine and suggested propeller. In order to perform such an analysis, the user must perform a resistance prediction and then click on ‘Size Propeller’ button. A new window will appear:



The screenshot shows a software window titled "quickPlaning - Propulsion Analysis (Prop Sizing)". The window is divided into several sections for data entry and results display.

**quickPlaning**  
PLANING CRAFT RESISTANCE PREDICTION AND PROPULSION ANALYSIS

**ENGINE / GEAR BOX DATA**

- Number of Engines:
- Max. Brake power:  kW
- Max. engine speed:  RPM
- Gear Ratio:  :1
- Gear Box efficiency:

**PROPELLER DATA**

- Max. Diameter:  m
- Number of blades:
- Prop immersion:  m

**EFFICIENCY FACTORS**

- Thrust Deduction:
- Wake Fraction:
- Relative Rotative:
- Shaft Efficiency:

**RESULTS**

Parameter	Value	Units
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Buttons: "Clear Results", "Close", "Calculate"

User is required to provide the following data:

### ENGINE / GEAR BOX DATA

- Number of Engines
- Max. brake power. This is the (brake) power to be used for propeller optimization. Usually is the power at maximum RPM.
- Max. engine speed. This is the RPM to be used for propeller optimization. Usually is the maximum engine RPM.
- Gear Ratio.
- Gear Box efficiency. This is the efficiency factor due to gear friction and heat at the gear box. A default value of 0.96 is provided.

## PROPELLER DATA

- Max. diameter. The maximum diameter the vessel can accommodate. This is limited by the hull bottom geometry and the minimum clearance between the propeller and the hull (usually about 10-15% of diameter).
- Number of blades. The number of blades of the propeller to be optimized. quickPlaning uses systematic data for 3, 4 or 5 bladed propellers.
- Prop. Immersion. The immersion of the propeller measured from waterline to propeller hub. This is used to calculate pressure and cavitation criteria.

## EFFICIENCY FACTORS

- Thrust Deduction. Difference between the calculated thrust of a propulsor and the delivered thrust that is applied to the hull. (Default value: 0.93)
- Wake Fraction. Difference between boat speed and water velocity at propulsor. (Default value: 0.96)
- Relative Rotative. Ratio of the propeller efficiency behind hull and open water. (Default Value: 0.98)
- Shaft Efficiency. Losses between the output side of the reduction gear and the propeller. (Default value: 0.97)

By clicking on the ‘calculate’ button, *quickPlaning* will attempt to estimate the sizing parameters of the propeller with maximum efficiency for the given resistance data, engine power, engine RPM, maximum diameter and efficiency factors as well as cavitation criteria.

The cavitation criteria used is the 10% Burrill Back Cavitation Limit (Burrill, 1962). Excessive back cavitation (reported values over 100%) indicate not enough blade area for the developed thrust (heavily loaded propeller).

The screenshot shows the 'quickPlaning - Propulsion Analysis (Prop Sizing)' window. It is divided into three main sections: ENGINE / GEAR BOX DATA, PROPELLER DATA, and EFFICIENCY FACTORS. The ENGINE / GEAR BOX DATA section includes: Number of Engines (2), Max. Brake power (600 kW), Max. engine speed (1900 RPM), Gear Ratio (2.56:1), and Gear Box efficiency (0.96). The PROPELLER DATA section includes: Max. Diameter (1 m), Number of blades (4), and Prop immersion (1 m). The EFFICIENCY FACTORS section includes: Thrust Deduction (0.93), Wake Fraction (0.96), Relative Rotative (0.98), and Shaft Efficiency (0.97). The RESULTS section displays a table with the following data:

Parameter	Value	Units
Vessel max. speed	23.13	knots
Thrust per propul...	32.507	kN
Torque per propul...	7.825	kNm
Power Delivered	633.216	kW
Shaft Power	652.0	kW
Brake Power	600	kW
Pitch Ratio	1.258	-
Blade Area Ratio	0.9	-
Propeller Diameter	0.888	m
Propeller Pitch	1.24	m
Propeller Efficiency	0.611	-
Propulsion Effice...	0.57	-
10% Back Cavit...	98.323	%

Buttons for 'Clear Results', 'Close', and 'Calculate' are visible at the bottom of the window.

The following data are reported in a spreadsheet like area:

- Vessel max speed. Maximum predicted speed for given parameters (resistance, engine data) and estimated optimum propeller parameters.
- Thrust per propulsor
- Torque per propulsor
- Power Delivered
- Shaft Power
- Brake Power
- Pitch Ratio (Pitch/Diameter)
- Blade Area Ratio
- Propeller Diameter
- Propeller Pitch
- Propeller Efficiency
- Overall Propulsion Efficiency (OPC)
- Cavitation Percentage

User can click on ‘Clear Results’ button to reset the tabular reporting area and perform a new calculation with new parameters.

## EVALUATING A PROPELLER

User can estimate the performance of the vessel and the efficiency of a propeller for given planing craft parameters (geometry, loading condition, etc), given propulsion engine characteristics (max. power and RPM) and sizing parameters of a propeller. In order to perform such an analysis, the user must perform a resistance prediction and then click on ‘Evaluate Propeller’ button. A new window will appear:

The screenshot shows the 'quickPlaning - Propulsion Analysis (Prop evaluation)' window. It is divided into several sections for data entry:

- ENGINE / GEAR BOX DATA:**
  - Number of Engines:
  - Max. Brake power:  kW
  - Gear Ratio:  1
  - Gear Box efficiency:
- PROPELLER DATA:**
  - Diameter:  m
  - Pitch:  m
  - EAR:
  - Number of blades:
  - Prop immersion:  m
- EFFICIENCY FACTORS:**
  - Thrust Deduction:
  - Wake Fraction:
  - Relative Rotative:
  - Shaft Efficiency:

On the right side, there is a **RESULTS** table with columns for Parameter, Value, and Units. Below the table is a 'Clear Results' button. At the bottom right, there are 'Close' and 'Calculate' buttons.

User is required to provide the following data:

### ENGINE / GEAR BOX DATA

- Number of Engines
- Max. brake power. This is the (brake) power to be used for estimating vessel speed, and engine RPM.
- Gear Ratio.
- Gear Box efficiency. This is the efficiency factor due to gear friction and heat at the gear box. A default value of 0.96 is provided.

### PROPELLER DATA

- Diameter.
- Pitch.
- Blade area ratio
- Number of blades. *quickPlaning* uses systematic data for 3, 4 or 5 bladed propellers.
- Prop. Immersion. The immersion of the propeller measured from waterline to propeller hub. This is used to calculate pressure and cavitation criteria.

### EFFICIENCY FACTORS

- Thrust Deduction. Difference between the calculated thrust of a propulsor and the delivered thrust that is applied to the hull. (Default value: 0.93)
- Wake Fraction. Difference between boat speed and water velocity at propulsor. (Default value: 0.96)
- Relative Rotative. Ratio of the propeller efficiency behind hull and open water. (Default Value: 0.98)
- Shaft Efficiency. Losses between the output side of the reduction gear and the propeller. (Default value: 0.97)

The screenshot shows the 'quickPlaning - Propulsion Analysis (Prop evaluation)' window. It is divided into three main input sections on the left and a results table on the right.

**ENGINE / GEAR BOX DATA:**

- Number of Engines: 2
- Max. Brake power: 600 kW
- Gear Ratio: 2.56
- Gear Box efficiency: 0.96

**PROPELLER DATA:**

- Diameter: 1 m
- Pitch: 1.2 m
- EAR: 0.9
- Number of blades: 4
- Prop immersion: 1 m

**EFFICIENCY FACTORS:**

- Thrust Deduction: 0.93
- Wake Fraction: 0.96
- Relative Rotative: 0.98
- Shaft Efficiency: 0.97

**RESULTS Table:**

Parameter	Value	Units
Vessel max speed	27.82	knots
Thrust per propulsor	33.901	kN
Torque per propulsor	7.716	kNm
Shaft Speed	763	RPM
Engine Speed	1927	RPM
Power Delivered	433.274	kW
Shaft Power	502.5	kW
Brake Power	600	kW
Pitch Ratio	1.2	-
Blade Area Ratio	0.9	-
Propeller Diameter	1	m
Propeller Pitch	1.2	m
Propeller Efficiency	0.421	-
Propulsion Efficiency	0.556	-
10% Sack Cavita.	93.593	%

Buttons: 'Clear Results', 'Close', 'Calculate'

By clicking on the 'calculate' button, *quickPlaning* will attempt to estimate speed of the vessel for the give resistance data, power, and propeller sizing parameters. It will report engine RPM at given power, propeller and overall efficiency as well as cavitation percentage.

The cavitation criteria used is the 10% Burrill Back Cavitation Limit (Burrill, 1962). Excessive back cavitation (reported values over 100%) indicate not enough blade area for the developed thrust (heavily loaded propeller).

*quickPlaning* is using data from a series of propellers known as Gawn-AEW series. The series is chosen as a representative of commercial available propellers for small craft performing at moderate planing speeds where little or no cavitation exists. GAWN-AEW series has the following data boundaries:

Number of blades: 3,4,5

Blade Area ratio: 0.5 – 1.1

Pitch / Diameter ratio: 0.6 – 1.6

Ensure that your propeller geometry and characteristics is represented by the GAWN-AEW series and well as no or little cavitation occurs in order to get reasonable results.

## LOADING A LICENCE

You can download and use quickPlaning for free for 20 days. After trial period expires, you need a valid license to continue using quickPlaning for Windows. In order to check you license status click on 'About' button located in the main window. A new window will appear with information about the version of the plugin. At the bottom of the 'About' window you can check the license status, days left until your copy expires as well as license information.



In order to license your evaluation copy follow the following instructions:

1. Purchase a valid license at [www.boatdesignlab.com](http://www.boatdesignlab.com)
2. After successful purchase, a license file will be sent to your email
3. Run quickPlaning as usual
4. Click on 'About'. A new 'About' window will appear
5. Click on 'Load License' button. A new Open File dialog will appear.
6. Locate and select the license file and click open
7. Your License Status will change from 'Evaluation Mode' to 'Licensed'
8. Your details (company, name, surname) will appear