

Figure 5-11 Oil Tanker DWT-DSP

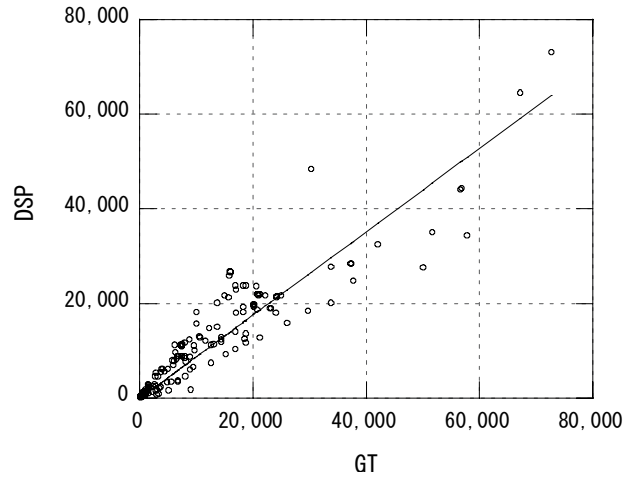


Figure 5-12 Roll-on/Roll-off Ship DSP-GT

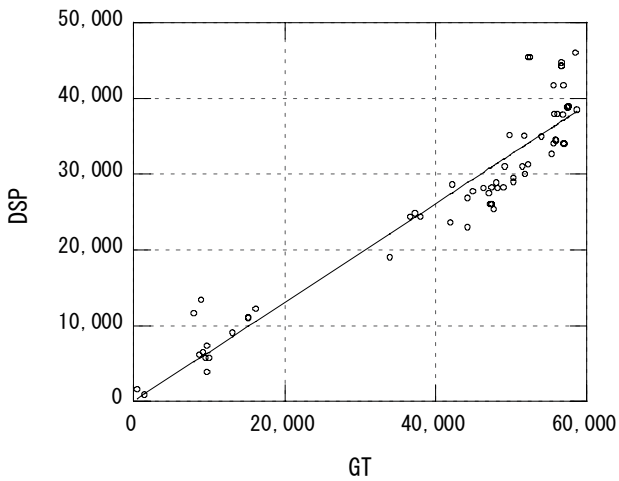


Figure 5-13 Pure Car Carrier Ship DSP-GT

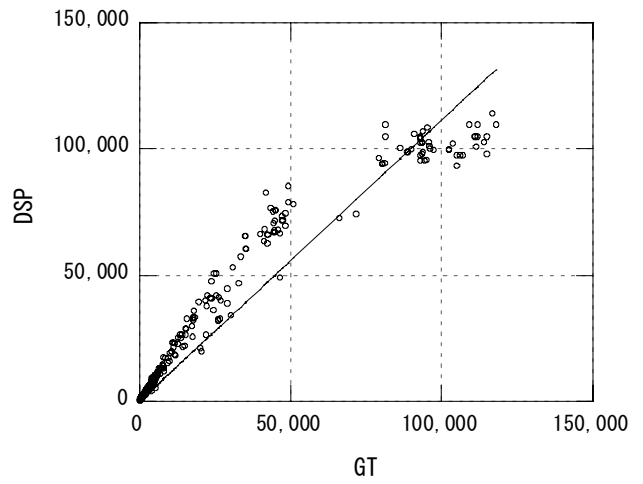


Figure 5-14 LPG Ship GT-DSP

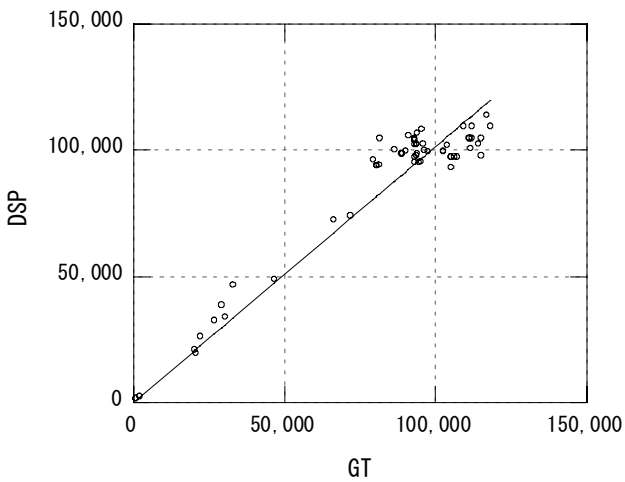


Figure 5-15 LNG Ship GT-DSP

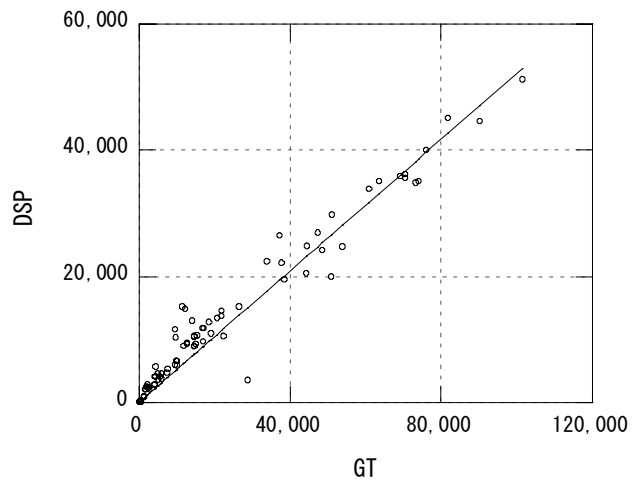


Figure 5-16 Passenger Ship GT-DSP

5.3 Block coefficient (Cb) and gross tonnage (GT) or dead weight tonnage (DWT)

The results of analyzing Cb calculated by the following equation for DWT or for GT are shown in **Figure 5-17** to **Figure 5-24**. It was analyzed only for the results of 0.4 to 1.0 considering the properties of Cb. From this figure, the average value analysis method was applied, with its results shown in **Table 5-3**. So Cb is the value calculated by the following equation.

$$Cb = \text{DSP} / (L_{pp} \cdot B \cdot d \cdot \text{sea water density})$$

Table 5-3 Block coefficient (Cb)

Type	50%	Standard deviation (σ)
General Cargo Ship	0.804	0.0712
Container Ship	0.668	0.0472
Oil Tanker	0.824	0.0381
Roll-on/Roll-off Ship	0.670	0.1140
Pure Car Carrier	0.594	0.0665
LPG Ship	0.737	0.0620
LNG Ship	0.716	0.0399
Passenger Ship	0.591	0.0595

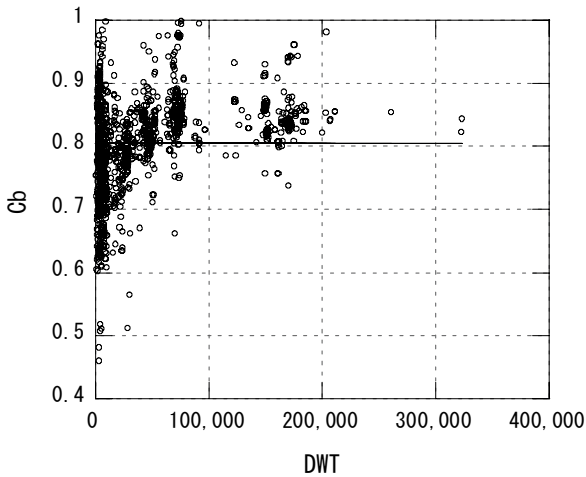


Figure 5-17 Cargo Ship DWT-Cb

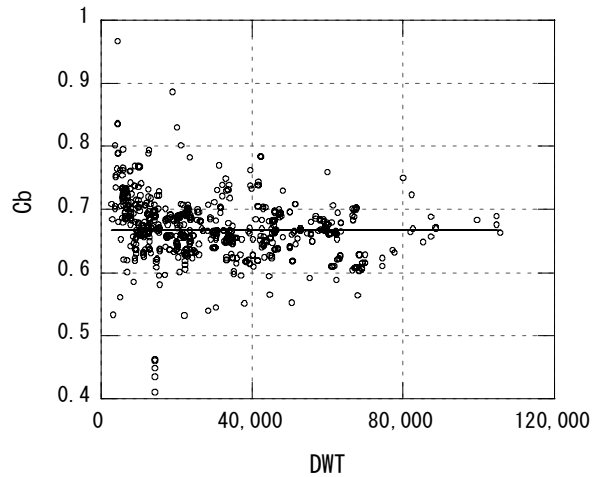


Figure 5-18 Container Ship DWT-Cb

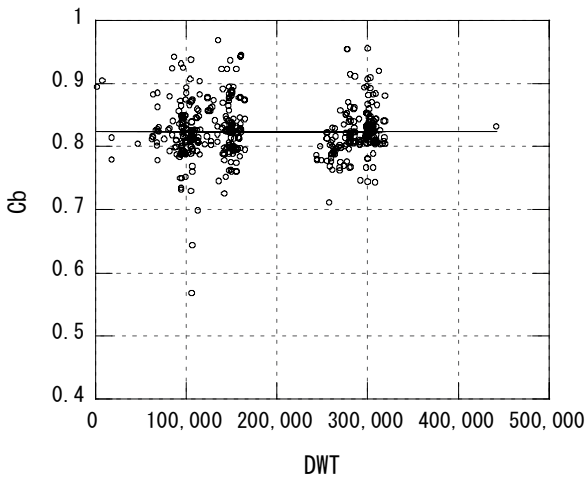


Figure 5-19 Oil Tanker DWT-Cb

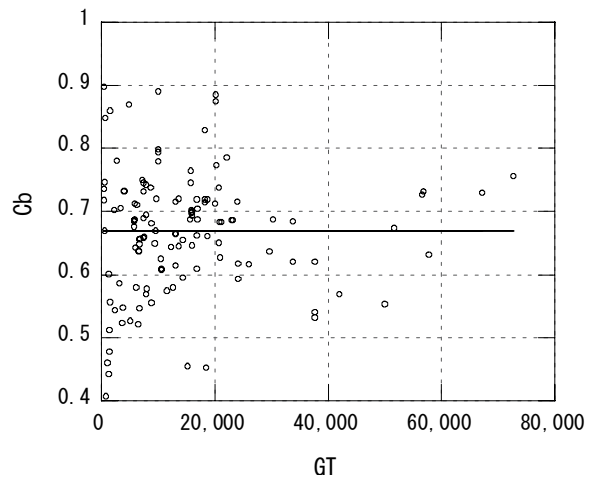


Figure 5-20 Roll-on/Roll-off Ship Cb-GT

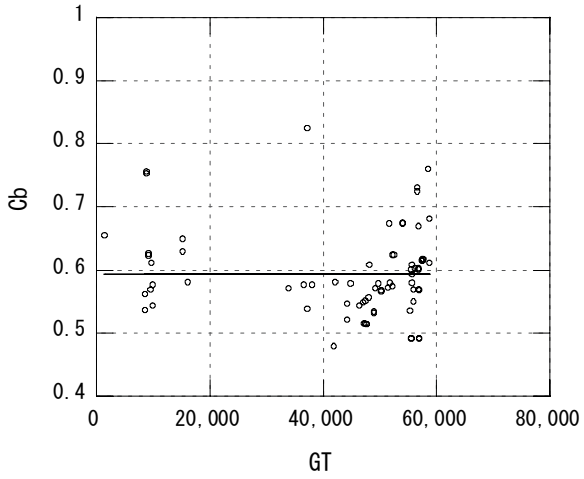


Figure 5-21 Pure Car Carrier Ship Cb-GT

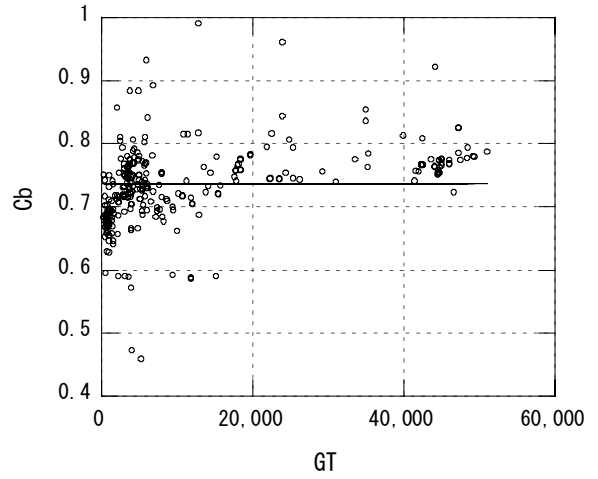


Figure 5-22 LPG Ship GT-Cb

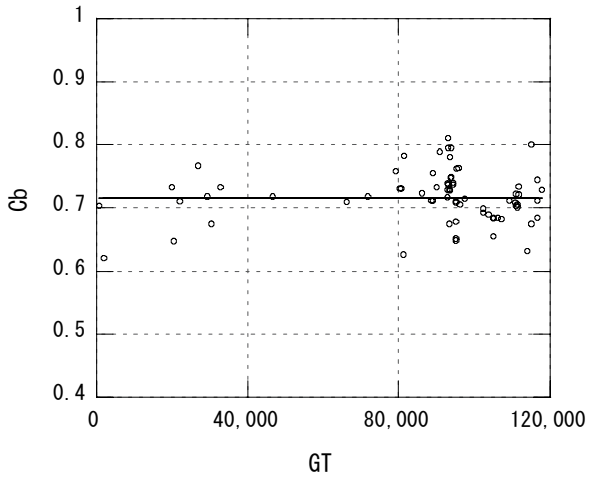


Figure 5-23 LNG Ship GT-Cb

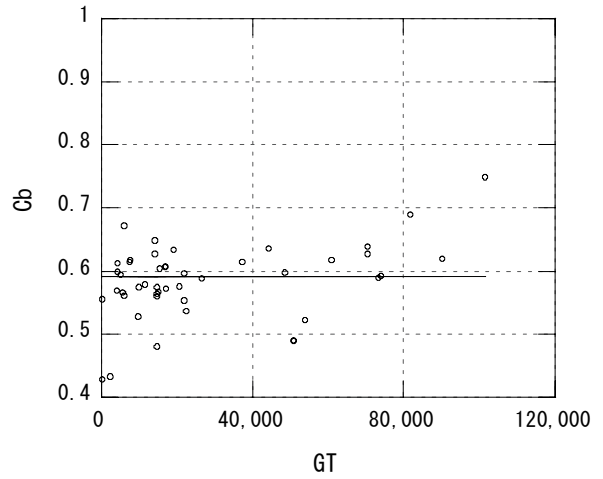


Figure 5-24 Passenger Ship GT-Cb

5.4 Wind projected front area (Ax) and the wind projected lateral area (Ay)

Because it is difficult to obtain new data for Ax and Ay, **Table 5-4** shows the results of the following equation proposed by Akakura and Takahashi³⁾. Here the category “cargo ship” is further categorized as general cargo ship and as bulk carrier.

$$\log_{10} (Y) = \alpha_w + \beta_w \cdot \log_{10} (X)$$

Where:

Y : Ax or Ay (m²)

X : DWT or GT of the ship analyzed (tons)

α_w , β_w : coefficients

Table 5-4 Coefficient used to estimate Ax, Ay

1) Fully loaded

	Unit	Coefficient used to estimate Ax				Coefficient used to estimate Ay			
		α_w	β_w	R ²	σ	α_w	β_w	R ²	σ
General Cargo Ship	DWT	-0.228	0.666	0.929	0.0451	0.507	0.616	0.824	0.1302
Bulk Carrier	DWT	0.944	0.370	0.823	0.0497	1.218	0.425	0.841	0.0729
Container Ship	DWT	0.136	0.609	0.812	0.0598	0.417	0.703	0.949	0.0675
Oil Tanker	DWT	0.469	0.474	0.901	0.0625	0.556	0.558	0.931	0.0708
Roll-on/Roll-off Ship	DWT	1.029	0.435	0.901	0.0469	1.453	0.464	0.719	0.1453

2) With ballast

	Unit	Coefficient used to estimate Ax				Coefficient used to estimate Ay			
		α_w	β_w	R ²	σ	α_w	β_w	R ²	σ
General Cargo Ship	DWT	0.099	0.615	0.935	0.0365	0.479	0.662	0.906	0.1007
Bulk Carrier	DWT	0.629	0.469	0.935	0.0376	0.970	0.530	0.956	0.0460
Container Ship	DWT	0.574	0.526	0.696	0.0741	0.731	0.625	0.819	0.1016
Oil Tanker	DWT	0.251	0.551	0.962	0.0408	0.650	0.592	0.984	0.0333
Roll-on/Roll-off Ship	DWT	0.917	0.473	0.910	0.0453	1.541	0.456	0.792	0.1123

6. Summary tables

Table 6-1 organize all the items analyzed as reported in Part 3. Here, not only the 75% coverage rate, but the results of analysis for the 50% coverage rate and for the 95% coverage rate are also shown. The breadth molded: B that is one of the analytic items was not corrected as Panamax type as it was done in 3.1, 3.2, and 3.8.

Table 6-1 Ship Dimensions

• Coverage rate : 50%

Type	Dead Weighth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Type	Gross Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	
Cargo Ship	5,000	101	94	15.9	5.8	Roll-on/ Roll-off	5,000	105	96	18.2	4.7	
	7,000	111	104	17.5	6.5		7,000	118	109	19.6	5.2	
	10,000	123	116	19.4	7.3		10,000	133	124	21.3	5.9	
	15,000	139	131	21.8	8.4		15,000	154	144	23.4	6.7	
	20,000	151	143	23.7	9.2		20,000	170	159	25.0	7.4	
	30,000	170	162	26.6	10.0		40,000	187	170	32.3	9.5	
	50,000	198	189	30.7	11.8		50,000	199	181	32.3	9.5	
	70,000	219	210	33.8	13.2		60,000	199	181	32.3	9.5	
	100,000	243	234	37.4	14.8		Pure Car Carrier Ship	5,000	95	81	17.3	4.8
	150,000	274	264	42.0	16.9			7,000	105	93	18.6	5.3
200,000	298	289	45.6	18.5	10,000	117		106	20.2	5.8		
Container Ship	5,000	105	97	17.2	6.1	LPG Ship	5,000	111	104	17.8	6.6	
	7,000	118	109	19.0	6.8		7,000	123	116	19.6	7.2	
	10,000	133	124	21.2	7.6		10,000	138	130	21.7	8.0	
	15,000	154	143	23.9	8.7		15,000	157	148	24.4	9.0	
	20,000	170	159	26.1	9.5		20,000	172	162	26.5	9.7	
	30,000	195	183	29.5	10.8		30,000	195	185	29.7	10.9	
	50,000	261	246	32.4	12.3		50,000	230	218	34.4	12.6	
	70,000	281	268	38.7	13.8		60,000	243	231	36.2	13.3	
Oil Tanker	5,000	95	94	15.4	5.7	LNG Ship	5,000	107	100	17.9	5.9	
	7,000	104	105	16.8	6.3		7,000	119	112	19.8	6.3	
	10,000	136	129	19.9	6.9		10,000	134	126	22.0	6.9	
	15,000	151	143	22.6	7.8		15,000	153	144	24.9	7.5	
	20,000	162	155	24.8	8.4		20,000	168	159	27.2	8.0	
	30,000	180	172	28.2	9.4		30,000	192	181	30.8	8.8	
	50,000	205	196	33.1	10.9		50,000	227	215	36.0	9.9	
	70,000	223	214	36.9	12.3		70,000	253	241	39.9	10.7	
	100,000	244	234	41.3	14.0		100,000	284	271	44.4	11.6	
	Passenger Ship	5,000	103	90	15.8		4.0	Passenger Ship	5,000	103	90	15.8
7,000		115	101	17.1	4.4	7,000	115		101	17.1	4.4	
10,000		130	113	18.6	5.0	10,000	130		113	18.6	5.0	
15,000		150	130	20.4	5.7	15,000	150		130	20.4	5.7	
20,000		165	143	21.9	7.0	20,000	165		143	21.9	7.0	
30,000		190	163	24.0	7.0	30,000	190		163	24.0	7.0	
50,000		227	193	31.6	7.0	50,000	227		193	31.6	7.0	
70,000		255	216	31.6	8.0	70,000	255		216	31.6	8.0	
100,000	288	243	31.6	8.0	100,000	288	243	31.6	8.0			

• Coverage rate : 75%

Type	Dead Weight Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Type	Gross Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)
Cargo Ship	5,000	107	99	17.0	6.4	Roll-on/	5,000	117	105	20.4	5.5
	7,000	118	110	18.7	7.2	Roll-off	7,000	131	119	22.0	6.2
	10,000	132	123	20.7	8.1		10,000	149	136	23.9	6.9
	15,000	148	139	23.2	9.2		15,000	171	157	26.2	7.9
	20,000	161	152	25.2	10.2		20,000	189	175	28.0	8.7
	30,000	182	171	28.3	10.5		40,000	194	174	32.3	9.7
	50,000	211	200	32.7	12.4		50,000	208	189	32.3	9.7
	70,000	233	222	36.0	13.8		60,000	208	189	32.3	9.7
	100,000	259	247	39.8	15.5	Pure Car Carrier Ship	5,000	104	88	18.0	5.4
	150,000	292	279	44.7	17.7		7,000	115	100	19.4	5.9
200,000	318	305	48.5	19.4	10,000		128	115	20.9	6.5	
300,000	358	345	54.5	22.1	15,000		145	134	22.9	7.3	
Container Ship	5,000	109	101	17.9	6.3		20,000	158	150	24.4	7.9
	7,000	123	114	19.8	7.1		30,000	179	175	26.7	8.8
	10,000	139	129	22.0	7.9		40,000	185	175	31.9	9.3
	15,000	160	149	24.9	9.0		50,000	203	194	32.3	10.4
	20,000	177	165	27.1	9.9		60,000	203	194	32.3	10.4
	30,000	203	191	30.7	11.2	LPG Ship	5,000	116	109	18.6	7.3
	50,000	274	258	33.2	12.7		7,000	129	121	20.5	8.0
	70,000	286	274	40.9	14.1		10,000	144	136	22.7	8.9
100,000	350	335	42.8	14.7	15,000		164	155	25.5	9.9	
Oil Tanker	5,000	100	97	16.7	6.3		20,000	179	170	27.7	10.8
	7,000	110	109	18.2	6.9		30,000	204	193	31.1	12.1
	10,000	139	131	20.6	7.6		50,000	240	228	36.0	14.0
	15,000	154	146	23.4	8.6		60,000	254	242	37.9	14.7
	20,000	166	157	25.6	9.3	LNG Ship	5,000	111	103	18.2	6.1
	30,000	184	175	29.1	10.4		7,000	123	116	20.2	6.6
	50,000	209	199	34.3	12.0		10,000	139	130	22.5	7.2
	70,000	228	217	38.1	12.9		15,000	158	149	25.5	7.9
	100,000	250	238	42.7	14.8		20,000	174	164	27.8	8.4
	150,000	277	265	48.6	17.2		30,000	199	188	31.4	9.2
200,000	334	321	59.4	19.2	50,000	235	223	36.7	10.4		
300,000	334	321	59.4	22.4	70,000	262	249	40.7	11.2		
						100,000	294	281	45.4	12.1	
						Passenger Ship	5,000	115	104	18.6	5.1
							7,000	130	117	20.1	5.7
							10,000	146	131	21.8	6.4
							15,000	168	150	24.0	7.3
							20,000	186	165	25.7	7.8
							30,000	214	189	28.2	7.8
							50,000	255	224	32.4	7.8
						70,000	286	250	32.4	8.1	
						100,000	324	281	32.4	8.1	

• Coverage rate : 95%

Type	Dead Weight Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Type	Gross Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)		
Cargo Ship	5,000	118	108	18.5	7.4	Roll-on/ Roll-off	5,000	137	120	24.0	7.0		
	7,000	130	119	20.4	8.3		7,000	154	136	26.0	7.8		
	10,000	145	133	22.6	9.3		10,000	174	155	28.2	8.8		
	15,000	163	150	25.4	10.6		15,000	200	179	30.9	10.0		
	20,000	177	164	27.5	11.7		20,000	222	199	33.0	11.0		
	30,000	200	186	30.9	11.2		40,000	204	179	32.3	9.9		
	50,000	232	217	35.8	13.3		50,000	217	201	32.3	9.9		
	70,000	256	240	39.4	14.8		60,000	217	201	32.3	9.9		
	100,000	285	268	43.6	16.6		Pure Car Carrier Ship	5,000	119	98	19.0	6.4	
	150,000	321	303	48.9	18.9			7,000	132	112	20.5	7.0	
200,000	349	330	53.1	20.8	10,000	147		128	22.1	7.7			
300,000	394	373	59.6	23.7	15,000	166		150	24.2	8.6			
Container Ship	5,000	116	107	18.9	6.7		20,000	181	167	25.8	9.3		
	7,000	130	121	20.9	7.4		30,000	205	196	28.2	10.4		
	10,000	147	137	23.3	8.3		40,000	192	182	33.4	10.0		
	15,000	170	158	26.3	9.5		50,000	214	204	32.4	11.2		
	20,000	187	175	28.7	10.4		60,000	214	204	32.4	11.2		
	30,000	216	203	32.4	11.9		LPG Ship	5,000	123	116	19.9	8.4	
	50,000	294	276	34.4	13.2			7,000	137	129	21.9	9.3	
	70,000	293	281	44.0	14.5			10,000	153	145	24.3	10.3	
100,000	361	342	43.2	14.9	15,000	174		165	27.3	11.5			
Oil Tanker	5,000	108	103	18.8	7.2		20,000	191	181	29.6	12.5		
	7,000	118	115	20.5	8.0		30,000	217	206	33.3	14.0		
	10,000	144	135	21.6	8.8		50,000	255	243	38.5	16.2		
	15,000	159	150	24.6	9.8		60,000	270	258	40.5	17.1		
	20,000	171	161	26.9	10.7		LNG Ship	5,000	116	108	18.8	6.6	
	30,000	190	179	30.6	11.9			7,000	130	121	20.8	7.1	
	50,000	216	204	36.0	13.8			10,000	146	137	23.2	7.7	
	70,000	235	223	40.1	13.8			15,000	167	156	26.2	8.4	
	100,000	258	244	44.9	15.8			20,000	183	172	28.6	9.0	
	150,000	286	271	51.0	18.5			30,000	209	197	32.4	9.9	
	200,000	339	326	61.0	20.6			50,000	247	234	37.8	11.1	
	300,000	339	326	61.0	24.0			70,000	275	262	41.9	11.9	
									100,000	309	295	46.7	13.0
									Passenger Ship	5,000	137	129	23.4
7,000						153				144	25.3	8.1	
10,000						173				162	27.5	9.1	
15,000						199				186	30.2	10.4	
20,000						220				204	32.3	8.9	
30,000						253				234	35.6	8.9	
50,000						302				277	33.5	8.9	
70,000						339				309	33.5	8.3	
100,000						383				348	33.5	8.3	

7. Conclusion

This report has presented the results of research on ship dimensions and the Standards for the Main Dimensions of Ships (Draft) based on statistical analysis carried out by the Port Planning Division, Port and Harbour Department, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport in preparation for the revision of the Technical Standards and Commentaries of Port and Harbor Facilities (scheduled for 2006).

The results of this paper differ partially from the results in the Japanese Language Report²⁾, that contains the results of research applied to revise the Technical Standards and Commentaries of Port and Harbor Facilities (scheduled for 2006) that is the foundation of this report. It differs because the Japanese Language Report, Study on Ship Dimensions by Statistical Analysis (Research Report of National Institute for Land and Infrastructure Management, No.28,2006) partially dealt with ships unique to Japan.

(Received on February 15.2006)

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- 2) Hironao TAKAHASHI, Ayako GOTO, Motohisa ABE :Study on Ship Dimensions by Statistical Analysis -Standard of Main Dimensions of Design Ship (Draft)-,Research Report of National Institute for Land and Infrastructure Management, No.28, 2006.3 (in Japanese)
- 3)Yasuhiro AKAKURA, Hironao TAKAHASHI:Ship Dimensions of Design Ship under Given Confidence Limits,Technical Note of P.H.R.I. , No.911 , 1998.9