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Design and model tests of a backward tip rake propeller for a low speed ship

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Summary: The design of unconventional blade tips has been studied for many years to increase propeller efficiency. The forward tip rake propellers (FTRP) having the tip rake to the suction side are expected to provide the propeller efficiency gain, while the backward tip rake propellers (BTRP) having the tip rake to the pressure side are expected to reduce the pressure fluctuations. In our previous study, BTRP was designed for a container ship and tested. Comparing with a standard propeller, the propeller open efficiency of BTRP was equivalent and the pressure fluctuations of BTRP decreased. But the risk of the cavitation erosion was confirmed around the trailing edge at 0.9R of BTRP. In this paper, three types of propellers were designed for a low speed ship of which the pressure fluctuations (2nd blade frequency) was high; a standard propeller, a tip unloaded propeller (TULP) and a backward tip rake propeller. The new BTRP was designed such that the blade surface changing due to a rake was smoother than that of previous BTRP in order to avoid the cavitation erosion. The theoretical calculation showed that the load around the tip of new BTRP was reduced and the axial induced velocity decreased considerably. And as a result of model tests, it was confirmed that the propeller open efficiency of new BTRP was equivalent and the pressure fluctuations (2nd blade frequency) of new BTRP was reduced by about 51% comparing with a standard propeller without the risk of the cavitation erosion due to the new rake distribution.

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