

INCREASING THE LEVEL OF MOORING SAFETY THROUGH THE INTRODUCTION OF MODERN TECHNOLOGIES

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The elements of the vessel's route in the concept of E-navigation are becoming the most relevant in the field of maritime transport management. The mooring process is one of the most complicated in this process, but modern technology makes it easier.

Artificial Intelligence (AI) ship control systems are being developed based on existing Dynamic Positioning (DP) technology. DP consoles connect to advanced software / devices that can analyze and predict the future position of the vessel.

At the end of 2018, the 85m ferry Folgefonn successfully completed tests of the Wärtsilä automatic mooring system. The vessel made three calls to the port, maneuvered in narrow Norwegian fjords, approached the berth and moored without the help of the crew. The voyage was controlled by radar paths and points that led the ship to the next destination. Meanwhile, an autonomous controller based on the existing DP system monitored the vessel's speed, position on a given track and heading [1].

MSL automatic mooring systems use vacuum pads instead of ropes to keep the vessel at the berth. Each cushion has a controlled workload, ensuring a reliable physical connection between the vessel and the berth. The vacuum cushions were tested and categorized under the supervision of the international classification society Det Norske Veritas, the results of which, combined with modern 3D hardware, showed the range and elasticity of automatic systems at the level of mooring with ropes. Since the automatic system keeps the vessel closer to the quay wall than the crossed ropes, it has greater mooring efficiency. Holding load information is obtained from measuring vacuum levels and lateral forces in the bow and stern bollards. Having information about all conditions of mooring at any time, the operator has full understanding and control over the condition of the mooring of the vessel [2].

FLIR announced in 2019 the new Raymarine DockSense mooring assist system, the industry's first docking solution for pleasure boats using intelligent object and motion recognition. Using FLIR CCTV cameras and video analytics, DockSense combines information from surrounding objects with the ship's propulsion and steering system to help the boat owners maneuver while docking.

Raymarine DockSense is designed to enhance the captain's handling skills with Virtual Bumper technology that surrounds the vessel's perimeter. If an object enters the range of the Virtual Bumper, FLIR's DockSense will automatically enter commands that will adjust steering to avoid a collision and help the captain correctly steer the boat to dock.

Using GPS and AHRS, DockSense negates the effects of wind and currents and allows the boat to moor without collisions or problems. The technology includes high-performance FLIR vision cameras, a central processing unit, DockSense app running on a Raymarine Axiom touchscreen display. Also integrated into the DockSense is a modern controller that provides auxiliary steering and throttle commands so that the captain can dock as smoothly as possible [3].

The European Maritime Safety Agency reports that over the past decade, there have been 16,539 accidents and incidents on board of maritime vessels, in which 600 people died and 5,607 were injured.

At the 5th session of the Subcommittee on the design and construction of ships, the working group on mooring and towing equipment, which included specialists from Denmark and Japan, presented proposals to the Maritime Safety Committee on introducing further amendments to SOLAS regulation II-1/3-8 on towing and mooring equipment and significant additional requirements of MSC / Circ. 1175.

The new circulaire draft offers a modern functional approach to the design of towing and mooring devices, which should provide the following:

- unimpeded access and operation of the mooring equipment;
- simplification of the configuration of the mooring lines;
- compliance with the peculiarities of the operation of the vessel;
- unobstructed view in the area of mooring operations;
- minimum exposure of crew members to rope-tension hazards and dynamic loads;
- consistency of characteristics of the mooring lines with the characteristics of the mooring equipment;
- constant visibility of the mooring area and control;
- adequate lighting and visibility for workers;
- sufficient work space;
- minimization of the mooring line rupture risk;
- exclusion of the possibility of injury by mooring lines;
- unobstructed communication during mooring operations;
- minimizing the risk of slip and fall injuries under any weather conditions;
- minimization of the mooring lines wear and tear;
- proper service and maintenance in operational readiness;
- versatility under extreme conditions.

To achieve functional objectives, all mooring equipment must comply with the revised chapter 5 of the circulaire. Among the measures to simplify the configuration of the winding of the mooring lines, it is proposed to think well of the position of the haws and rollers; to improve the means of communication - reduce the noise of mechanisms and not to obstruct the view; at least two people must be granted access to the mooring equipment at all times, also manual labor is minimized, etc.

Three new characteristics have been introduced for the choice of mooring lines and equipment strength:

- SDMBL (Ship Design Minimum Break Load) - the minimum breaking load of a new dry mooring line, for which a mooring system has been designed that meets the requirements;
- WLL (Working Load Limit) - the maximum load which the mooring line is subjected to during operation, shown in percentage, as a limit that should not be exceeded. For the steel mooring line it is 55% of the MBLSD, for the synthetic mooring line it is 50%;
- LDBF (Line Design Break Force) - the minimum force sufficient to the destruction of a new dry mooring line with the eye splice attached. Accepted from 100 to 105% of SDMBL.

The specified values should be indicated in the Mooring and towing equipment plan both during normal mooring and in high wind and current conditions [4].

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