

# Some Notes on Draft Survey Calculations

Short Communication

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Presented review relates to the influence of the accuracy of calculations on the results of the Draft Survey method. This method is designed for determine the total weight of cargo a ship is actually loaded in tons.

The actual cargo loaded depends on the ship's maximum allowable immersion (deadweight) at the relevant season, which will include the capacity of fuel, lubricating oil, provisions, fresh water, crew, ballast water, and the ship-constant.

Cargo capacity (ton) = deadweight (ton)-balast, fuel, provisions, etc. (ton)

**Table 1:** Table of initial data.

	m [t]	LCG [m]	VCG [m]	M <sub>LCG</sub> [tm]	M <sub>VCG</sub> [tm]	Δmh [tm]
Light ship	9773.00	66.94	8.65	654204.62	84536.45	2439.00
Ship-constant	300.00	60.00	10.00	18000.00	3000.00	00.00
Cargo in hold No. 2	1055.34	103.30	3.01	109016.62	3176.57	12430.07
Displacement	11128.34	70.20	8.15	781221.24	90713.02	14869.07

The drafts fore and aft are respectfully:

$$T_{fore} = T + (L_{pp}/2 - LCF) \times (t/L_{pp}) = 5.19m.$$

$$T_{aft} = T + (-L_{pp}/2 - LCF) \times (t/L_{pp}) = 5.40m.$$

## The Influence of Draft Accuracy on A Ship-Constant Determination

The more accurate calculation of the mean draft is giving the new value T = 5.295m.

The hydrostatics data for that value of the mean draft are:

## The Accurate Calculations of Cargo Capacity

Draft has a direct correlation to the displacement of the ship and to the deadweight at the same time.

$$\text{Deadweight (ton)} = \text{displacement } \Delta \text{ (ton)} - \text{light ship weight (ton)}$$

It is important that the draft is accurately determined since each incorrect centimeter in draft can mean a displacement difference of several tons. The density of water  $\rho$ , in which the ship floats must be determined accurately. In seawater:  $\rho=1.025 \text{ t/m}^3$  [Table 1].

For the Displacement ( $\Delta$ ) of 11 128.34t, the mean draft T =5.29m, LCB=0.52m, LCF= 0.66m, MJ=16 724 tm/m, the length of the ship between Perpendiculars:  $L_{pp}=140m$ . Calculated trim t= -0.21m.

$$TPC = 23.4 \text{ t/cm}, LCF = 0.66m, M_j = 16 728 \text{ tm/m};$$

$$M_j (T+ 0.5m) = 17 127 \text{ tm/m}; M_j (T- 0.5 m) = 16364 \text{ tm/m}$$

$$\text{Displacement}_1 (\Delta_1) = 11149 \text{ t}$$

The corrections for the ship's trim are as follows:

$$CORR 1 = 100 \times VCF \times (t/L) \times TPC = - 2.32t$$

$$CORR 2 = 0,5 \times (t^2 / L) \times [ M_j (T + 0.5m) - M_j (T - 0,5 m) ] = 0.12t$$

The corrected Displacement is:



$$\Delta_2 = \Delta_1 + \text{CORR 1} + \text{CORR 2} = 11\,146.80\text{t.}$$

The calculations of the ship-constant value are presented in Table 2.

The Ship-constant value from Table 2 is not the same as the initial.

The drafts which has been used for calculations were defined with the accuracy of 1cm. That is clear that it is not a satisfactory degree. When improved the accuracy of the draft determination to 0.1cm, the results of Ship-constant calculations are presented in Table 3.

In a general, the amount of cargo loaded on the ship depends on, among other things:

- the capacity of space reserved for cargo,
- the maximum cargo capacity (tonnage) of the trade route,
- the duration of voyage relative to the amount of fuel which reduces the cargo capacity
- the maximal permissible draft during the voyage.

However, on the beginning of the voyage the captain should be familiar with the actual weight of cargo loaded. The total weight of cargo is calculating by Draft Survey method. How accurate the result can be obtained, it has been presented in the above review and compared in Table 4.

**Table 2:** The results of ship-constant calculations.

	m [t]	LCG [m]	VCG [m]	M <sub>LCG</sub> [tm]	M <sub>VCG</sub> [tm]
Ship's Displacement	11146.80	70.20	8.15	782505.36	90846.42
Light ship	-9773.00	66.94	8.65	-654204.62	-84536.45
Cargo in hold No.2	-1055.00	103.30	3.01	-108981.50	-3175.55
Ship-constant	318.80	60.60	9.83	19319.24	3134.42

**Table 3:** The more accurate results of Ship-constant calculations.

	m [t]	LCG [m]	VCG [m]	M <sub>LCG</sub> [tm]	M <sub>VCG</sub> [tm]
Ship's Displacement	11127.80	70.20	8.15	78117.56	90691.57
Light Ship	-9773.00	66.94	8.65	-654204.62	-84536.45
Cargo in Hold No. 2	-1055.00	103.30	3.01	-108981.50	-3175.55
Ship-constant	299,8	59.99	9.94	17985.44	2979.57

**Table 4:** The comparison of obtained results of Draft Survey calculations.

	Ship-constant [t]	LCG (X) [m]	VCG (Z) [m]
Initial Data	300,00	60,00	10,00
Accuracy Calculations 1cm	318,80	60,95	9,83
Accuracy Calculations 0.1cm	299,80	59,99	9,94
Accuracy Calculations 0.01cm	30,04,348	6,00,163	99,961

## References

1. M Szymoński Z Piątek, The influence of accuracy calculations on Draft

Survey results, unpublished review Department of ship's exploitation Naval Academy of Gdynia, Poland.

