CONCEPT

TURBO-KEELS® CONCEPT

The patented ***Turbo-keels®*** concept makes it possible to advantageously replace the tilting keels used today in competition for a use more suited to yachting.

TurboKeels® make it possible to considerably **increase** the **power** and **speed** of a sailboat without weighing it down, and to **reduce its draft**, in a simple and economical way.

A / Preamble

To move forward, any sailboat opposes to the force of the wind which tends to make it heel, its stability more commonly called "stiffness to the canvas", or more scientifically **righting torque** (**Cr**).

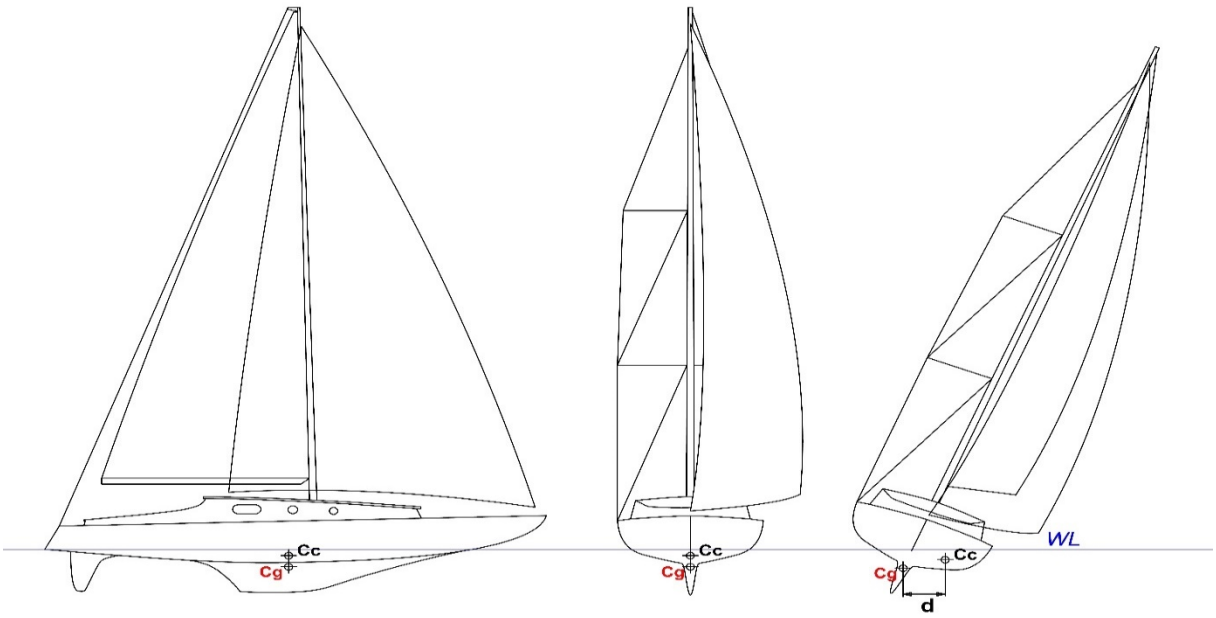
Cr = d(Cg, Cc) x Dep

With d = distance / Cg = center of gravity / Cc = center of hull / Dep = Displacement = volume of water displaced = weight of the boat.

The higher the righting torque (**Cr**) of a sailboat, the more it is able to maintain a large sail area and thus increase its speed.

Righting torque expresses the potential **power** of a sailboat.

The naval architecture of recent decades with the appearance of offshore racing has therefore sought to increase the righting torque (Cr) of sailboats without increasing their displacement (weight), so that one does not lose a side what we earn on the other.

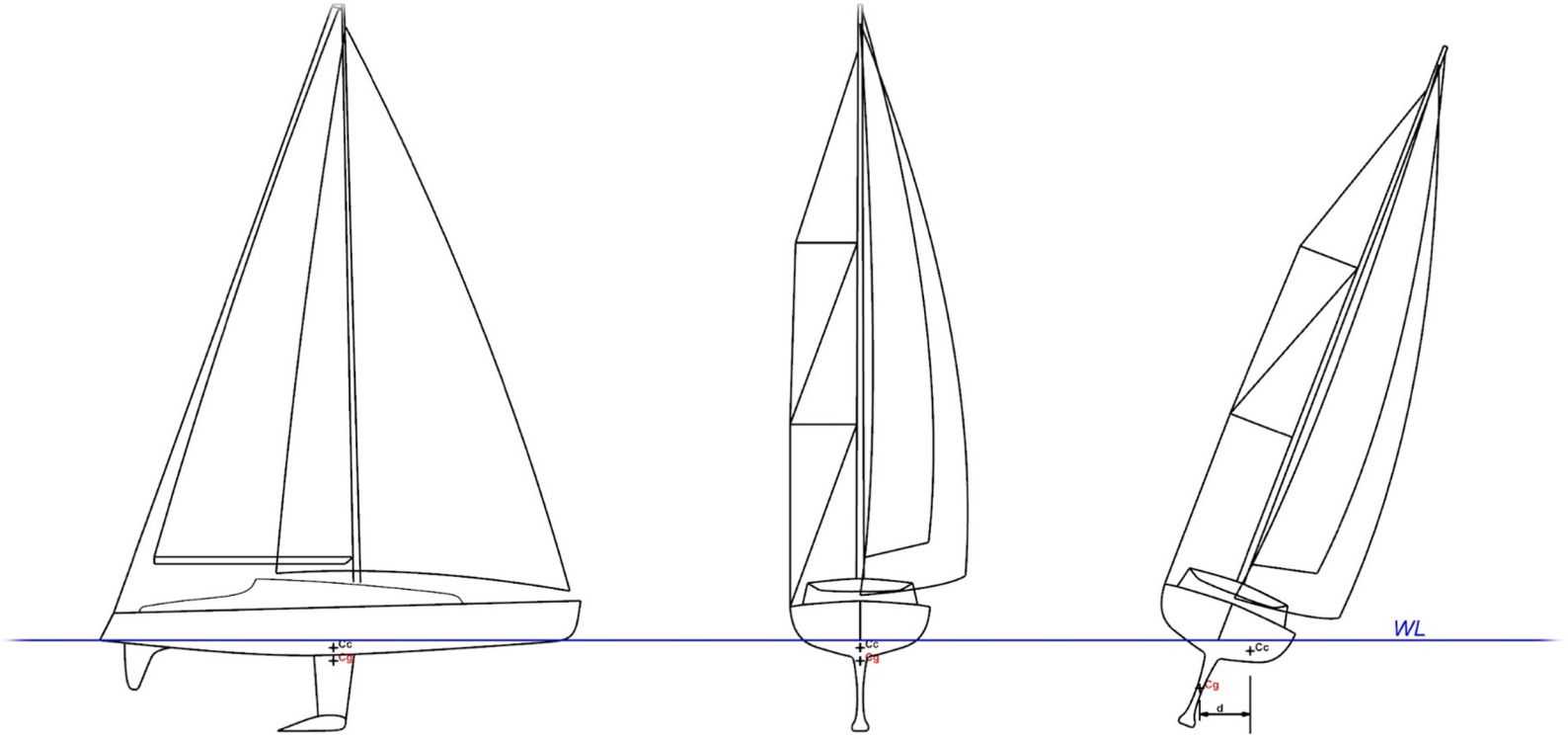


To increase the righting torque (Cr), without increasing the displacement (weight), it is therefore necessary to increase the horizontal distance (d) between the center of the hull (Cc) and the center of gravity (Cg) of the sailboat.

B / State of the art

Let's review the different solutions that have emerged in recent decades to solve this equation:

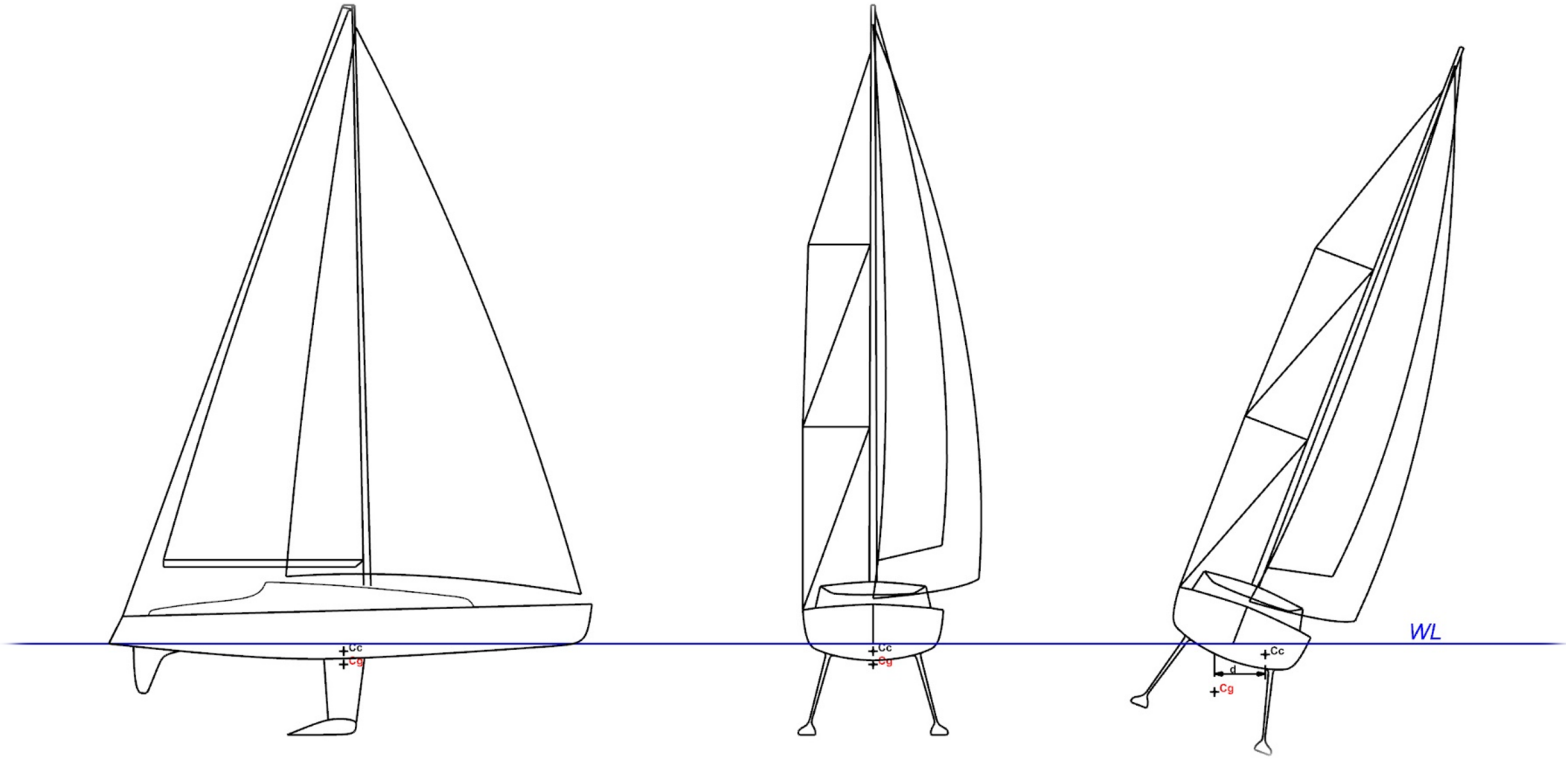
1 / The keelboat or weighted single keel: A keel sail, also acting as an anti-drift surface, equipped with a profiled lead ballast at its end. This is the most widely used solution in yachting to lower the CG of a boat.



Advantages: efficiency, easy to use, reliability, economy.

Disadvantages: to increase the righting torque and the performance of the sailboat without increasing its displacement (weight), the length of the keel sail must be increased, which increases the draft. The limits to the elongation of the keel sail are therefore a reasonable draft allowing entry into ports and anchorages as well as the mechanical resistance of the keel sail.

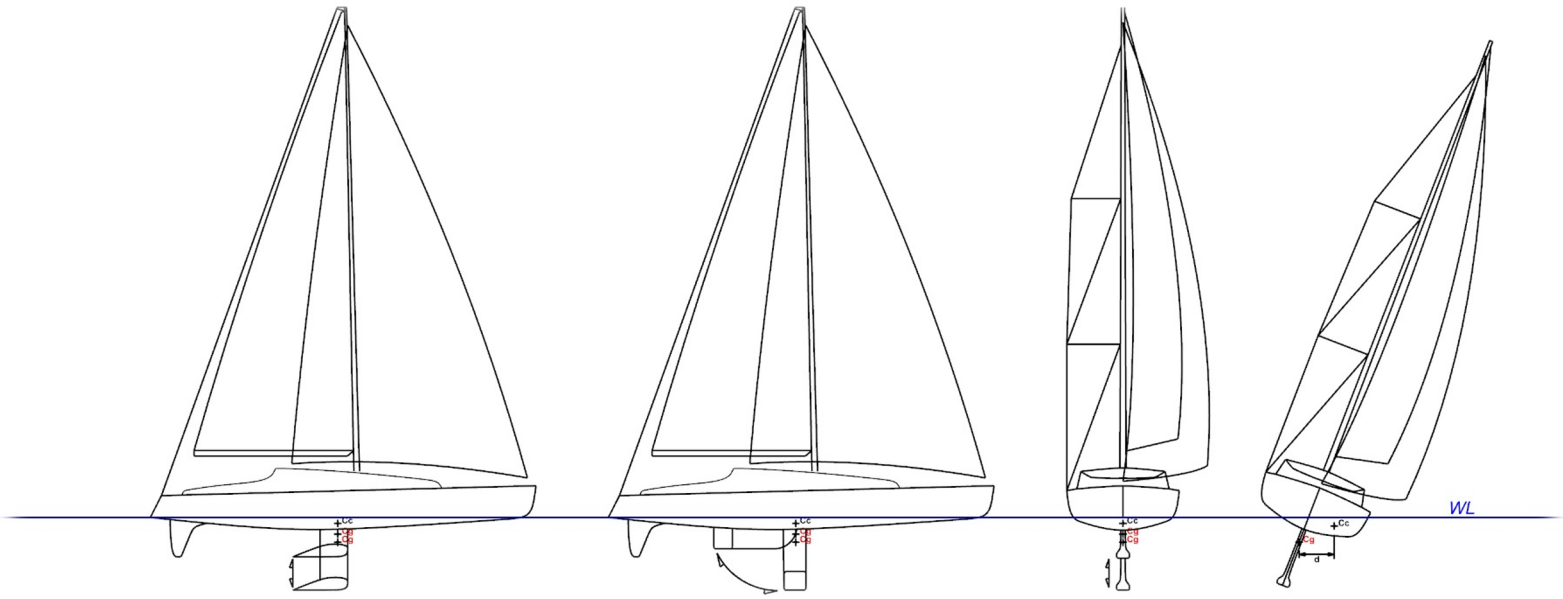
2/ the Bi keel: commonly used on more or less efficient cruising sailboats.



Advantages: same efficiency, easy handling, reliability, economy as for the single keel, with the added advantage of losing little anti-drift surface with the increase in heel and being able to land on both keels.

Disadvantages: as for the single keel to increase the performance of the sailboat one must increase the drift. Hydrodynamic drag of a double keel is slightly superior to a single keel.

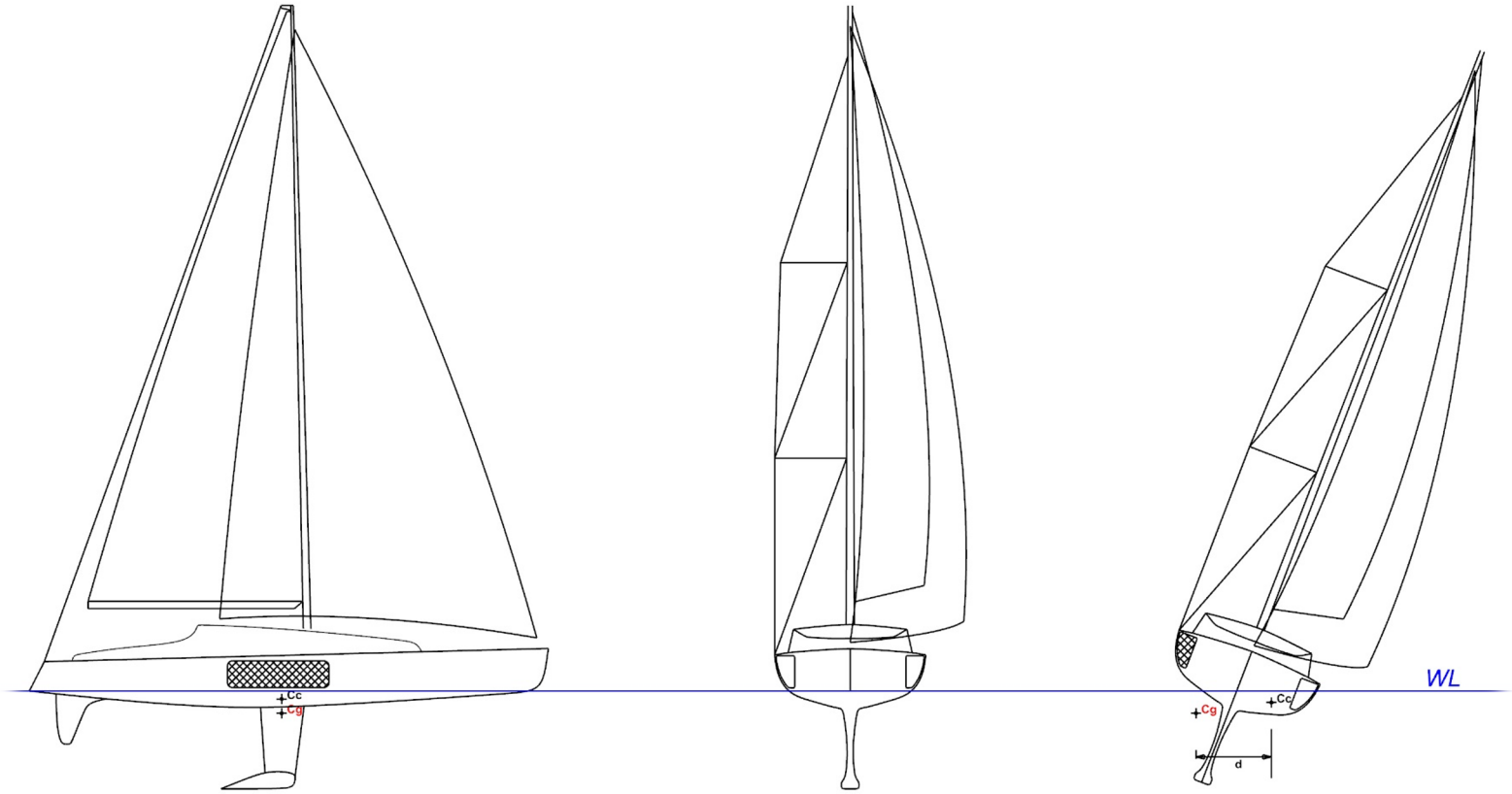
3/ vertically or swiveling **lifting keel**: becoming more widespread on cruising sailboats.



Advantages: allows the combination of good sailing performance and a low draft for accessibility to ports and mooring areas.

Disadvantages: large moving parts, therefore fragile. Expensive and bulky mechanisms.

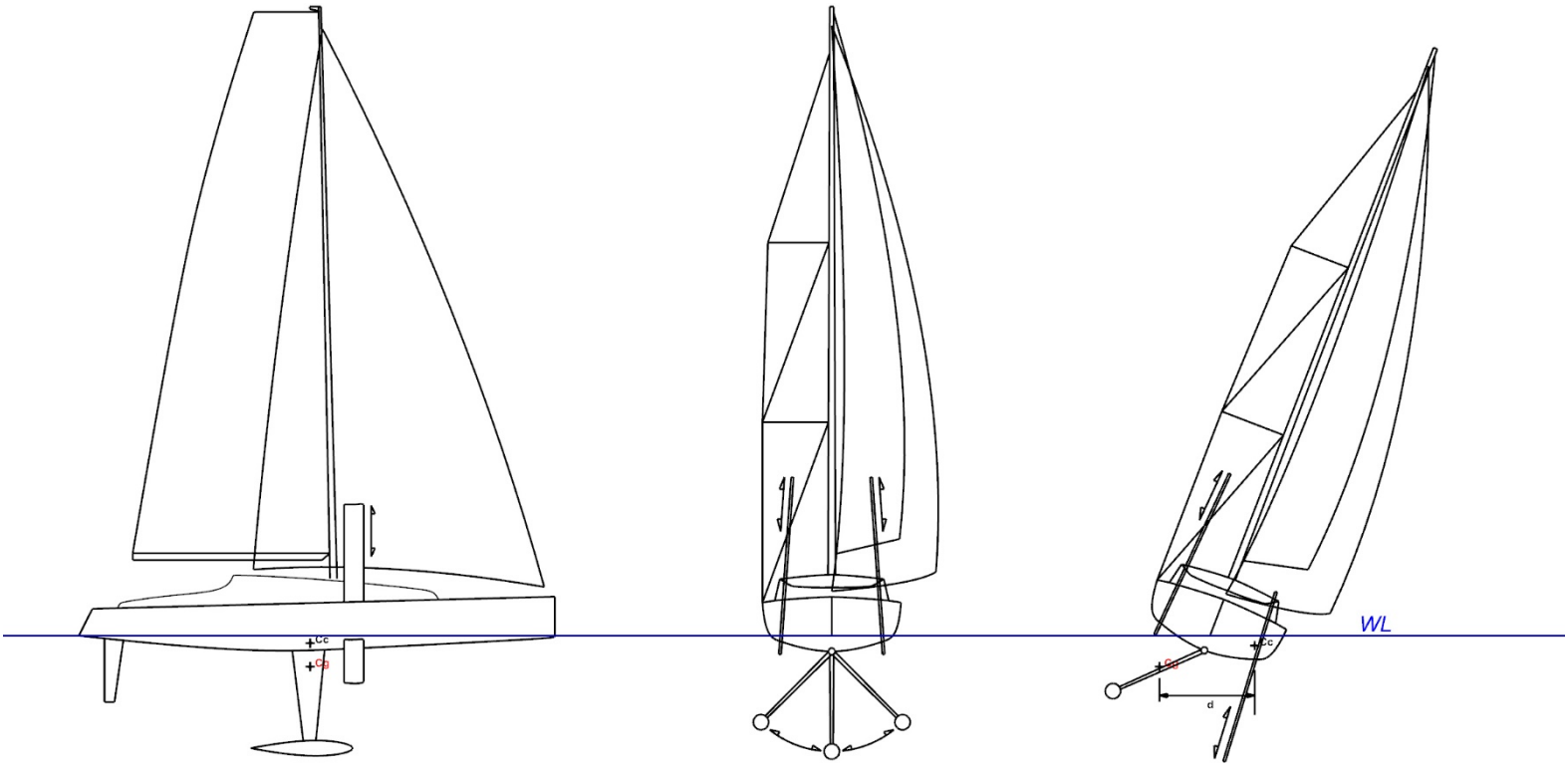
4/ Ballast: commonly used on offshore racing sailboats and more rarely on certain fast cruising sailboats.



Advantage: increases the righting torque at current heel angles (from 0 to 30 °) by moving the Cg sideways.

Disadvantages: more complex and time-consuming maneuvers, increased displacement (weight) of the sailboat, significant bulk in the cockpit.

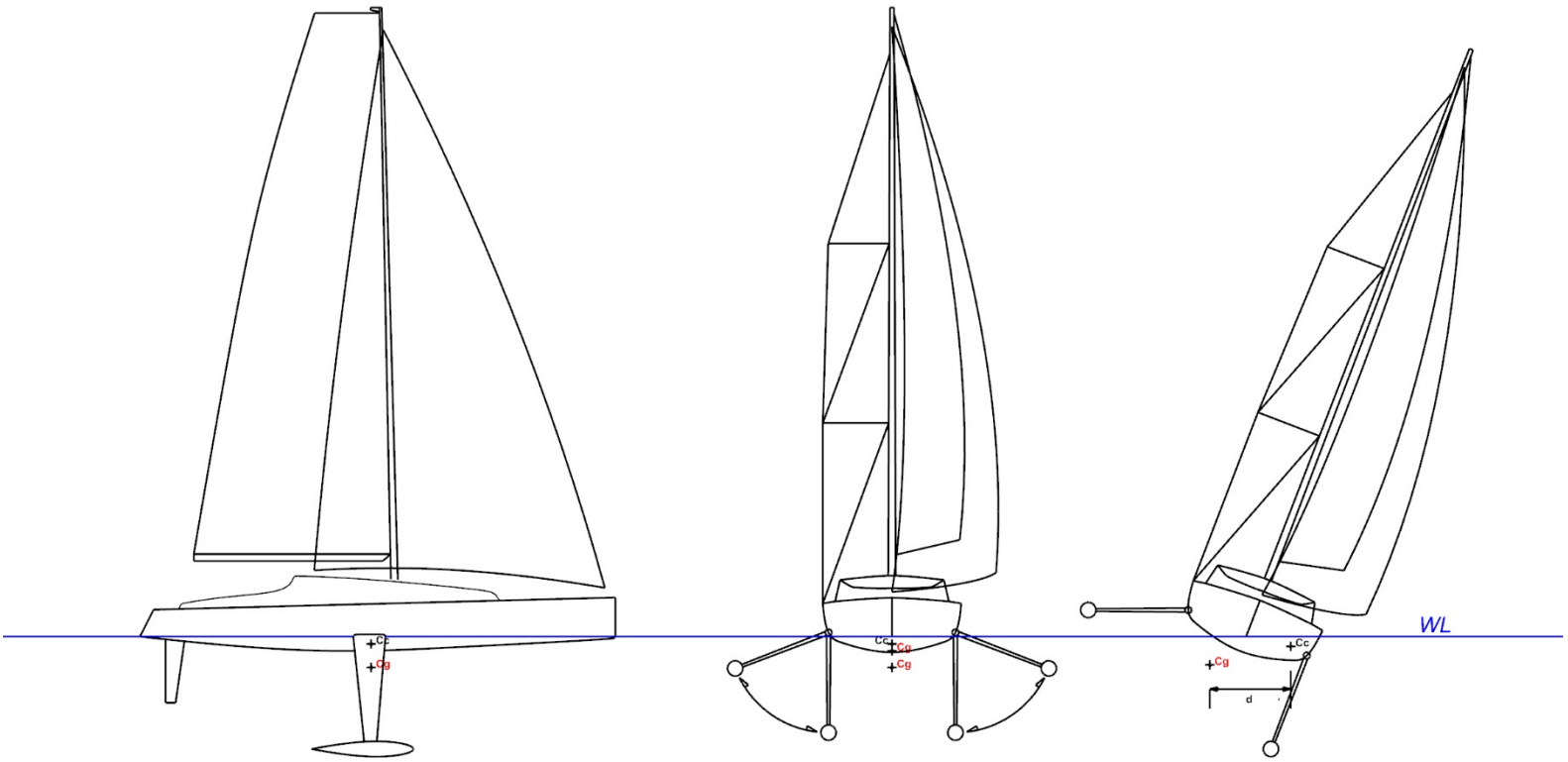
5/ tilting keel (+ saber daggerboards)**:** THE solution adopted today on offshore racing yachts which has greatly increased their performance, exists on a few rare, fairly exclusive pleasure yachts (jpk54) or some high-end one-shots.



Advantage: considerably increases the righting torque (Cr) at current heeling angles (0 to 30 °) by moving the Cg sideways.

Disadvantages: complex, fragile, expensive and cumbersome mechanism to which must be added saber daggerboards and, as for fixed keels (single or double), its efficiency is directly proportional to the TE.

6/ Pendulum twin keel (2QP): tested on a 6.50 prototype currently being developed (Imagine 55 'from Nouvelle Vague).



Advantages: partly combines the high righting torque (Cr) obtained by the tilting keel and the possibility of reducing the draft. Simpler maneuvers, two mobile appendages (electronically assisted) instead of three (no daggerboards necessary).

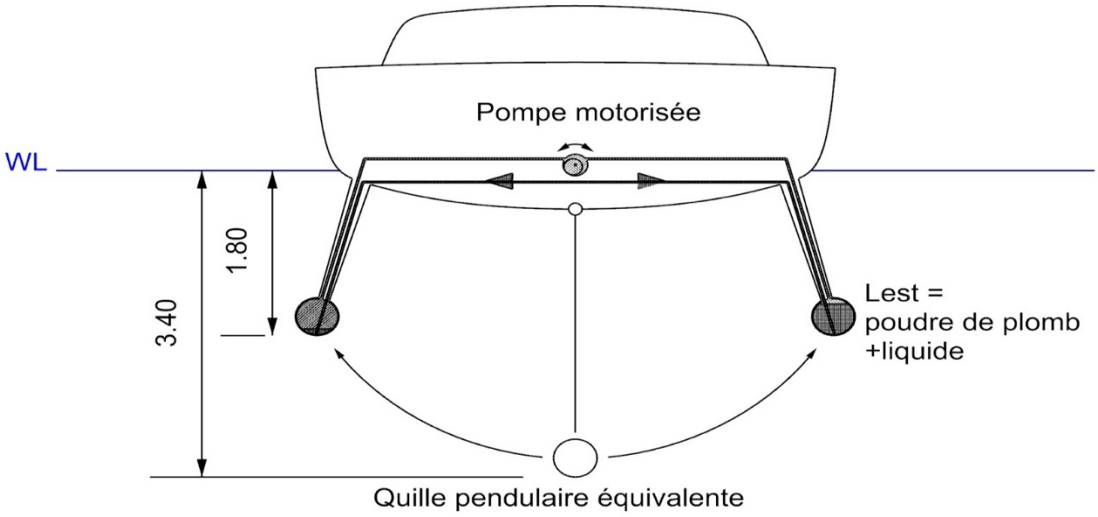
Disadvantages: less powerful than a pendulum single keel with equal draft. Complex, fragile, expensive and bulky mechanisms.

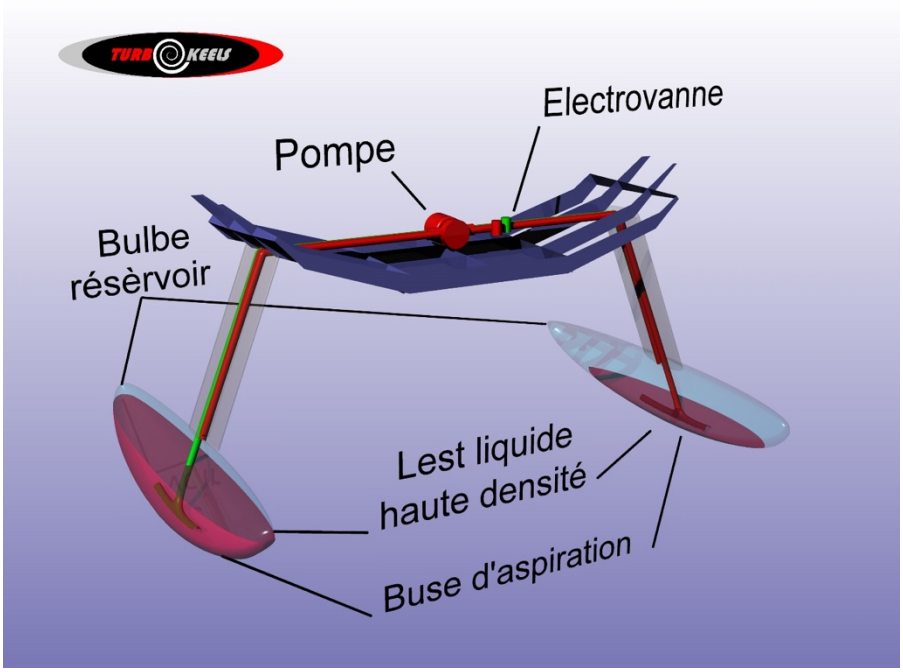
C/ TurboKeels® Concept:

Concept: laterally move the center of gravity (Cg) in order to increase the righting torque (Cr) without the aforementioned drawbacks: expensive, complex, fragile, cumbersome mechanisms, and high draft.

Solution: ballast a fluid denser than water from keel to keel. A motorized reversible pump drives from one bulb tank to another, a dense liquid (d = + / - 10) consisting, for example, of a mixture of oil and lead shot.

Advantage: simplicity, lightness, reliability and economy: a simple, compact pump quickly ensures all the ballast transfer. This concept retains the advantages specific to twin keels (possible grounding, good anti-drift surface), and gives a righting torque equivalent to a tilting keel with a draft reduced by half!





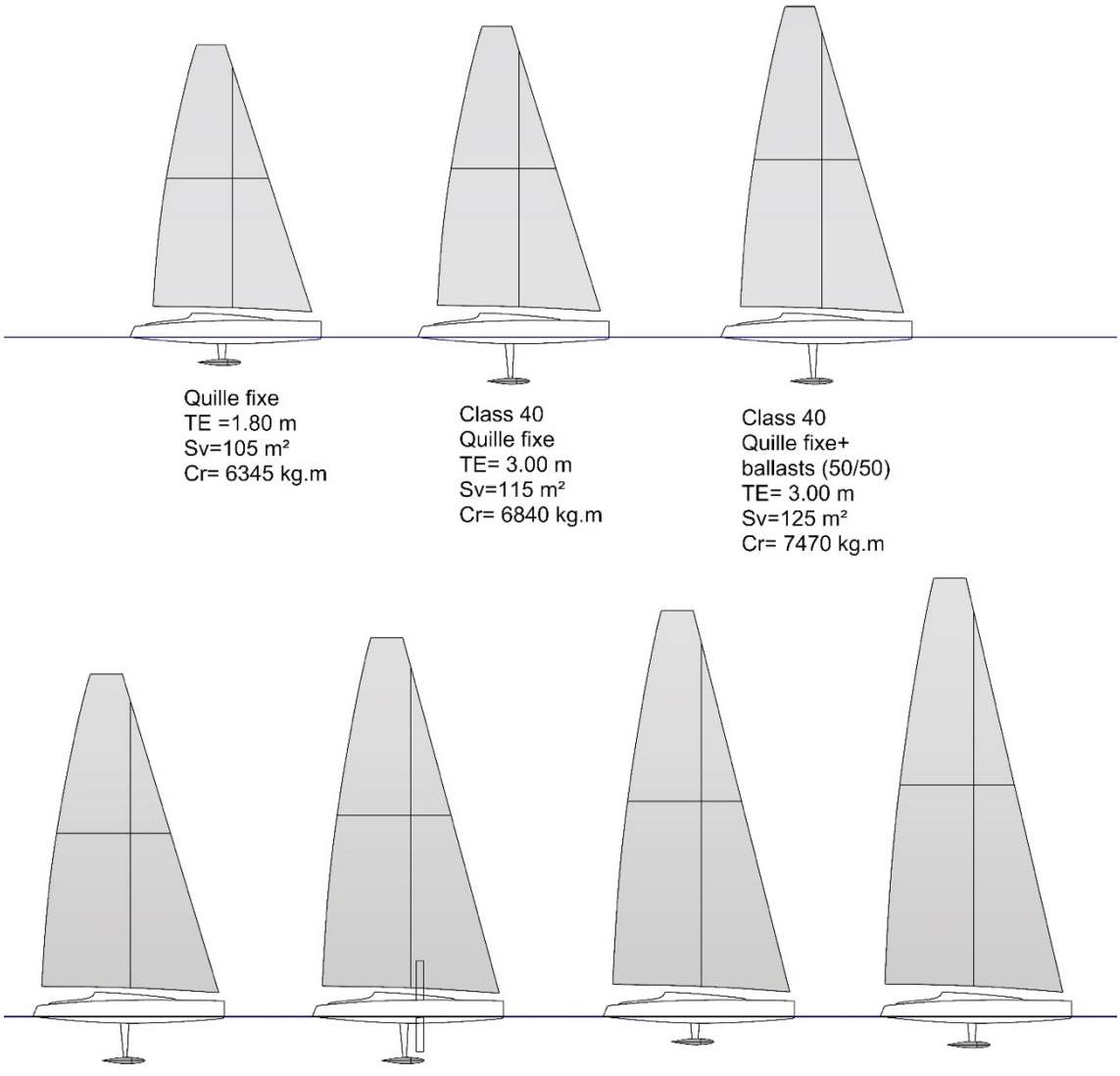
D/ Comparatifs

Comparison and illustration of the righting torque (Cr) between 7 sailboats of 12m, class 40 'type, equipped with the various aforementioned ballasting principles.

Hull length = 12.19m / Hull width = 4.50 m / Displacement = 4.5t including 1.5t ballast

Draft = 1.8m to 3.00m / Gite 15 ° / Beaufort 3/4

Illustration of the sails (Sv) and the draft (TE) of these 7 identical sailboats by their hull shape and their displacement, sailing at equal heel and Beaufort, but with the righting torque varying almost from single to double:



Comparison between fixed keel and TurboKeels®

The stability curves below illustrate the righting moments and heeling angles on a 52 'Vismara sailboat with 11t displacement L = 15.86m, W = 4.19m.

The brown and sky blue curve in particular, compare with the original dark blue curve.

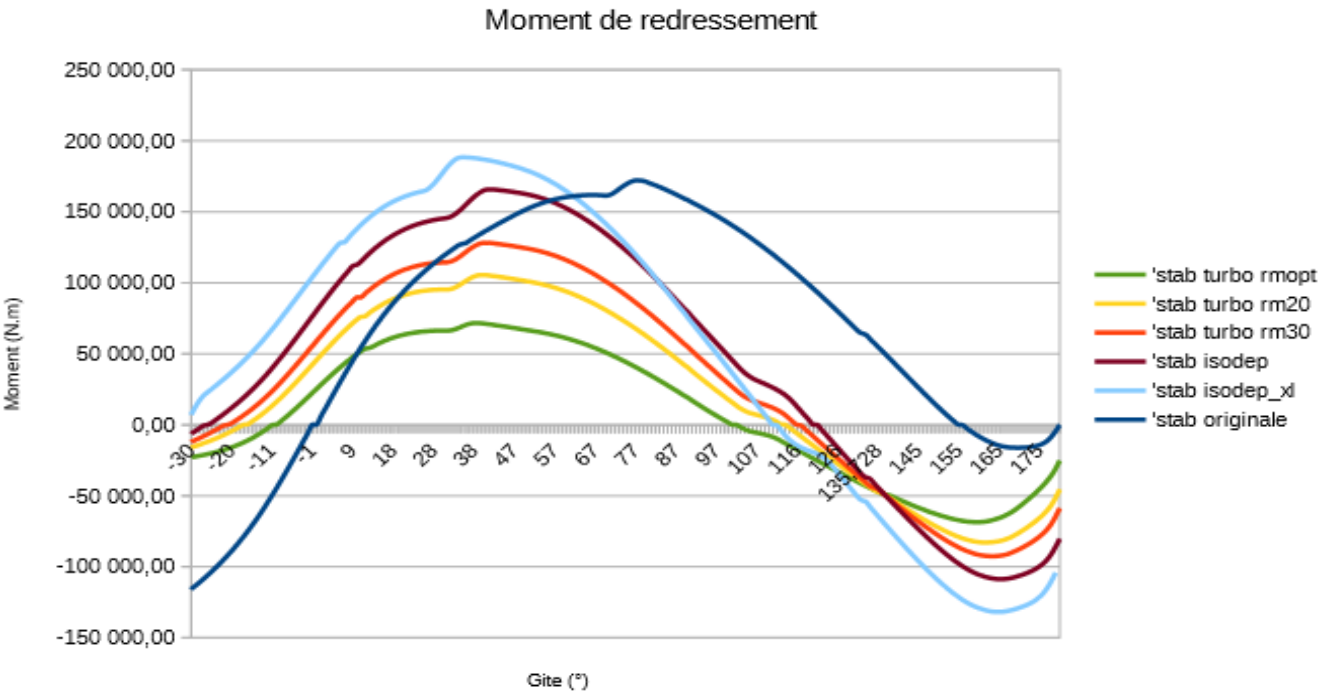
In dark blue the original 11t sailboat, in normal loading condition, equipped with a fixed keel of 3.40m draft.

In brown, the stability curve corresponds to the same 11t sailboat equipped with a TurboKeels® with a draft of 2m and the width of the boat (4.19m)

In sky blue, the stability curve corresponds to the same 11t sailboat equipped with a 2m draft Turbo keel and a little wider than the boat (+60 cm on each side).

The maximum righting moment is obtained from 35 ° of heel with the TurboKeels® against 85 ° with the classic fixed keel and the maximum torque is even greater than the original maximum torque on the sky-blue curve.

When the classic keelboat sails at +/- 50 ° heel (an already very uncomfortable angle), the sailboat equipped with a TurboKeels® sails comfortably at +/- 15 ° at an equivalent or higher speed.



Perspective

As shown in the previous illustrations, it is easy to increase power and therefore sail area and speed with TurboKeels®.

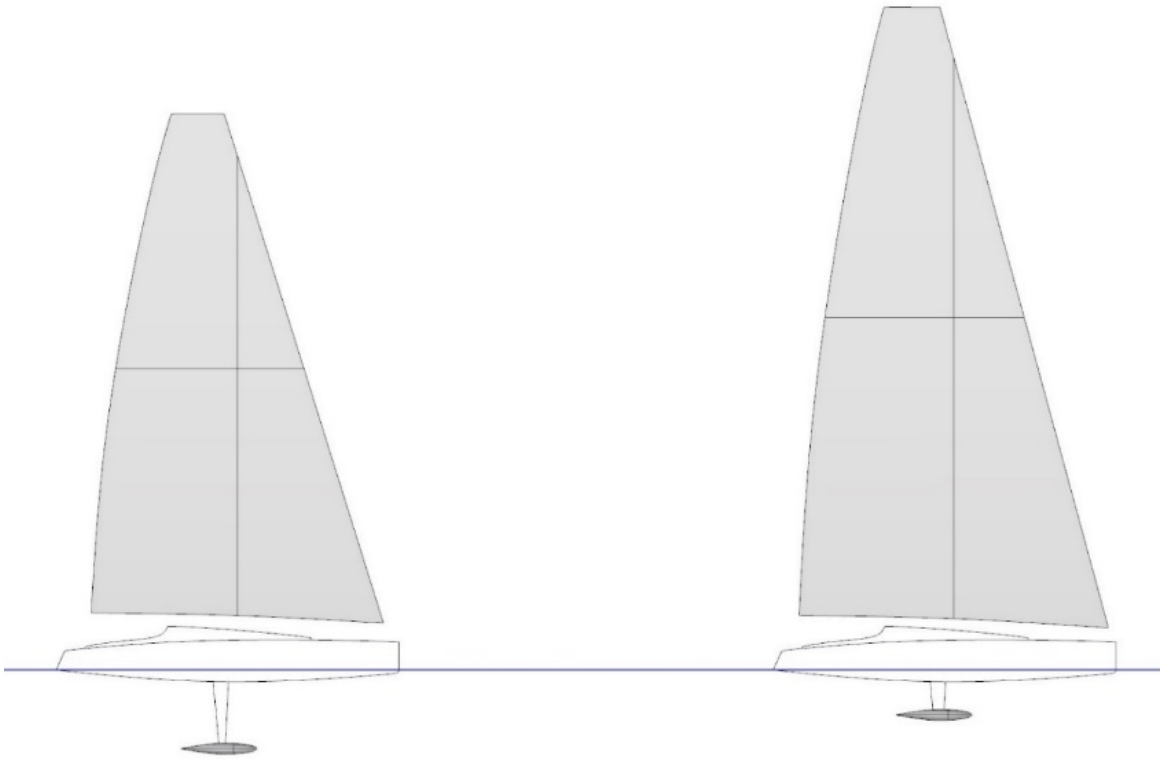
But the search for speed is not always the main objective in yachting: for those who wish to favor comfort, TurboKeels®, without increasing the sails, can considerably reduce the sailboat's list and therefore improve its comfort. general in navigation.

From a purely economic point of view, the lateral displacement of the center of gravity can also allow a reduction in the mass of lead and therefore a reduction in cost.

The optimal solution for using the Turbo-keel will therefore be found in the subtle balance sought between speed, comfort and economy, the three not necessarily being completely contradictory.

Thus, TurboKeels® present advantages both for high-performance sport yachts and for cruising yachts favoring comfort, whatever their size.

By taking the characteristics of the previous 40 'sailboats, we could for example project a 40' equipped with TurboKeels®, TE (draft) of 1.8m and SV of 150 m², which will be both more efficient and more comfortable than a class 40 ', TE of 3m and SV of 115 m², and “beachable” with a shallow draft, for a comparable price.



Class 40
Quille fixe
TE= 3.00 m
Sv=115 m²
Cr= 6840 kg.m

TURBO QUILLE (15°)
TE= 1.80m
Sv=150 m²
Cr= 9900 kg.m