

Having been bombarded with requests for information from journalists around the World for my input into the loss of S/Y Bayesian a week ago, I have finally decided to make some notes on the subject. I have no desire to contribute to the wild speculation and claims that we have seen so far, or in any way suggest what really happened... Only those on board at the time will know that, but I can shed some light on the characteristics of the vessel and some of the limitations that would likely be involved in this disaster.

Bayesian (ex Salute) was a 56m Perini Navi, part of a very successful series of hulls. She was the only one built as a sloop rig (single mast), with the tallest aluminium mast ever constructed. I'm going to discuss step by step what I hope are pertinent facts about the boat and her design and operation that are relevant to this event.

## 1. Mast

The mast and rig were certainly a major feature of the yacht and presented structural challenges in construction and ongoing life. As it pushed the boundaries of aluminium mast construction there were lessons that had to be learned over the years, but the result was a robust and well controlled rig in the end that performed well, within the limits of the design. The vessel is delivered with a set of sailplan recommendations that for a range of wind strengths will cause the vessel to sail within the structural limits of the rig and heeling limits of the hull.

## 2. Ballast

The height of Bayesian's mast was of course considered in the overall design of the boat by Perini's engineers. To this end she was equipped with an extra 30T of lead ballast in her keel box (we'll come to that in a bit) compared to the 56m ketch rigged sister ships. This was to counter the extra mass, higher centre of gravity and higher centre of effort (from sailing forces) that the sloop rig created.

The main lead ballast was contained in a more or less rectangular box (keel box) attached below the canoe shaped part of the hull. The precise mass of this ballast I do not recall, but it's probably around 200T or so. In the centre part of this box there is the moveable keel, which weighed around 60T and extended almost 6m below the keel box when lowered. This arrangement means that the majority of the righting moment of the vessel comes from the main ballast... the moveable keel acting more as a centreboard to reduce sideslip under sail (leeway)...

## 3. Stability

All yachts such as Bayesian are delivered with a "Stability information Book". This document is approved by the flag state of the boat and defines the loading and operation limits. It also contains information on the righting characteristics. The operational limitations defined in the stability book must be adhered to at all times which is the responsibility of the master.

One section of the Bayesian Stability book related to the use of the moveable keel.. and defines when it must be lowered. In this vessel's case it was required to be lowered when using sails, and/or when over 60 nautical miles offshore (regardless of whether sailing or only using engines). At all other times, it could be in the raised position.

The stability book also contains information regarding righting angles and the watertight integrity of the hull. There are two important numbers here... Angle of Vanishing Stability (AVS) and the Downflooding Angle.

The Angle of Vanishing Stability is the angle of heel at which the vessel righting moment reaches zero, meaning that the vessel will not return to upright. Again, I forget the actual numbers for this, but the figures would be around 90 degrees with the moveable keel lowered and 75 degrees with it raised.

The Downflooding Angle is much more important though in the scenario we are talking about. This is the angle of heel at which water will start to enter the vessel (usually through engine room

or accommodation ventilation ducts)... once this starts the vessels is in serious trouble as stability is quickly reduced or lost due to the flooding. The downflooding angle for Bayesian was around 40-45 degrees... much less than the AVS. So, unless the vent dampers are closed (which with HVAC systems and generator running they would NOT be as they need to be open for that), the vessel will start to flood rapidly if heeled more than the downflooding angle.

#### 4. Hull Openings

Bayesian had only one shell door in the hull, on the port side aft. As this was very close to the waterline, it was rarely used (remembering the extra 30T of ballast mentioned earlier... this caused the water line to be 100mm higher than other 56m Perinis, hence much closer to the bottom of the shell opening meaning it could only be opened in flat calm conditions... 100% it was NOT open at night)

There are no opening windows or portholes, which are all made from laminated marine glass bonded to the hull & superstructure.

Other deck hatch / superstructure openings that breach the watertight integrity on Bayesian are on or close to the centreline of the vessel. For these to be taking water if open, the vessel would have to be heeled way beyond the Downflooding Angle mentioned earlier, and hence already flooding via ducting/vents.

Only one opening was located far from the centreline, and could be vulnerable to downflooding at lower angles of heel... this is the deck access to the lazarett area towards the stern. However, as it is located on the port (left) side of the aft deck, it would be unlikely to be an initial factor in this scenario as we know that Bayesian was knocked down to starboard, and as such this hatch, even if opened as crew were on deck etc, would have been one of the later parts to submerge.

#### 5. Summary

The vessel Bayesian was sound and seaworthy by design, and to my knowledge well maintained as such. However heeling her to more than around 45 degrees while in normal operational state could result in flooding and subsequent loss if the flooding could not be controlled.

The weather conditions that could have created these extreme circumstances can indeed occur with very little warning and being so localised are difficult to prepare for, leaving a very short time for the crew to react.

How the vessel came to be taken outside her operation limits is what the investigators will need to determine, which I'm sure they will.