(2) Analysis of container ships by type (Under-Panamax, Panamax, Over-Panamax)

In **Figure 3-10**, the B analysis diagram for DWT, B is a constant value of about 32m from approximately 30,000DWT regardless of the increase of DWT, and over 50,000DWT, it clearly rises discretely. This is caused by restrictions on overall width of ships passing through the Panama Canal. A ship shape with B that is the maximum overall width (32.3m) that can pass through the canal is called Panamax type. If B does not reach approximately 32m, it is called Under-Panamax type, and if it exceeds approximately 32m, it is called Over-Panamax type. Therefore with B = 32 m as the threshold, they are analyzed in three types: Under-Panamax, Panamax, and Over-Panamax types.

1) Under-Panamax type (**Figure 3-41** to **Figure 3-44**)

All Loa, Lpp, B, and d were analyzed by the logarithmic regression analysis method, obtaining $R^2 = 0.930$ for Loa, $R^2 = 0.932$ for Lpp, $R^2 = 0.918$ for B, and $R^2 = 0.915$ for d. But for B, the results of the logarithmic regression analysis method were used only up to 30,000DWT, and the average value was used for 40,000DWT. This is because the results for 40,000DWT that was analyzed applying the logarithmic regression analysis method exceeded 32.3. **Table 3-3** shows the results of analysis of each main dimension according to the ship class that was set.

2) Panamax type

i) Loa, Lpp (**Figure 3-45** to **Figure 3-46**)

Both Loa and Lpp were analyzed by the logarithmic regression analysis method, obtaining $R^2 = 0.818$ for Loa and $R^2 = 0.839$ for Lpp.

ii) B (**Figure 3-47**)

B was analyzed by the average value analysis method.

iii) d (**Figure 3-48**

d was analyzed by the linear regression analysis method, obtaining $R^2 = 0.645$. **Table 3-4** shows the results of analysis of each main dimension according to the ship class that was set.

3) Over-Panamax type (**Figure 3-49** to **Figure 3-52**)

Loa, Lpp, B, and D, were analyzed by the average value analysis method, with the following classification set for ships of 55,00DWT and higher.

- 55,000DWT or higher, less than 65,000DWT
- 65,000DWT or higher, less than 75,000DWT
- 75,000DWT or higher, less than 100,000DWT

Table 3-5 shows the results of analysis of each main dimension according to the ship class that was set.

And in the case of the Over-Panamax type, **Table 3-6** presents the one-fourth value (25% value) and the three-fourth value (75% value) when, instead of statistical analysis results, the dimension for each ship class are aligned in rising order.

4) Super-large Container Ship – 1 (100,000DWT or more)

Table 3-7 shows the specific main dimensions for super-large Container Ship (100,000DWT or more) because the number of this class is limited.

5) Super-large Container Ship – 2 (8,000TEU or more)

Table 3-8 shows the specific main dimensions for super-large Container Ship (8,000TEU or more) because the number of this class is limited.

Table 3-3 The results of analysis of main dimensions (Under-Panamax)

Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Reference：the number of containers that can be loaded (TEU)
5,000	109	101	17.9	6.3	300 ～ 500
10,000	139	129	22.0	7.9	630 ～ 850
20,000	177	165	27.0	10.0	1,300 ～ 1,500
30,000	203	191	30.4	11.4	2,000 ～ 2,200
40,000	225	211	30.6	12.5	2,600 ～ 2,900

Table 3-4 The results of analysis of main dimensions (Panamax)

Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Reference：the number of containers that can be loaded (TEU)
30,000	201	187	32.3	11.3	2,100 ～ 2,400
40,000	237	223	32.3	12.0	2,800 ～ 3,200
50,000	270	255	32.3	12.7	3,400 ～ 3,900
60,000	300	285	32.3	13.4	4,000 ～ 4,600

Table 3-5 The results of analysis of main dimensions (Over-Panamax)

Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)
60,000	285	268	40.0	13.8
70,000	280	266	40.0	14.0
85,000	304	292	42.8	14.5

Table 3-6 The results of analysis of main dimensions (Over Panamax) 25%/75%

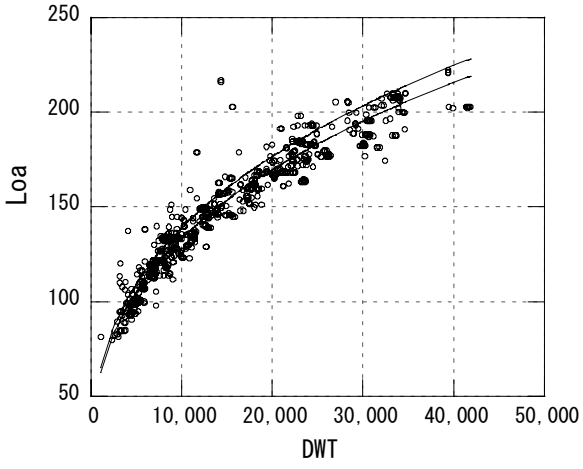
Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Reference：the number of containers that can be loaded (TEU)
60,000	275／285	260／268	37.2／40.0	12.7／13.8	4,300 ～ 5,400
70,000	276／280	263／266	40.0／40.0	14.0／14.0	5,300 ～ 5,600
80,000～100,000	300／304	285／292	40.0／42.8	13.5／14.5	6,300 ～ 6,700

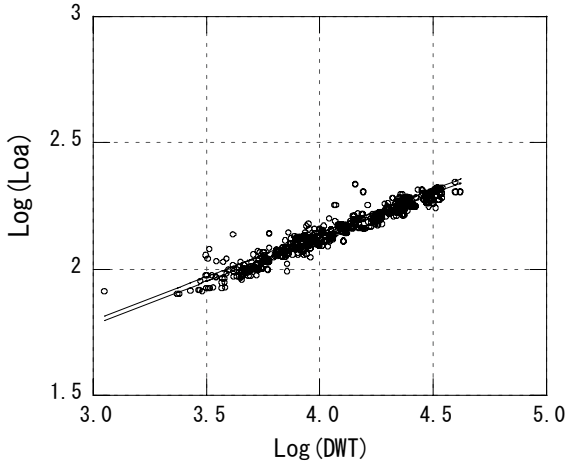
Table 3-7 The super-large container ships (100,000DWT or more)

Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Reference：the number of containers that can be loaded (TEU)
100,019	320	—	42.8	14.5	7,179
104,690	347	332	42.8	14.5	7,226
104,696	347	332	42.0	14.5	7,226
104,700	347	332	42.0	14.5	7,226
104,750	347	332	42.8	14.5	7,226
104,750	353	336	42.8	15.0	7,900

Table 3-8 The super-large container ships (80,000TEU or more)

Dead Weigth Tonnage (t)	Length Overall (m)	Length P.P. (m)	Breadth Molded (m)	Full Load Draft (m)	Reference : the number of containers that can be loaded (TEU)
99,518	323	308	42.8	14.5	8,063
101,898	334	—	42.8	14.5	8,238
97,517	335	—	42.8	14.0	8,450
101,612	334	—	42.8	14.5	8,468





$Y=\alpha \cdot X^{\beta}$

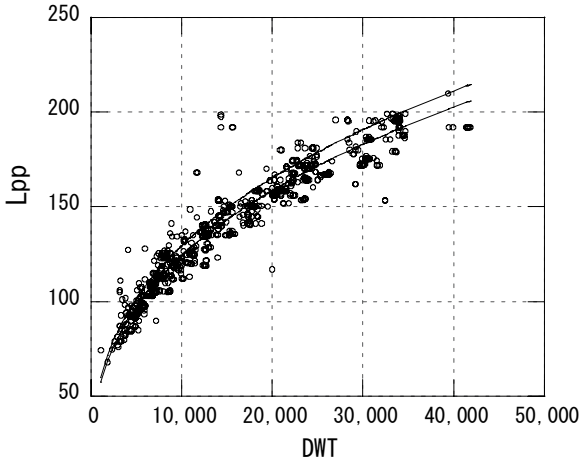
	50%	75%
α	5.4713	5.6992
β	0.3467	0.3467

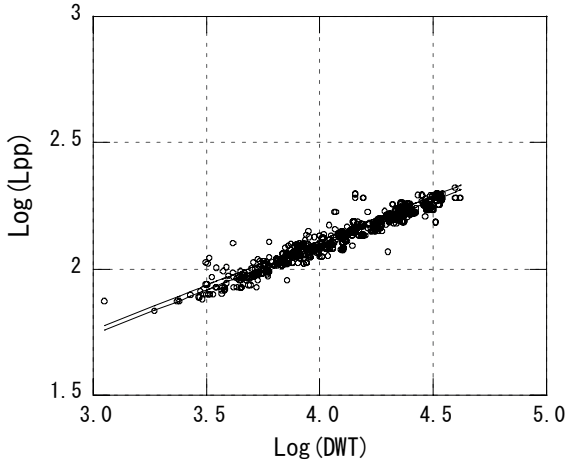
$\log Y=a+b\log X$

(R^2= 0.930 , σ= 0.026)

	50%	75%
a	0.7381	0.7558
b	0.3467	0.3467

Figure 3-41 Container Ship (Under-Panamax)Loa-DWT





$Y=\alpha \cdot X^{\beta}$

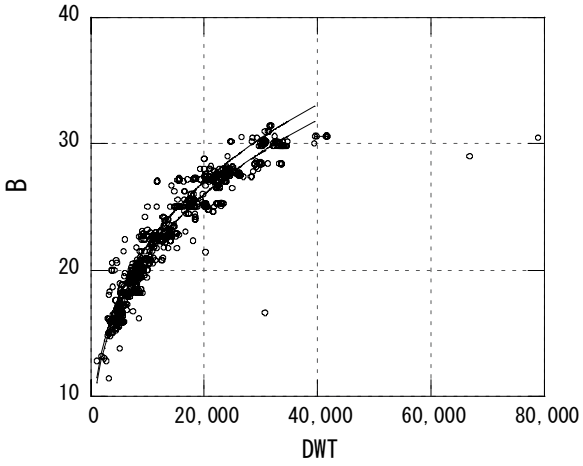
	50%	75%
α	4.7889	4.9920
β	0.3534	0.3534

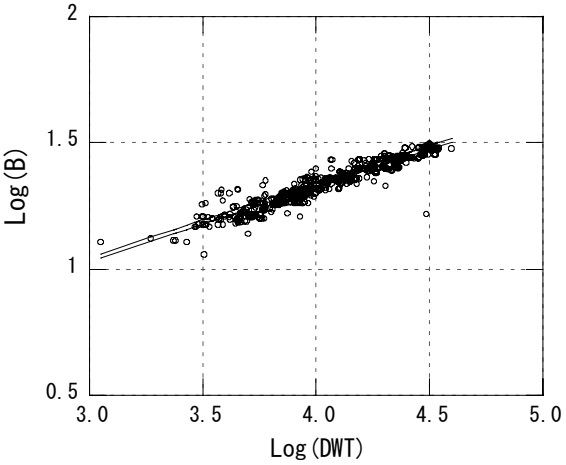
$\log Y=a+b\log X$

(R^2= 0.932 , σ= 0.027)

	50%	75%
a	0.6802	0.6983
b	0.3534	0.3534

Figure 3-42 Container Ship （Under-Panamax)Lpp-DWT





・Less than 40,000DWT

$Y=\alpha \cdot X^{\beta}$

	50%	75%
α	1.3858	1.4393
β	0.2960	0.2960

・40,000DWT～

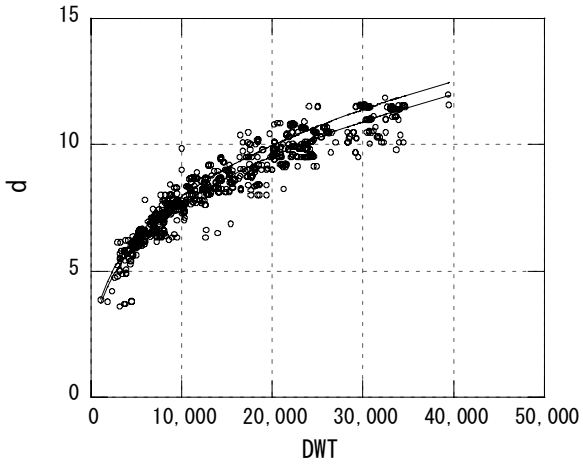
Y＝30.6

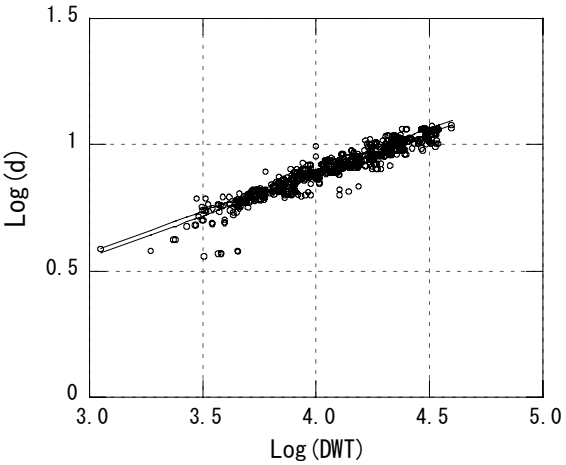
$\log Y=a+b\log X$

(R^2= 0.918 , σ= 0.024)

	50%	75%
a	0.1417	0.1582
b	0.2960	0.2960

Figure 3-43 Container Ship（Under-Panamax)B-DWT





$Y=\alpha \cdot X^{\beta}$

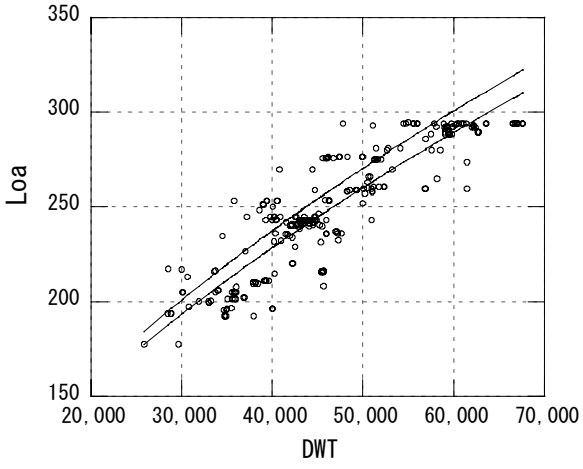
	50%	75%
α	0.3719	0.3882
β	0.3277	0.3277

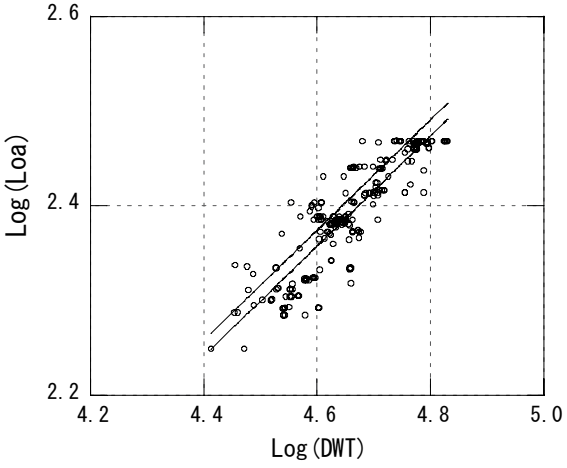
$\log Y=a+b\log X$

(R^2= 0.915 , σ= 0.028)

	50%	75%
a	-0.4296	-0.4109
b	0.3277	0.3277

Figure 3-44 Container Ship (Under-Panamax)d-DWT





$Y=\alpha \cdot X^{\beta}$

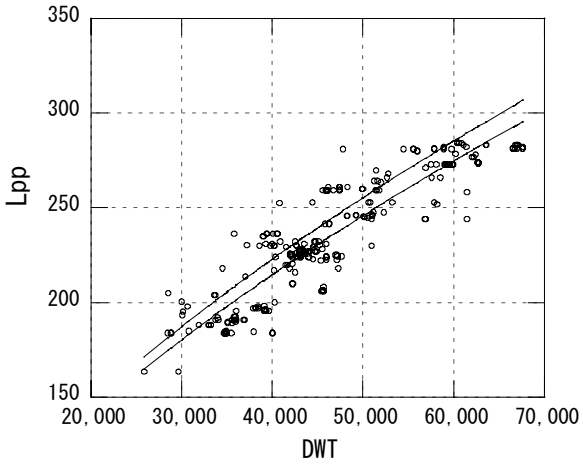
$\log Y=a+b\log X$

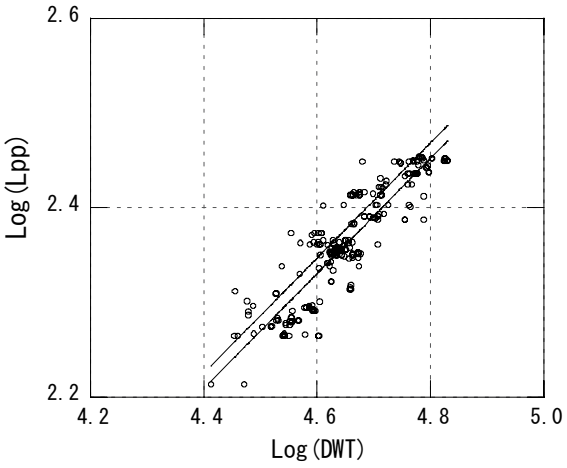
($R^2=$ 0.818 , $\sigma=$ 0.025)

	50%	75%
α	0.4772	0.4959
β	0.5824	0.5824

	50%	75%
a	-0.3213	-0.3046
b	0.5824	0.5824

Figure 3-45 Container Ship (Panamax)Loa-DWT





$Y=\alpha \cdot X^{\beta}$

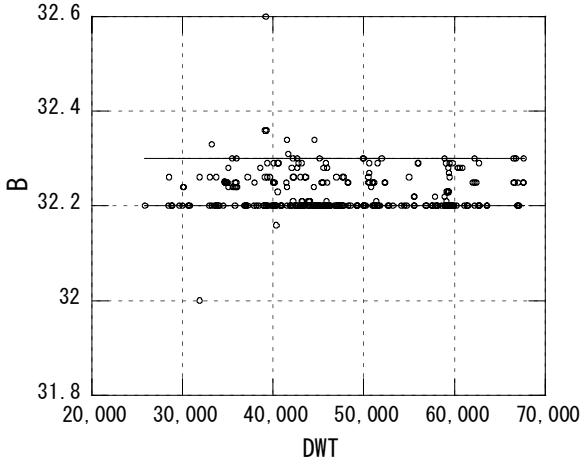
$\log Y=a+b\log X$

($R^2=$ 0.839 , $\sigma=$ 0.024)

	50%	75%
α	0.3411	0.3542
β	0.6082	0.6082

	50%	75%
a	-0.4671	-0.4507
b	0.6082	0.6082

Figure 3-46 Container Ship (Panamax)Lpp-DWT

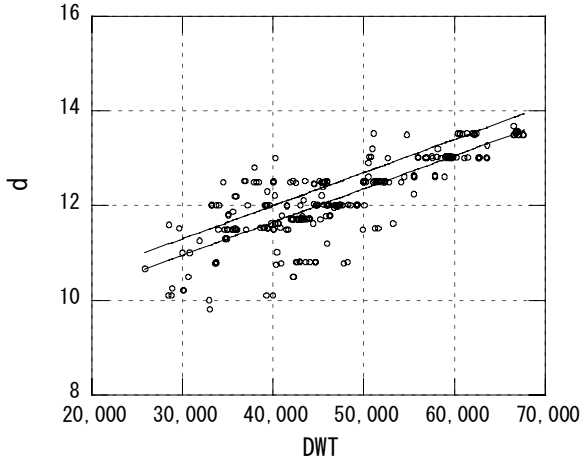


$Y=a_0$

（σ= 0.039 ）

	Average	75%
a_0	32.2	32.3

Figure 3-47 Container Ship (Panamax)B-DWT



$Y=a_0+b_0X$

(R^2= 0.645 , σ= 0.510)

	50%	75%
a_0	8.8539	9.1978
b_0	0.000070	0.000070

Figure 3-48 Container Ship（Panamax)d-DWT

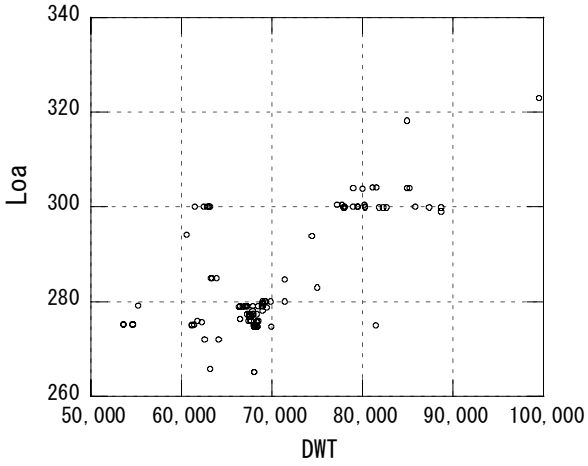


Figure 3-49 Container Ship(Over-Panamax) Loa-DWT

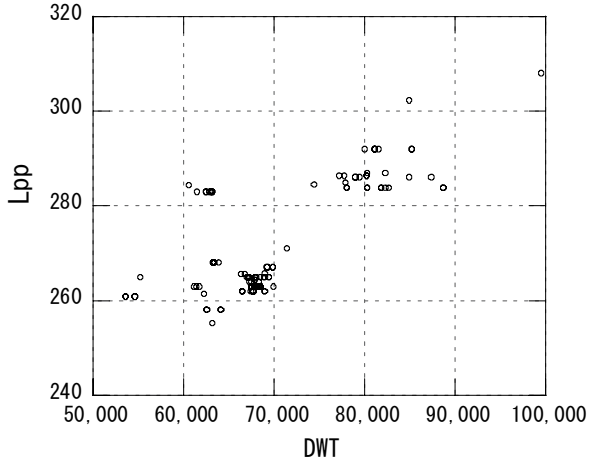


Figure 3-50 Container Ship (Over-Panamax) Lpp-DWT

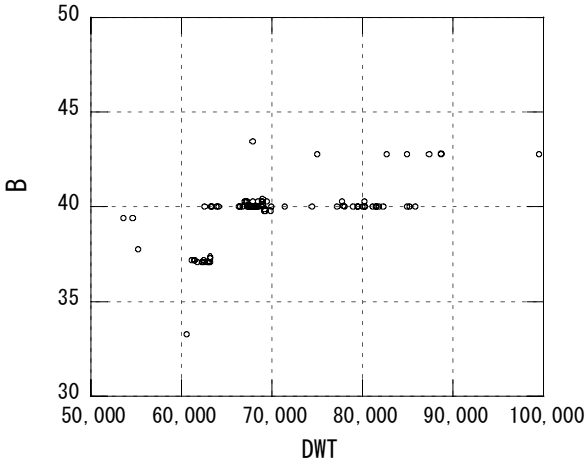


Figure 3-51 Container Ship (Over-Panamax) B-DWT

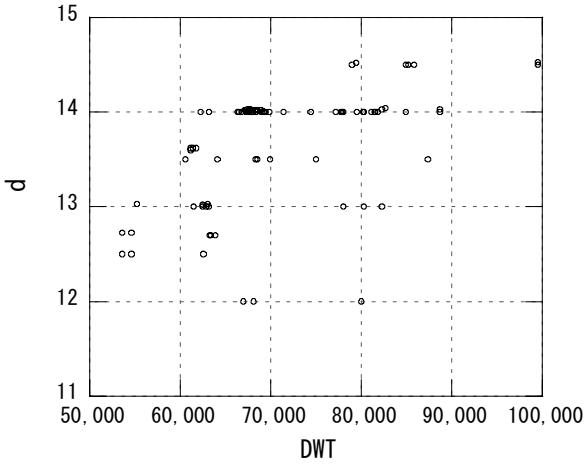


Figure 3-52 Container Ship (Over-Panamax) d-DWT

(3) Analysis of TEU

1) Integrated analysis of all ships (**Figure 3-53**)

TEU was analyzed by the linear regression analysis method, obtaining $R^2 = 0.974$.

2) Under-Panamax type（**Figure 3-54**）

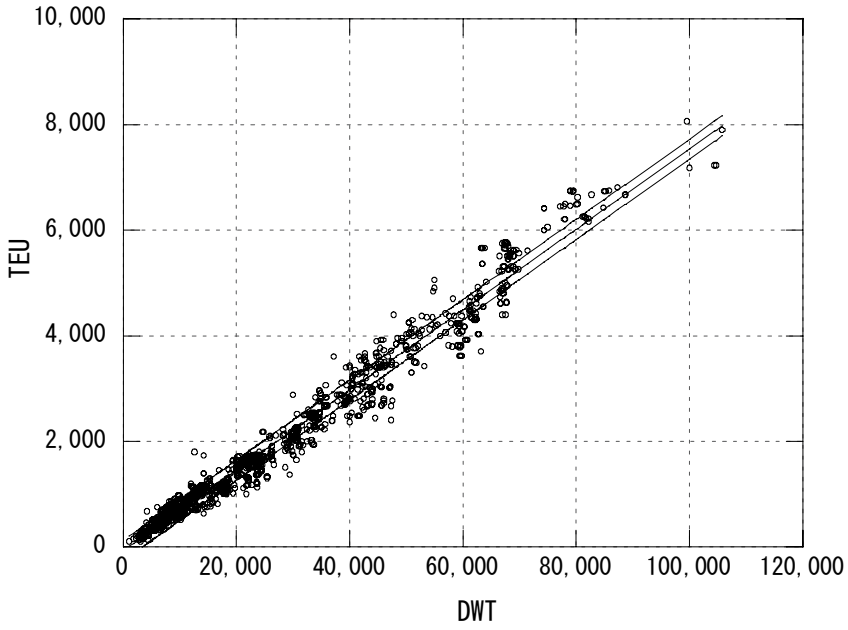
TEU was analyzed by the linear regression analysis method, obtaining $R^2 = 0.939$.

3) Panamax type (**Figure 3-55**)

TEU was analyzed by the logarithmic regression analysis method, obtaining $R^2 = 0.786$.

4) Over-Panamax type (**Figure 3-56**)

TEU was analyzed by the logarithmic regression analysis method, obtaining $R^2 = 0.825$.



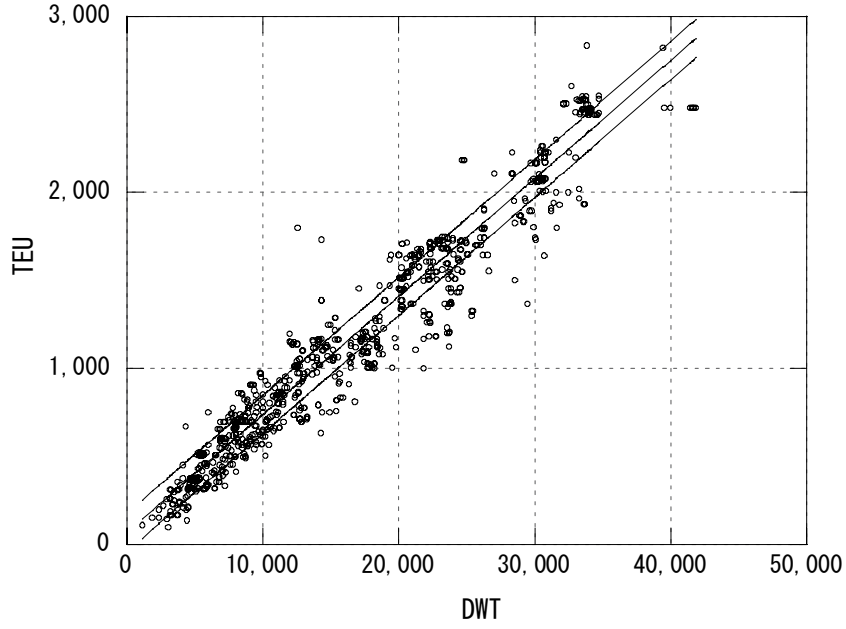
$Y=a_0+b_0X$

(R^2= 0.974 , σ= 283.065)

	25%	50%	75%
a_0	-260.0735	-69.2877	121.4981
b_0	0.0760	0.0760	0.0760

DWT	TEU		
	25%	50%	75%
5,000	119.9	310.7	501.5
10,000	499.9	690.7	881.5
20,000	1259.9	1450.7	1641.5
30,000	2019.9	2210.7	2401.5
40,000	2779.9	2970.7	3161.5
50,000	3539.9	3730.7	3921.5
60,000	4299.9	4490.7	4681.5
70,000	5059.9	5250.7	5441.5
80,000	5819.9	6010.7	6201.5
90,000	6579.9	6770.7	6961.5
100,000	7339.9	7530.7	7721.5

Figure 3-53 Container Ship TEU-DWT



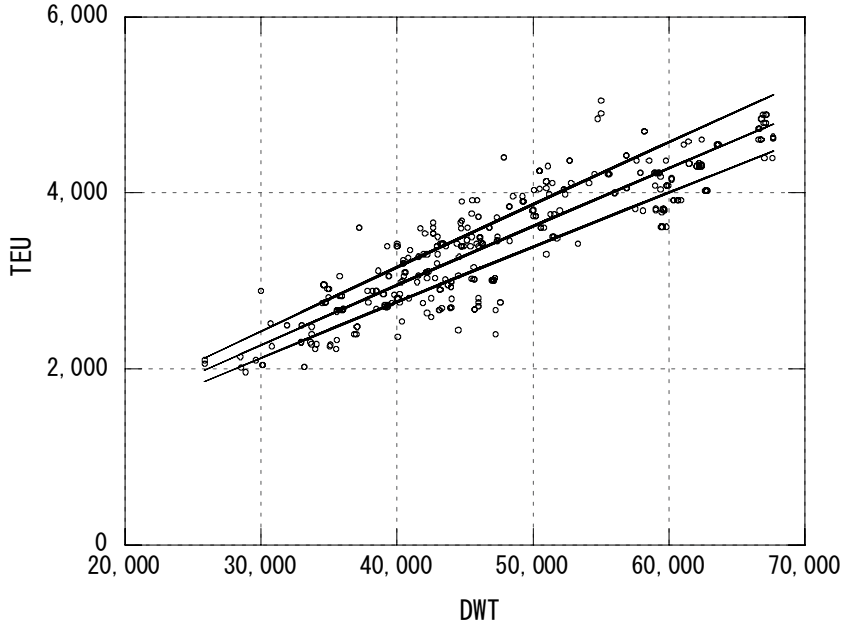
$Y=a_0+b_0X$

(R^2= 0.939 , σ= 160.274)

	25%	50%	75%
a_0	-39.2625	68.7622	176.7870
b_0	0.0670	0.0670	0.0670

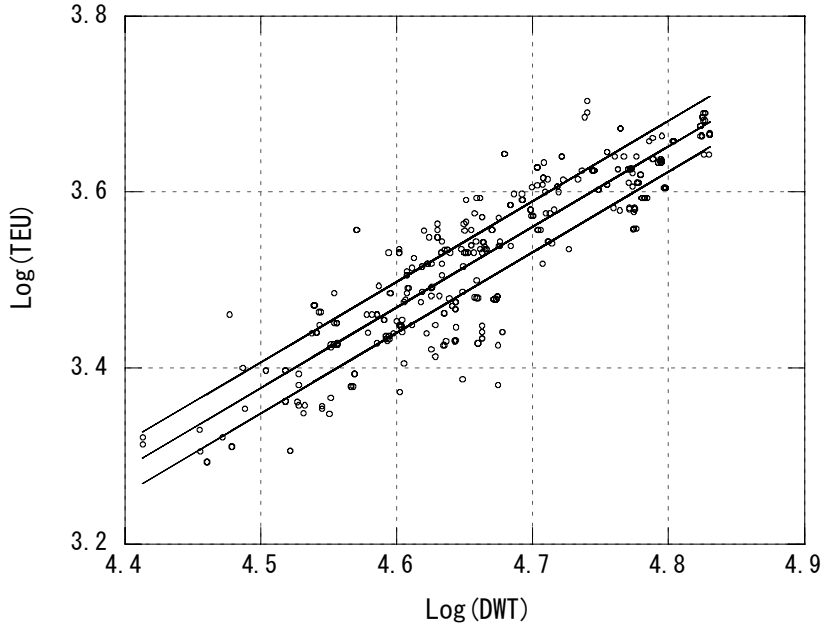
DWT	TEU		
	25%	50%	75%
5,000	296	404	512
10,000	631	739	847
20,000	1302	1410	1518
30,000	1972	2080	2188
40,000	2642	2750	2858

Figure 3-54 Container Ship (Under-Panamax) TEU-DWT



$Y=\alpha \cdot X^{\beta}$

	50%	75%	25%
α	0.1820	0.1946	0.1703
β	0.9150	0.9150	0.9150



logY=a+blogX

(R^2= 0.786 , σ= 0.043)

	50%	75%	25%
a	-0.7399	-0.7109	-0.7689
b	0.9150	0.9150	0.9150

DWT	TEU		
	25%	50%	75%
30,000	2127	2273	2431
40,000	2768	2958	3162
50,000	3394	3628	3879
60,000	4011	4286	4583

Figure 3-55 Container Ship (Panamax) TEU-DWT