

Ship hull forms have evolved step by step but there has been very little change in the design of rudders. A group of people who challenged this situation by asking “can’t the propulsion performance by newly developed rudder be improved?” have now come up with the world’s first gate shaped rudder.



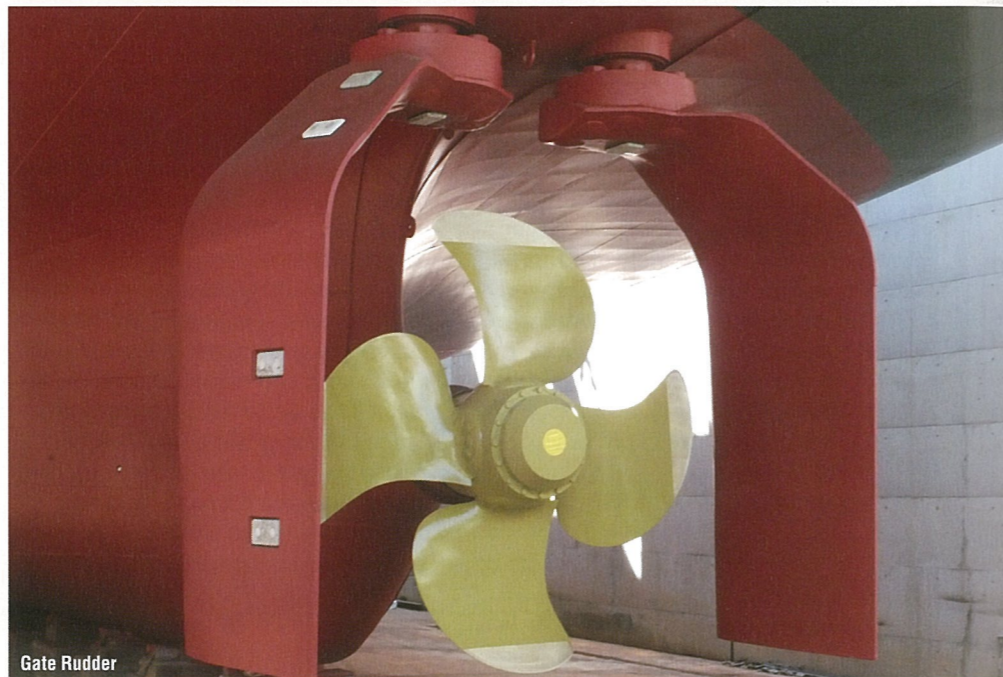
A GATEWAY TO INNOVATIVE PROPULSION SYSTEM



Japan’s first specialist rudder is now drawing considerable attention as a subject of research in the shipbuilding field. The name of this device is the Gate Rudder, which Japanese ship-owners, shipyards, foreign engine makers and oil majors are all now considering.

As the name suggests the Gate Rudder consists of two uniquely shaped rudders placed in parallel either side of the propeller, which reduces resistance of rudder and creates thrust to improve the fuel consumption. And also, at slow speeds, by changing water flow of the propeller, in combination with a high-powered bow thruster, berthing and unberthing performance can be improved considerably. Further a stern thruster is then no longer required. Vibration and noise can be reduced because of reducing the required thrust of the propeller as main source by generating thrust from the rudder, and of equalizing the non-uniform flow into the propeller disk area by placing a rudder either side of the propeller. The benefits of the Gate Rudder are quite wide. For example, as the rudder and propeller are integrated, a ship can be compact. By moving the propeller toward the rear, the main engine room can also be placed at the stern. As a result, without changing the size of the vessel, cargo space can be increased. Removal of the propeller and shaft is also easier.

The company that took on the challenge of developing this technology is Kamome Propeller Co., Ltd. established in 1924 in Tokyo which is a comprehensive manufacturer and service provider involved in the development, manufacture and sales of



Gate Rudder

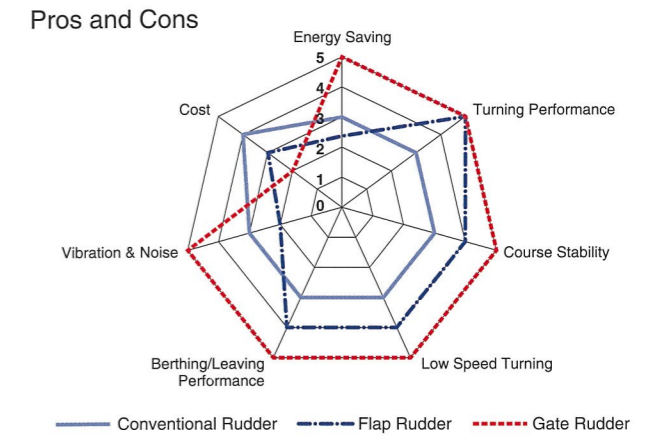
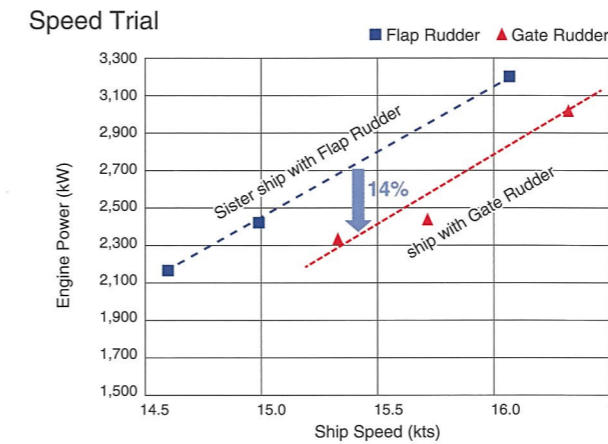
ship machinery, propulsion and maneuvering systems, now based in Yokohama and tackling the development of energy saving products. Originally, rudders were equipment using lift forces to change the direction of the ship. The basic principle of placing the rudder in the area where the flow of water is the quickest, behind the propeller, has not changed in the last 200 years. However, a rudder which protrudes from the ship’s stern also acts as a brake creating resistance.

Technology has advanced, and ship’s hull form has developed, but improvements in the main rudder have remained elusive. Within the shipbuilding industry it has long been held that major

improvements in performance cannot be expected from the rudder.

But there were some people who questioned the industry’s common knowledge and asked the question “Can the performance of the rudder really not be improved upon?” Kamome Propeller also went along with that line of thinking and joined in the challenge of developing a new type of rudder. The result was it completed an integrated system of propeller and rudder which was to become the Gate Rudder, the world’s first new type energy saving rudder.

The development project began in 2012 by Chairman Sadatomo Kuribayashi of Kuribayashi Steamship Co., Ltd. who brought the idea of the



hollow rectangular type rudder to the National Maritime Research Institute (NMRI). From his own experience as a yachtmen company chairman Kuribayashi has some familiarity with how things were in the age of sailing ships, when rudders not only played a part in changing the direction of the ship, but also in providing propulsion. Strathclyde University visiting Professor Noriyuki Sasaki, now technical consultant at Kamome Propeller, was at NMRI at the time and with his partners began conducting trials.

The rudder shape was revolutionary but at first it was installed in the traditional place behind the propeller. The results were not so good as expected, but the opportunity was taken to develop a new rudder and the momentum of the project began to pick up. As the trials and discussions progressed, the idea to locate the rudder to the side of the propeller was proposed by NMRI, while company chairman Kuribayashi suggested dividing the rudder shaft and operating each rudder plate independently in an improvement of the design. The idea to have the integrated propeller and rudder system was then born. Professor Sasaki said: “There was an understanding that if the rudder is not behind the propeller it will not be effective. It was necessary for the research to reverse that thinking and look at it from an original view point.”

It was the world’s first attempt to develop a new type rudder. Kamome Propeller and Kuribayashi Steamship group company Kay Seven Co., Ltd., with the support of The Nippon Foundation, began a project for two years including actual ship test from fiscal 2018. Many young engineers from Kamome Propeller were assigned to the project. Kuribayashi Steamship and Yamanaka Shipbuilding Co., Ltd. and others were also involved in working together toward the realizing the product.

As this was a rudder which had not been built before, a few miscalculations were made. For example, it was decided to test the rudder on a containership and tests on the efficiency of the rudder and propulsion system were carried out in advance. Professor Sasaki estimates were for energy savings of around 8% but model tank tests showed zero savings. Company chairman Kuribayashi did not believe the result. Later it was realized that, as this was a new type of rudder, it is not possible to use the existing testing and estimation procedures. At the time some of the partners for research group doubted the usefulness of the system but Professor Sasaki said, “it will be ok,” and progressed with the research.

Six years after the outset of the project in 2017 Kamome Propeller, Kay Seven, Yamanaka Shipbuilding, navigation equipment maker Tokyo Keiki Inc. took on the challenge of sea trials. The Gate Rudder was fitted onto 416-teu containership *Shigenobu* operated by coastal shipping company in Japan Imoto Lines, Ltd. and its basic reliability was confirmed.

The earlier miscalculation turned out to be a happy one. Compared to the sister ship *Sakura*, built one year earlier, *Shigenobu* showed a 14% improvement in energy saving comparing higher than

the estimate.

In fiscal 2018, to collect a full year’s data, an experienced engineer was put on *Shigenobu* to test all performance data and in-service monitoring began. The vessel outperformed the previous year averaging a 33% improvement in energy savings. By repeating these experiments, the various benefits of the Gate Rudder were confirmed.

Professor Sasaki bravely predicted: “In three or four years time, considerable numbers of the gate shape twin rudder will come onto the market.” As for the future development on he said: “First we need to improve the manufacturing.” From now on developing high accurate design methods along with testing and analysis on a variety of vessels is planned, following the survey planned for the 499GT cargo ship of Kuribayashi Logistics System to be built this summer. There are still a lot of unknowns about the Gate Rudder, and crew on ships where it has been tested have said there are merits still to be uncovered. “I expect there are still uses which have not been realized yet, I’m looking forward to it,” said Professor Sasaki. Sasaki and the Kamome Propeller members have bright eyed optimism and say they are looking forward to the future.



Development team of Gate Rudder