# Energy Saving Devices

Save The Environment • Save Life

YUANHANG PROPELLERS 远航螺旋桨

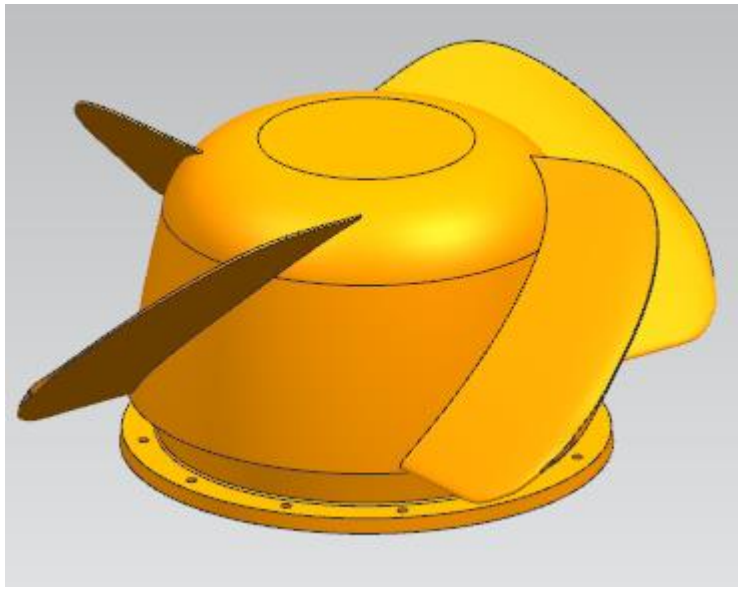
# Urgent Need of Energy Saving Action

The shipping industry consumes 300 million tons of fuel every year, releasing around 3 percent of the world's carbon-dioxide emissions into the atmosphere.

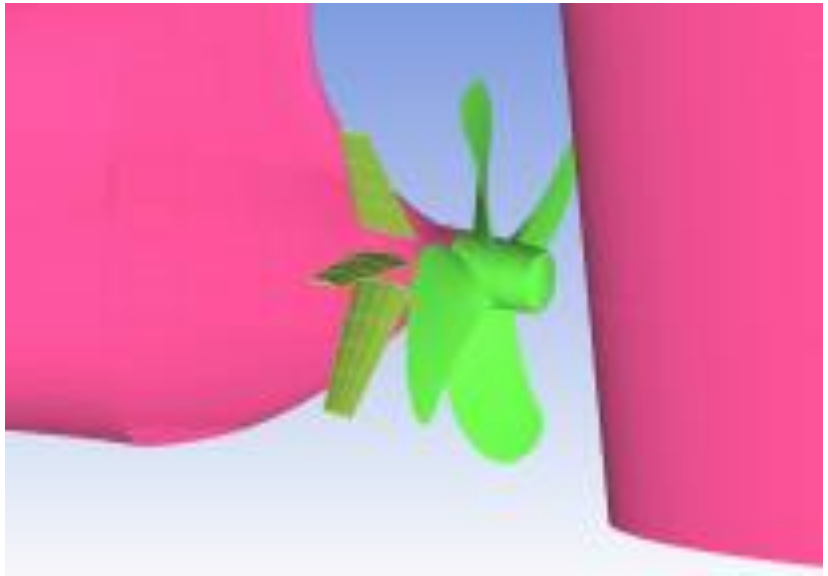
In 2018, the U.N. agency that regulates global shipping set a goal of reducing ships' carbon emissions to half of 2008 levels by mid-century. The IMO has agreed to cut ships' carbon intensity by 40% by 2030.

About 75% of the global fleet of bulk carriers and tankers will not be able to comply with new technical metrics mandated by the IMO and which come into force in January 2023, unless they take remedial action.

# YuanHang Energy Saving Devices



Cap Fins

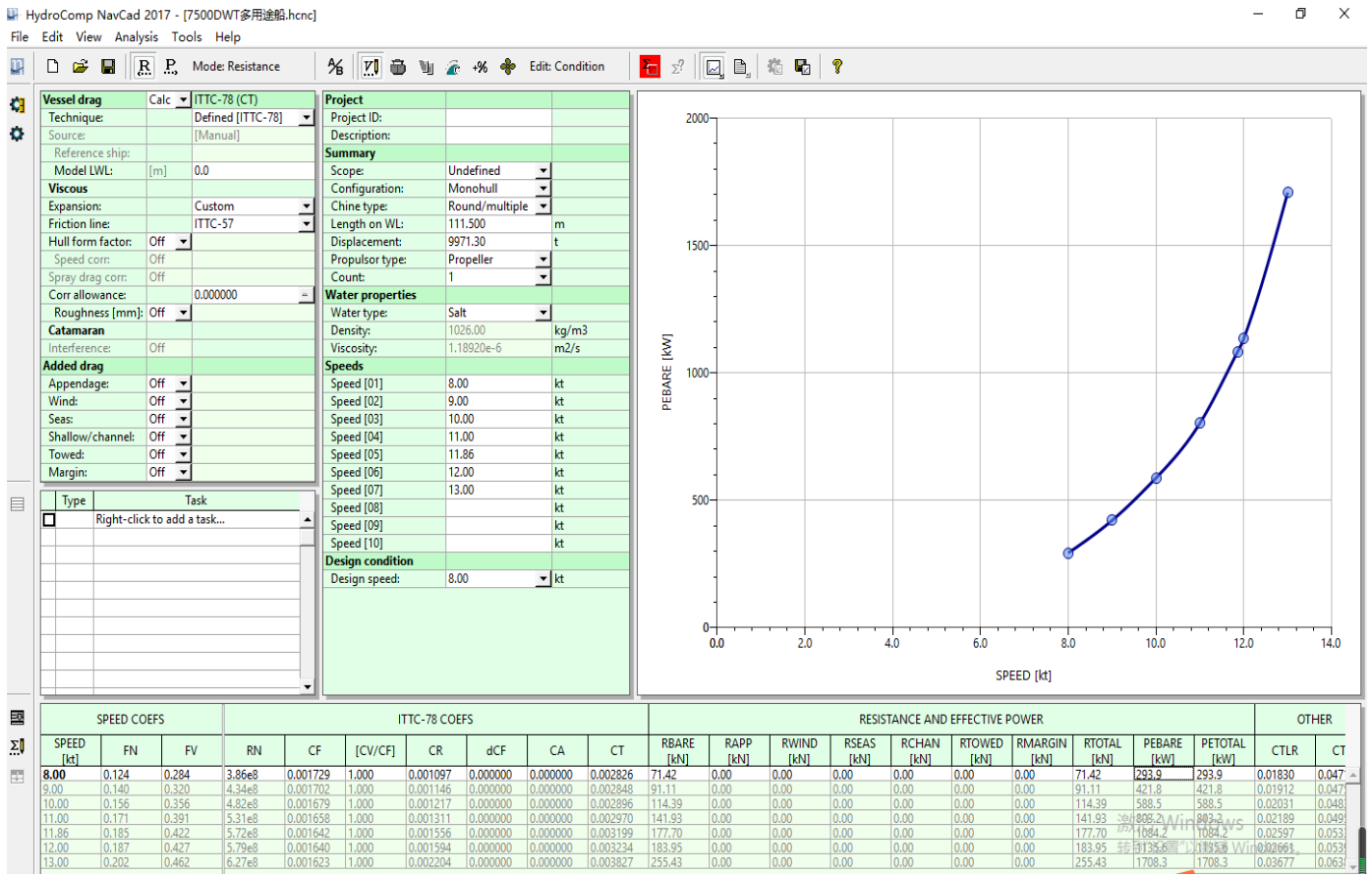


Front Deflector Fins

Aimed at increasing propulsion efficiency as well as reducing energy loss, YuanHang develops two kind of energy saving devices which are simple, relatively cheap to install and easy to maintain.

# Technology and application

## Hull Resistance analysis by conventional method



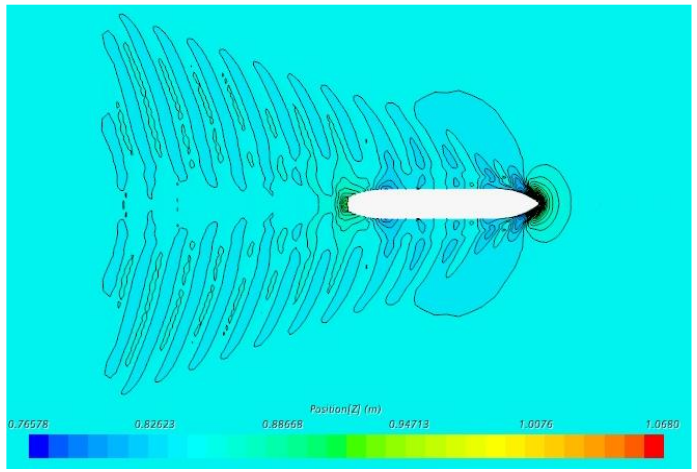

Hull Resistance analysis can be fulfilled by Atlas, Formula and Software. Its prediction is based on an extensive library of model tests and ship trial data. YH currently utilizes NavCad software.

Advantages: Convenient and efficient. The vessel speed analysis of existing ship type is reliable.

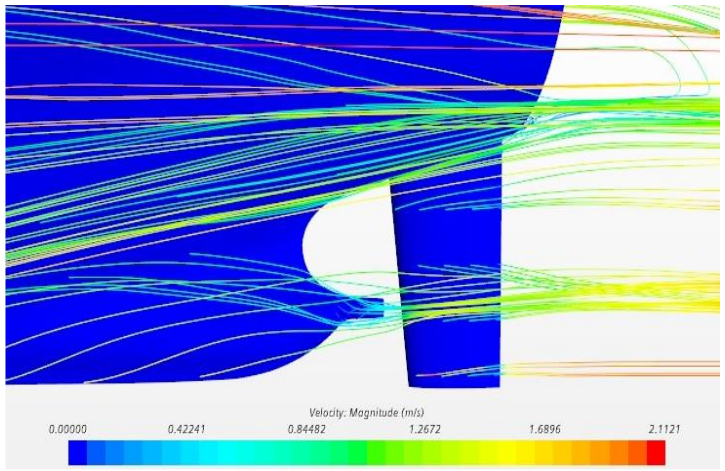
Disadvantages: The accuracy of speed analysis of the new type of ship is uncertain.

## Techlonogy and application

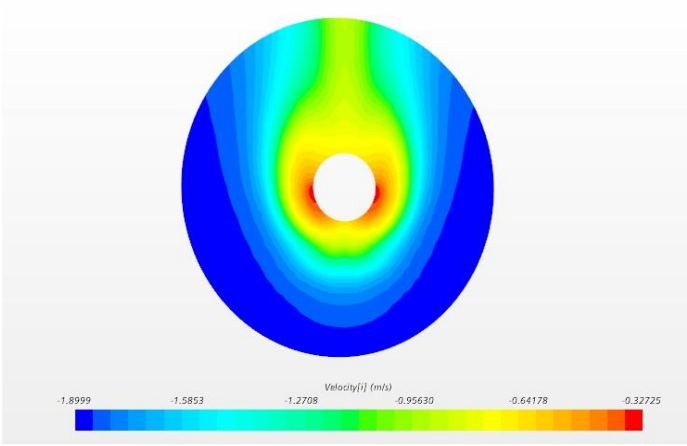
Hull Resistance analysis by Computational Fluid Dynamics (CFD)



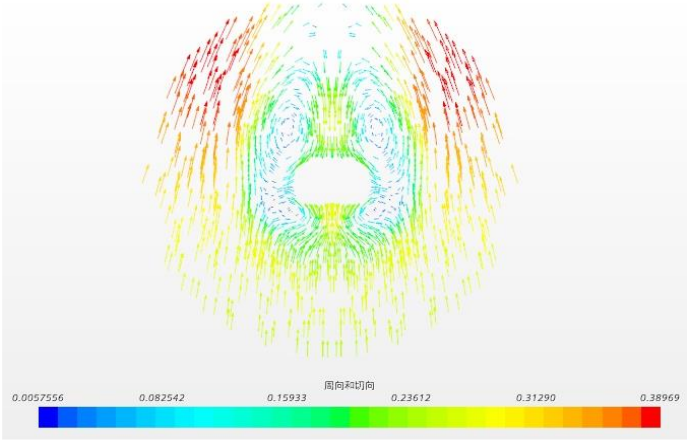

Hull Wave-making




Stern Flow Field




Axial wake on propeller disk




Circumferential and tangential wake on propeller disk

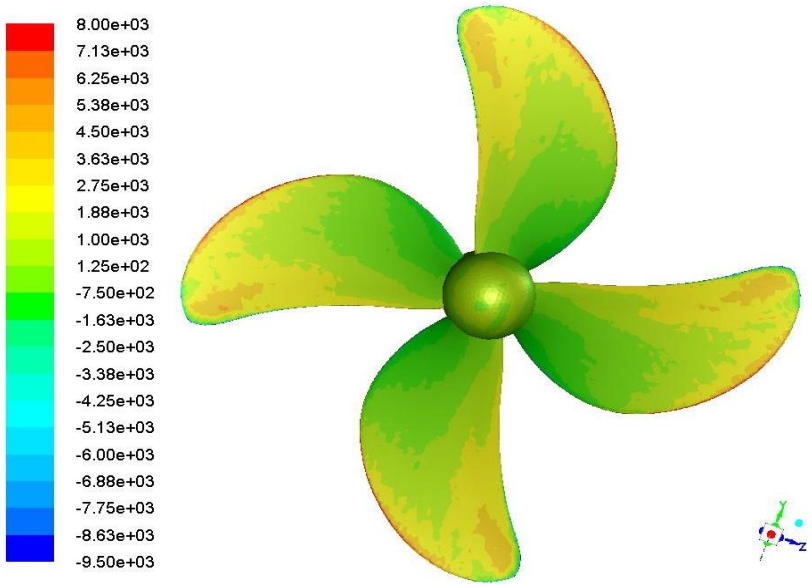
A proper understanding of hull resistance, streamline and Wakefield, and propeller-hull interaction can be achieved with CFD simulations.

YH's engineers have been committing to the application of CFD simulation for many years and has made breakthroughs in designing propellers and energy-saving devices.

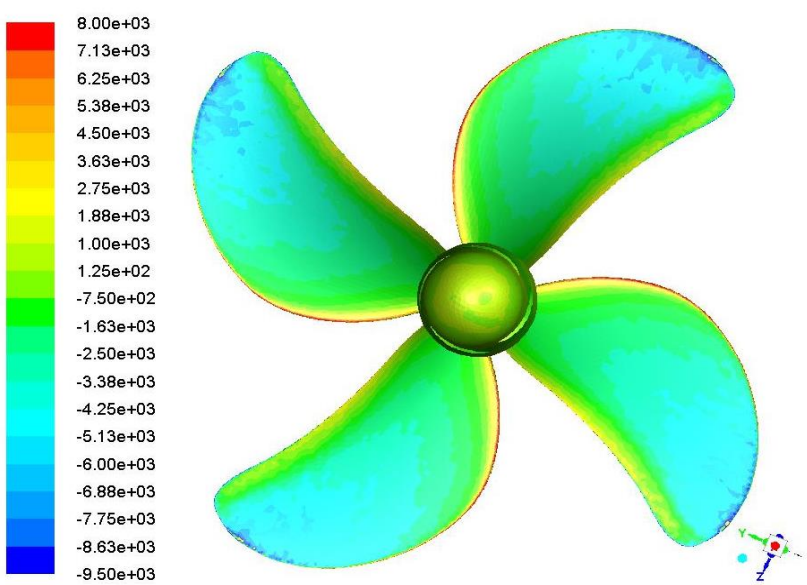
## Technology and application

Propeller design with CFD simulation.

As marine propeller has complicated geometries, the flow around the propeller is complicated. The open-water performance of the propeller can be calculated with CFD simulations. And the propeller load is adjusted according to the results.




**Pressure Side Distribution**

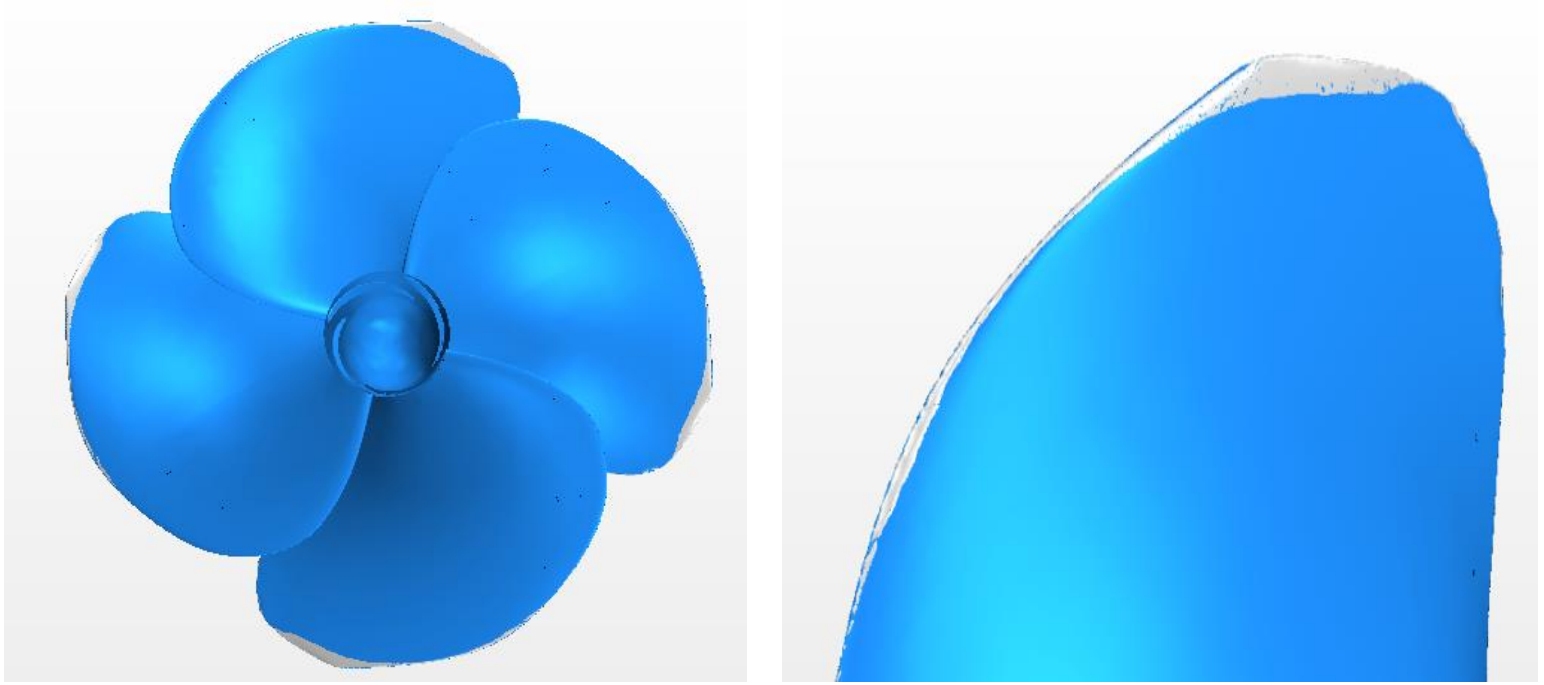



**Suction Side Distribution**

With the application of NavCad software and CFD simulation, the optimum design of the propeller can be made to the propeller's chord, skew, pitch, camber and rake distribution.

## Technology and application

Check propeller cavitation with CFD simulation and adjust the propeller design.

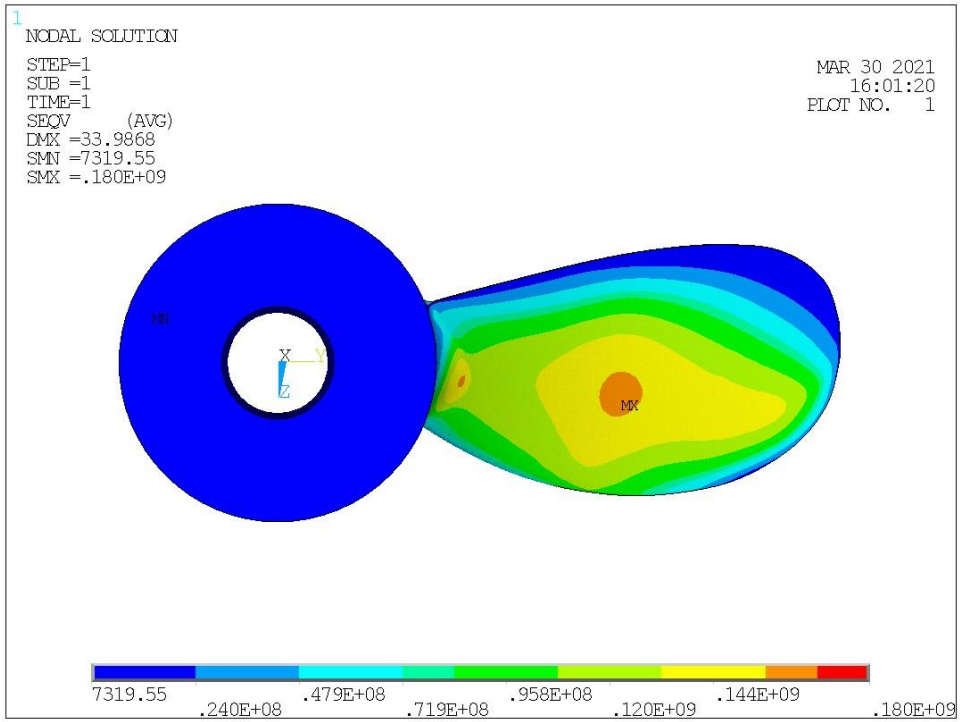


**Cavitation occurs at the back leading edge and tip of high-speed Propeller**

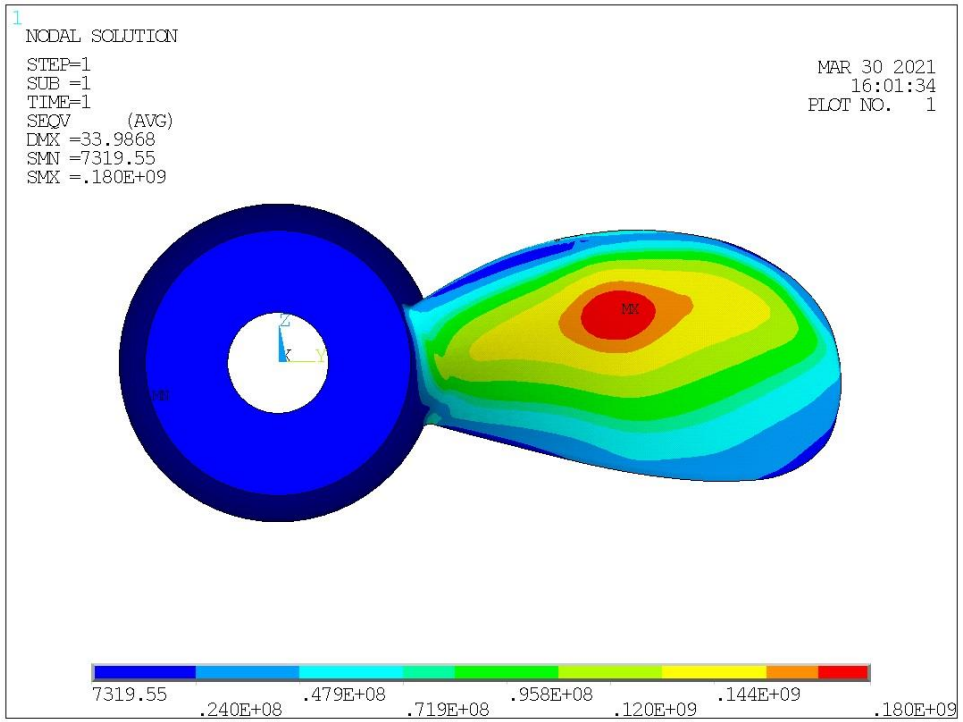
## Technology and application

Strength check of propeller for ships running in ice sea

Analyze the finite element structure with CFD simulation, check the propeller strength and adjust the propeller design to meet the requirements of Class Society Rules.




**Propeller blade face stress distribution**

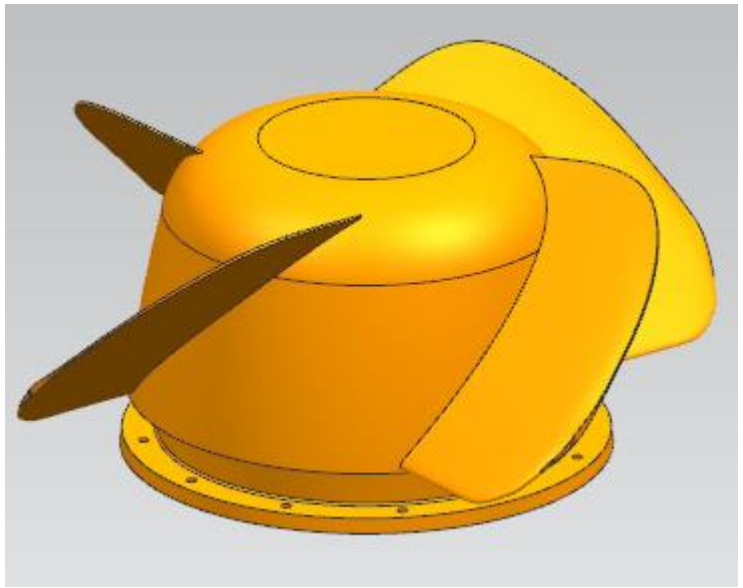


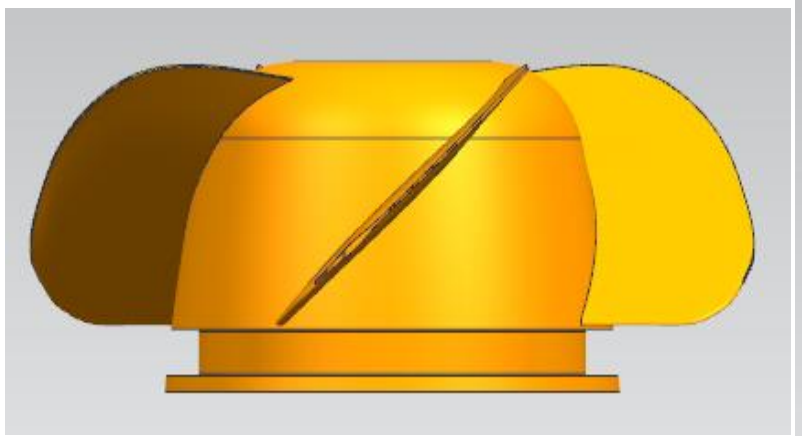

**Propeller blade back stress distribution**

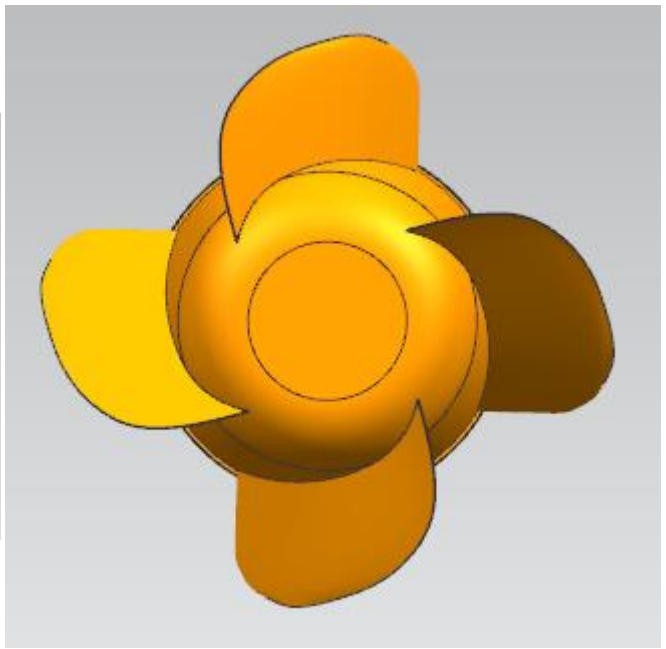
# Cap Fins

# Technology and application for Cap Fins

In order to be able to give a proper evaluation of the effectiveness of these Cap Fins, it is important to understand the occurring flow phenomena near the hub and to minimize the impact of laminar flow and Reynolds scaling effects. CFD simulations of the hull, propeller and rudder can provide the proper information to reach this goal.



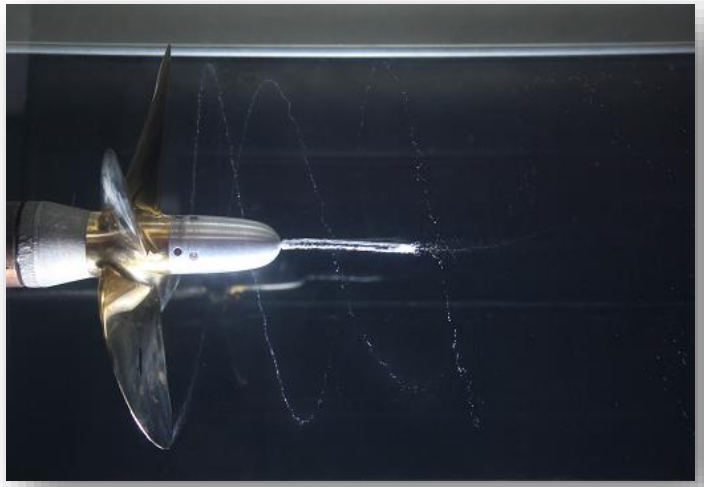


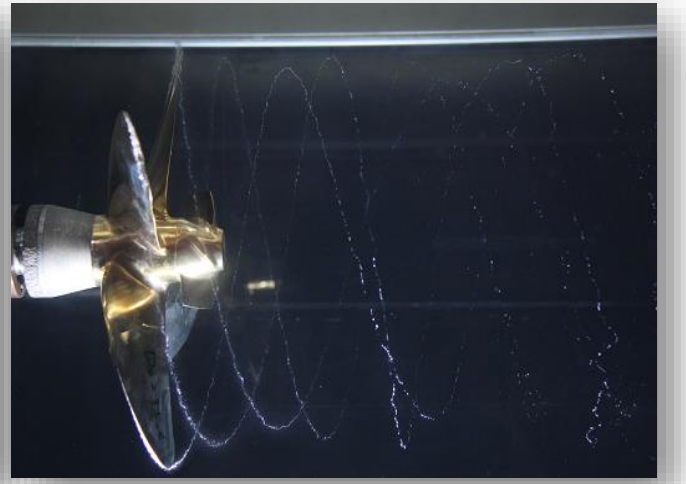


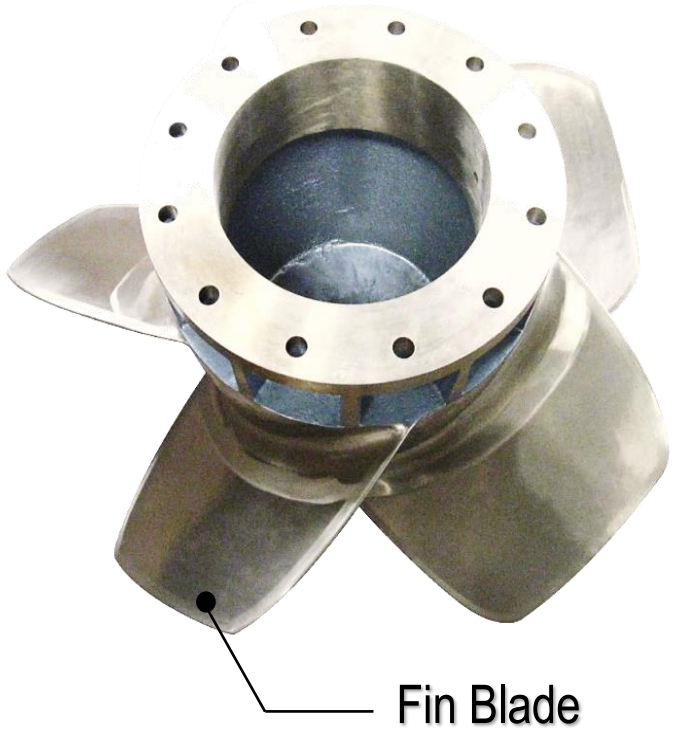
# Cap Fins

Cap Fins is a boss cap by adding an equal number of custom-made post-swirl fins, which minimize the hub vortex, reduce the engine's torque, increase propeller efficiency and save fuel consumption. As a result, Cap Fins can facilitate energy saving up to 4%. YuanHang is the first enterprise in China to promote the use of cap fins and got the patent in 2012

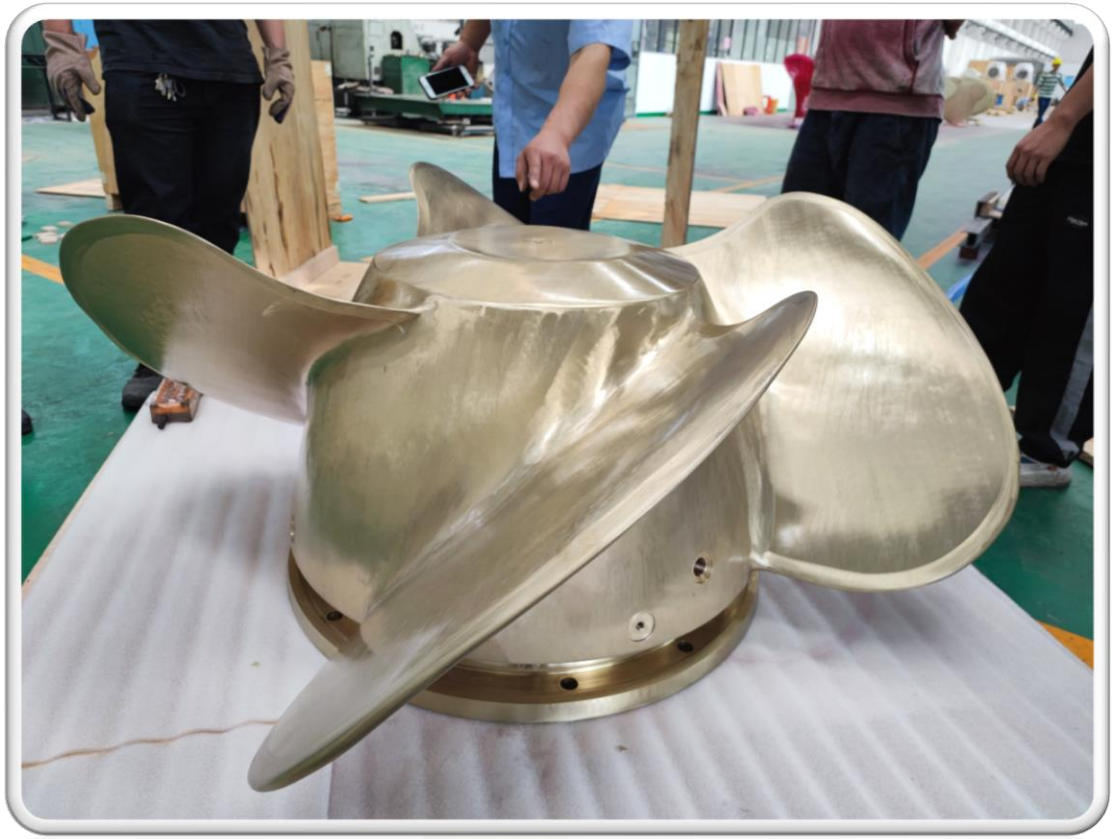
(Patent No.: ZL 2012 2 0206313.9)







# Benefit from installing Cap Fins



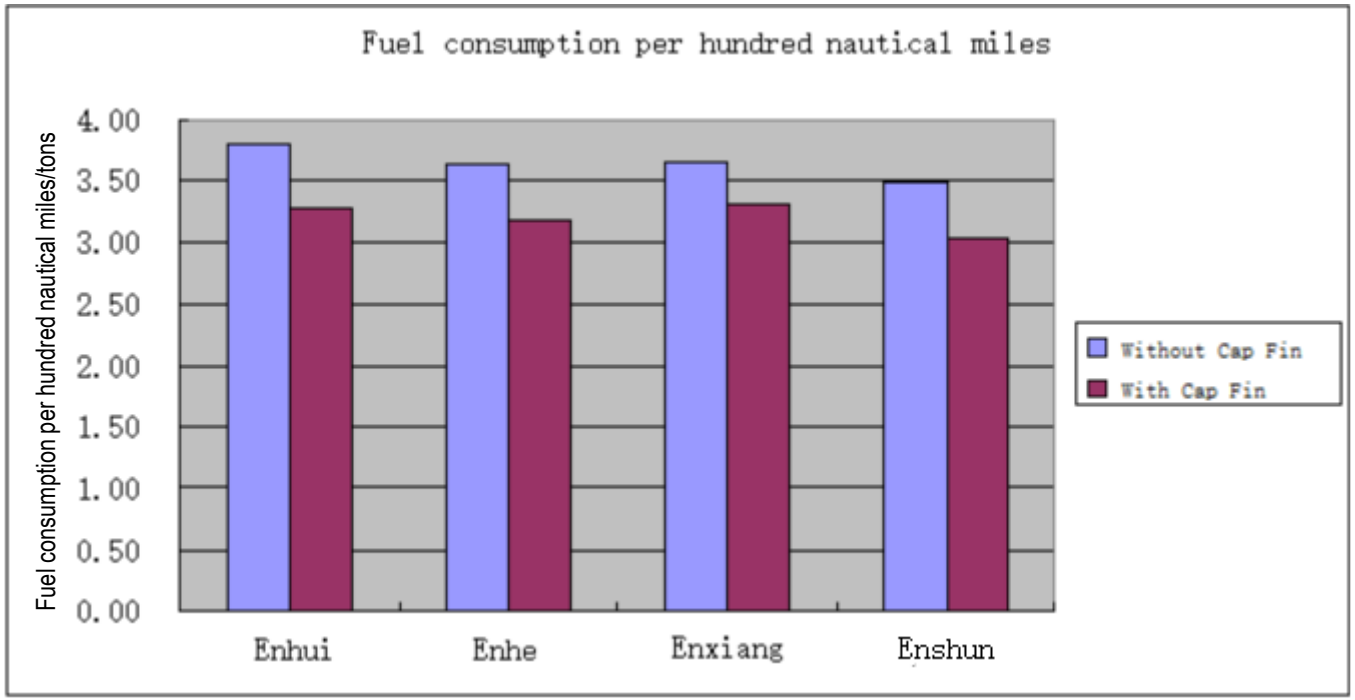
| | |
|---|---|
| **Low cost** | The investment return period is within 3 ~ 8 months |
| **Stable use** | All projects received good feedback |
| **Simple structure** | There are only a few more fins than the ordinary cap |
| **Easy installation** | The installation process is the same as that of ordinary cap |

# Anda Shipping Bulk Carrier Project (Ship Enhui)

Deadweight: 20500DWT Propeller Diameter: 4800mm

Engine Power: 3300KW Cap Fins Diameter: 1344mm

| | Total voyage mileage | Save fuel | Savings Oil price ￥4000 / t | Payback time |
|---|---|---|---|---|
| First quarter of 2012 | 7001.1NM | 16.1 tons | ￥64,400 | 5 months |




Comparing the performance of the two sister ships, Enyao installed Cap Fins, and Enhui installed normal Caps. The speed of the two ships is basically the same, but the engine operating speed of Enyao has decreased slightly, **saving an average of 410 kg of fuel per 100 nautical miles.**

With the significant gain, Anda Shipping has installed Cap Fins on all of their vessels, saving an average of 230kg to 500kg of fuel per 100 nautical miles per vessel.

The above data for the ship Enhui was provided by Anda Shipping Bulk Carrier in 2012.

# Greek Alpine Amalia Product Tanker Project

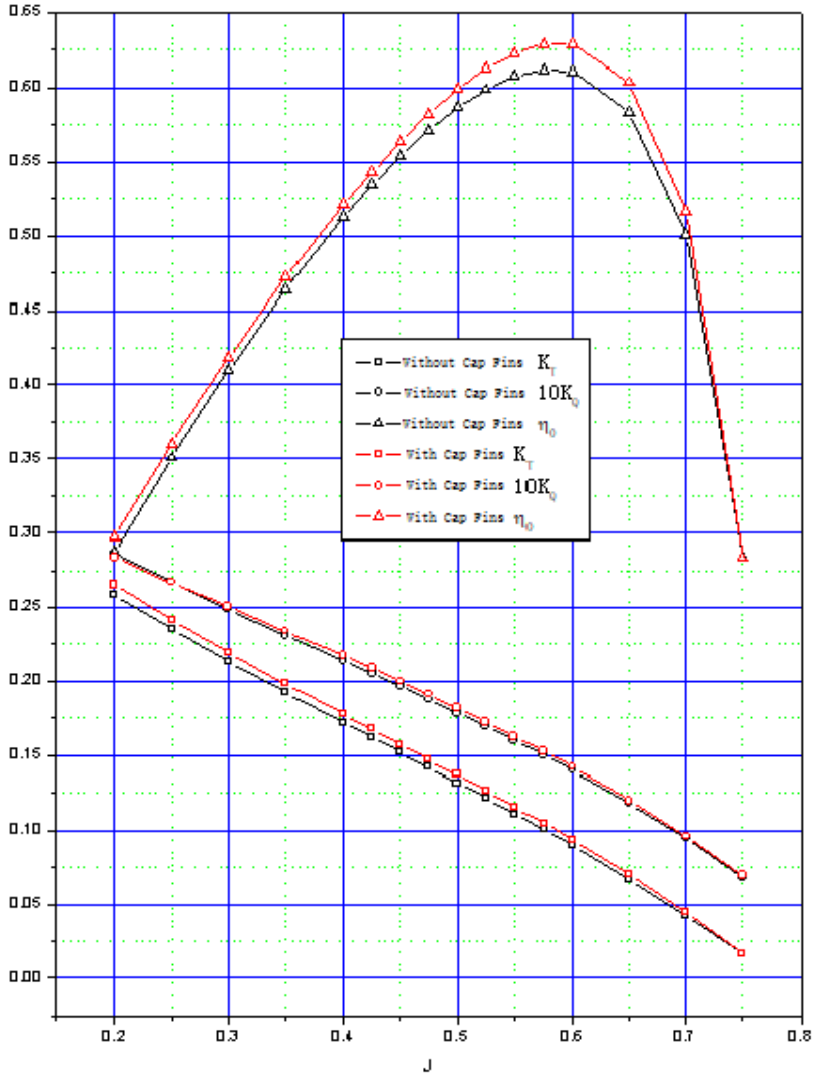
Deadweight: 105000DWT

Engine Power：14280KW

Propeller Diameter：7200mm

Cap Fins Diameter：2000mm

The propeller efficiency can be improved by nearly 2.55% by installing cap fins near the common working point J = 0.55.



# Installation of Cap Fins of 1134TEU Container Ship Project

# Cost Saving


Using a propeller boss Cap Fins instead of ordinary boss Cap on new shipbuilding or replacing the ordinary boss Cap with Cap Fins on existing vessels is simple work.
Cap Fins are energy-saving devices that are cheap, durable, and cost-effective.

# Customer Representative

中海油轮运输有限公司
China Shipping Tanker Company Limited

福建安达船务有限公司
FUJIAN ANDA SHIPPING CO.,LTD

福建东南造船有限公司
Fujian Southeast Shipbuilding Co.,Ltd

宁波开发投资集团有限公司
Ningbo Development & Investment Group Co., Ltd.

CSSC 广船国际有限公司
GUANGZHOU SHIPYARD INTERNATIONAL COMPANY LIMITED

Since 1981
HONG LAM MARINE
QUALITY TANKERS
QUALITY OPERATIONS

長榮集團
EVERGREEN GROUP

BAOSTEEL 宝钢

仁建集团
REN JIAN GROUP

中海通
SINOCEAN

oceangold

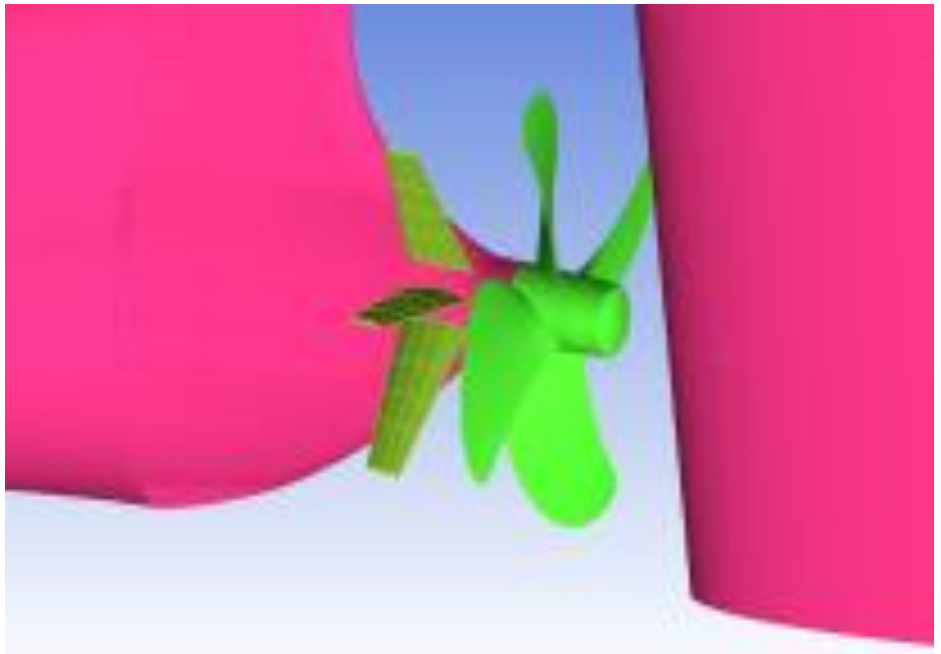
# Front Deflector Fins(FDF)

# Front Deflector Fins

The Front Deflector Fins are fins mounted on the stern in front of the propeller so that the flow is re-directed before it enters the propeller disc. They reduce the rotational energy loss of the water flow behind the propeller by weakening the pre-swirl in the same direction as the propeller steering. Its interaction with the propeller blade improves the propulsive efficiency to achieve energy saving.

Application： Large vessel with single propeller

Yuanhang is applying for a patent for Front Deflector Fins --a marine monolithic casting front deflector fins.

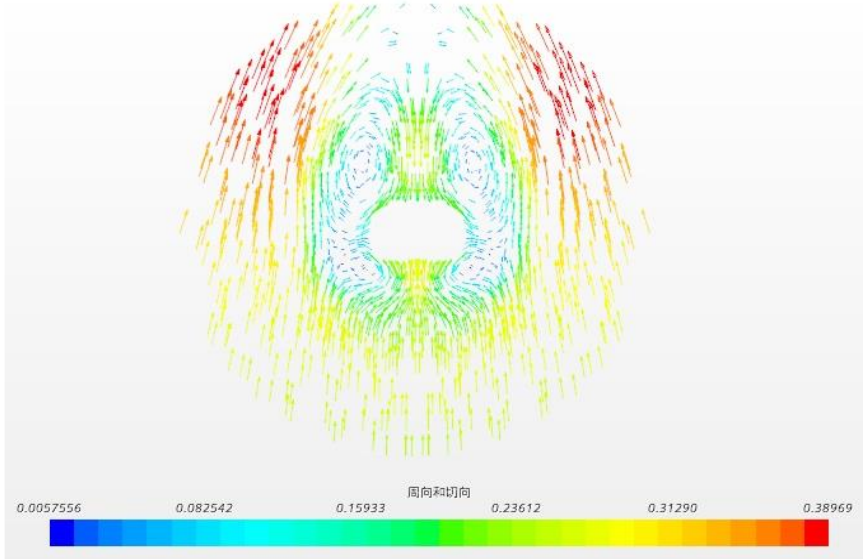


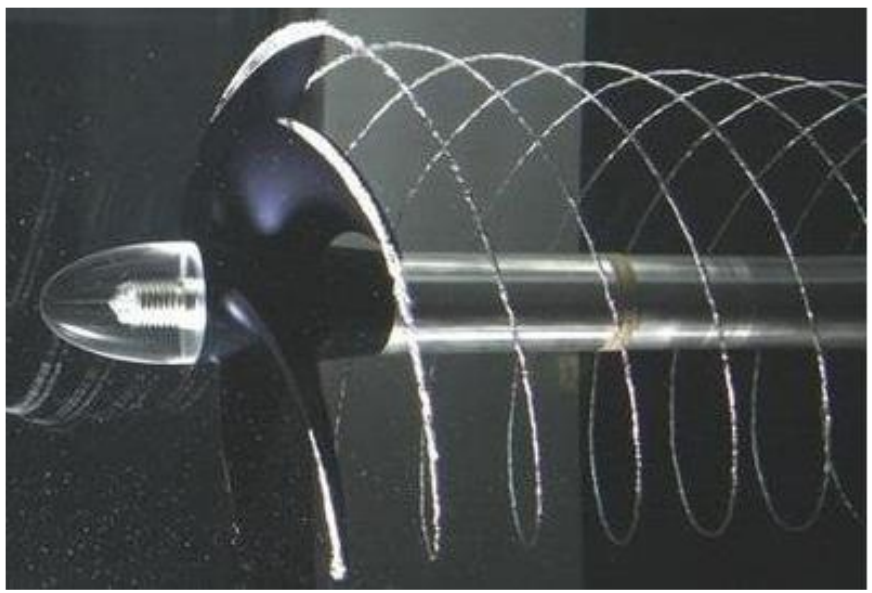
## Technology and application for FDF

The water flowing through the hull will generate a clockwise swirl on the port side in front of the propeller (looking from the stern to the bow), and a counterclockwise swirl on the starboard side

When the propeller is running, it will drive the water behind the propeller to rotate in the same direction as the propeller, resulting in energy loss.

For the RH propeller (looking from the stern to the bow, clockwise), the water flow in front of the propeller in the clockwise direction on the port side will intensify the rotation of the water flow behind the propeller, thus weakening the rotating water flow on the port side, which can reduce the loss of rotating energy behind the propeller and achieve the purpose of energy saving.



## Project CFD

### 45700DWT Bulk Carrier（Engine 5400KW@116RPM）

| | Ship Speed | Propeller Speed | Resistance | Engine output power | Energy saving effect |
|---|---|---|---|---|---|
| Without FDF | 13.0kn | 116RPM | 580981N | 4833KW | |
| With FDF | 13.0kn | 115.4RPM | 581165N | 4604KW | 4.74% |

### 23000DWT Double-skin Bulk Carrier（Engine 6000hp@520RPM）

| | Ship Speed | Propeller Speed | Resistance | Engine output power | Energy saving effect |
|---|---|---|---|---|---|
| Without FDF | 10.1kn | 90.0RPM | 255981N | 1612.3KW | |
| With FDF | 10.1kn | 87.5RPM | 252702N | 1540.4KW | 4.46% |

The energy-saving effectiveness of the front deflector fins is determined by the stern's shape, main engine, gearbox ratio and propeller. Since the front deflector fins interact with the propeller, the propeller design should match the front deflector fins design.

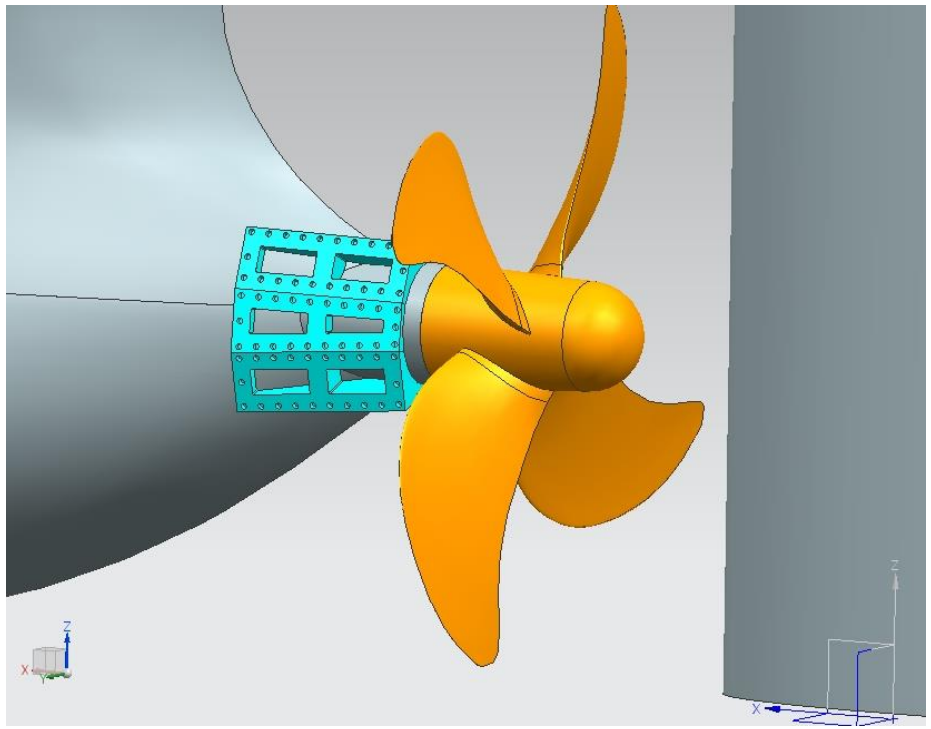
# Cost saving of FDF

## 45700DWT Bulk Carrier （Engine 5400KW@116RPM）

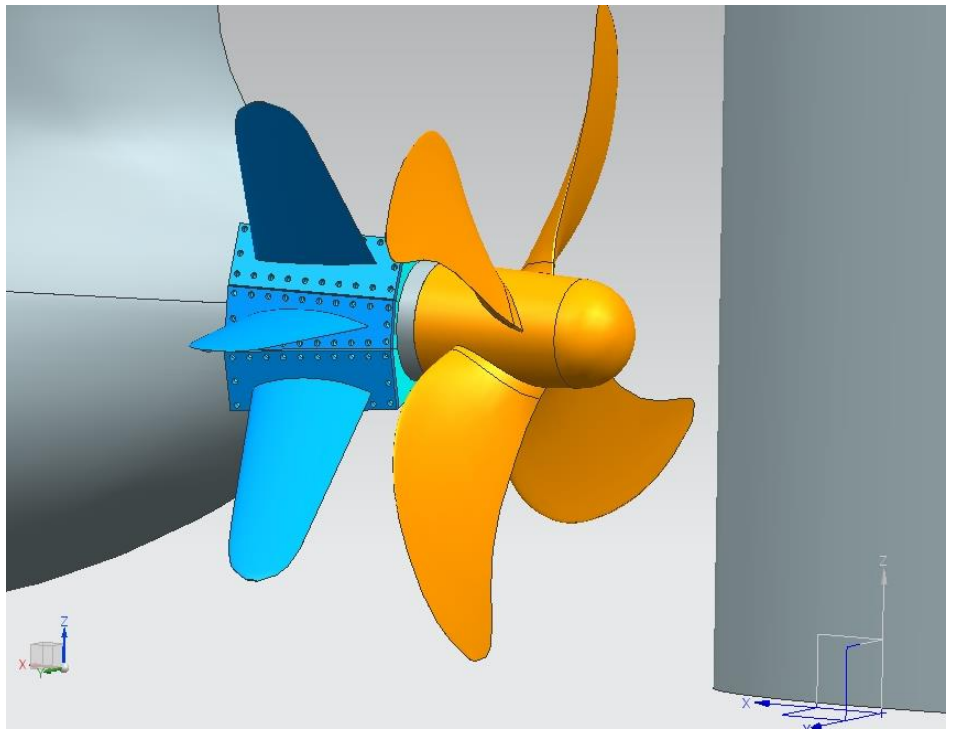
| Engine Speed rpm | Speed kn | Engine output power kw | oil consumption t/day | Energy saving efficiency of fins | Fuel saving (t/day) | Cost savings (yuan/day) |
|---|---|---|---|---|---|---|
| 96 | 11 | 2734 | 12.1 | 4.74% | 0.575 | 3452 |
| 100 | 11.5 | 3100 | 13.8 | 4.74% | 0.652 | 3914 |
| 109 | 12.5 | 3945 | 17.5 | 4.74% | 0.830 | 4981 |
| 116 | 13 | 4833 | 21.5 | 4.74% | 1.017 | 6103 |
| Remarks: Fuel consumption rate is 185g/kwh, fuel is 6000 yuan/ton | | | | | | |

The Front Deflector Fins can be made in cast steel or stainless steel.
The fuel saving is significant. Payback time is about 6 to 12 months.

# Model of Front Deflector Fins



Deflector Fins Base



Front Deflector Fins Set

# Cooperative institutions


South China University of Technology

**Pool test Strategic partners**

广州船舶及海洋工程设计研究院

Guangzhou Ship and Marine Engineering Design and Institute

**Strength verification Strategic partner**

上海船舶运输科学研究所

SHANGHAI SHIP AND SHIPPING RESEARCH INSTITUTE Co.,Ltd

**Pool test Strategic partners**

Appoint a third-party organization to carry out a pool test of the model to verify the theoretical calculation of an FDF design.

# Thank You


**YUANHANG PROPELLERS MANUFACTURING CO., LTD.**
Factory ADD: No. 10 Huancui East Road, Jiangmen, Kaiping 529300, Guangdong, China
Tel: +86-750-2272888 /+86-750-2277909 Fax: +86-750-2277929
Email: yuanhang@yhpropeller.com Web: http://www.yhpropeller.com