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VII CONGRESO INTERNACIONAL DE DISEÑO E INGENIERIA NAVAL

NUMERICAL SIMULATION OF A SEA ARROW BOW FOR A FISHING VESSEL

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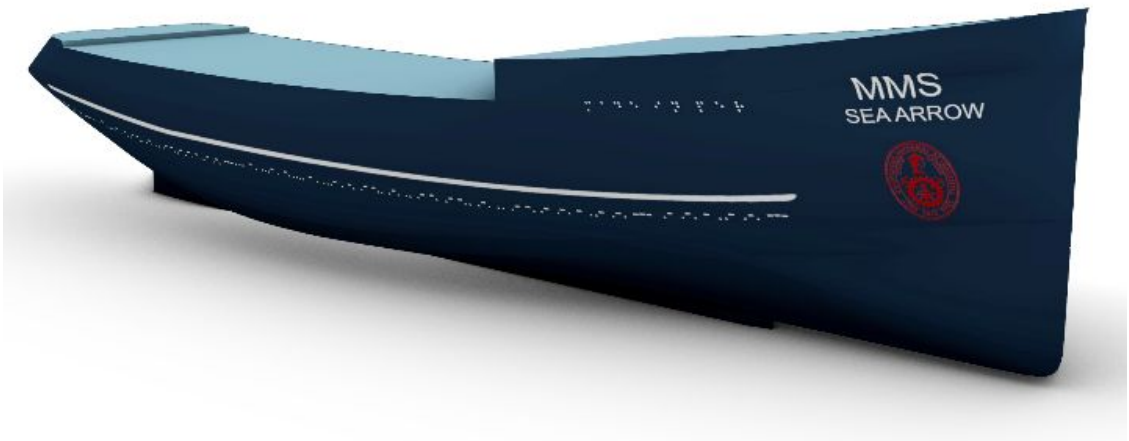
Problem

- Lack of hydrodynamic studies on fishing vessels.
- High cost of the towing tank hydrodynamic test.

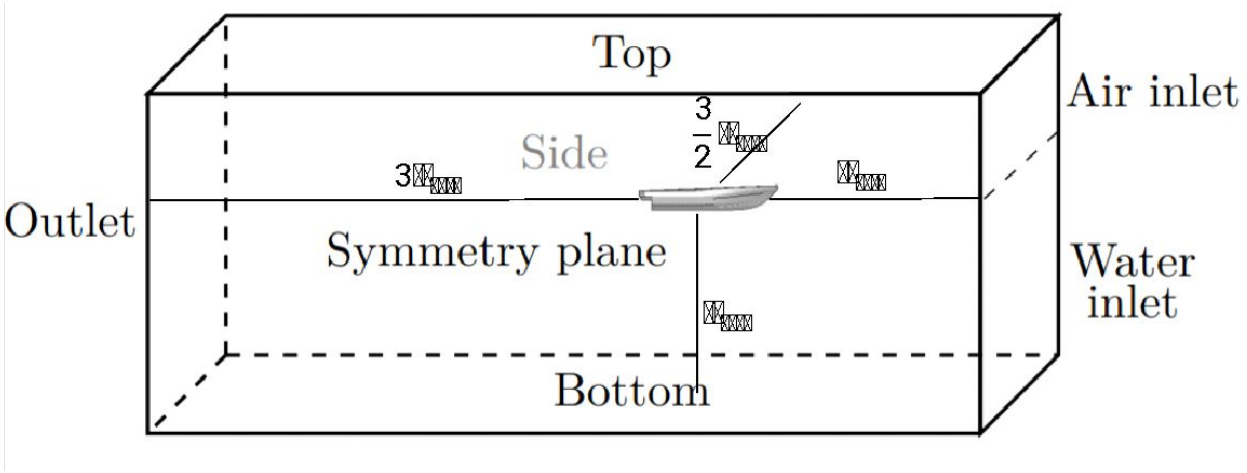
Study Model

Marco Marine Seattle (MMS) ship model with a bow modification adopting the SEA-Arrow type bow (Sharp Entrance Angle bow as an Arrow).

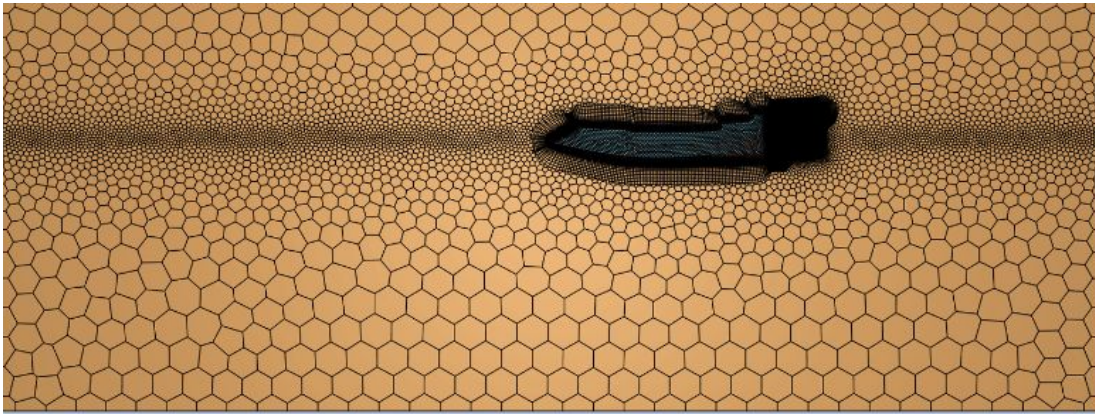


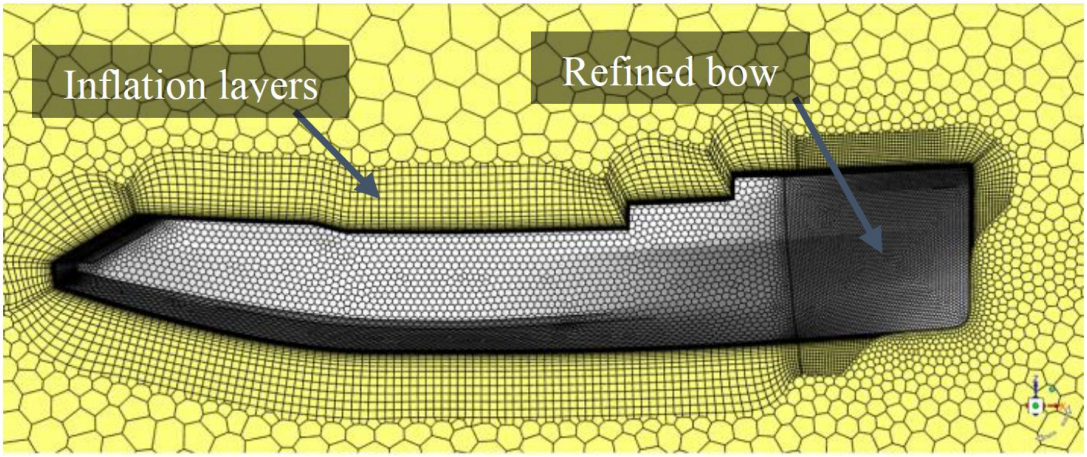
Computational Domain

The conditions of a hydrodynamic test channel are simulated using the recommendations given by the ITTC (International Towing Tank Conference).



Mesh



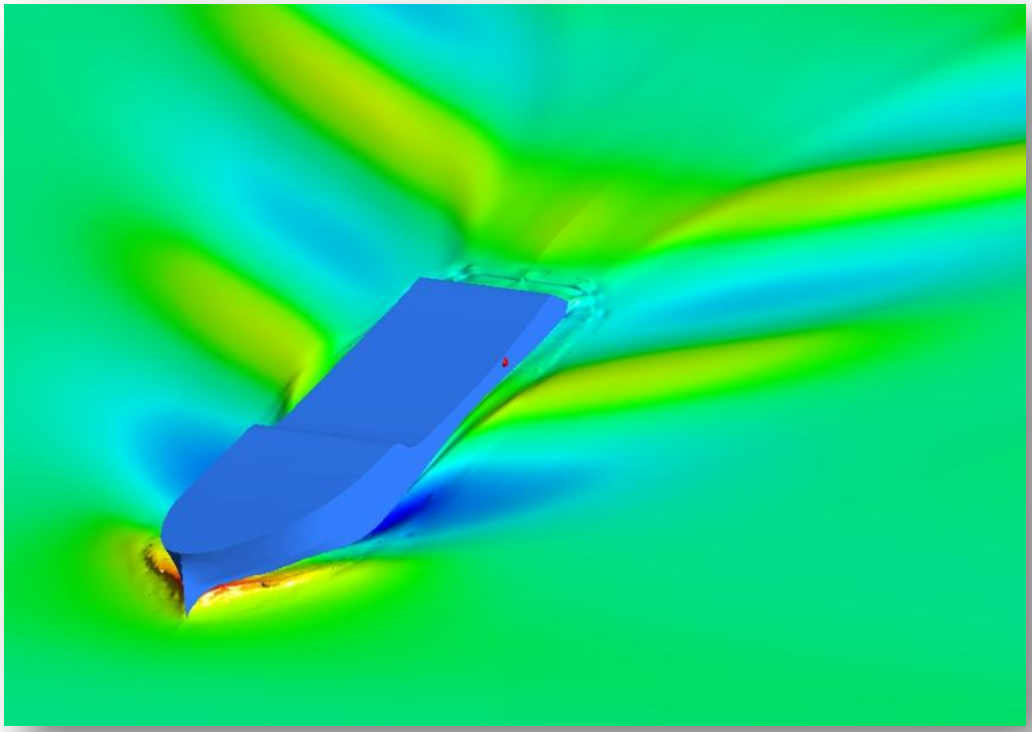


Boundary Conditions

Boundary	Type of boundary	Specification
Inlet	Pressure Inlet	8 knot – Inlet Velocity; Open Channel: Free Surface level: 0 m Bottom level: 46m
Outlet	Pressure Outlet	Open Channel: Free Surface level: 0 m Bottom level: 46 m
Top, side, bottom	Wall	
Symmetry Plane	Symmetry	
Hull	Wall	

Simulation Results

Marco Marine Seattle (MMS) SEA Arrow 12 kn.



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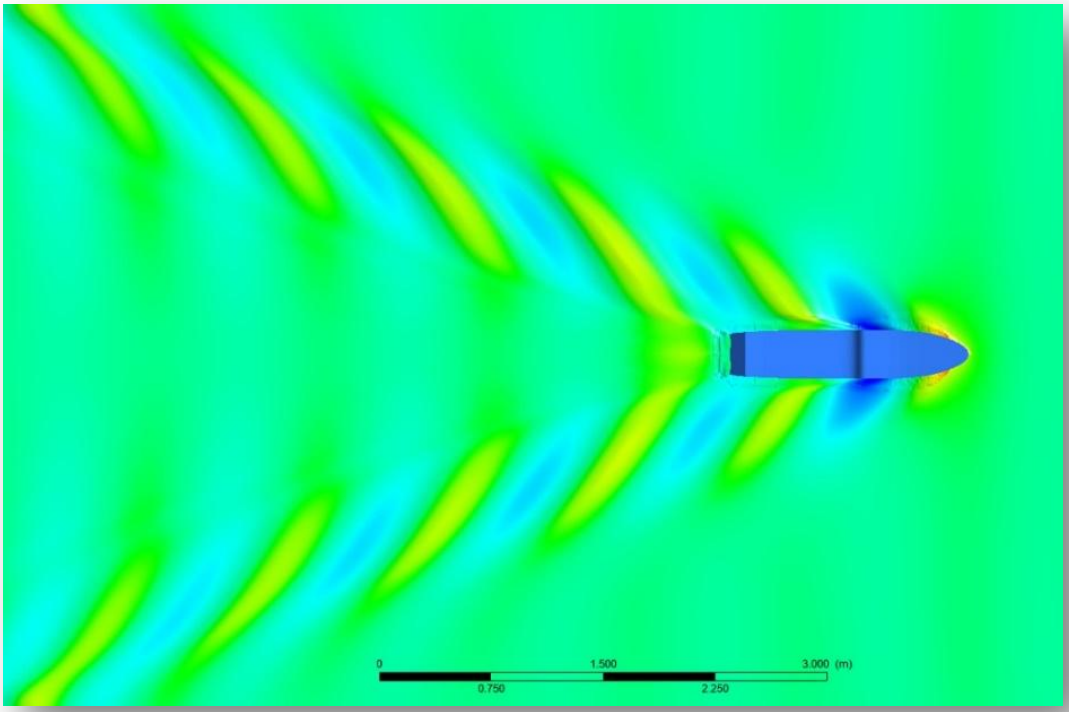


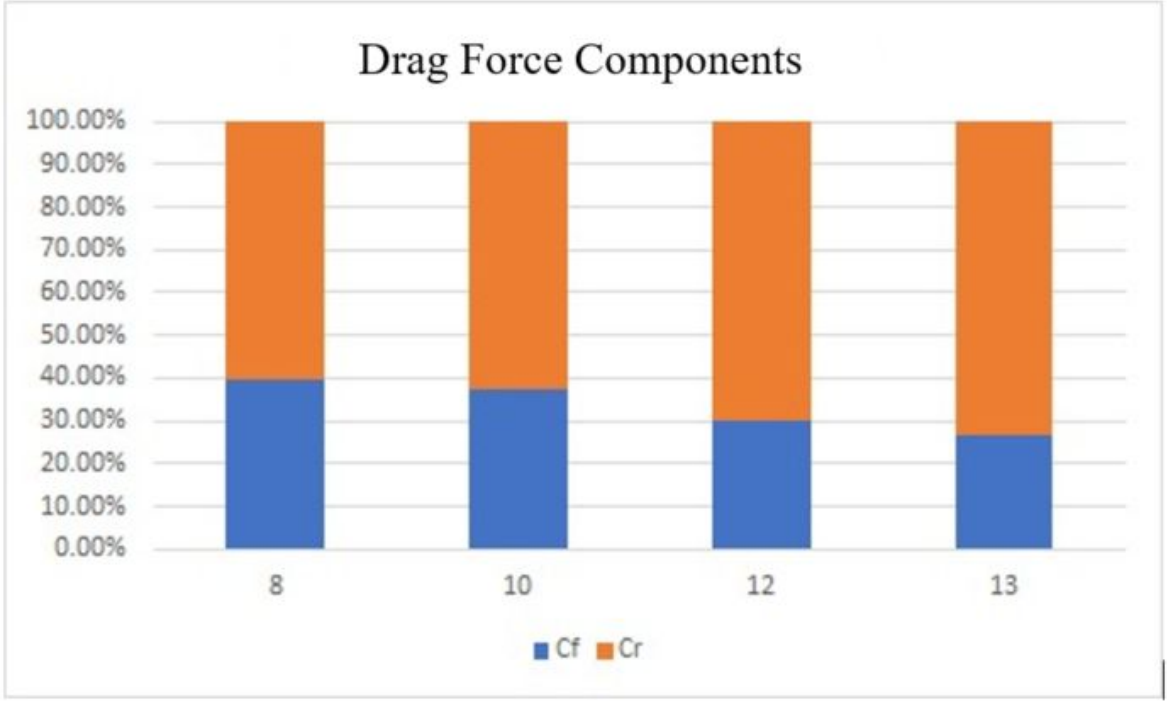
Results

The table reflects the wide margin of error of the Holtrop method, mainly in unusual vessel shapes, such as the SEA-Arrow bow analyzed in the present investigation

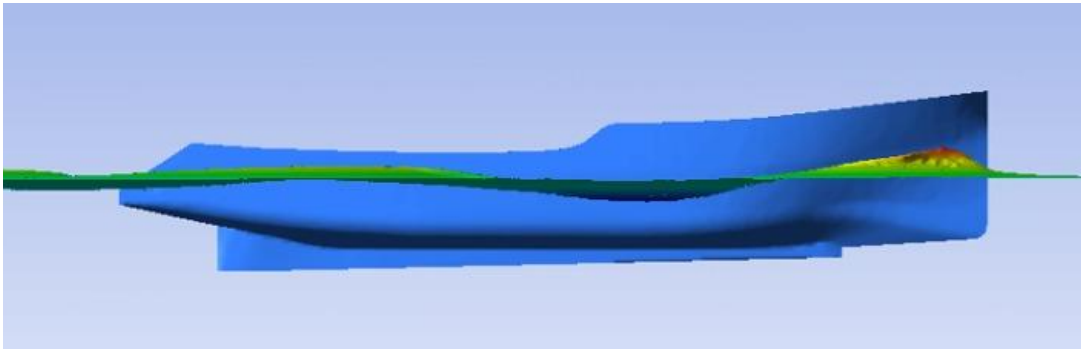
Velocity	Drag Force (Holtrop)	Drag Force (CFD)
8	19678.52	19,296.30
10	36995.88	31,230.12
11	52098.22	38,090.05
12	78724.57	62,415.55
13	102404.84	97,488.66

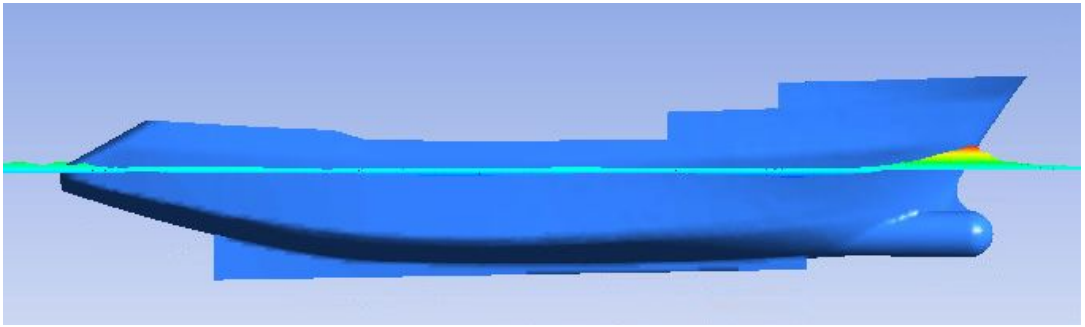
Drag Force Components

From the total resistance values, it can be broken down into frictional resistance and wave resistance. Figure 6 shows the percentage of the frictional and wave-forming resistance values with respect to the total resistance represented by 100 % of the MMS SEA Arrow model.

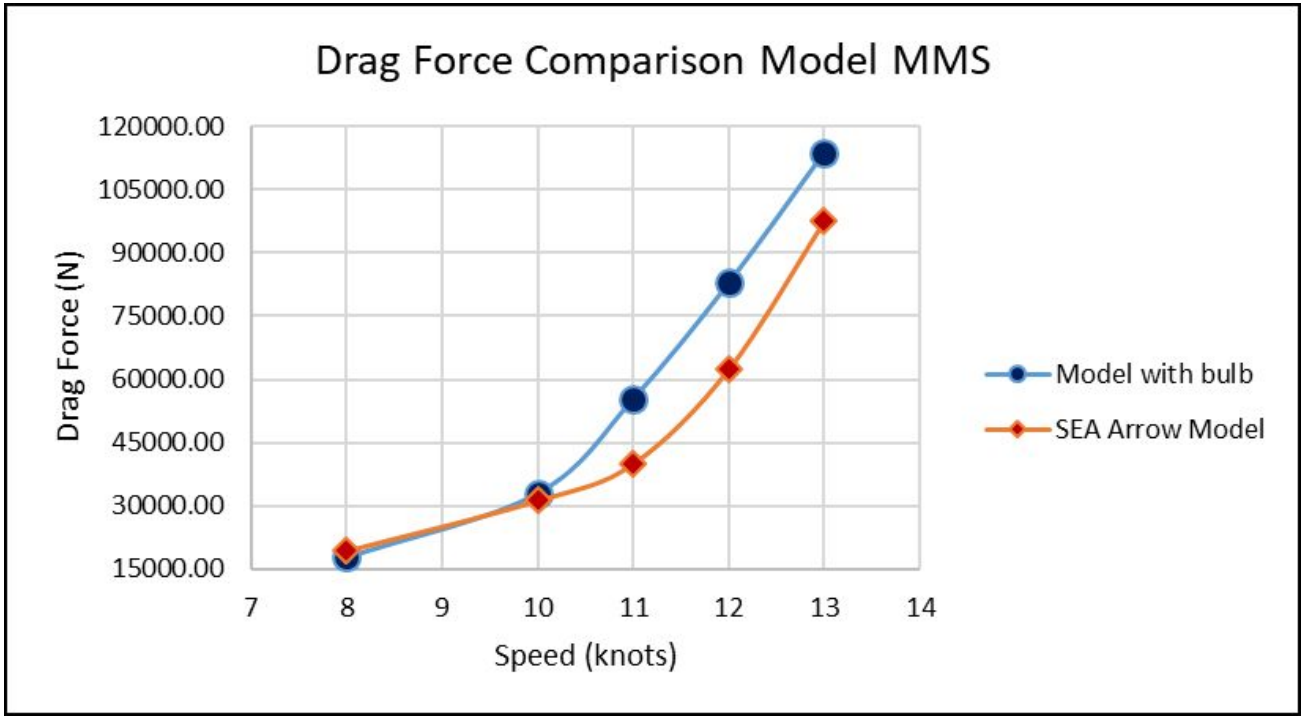


Comparation of wave profile





Drag Force Comparation



Conclusion

For the correct simulation of the phenomenon, the k-ω turbulence model was used, which satisfied the criteria to validate the simulation.

For the meshing of the vessels, the important parameters such as the size of the elements in the different regions, the layer of prisms around the hull surface were calculated complying with the recommendations given by the ITTC for these simulations.

The Holtrop empirical method presents an error in the results of the ship resistance that varies between 8 and 35%.

ANSYS Fluent software was used to simulate these hulls of typical Peruvian vessels with the SEA ARROW bow to corroborate the reduction in drag, obtaining reductions of up to 25%.

Thanks for your attention