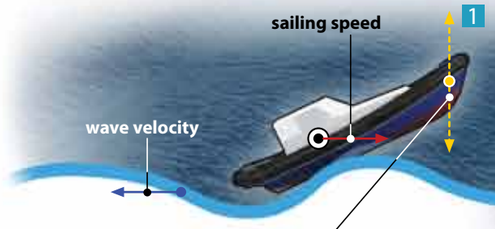
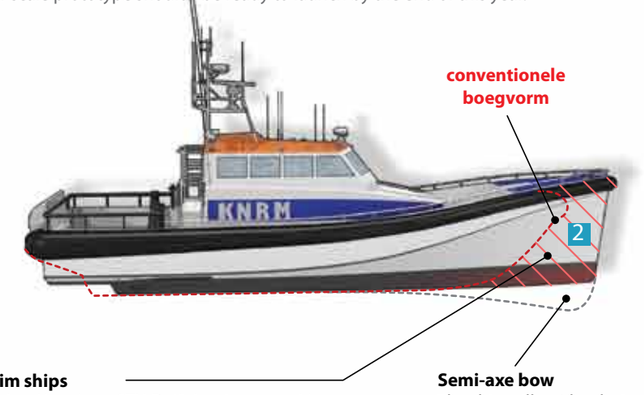
Sailing comfort through axe bow

Every year, the Royal Netherlands Sea Rescue Institution (KNRM) heads out to sea 2000 times to rescue people. In conditions with high waves, the lifeboats hit the water so hard that the crew have difficulty keeping upright in the pilot house. Sailing slowly is therefore the only option. But the boats also make so much noise that the crew have to wear hearing protection gear and can only communicate with each other by means of headphones. Together with TU Delft, Damen Shipyards and De Vries Lentsch, the KNRM has developed a new lifeboat which should put an end to these disadvantages. The new design is based on the axe-shaped bow concept created by the Ship Hydromechanics section of the department of Marine and Transport Technology of the 3mE Faculty. A full-scale prototype should be ready to launch by the end of this year.

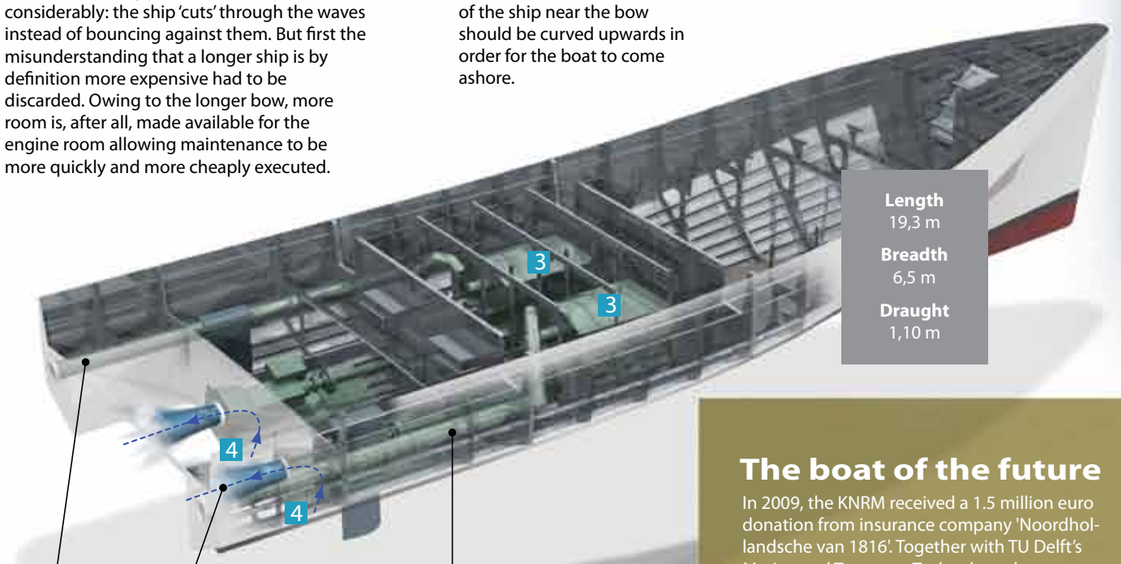


Extremely high speeds
It is predominantly under rough weather conditions that the KNRM lifeboats are launched. If a boat sails straight or at a slant through high waves (five metres high), the broad round bow crashes heavily against the water. The crew reduce sailing speed if waves are higher than two metres as the accelerations in the bow 1 and the pilot house become too high. At extreme wave heights of nine metres, the accelerations in the bow can increase to 8 g. At the time the KNRM's largest existing lifeboats ('Arie Visser' type) were built, the emphasis was on high sailing speeds, good manoeuvrability and shallow draught – the crew's comfort took less priority in 1999. Although occupational health and safety demands do not apply to the more than 800 volunteer crew members, the KNRM wants to replace the 15 existing 'Arie Visser' boats in the coming 10 years by a new type of ship where comfort on board meets the minimum demands that can be expected in this day and age.



Slim ships
Dr Lex Keuning of TU Delft has been working for 15 years on the 'Enlarged Ship' concept. While retaining the same width and making these ships slimmer (for example 25% longer 2 as well as shaping the bow in the form of an axe, the sailing performance improves considerably: the ship 'cuts' through the waves instead of bouncing against them. But first the misunderstanding that a longer ship is by definition more expensive had to be discarded. Owing to the longer bow, more room is, after all, made available for the engine room allowing maintenance to be more quickly and more cheaply executed.

Semi-axe bow
The ship will not be designed with a complete axe bow in which the axe also fans out in a downward direction. As lifeboats often operate in shallow waters, the bottom of the ship near the bow should be curved upwards in order for the boat to come ashore.



Length
19,3 m
Breadth
6,5 m
Draught
1,10 m

Powering
The ships are powered by means of two engines 3 and two water jets. Via an inlet nozzle 4 in the flat bottom, water is sucked in through each pump. The pressure of the water is increased and is then forced out at great speed through the jet pipe.

The boat of the future

In 2009, the KNRM received a 1.5 million euro donation from insurance company 'Noordhollandsche van 1816'. Together with TU Delft's Marine and Transport Technology department, Damen Shipyards and De Vries Lentsch Yachts, the KNRM initiated a project to design an improved lifeboat. This new boat should experience less vertical acceleration at high sailing speeds and less vibrations and noise (a maximum of 75 compared to the current 90 decibels).

DESIGN REQUIREMENT: BETTER SEAFARING PERFORMANCE IN WAVES AT HIGH SPEED

Sleeptanktests tegen de golven in

Scale models of the 'Arie Visser' and of the two new designs (scale of 1:10) were towed at high speeds against the waves in the towing tank in Delft. The experiments confirm the results of computer simulations: less vertical movements arise in the axe bow and less high vertical accelerations in the bow and pilot house occur than is the case in the other two ships.

DESIGN REQUIREMENT: COMPARABLE PERFORMANCE WHERE BOWDIVING IS CONCERNED

Self-sailing models in successive waves

Captains of the current lifeboats were concerned that the axe bow would plough more quickly into the preceding wave than the wide round bow of the 'Arie Visser'. Experiments at Marin showed that none of the ships exhibited any tendency to bow-dive.

Two parallel designs
The design team got started with two designs: an improvement of the existing lifeboats with a slim bow and a new design based on the axe bow. Due to the test results, it was decided to go ahead with the further development of the axe bow concept.

Tilting container 5
With the aid of a tilting container, persons in danger of drowning are taken on board. The boot has room for 120 saved persons.

Composite pilot house
By constructing the pilot house entirely from fibreglass hardened plastic (instead of aluminium), the design weight is reduced by 20%. The pilot house will be placed on dampers that should prevent it operating as a sound box and strengthening vibrations from the engine room.

Axe bow fund
Damen Shipyards has a licence to sell the axe bow. For each axe box sold, the company from Gorinchem will donate money to a Delft research fund with which the Marine and Transport Technology department can carry out follow-up research and can finance new PhD candidates.

Weight
35 tons
Maximum speed
35 knots
Crew
6 persons

DESIGN REQUIREMENT: BETTER COURSE STABILITY AND BETTER MANOEVRABILITY

Extendable fins

To eliminate the problem of the boat running off course in backward moving waves, it is equipped with special fins. But as the ship has to be extremely manoeuvrable at other times, the fins can be pulled in to carry out a manoeuvre.

Prototype
Calls for tender will take place later this year and the new lifeboat will be launched at the end of 2012. The captains of the current 'Arie Visser' boats can then experience in practice whether the new ship lives up to all its promises.

Monster waves

The extreme conditions in which ships have to operate cannot normally be reproduced with model tests: the maximum full-scale wave height reproduction is 4 m. By generating waves in the towing tank in a smart way, it nevertheless appears possible to test the model with monster waves 6 of 8 m high.