Notes on the Resistances of Fishing Boats (1)

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The model tests with seven fihsing boats on the hull resistance were carried out and the results were compared with those calculated using the regression equation obtained by statistical analysis of resistance data for fishing boats.

1. Introduction

Although, the determination of resistance quality is very important for the fishing boats of which the length-beam and length-draft ratios are smaller than those of ordinary merchant ships, the model test has hardly carried out because of the relatively high cost in relation to the capital cost. The principal particulars of fishing boats are so various, as shown in the papers published by one of the authors in this Bulletin[1)~4)], that the conducting of any systematic experimental programme is difficult. The aboves are the main obstacles to progress in fishing boat design.

Food and Agriculture Organization of the United Nations (FAO) has, for a long time, collected results of model tests on fishing boats in many countries with Traung as the central figure. With those data, Doust, Hayes, Tsuchiya and Engvall had made the statistical analysis, and showed that the hull resistance criterion $C_R = R \times L/\Delta \times V$ proposed by Talfer may be expressed by a function of ten form parameters as follows,

$$C_R = f(L/B,\ B/T,\ C_m,\ C_p,\ l.c.b,\ \tfrac{1}{2}\alpha_e,\ \tfrac{1}{2}\alpha_r,\ \alpha_{BS},\ trim,\ a/A_{\max})$$

These ten parameters are those listed in section 2. Hayes and Engvall published the hull resistance regression equation for each of a number of values of speed-length ratio and their coefficients[5)]. These equations are reliable only when they are used in parameter regions of validity which are illustrated in Fig. 1 by oblique lines. Outside such regions, the equations can be grossly in error. Japanese fishing boats have larger prismatic and maximum area coefficients than those of European fishing boats, and the regions of validity of these form parameters are too narrow for Japanese boats to apply.

In order to make the regression equation more available to Japanese fishing boats, the model tests on hull resistance with seven fishing boat models, three of which were designed varying the position of the longitudinal center of buoyancy systematically, were carried out and the measured results were compared with those calculated using the regression equation.

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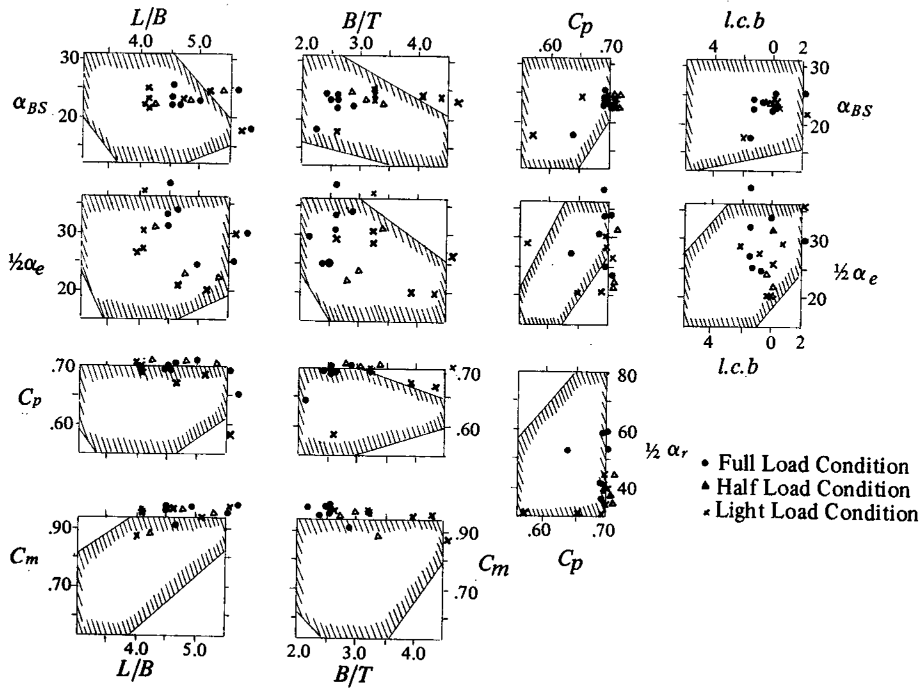


Fig. 1. Appreciable parameter regions.

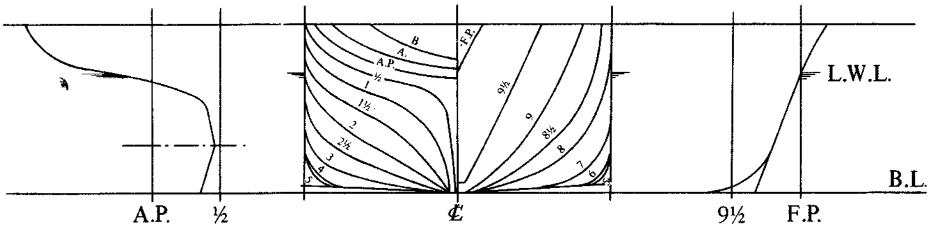
2. Nomenclature

$a/A_{\max}$	keel sectional area-maximum immersed sectional area ratio
L/B	length-beam ratio
B/T	beam-draft ratio
C_m	maximum area coefficient
C_p	prismatic coefficient
L	length on floating waterline in ft
C_{R16}	resistance coefficient when $L=16$ ft
$l.c.b$	position of the longitudinal center of buoyancy in relation to the midlength of L, expressed as a percentage of the length + indicates the position forward of $\frac{1}{2}L$ − indicates the position aft of $\frac{1}{2}L$
R	ship resistance in lb
V	ship speed in knots
$V/\sqrt{L}$	speed-length ratio in knots/$\sqrt{\text{ft}}$
Δ	displacement of ship in salt water in tons
α_{BS}	maximum buttock slope of the 1/4 beam buttock measured relative to the floating waterline in degree
$\frac{1}{2}\alpha_e$	the angle which the waterline makes with the center line at the stem in degree

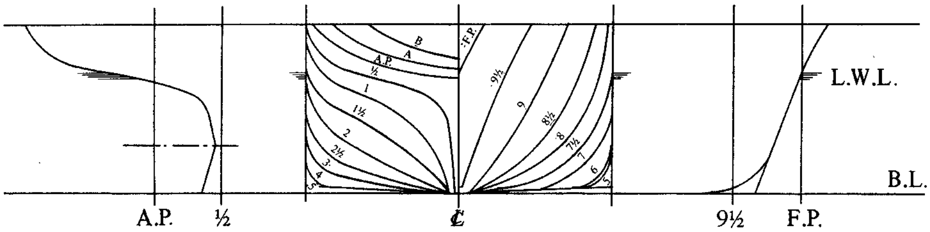
$\frac{1}{2}\alpha_r$	the maximum angle of run up to and including the designed floating waterline in degree
S	wetted area of the underwater body to waterline in m^2

3. Model and test condition

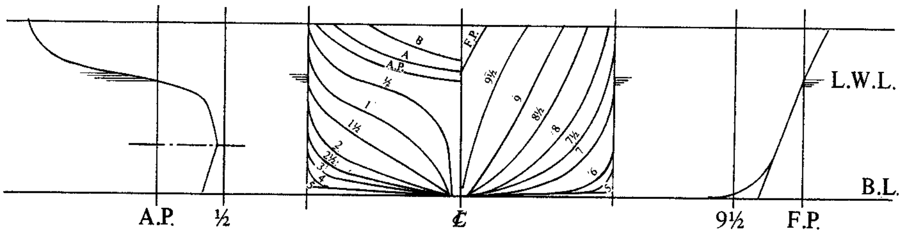
The body planes of models used in present paper are shown in Fig. 2 and 3 and



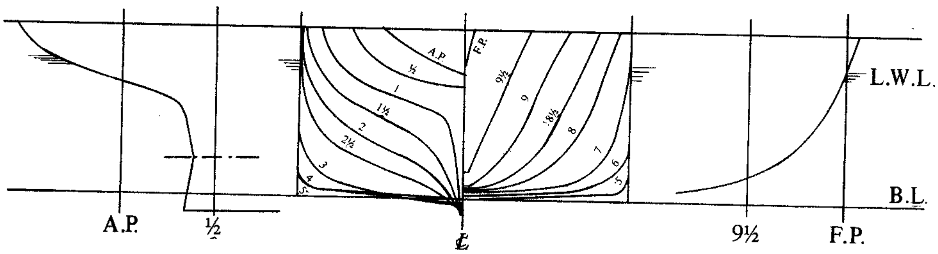
Model 7101



Model 7102



Model 7103



Model 6061

Fig. 2. Body planes of model.

Table 1.

Model	7101		7102		7103		6061	
Load Cond.	Full	Light	Full	Light	Full	Light	Full	Light
L/B	4.568	4.294	4.568	4.294	4.568	4.294	5.956	5.877
B/T	2.578	3.326	2.578	3.326	2.578	3.326	2.290	2.643
C_m	0.964	0.954	0.967	0.953	0.963	0.952	0.965	0.960
C_p	0.686	0.700	0.691	0.695	0.692	0.696	0.645	0.578
$\ell.c.b$	1.71	2.505	-0.052	0.509	-2.133	-1.924	-1.90	-1.54
$\frac{1}{2}\alpha_e$	40.0	37.0	33.5	30.0	30.0	28.0	30.5	30.0
$\frac{1}{2}\alpha_\gamma$	42.5	39.0	48.0	42.0	60.5	46.0	53.0	31.0
α_{BS}	23.0	23.0	24.5	24.5	27.0	27.0	18.0	18.0
trim	0.0	0.0	0.0	0.0	0.0	0.0	0.020	0.042
a/A_{max}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Δ	0.139	0.101	0.140	0.101	0.140	0.101	0.104	0.080
S	1.415	1.237	1.415	1.237	1.453	1.228	1.320	1.170

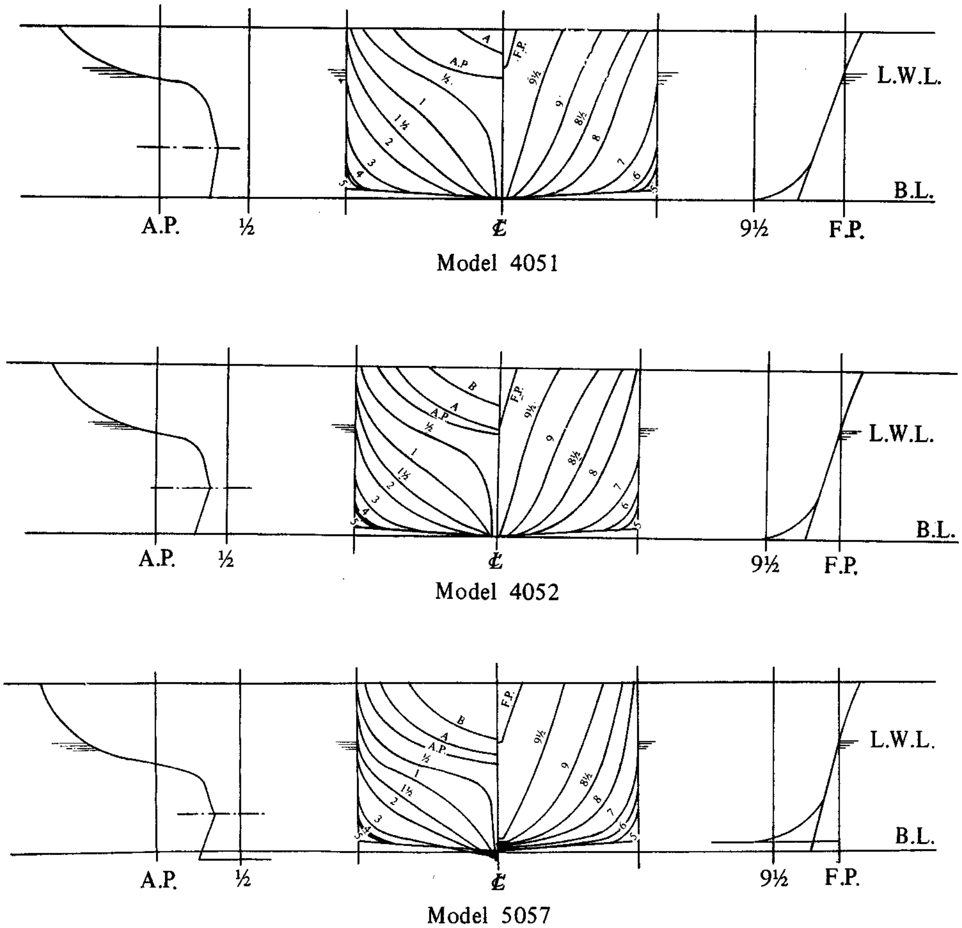


Fig. 3. Body planes of model.

Table 2.

Model	4052			4051			6061		
Load Cond.	Full	Half	Light	Full	Half	Light	Full	Half	Light
L/B	5.221	4.972	4.872	5.768	5.469	5.381	4.677	4.356	4.283
B/T	2.634	3.199	4.478	2.408	2.924	4.094	2.824	3.429	4.800
C_m	0.958	0.959	0.958	0.963	0.950	0.935	0.912	0.892	0.820
C_p	0.703	0.703	0.666	0.696	0.711	0.688	0.716	0.735	0.734
ℓc.b	-1.047	-0.710	-0.301	-1.248	-0.892	-0.533	-0.356	-0.181	0.0
$½\alpha_e$	24.25	23.75	20.5	25.0	22.5	20.0	34.0	32.5	27.5
$½\alpha_r$	54.0	34.5	36.0	35.0	33.5	30.5	59.5	42.5	36.0
$\alpha_{B.S}$	23.0	23.0	23.0	25.5	25.5	25.5	22.0	22.0	22.0
trim	0.0	0.0	0.0	0.0	0.0	0.0	0.015	0.013	0.015
a/A_{max}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Δ	0.126	0.100	0.656	0.116	0.091	0.062	0.126	0.096	0.063
S	1.441	1.275	1.052	1.388	1.239	1.039	1.404	1.233	1.041

test conditions are listed in Table 1 and 2 together with the form parameters. Three models from 7101 to 7103 which are the saury stick-held dip net boats are designed to investigate the influence of the position of the longitudinal center of buoyancy. The other four models are the tuna long liners which were built in Japan. The form parameters of these seven models are plotted in Fig. 1, from which it is found that many parameters are out of the regions of validity and that the C_m and the C_p are especially large.

The models had been made of wood and the turblence stimulators were fitted at 9½ station. The model tests were carried out in Experimental Tank of University of Osaka Prefecture (70 m$\times$2.95 m$\times$1.6 m).

4. Model test results and their considerations

All measured results are extrapolated to the models of 16 feet length using the ITTC friction coefficient and compared with the calculated ones by the regression equation as shown in Fig. 4 to 10. Although, many form parameters of Japanese fishing boats were out of the regions of validity, the calculations were carried out in disregard of the regions. Generally speaking, the results obtained from the regression equation are under-estimated and the differences between the measured and calculated results are not so large in full load condition while they are considerably large in light load condition.

Taking the position of longitudinal center of buoyancy more aft, the values of $½\alpha_r$ and α_{BS} may become large and the value of $½\alpha_e$ small as shown in Table 1. In the regression equation, there are 12, 17, 3 and 13 terms containing the powers and the products of powers of the *l.c.b*, the $½\alpha_e$, the $½\alpha_r$ and the α_{BS} respectively. The resistance coefficients calculated varying the above four parameters are nearly constant as shown in Fig. 4 to 6, in spite of the fact that almost of the four parameters are within the regions of validity.

On the other hand, the measured results show clearly that the resistance decreases with taking the *l.c.b* more aft. The *l.c.b* series test were carried out with even keel. The change of trim is accompanied by the movement of the position of the longitudinal center of bouyancy. The effect of the *l.c.b* on the resistance could not be discussed enough, however, it will be discussed in the later report taking into account of the effect of change of trim.

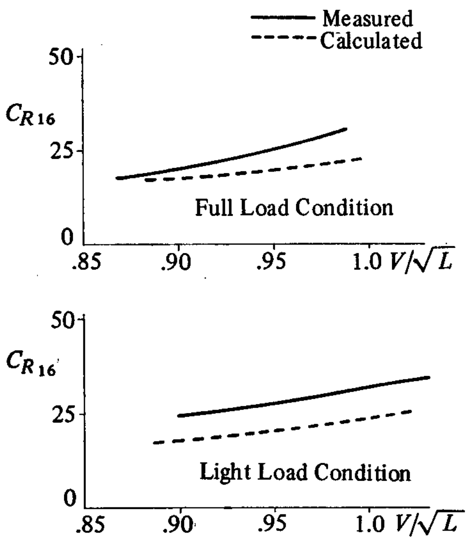


Fig. 4. C_{R16} of model 7101.

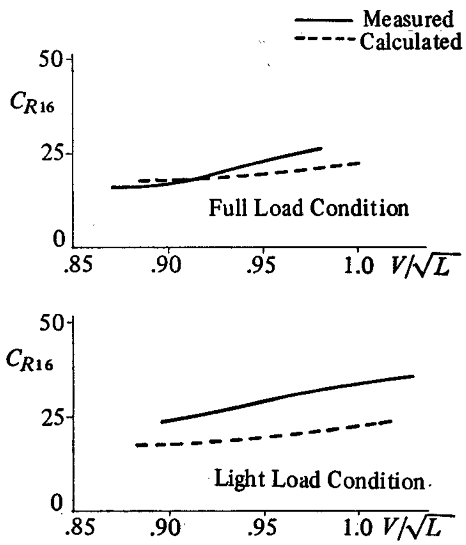


Fig. 5. C_{R16} of model 7102.

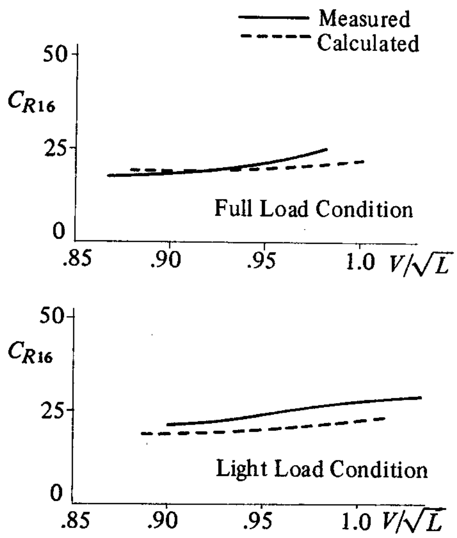


Fig. 6 C_{R16} of model 7103.

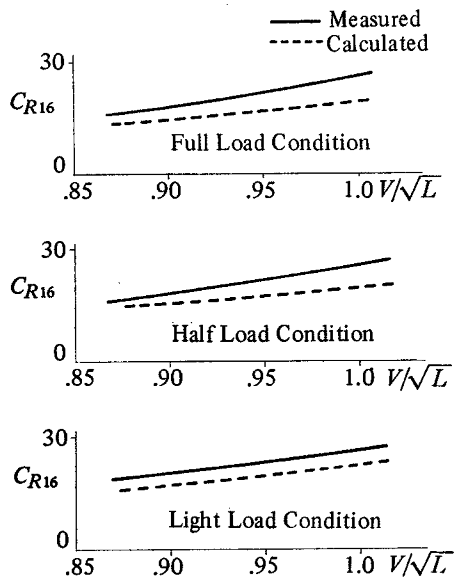


Fig. 7. C_{R16} of model 4051.

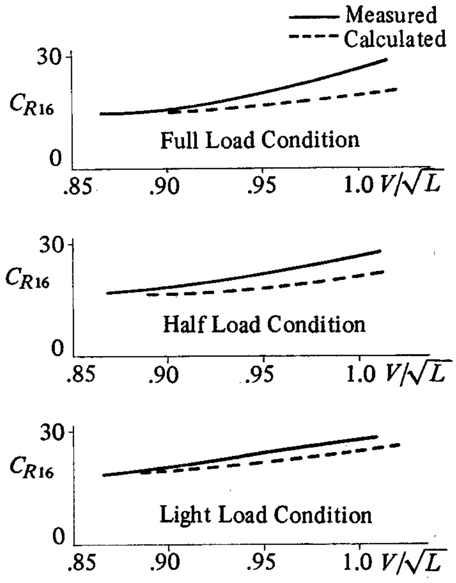


Fig. 8. C_{R16} of model 4052.

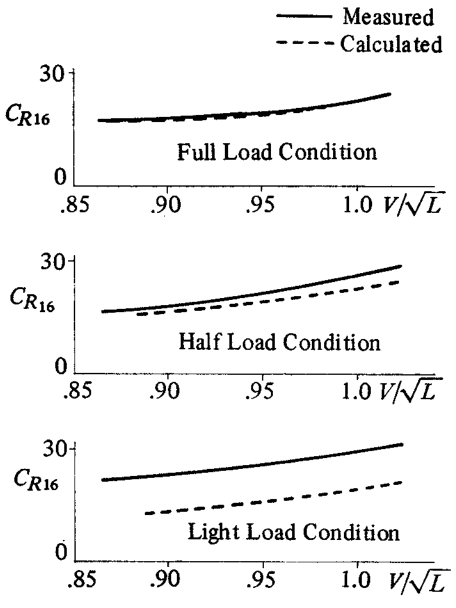


Fig. 9. C_{R16} of model 5057.

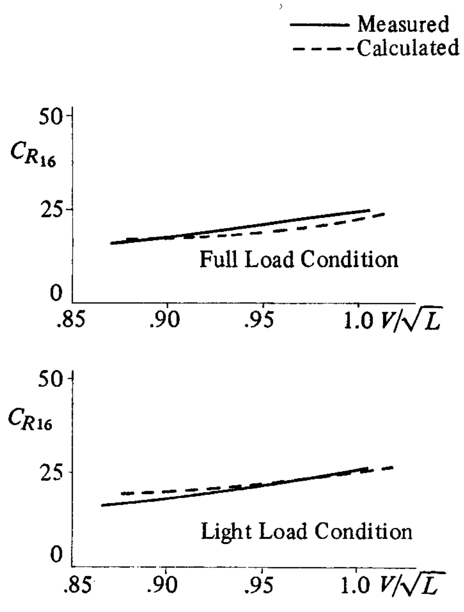


Fig. 10. C_{R16} of model 6061.

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ical calculation were made using TOSBAC-3400 type computer of Computation Center, University of Osaka Prefecture.

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