Potential of Transfer of the Skill of Working a Ro-Scull to Indonesian Canoe – II - Evaluation of the Stability due to the Difference of Distance between Two Outriggers after Mounting a Floating Structure on the After Part of Canoe -

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Abstract

In the previous report, the authors compared the hull form of canoe to that of Japanese Wasen and examined the possibility of applying Wasen's Ro-scull to canoe in order to transfer the skill of working Japanese Wasen's Ro-scull to traditional Indonesian outrigger canoe (hereinafter just called canoe). As the result, it was difficult from the viewpoint of stability to apply the Ro-scull of Japanese Wasen, which was operated by a person standing up, to the canoe hull form. Therefore, it was found the enhancement of stability was necessary by mounting a floating structure on the after part of canoe to reduce oscillation in addition to Rogui and Rodoko, a bed to which Rogui was mounted. Rogui is a pivot for Ro-scull and becomes a fulcrum when a Wasen is propelled by the Ro-scull. In this report, authors made trials for improving the hull form of canoe and evaluated the stability through the experimental confirmation about the optimal distance between outriggers when working a Ro-scull.

Keywords : ship handling and propulsion, outfitting, Indonesian canoe, working a Ro-scull, stability

1. Introduction

In the previous report[1], the authors tried to transfer the skill of working a Ro-scull, which was an efficient propulsor of Japanese Wasen, to Indonesian conventional canoes that were gradually fading just like Japanese traditional Wasens. The authors studied the potential of transfer of the skill of working a "Ro-scull" to the hull form of canoe through the comparison between canoe hull form and Wasen. From the analysis of hull form data of 604 Wasens and 492 Indonesian canoes, concerning the length (L) and breadth (B) that were the principal dimensions of Wasen and canoe, the length breadth ratio could be obtained. The average size of a half of distance between two outriggers (BB/2) corresponding to the minimum length (L) of canoe hull form could be found. The breadth of Wasen with minimum 3 meters length and a half of distance between two outriggers (BB/2) were both 1 meter and were almost the same size. This suggested the possibility of applying Wasen's Ro-scull to a canoe maintaining its hull form. However, to work a Ro-scull of canoe with staying standing up, it was necessary, in addition to the aforementioned hull form comparison, to mount a Rodoko on which a Rogui, a fixed point (fulcrum) of Ro-scull, was mounted and to solve the problem of hull stability to match the rise of gravity associated with the standing position. Therefore, the partial refurbishment of the after part of canoe and the optimization of outrigger distance (BB/2) were considered. More specifically, these were: (1) the mounting of Rodoko and Hayao, a rope connecting Ro-scull with hull; (2) the mounting of a floating structure on the after part of canoe for more reserve buoyancy and reduced oscillation; and (3) the assessment of outrigger distance for more stability. A Rodoko was newly mounted on the after part of canoe. In particular, as for the abovementioned (2) and (3), the necessary knowledge for the propulsion by working a Ro-scull was obtained through the examination of stability depending on the form of floating structure and the outrigger distance.

2. Method

2.1 Test canoe

The canoe used for the working a Ro-scull experiment was a monohull type one (Loa=3.62m, B=0.432m, D=0.272m) with weight 45.0kg that had been kept at the Nagasaki University Faculty of Fisheries.

2.2 Mounting of after part floating structure, Rodoko, and outriggers

When mounting a floating structure on the after part of canoe, Okinawa's Sabani hull form[2] was referred to. Also, a Rodoko and outrigger arms were bolted on the canoe for removal. In particular, the outrigger distance was adjustable in five stages (1.0m to 1.7m). The statical stability when the outrigger distance was arbitrarily varied was examined by inclining test and oscillation test. Thus, the outrigger distance that made working a Ro-scull able was examined.

2.3 Inclining test and oscillation test

The inclining test and the oscillation test were conducted under the following conditions depending on the set outrigger distance:

(1) Nobody onboard
(inclining test and oscillation test),
(2) One person onboard sitting down
(inclining test and oscillation test), and
(3) One person onboard standing up
(inclining test only).

The statical stability of canoe was examined from the data of inclining test and oscillation test. Although the test canoe was an outrigger one, the authors regarded it to be a standard dugout canoe and performed inclining tests. The experiment was conducted on the calm water of coastal area of Omura Bay in Nagasaki Prefecture where there was no wind and tide disturbance. The weight of portable weights used for the inclining test was 10 kilograms.

2.4 Reproduction of hull form and displacement calculation by ship design software

There was no drawing of the test canoe. Therefore, the hull form was measured by a pantograph. By using ship design software (MaxSurf), the hull form was reproduced and the displacement, etc. were calculated.

3. Result

3.1 Hull form refinement

The test canoe was refined as shown in Fig.1. Figure 2 and 3 show the drawings in which the hull form was reproduced by ship design software before and after the refinement.

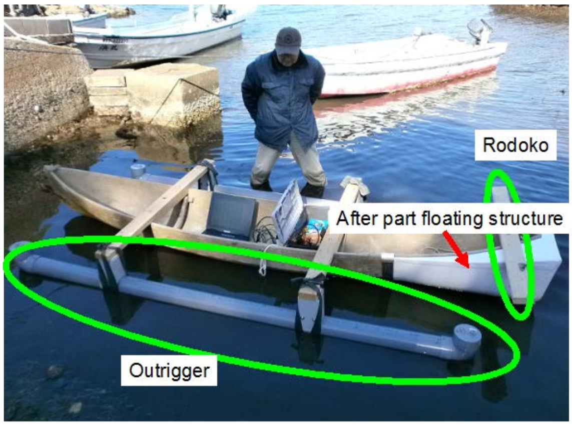

Fig.1 State of refined canoe

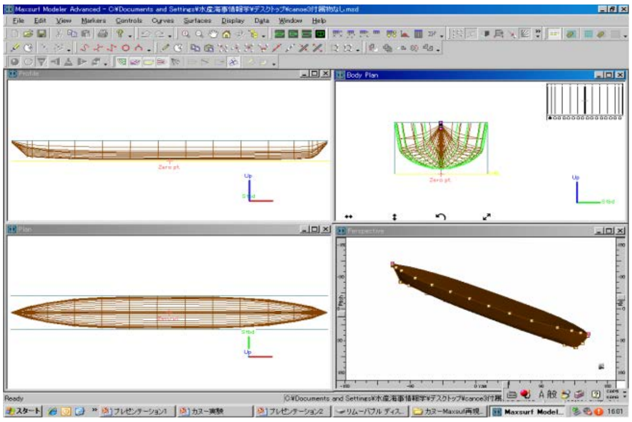

Fig.2 Reproduction by MaxSurf ship design software (Before refinement)

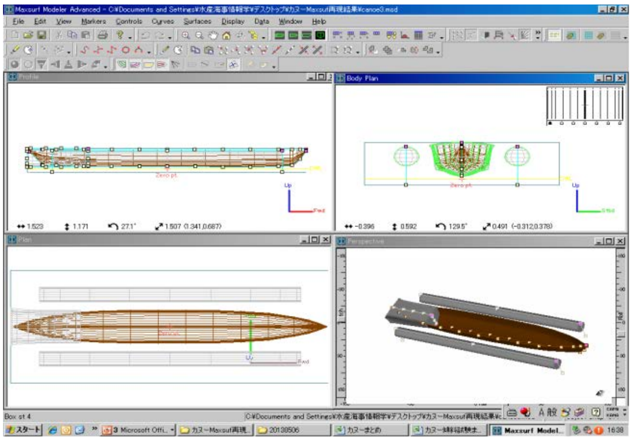

Fig.3 Reproduction by MaxSurf ship design software (After refinement)

3.2 Examination on stability and optimal outrigger distance by inclining test and oscillation test

The outrigger distance was arbitrarily varied, and the optimal outrigger distance was examined by inclining test and oscillation test. Fig.4 shows the placement of equipments in inclining test. Table 1 shows the weight of each equipment. Fig.5 shows an example of wave forms obtained in the actual inclining test. Based on these results, GM values when the outrigger distance was arbitrarily varied were calculated and shown in Fig.6. According to Figure 6, GM value with one person standing up became around 1.0 meter in the case of 1.3 meters outrigger distance. Then it was found that working a Ro-scull was possible.

The hull form was reproduced by ship design software. Fig.7 shows the calculated displacement of reproduced hull form. Where the draft when lightly loaded and nobody onboard was about 14 centimeters, the displacement became about 120 kilograms that was almost equal to the weight at the actual experiment.

Meanwhile, when outriggers were mounted, GM values calculated by ship stability software were shown in Fig.8. In the case of the narrowest outrigger distance of 1 meter, GM value became about 1.5 meters according to Fig.8. In the same distance, GM value obtained from inclining test was about 1.7 meters. GM value calculated by ship stability software was little smaller than that obtained from inclining test.

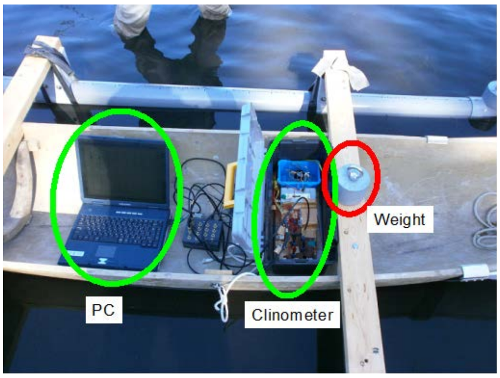

Fig.4 State of the placement of equipments in inclining test

4. Conclusion

In this study, the authors intended to transfer the skill of working a Ro-scull of Wasen to the canoe hull form. The authors refined the hull form of test canoe so that working a Ro-scull became able in the canoe. Figure 9 shows the state of working a Ro-scull in the canoe. As a result of this study, the following points became apparent.

Table 1 Weight of each test equipment

Specific weight of onboard equipments (Unit: kilogram)

1	Empty canoe weight		45	45	45	45
2	Outrigger arms One arm's weight is 5.3 kilograms (5.3kg×2)		10.6	10.6	10.6	10.6
3	Rodoko		2.1	2.1	2.1	2.1
4	Floating structure		6.1	6.1	6.1	6.1
5	Fixing rubber band		1.2	1.2	1.2	1.2
6	Outriggers One outrigger's weight is 6.7 kilograms (6.7kg×2)		13.4	13.4	13.4	13.4
7	Measuring instruments		21.7	21.7	26.5	26.5
	Breakdown	Weight	5.2	5.2	10	10
		Battery	8.2	8.2	8.2	8.2
		Sensor	4.1	4.1	4.1	4.1
		PC	4.2	4.2	4.2	4.2
8	Person onboard					56.8
	Total weight (kilograms)		100.1	100.1	104.9	161.7

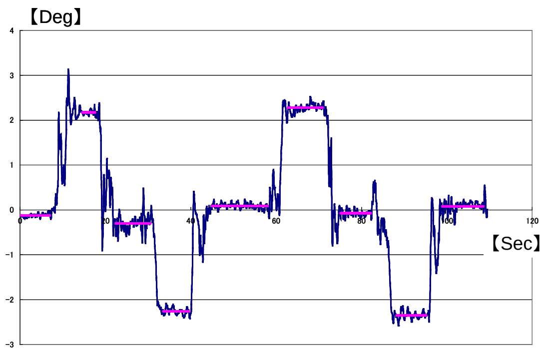

Fig.5 Example of wave forms in inclining test

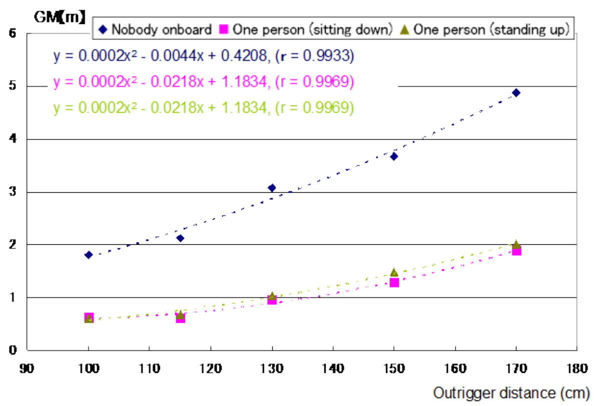

Fig.6 Relationship between outrigger distance and GM obtained by inclining test

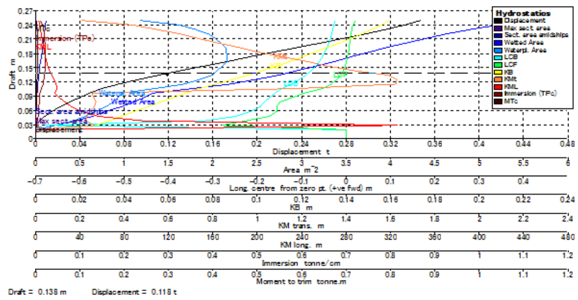

Fig.7 Displacement curves of test canoe by Hydromax ship stability software

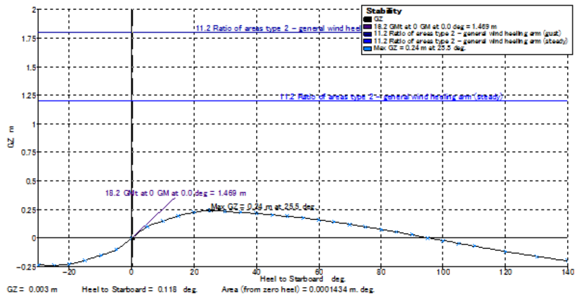

Fig.8 GM values of test canoe by Hydromax ship stability software

Fig.9 State of working a Ro-scull in the canoe

(1) It is difficult to work a Ro-scull standing up in the dugout canoe because of too small GM value and poor stability.

(2) When boarding the canoe, it is believed that there is a margin load carrying the weight to maintain the outrigger inclination. When one person boarded the canoe and worked a Ro-scull, in the case of outrigger distance of 1.3 meters, GM value became about 1 meter, and the stability increased.

(3) The hull form was reproduced by ship design software, and the drawings were obtained. A calculation was made by using such drawings. In consequence, although the displacement was almost equal to the actual measurement value, GM value was underestimated a little bit.

The breadth of canoe is narrower than that of Wasen. Therefore, the motion at working a Ro-scull is limited because of insufficient foot space. As future tasks to realize working a Ro-scull in the canoe, the improvement such as preparing more foot space will be needed.

Reference

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