

DESIGN OF 30,000 DWT AND 53,000 DWT BULK CARRIERS BOTH CONVENTIONAL AND COMPUTER AIDED DESIGN SOFTWARE

V. CH SANDEEP RAJ¹, B. N MALLESWARA RAO² & V. V. S PRASAD³

^{1,2}M.E (Marine and Mechanical Handling) Students, Department of Marine Engineering, Andhra University College of Engineering, Visakhapatnam, Andhra Pradesh, India

³Professor, Department of Marine Engineering, Andhra University College of engineering, Visakhapatnam, India

ABSTRACT

The design of a bulk carrier ship hull is done either by using B.S.R.A results or Taylor s series by conventional methods which may results in some inaccuracies in the design. Two bulk carriers of 30,000 DWT and 53,000 DWT are designed using the computer aided design software and the results are shown the ship is designed using the modern computer design application softwares

KEYWORDS: Computer Design Application Softwares, Ships, DWT

INTRODUCTION

Bulk carriers make up 15% to 17% of the worlds merchant fleet used to carry material in bulks around the world. The hull of the ship is considered as the of prime importance which was carried out from predetermined graphs and results like B.S.R.A results and Tylor series. Sometimes the designs end up with the inaccurate performance. Two bulk carriers 30,000 DWT and 50,000 DWT are designed using the conventional method by deriving the data from the existing ships and they are redrawn manually. This process in carried out at Hindustan shipyard limited(HSL) and Andhra university Marine engineering department .The design of the ships are made in two phases first by the conventional method and second by computer design software like NAPA,TRIBON,CATIA and AUTOCAD

FIXING THE MAIN DIMENSIONS OF THE SHIP

The main dimensions like length between perpendiculars, breadth, depth, draught, coefficient of forms are calculated from parental ship analysis using graphs and empirical formulas using data from Bureau Veritas. The table below shows the final dimensions of the vessels

Table 1

S. No	Principle Dimension	30.000 DWT Ship	53,000 DWT Ship
1.	Length between perpendiculars (LBP)	166.83 m	206 m
2.	Moulded Breadth	26 m	30 m
3.	Moulded Depth	14.86 m	17.7 m
4.	Moulded Draught	11.37 m	13.1 m
5.	Block Coefficient (C_b)	0.81	0.82
6.	Midshipsection coefficient(C_M)	0.99	0.99
7.	Waterplane Area Coefficient(C_w)	0.88	0.89
8.	Longitudinal prismatic coefficient(C_{pl})	0.81	0.83
9.	Vertical Prismatic Coefficient (C_{pv})	0.92	0.92
10.	Displacement at Moulded draft	42040.5	67938.5
11.	Speed	14 knots	15 knots

FREEBOARD CALCULATIONS

Freeboard may be broadly defined as the height that the sides of a floating vessel project above the water. The maximum waterline to which a ship can be loaded is governed by the plimsoll marks, which are permanently marked on the vessels sides at midship. The freeboard deck means the uppermost complete deck having permanent means of closing all opening in freeboard deck. The ships with very small openings are known as type “A” ships and with very large openings are known as type “B” ships. Bulk carriers will have large openings come under type B ships and the

Table 2

S. No	Ship Type	Freeboard Height
1.	30,000 type B ship	3.25 m
2.	53,000 type B ship	4.62 m

GENERATION OF HULL FORM FROM B.S.R.A RESULTS

Hull of the ship is a very important aspect. There are several methods used for designing the hull form like Taylor’s series and B.S.R.A results which are a set of graphs which define the structure of the ship at different stations. The main parameters such as dimensions - length, breadth, draught, are to be arrived at coefficients of form and the longitudinal position of centre of buoyancy. The geometry of ship has influence on the following characteristics so the design of the hull is derived from the B.S.R.A Results. Length between Perpendiculars is divided into 10 equal parts with ordinate stations. More stations are taken at the ends to define the curvature of a ship more accurately. The sectional area up to moulded draft can be drawn by taking the sectional areas on Y-axis and ordinate stations on X-axis. The ordinates for sectional area curve are given as the ratio of sectional area to midship section at various stations from ordinates Sectional areas are calculated More stations are taken at the ends to define the curvature of a ship more accurately. The sectional axis. The ordinates for sectional area curve are given as the ratio of sectional area to midship section at various stations from ordinates lifted from B.S.R.A. results at the C_B 0.81 and 0.82 of the ship under design.

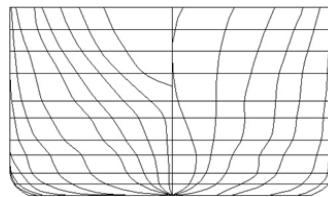


Figure 1: Showing the Body Plan of 30,000 DWT Drawn from B.S.R.A Results

The above body plan is inaccurate as it observed which may cause resistance increase in the seaway, maneuverability, course keeping capability, roll damping and hydrostatic characteristics. In order to overcome these problems the above drawing points were transferred to TRIBON or NAPA and the results in the shapes are as follows

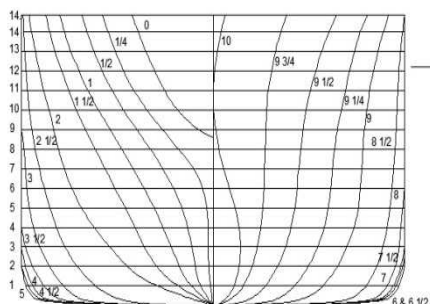


Figure 2: The Body Plan of the 30,000 DWT after Fairing in TRIBON/NAPA

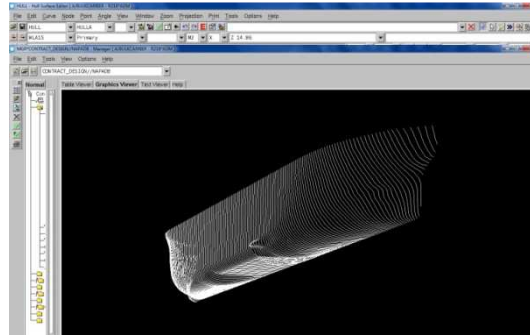


Figure 3: The Half Breadth View of the Hull Form of 30,000 DWT Bulk Carrier

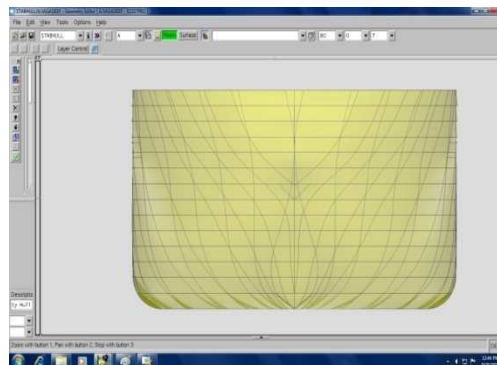


Figure 4: Body Plan of 53,000 DWT Bulk Carrier

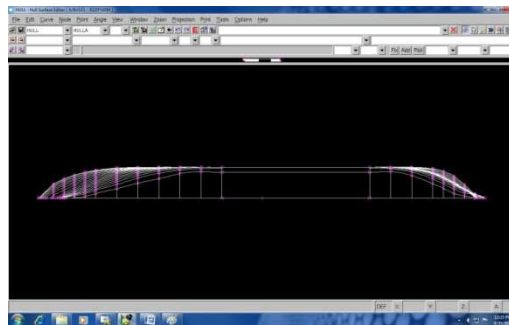


Figure 5: Half-Breadth View of the Bulk Carrier

From the lines plan various parameters are obtained. The change in L.C.B for the vessels is 3.3m and 4.20m for 30,000 and 53,000 vessels.

SECTIONAL AREAS AND VERTICAL MOMENTS WITH RESPECT TO BASELINE AT ORDINATE STATIONS FROM BONJEAN CURVES

One of the fundamental hull form characteristics required to prepare the hydrostatic curves are the *immersed sectional areas at ordinate stations*. The cross-sectional area of each ordinate station shown in the body plan up to the waterline in question is determined which is input into the calculation of the volume of displacement; this set of curves is known as the *Bonjean curves*. A typical plot of the Bonjean curves is shown in Figure. When plotted against length, the immersed areas at the ordinate stations from a *sectional area curve*, whose shape represents the “fullness” or “finesness” of the ship form, an important consideration in ship resistance and powering.

To find out the volume of the displacement and LCB at a trimmed water line at which the ship is floating due to distribution of cargo or when the ship is floating on even keel.

In sub division of ships from the safety point of view so that when the ship is flooded due to accident or damaged the ship will not sink beyond the margin line. In strength calculations to find out the buoyancy when the ship is floating in waves in launching calculations

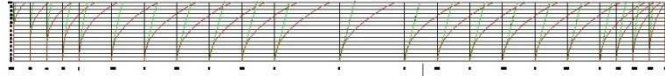


Figure 6: Showing the Sectional Areas and Vertical Moments at Each Section of the Hull Taken from Manual Drawing

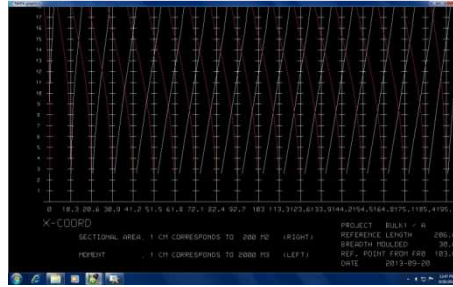


Figure 7: The Sectional Area Curves Obtained from Tribon

EASE OF USE

Hydrostatic Characteristics of Ships

Throughout the life a ship changes its weight and disposition of cargo, its draft, trim and freeboard. The density of water in which ship floats varies. Ship's stability also changes. Its condition at any stated set of circumstances to be estimated, its condition in a precise state must be known so that the effect of changes from that state can be calculated. This precise condition is known as the design condition. For this, changes from the design and properties of underwater form are calculated for a complete range of water lines. This information is known as hydrostatic data and are plotted against drafts. Drafts are spaced equally generally one meter apart. These curves are shown on displacement sheet. The following properties are plotted against draft to form hydrostatic curves.

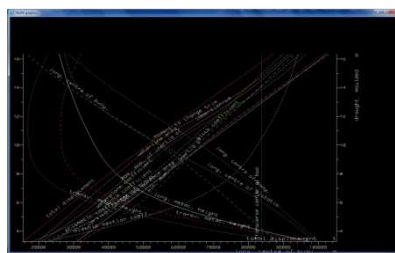


Figure 8: Hydrostatic Curves of 53,000 DWT Ship at a Draught of Sections, Moderate Cruiser Stern and Raked Stem

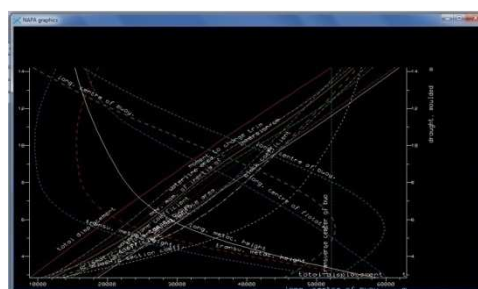


Figure 9

Resistance Calculations

The total resistance coefficient When a ship is moving with velocity V , the effect of this forward motion is to generate dynamic pressures on the hull which modify the original normal static pressure and if the forces arising from this modified pressure system resolved in the force and aft direction there is a resultant which opposes the motion of the ship through the water. If the forces are resolved in the transverse direction the resultant is zero because of symmetry of the ship form.

When the ship is in motion, another set of forces also influence the motion of the ship. Generally all fluids possess to a great extent the property known as viscosity and therefore when a surface such as the immersed surface of the ship moves through the water, tangential forces are generated which when summed up produce a resultant opposing the motion of the ship. The two sets of forces both normal and tangential produce resultants, which act in a direction opposite to the motion of the ship. This total force is the resistance of the ship. The ship is actually moving in two fluid medium with different densities. While the lower part of the hull is moving in water and the upper part is moving through air. Due to air also some resistance occurs and this type of resistance is dependent only on velocity of air. However the total resistance of the ship is split into frictional resistance and residuary resistance, appendage resistance and air resistance. Frictional resistance contributes 80% to 85% of the total. In the following resistance calculations are made on the basis of Guldhammer and Harvald method.

Results of the models corresponding to ships up to 1960, with standard hull form (i.e.) standard position of LCB, standard B/T of 2.5, normally shaped of the ship

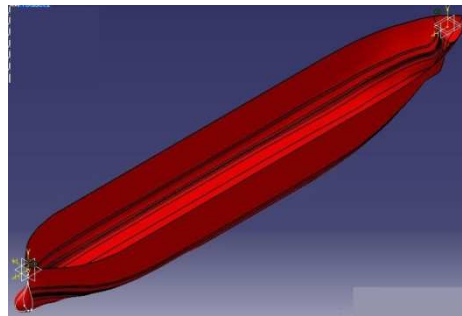


Figure 10

The total resistance coefficient of the ship

$$C_T = \frac{R_T}{\frac{1}{2}\rho S V^2} \quad (1)$$

Table 3

No	Resistance Coefficients	30,000DWT	53000DWT
1	Frictional resistance coefficient C_F	1.45	1.42
2	Residual resistance coefficient C_R	0.722	0.790
3	Incremental resistance coefficient C_A	0.040	0.040
5	Air resistance coefficient	0.070	0.070

Table 3: Contd.,

6	Steering Resistance coefficient (C_{AS})	0.040	0.40
4	$C_T = C_F + C_R + C_A$	2.65×10^{-3}	2.31×10^{-3}

The resistance coefficient is low when compared to the conventional method of designing from the above results

GENERAL ARRANGEMENT

The General arrangement of a ship can be defined as the assignment of spaces for all required functions and equipment, properly coordinated for location and access. The general arrangement represents a summary and integration of information from other divisions and specialties in ship design, intended to provide for all the necessary functions of the ship in the most efficient and economical way.

The efficient operation of a ship depends on the proper arrangement of each separate spaces and provision of effective inter relationships between these spaces. General arrangement must be functionally and economically developed with respect to factors that affect construction and operation costs especially the manpower required to run the ship.

The first step in solving the general arrangement problems of a cargo ship is locating the main spaces and their boundaries within the ship hull and superstructure.

These Spaces are:

- Cargo spaces
- Machinery spaces.
- Crew, passenger and associated spaces.
- Tanks (Double bottom fore peak, after peak etc)
- Miscellaneous

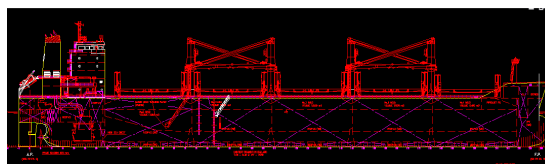


Figure 11: The General Arrangement of the Vessel

CONCLUSIONS

We would finally conclude that the above ship designs using computer software not only gives accurate values but also reduces resistances in the sea ways.

ACKNOWLEDGEMENTS

we would like to thank marine engineering department and hindusthan shipyard limited for their support to design the ships in the advanced softwares

REFERENCES

1. Principles of Naval Architecture- Edward Lewis
2. Ship Design for Efficiency And Economy- Schneekluth's
3. Principles of Naval Architectures- Rawson Ans Tupper
4. Irs, Abs, Lrs, Solas, Ilc, Imca & Marpol
5. Registry of Ships of Lrs, Irs & Abs
6. Muckles Naval Architecture- W.Muckle & D.A.Taylor
7. Ship Design and Construction- Robert Taggart
8. Resistance and Propulsion of Ships- S.A.Harvald
9. Practical Ship Design- Watson

