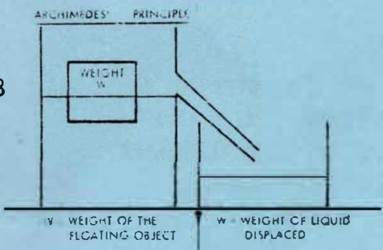
San Diego Ship Modelers Guild

Volume II NEWSLETTER -- January 1978 Number 1



...a body floating or submerged in a liquid is buoyed up by a force equal to the weigh of the liquid displaced.

...Archimedes' (about 250BC)

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NOTES from the Last Meeting/Party:

Our "annual" Christmas party was held December 16th aboard the "STAR." Lost count on the number attending, but we had a very good turnout with more than enough food to go around. Special thanks to all the wives for the tasty "goodies" prepared and also to Bill BENSON for generously providing the champagne.

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CALIFORNIA WHALE WATCH CRUISE:

Saturday, January 14th is just around the corner and as of this writing Doug McFarland has 10 more tickets to sell in order to make the cruise possible. Sailing time is 1 PM and the cruise will last four hours. Costs: $9.95 if 45 go; $8.95 if 49 sign on. Remember, 20% of the total proceeds will be donated to the Maritime Museum. So have fun while supporting the Museum; Give Doug a call at / redacted/.

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SPECIAL MEETS for the MISSION BAY MODEL YACHT BASIN:

As most of you know, the "pond" is closed 5-6 times a year for the purpose of special meets sponsored by the "San Diego Argonauts." Additionally, the first Saturday in June is generally reserved for teen age students free sailing their class "project." The remaining weekends are used as follows: Saturday mornings; R/C electrics and steam as well as any scale; Saturday afternoons (after 12); R/C sail. Sundays are for high speed gas models. This arrangement gives everyone a chance to use the limited number of R/C frequencies available, not to mention reducing the danger of damage to finely-detailed scale models. For 1978, the schedule is as follows:

April	29-30	Spring Sail Regatta	S/B & N-12M
June	3	"School kids day"	
June	17-18	Soling O.D.A.C.C.R.	Soling O.D.
July	22-23	Western Div. Championships - 50/800	
Oct.	28-29	Fall Sail Regatta	Soling O.D.;N-12M
Dec.	2-3	SCRS #4	50/800

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NEW YEARS GREETING:

May you and "yours" have a happy and prosperous 1978 while accomplishing all the ship modelling you've set out to do in the next twelve months. ...from the entire staff of the SDSMG Newsletter.

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AL DOES IT AGAIN:

The January/February issue of "Model Ships & Boats" features a very fine article written by Al L'Heureux and Phil Headley on their nearly identical "Balao" class WWII submarines. Since every member doesn't yet subscribe, perhaps we can include a copy in the next newsletter. Congratulations, Al and Phil for the fine work.

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NEW MEMBERS:

John Christoper MATHEWS III /redacted/
CDR. USN (Ret.)
Edmond F. WHITE /redacted/

"Welcome Aboard"

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NEXT MEETING:

Plan to attend our next meeting on Friday, January 20th. We'll be holding elections and voting on several key questions addressed in last month's newsletter. We should also be collecting dues for 1978, after we decide "how much." So besides bring your models, bring your checkbook or a number of small unmarked bills.

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THE FINAL SHOWING of DINAH:

KCST Channel 39 has agreed to provide a special showing of the segment of the Dinah Shore Show which featured model boats on Mission Bay. Many people missed the show or perhaps would like the opportunity to see it again. Unfortunately, the film cannot be taken out of the studio or we'd show it at the next meeting. Arrangements have been made for a special showing at the studio (near the Sands Hotel) on Friday, 13 January at 7 PM. Since the film is short, if enough members are interested, we might try to get a group up afterwards for a little "libation" and dinner at the "Rib Cage" located nearby. Bob and Alice DeBow of the San Diego Argonauts are setting this up and state several of their members are interested. If you are interested, call Fred Fraas at /redacted/ for more details.

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NEWSLETTERS for 1978:

The recent discovery of a "cut-rate copier" has made it possible to run 9 page newsletters in the future, at the same approximate cost of what we've previously paid for 5 pages. This issue is an example. By printing both sides of each page, this is possible since postage will remain constant. Your editor visualizes future newsletters containing the usual amount of "club news", followed by 4 to 5 pages of helpful hints reprinted from various magazines or submitted by individual members. Every effort will be made to keep these "filler" articles of general interest to most members. A wealth of material exists to help us all become more proficient modellers.

Few people viewing scale models (including their builders) ever consider that the physics of a ship model are remarkably close to the full-sized ship; only proportionately scaled-down in a similar manner as all other measurements of hull lines, fittings etc. Even if you build meticulous scale models for static display only, it might be nice to know or predict how your model would react if placed in salt water (heaven forbid) or the fresh water of your bath tub. Of even more importance, when considering a scale for a planned operating model, displacement is of critical importance especially with smaller models.

For example, a DUMAS 33" PT Boat cannot weigh more than $3\frac{1}{2}$ lbs. if it is accurately float at the scale water line. An "IOWA" class battleship built in 1/8" scale (110" overall length) should weigh or displace about 120 lbs. In these examples, one model is slightly more than 3 times longer than the other, yet it displaces 34.3 times more water.

We don't need large volumes of naval architecture books to calculate these figures. Nor are elaborate testing tanks necessary even though full-sized prototype hulls are never built until they have been tested exhaustively with models.

MINISCALE

Dear Sir,

I was so intrigued by M. F. Woodward's article on the motorisation of plastic ship kits that I rescued several static models which I have stacked away with a view to utilising some of his ideas. I floated them in the sink to try and get an idea of how much it was possible to load them. It occurred to me that since the hulls are accurate replicas of the real thing a simple calculation should give a good estimate of load carrying capacity. By dividing the weight (displacement) of the prototype by the cube of the scale factor, the "scale" weight would be obtained. For example, in the case of *Hood* which displaced about 48,000 tons at full load, the calculation is:

$$\frac{48{,}000 \times 2{,}240 \times 16}{600/^3} \text{ oz.}$$

(the Airfix vessels are to a scale of 1: 600) which is 8 oz.

The kitchen scales gave me the weight of the static model, which was $3\frac{1}{2}$ oz. Of course the kit itself could be weighed. If the "trees" are included they would compensate for the weight of paint, with a safety margin. I conclude therefore that I can add about $4\frac{1}{2}$ oz. of motor, batteries and other "works", suitably distributed, and the model would float on her scale waterline, in salt water.

The Airfix *Warspite* has a scale displacement of 6 oz., the model weighs $2\frac{1}{2}$ oz., leaving $3\frac{1}{2}$ oz. for gubbins.

I think Mr. Woodward will be disappointed in his wish to hear of anyone motorising the Airfix cruisers and destroyers, because the calculation shows that in the case of *Tiger* only $\frac{1}{2}$ oz. is available for "works", and even with extensive lightening operations this is hardly enough. I have a fealing (though I have not checked) that the destroyers will be too heavy already !

A final thought on *Hood*—I will remember to keep her a trifle high in the water as I remember that the vessel was notorious for proceeding with her quarterdeck awash in heavy weather !

Bridgwater. *G. D. Pearce.*

(from "MODEL BOATS" May 1967, page 213)

Having been a subscriber to "Model Boats" for a number of years, my admiration is with the British for the many fine articles they have documented in their magazine. If their grammar, verbage, trade names and geographical references seem "foreign", bear along, for the laws of physics in both countries are, of course, identical. Hopefully, we'll all profit by their willingness to write and publish their findings.

So watch for future issues. Articles explaining hull lines, stability, ship resistance and model testing, scaling up and down, propellers and perhaps even a series on "pop-pop" boats (for simple, cheap propulsion) will be featured. Equally of interest should be how others around the world build their models when well-stocked model shops are not available.

DISPLACEMENT CALCULATIONS: "Cube of scale" or "Block Coefficients??"

From several different articles written by more knowledgeable persons than your editor, it is apparent that there exists two different methods of roughly calculating displacement of ship models. The first and perhaps simplest is: scale cube divided into "full load tonnage". In order to do this one cannot cube scales as we in America normally use, i.e. 1/8", 1/16" or 1/4"= 1 ft. This scale must be converted to the actual ratio of 1 foot of model to 1 foot of real ship which is also the scale most commonly used with models sold on the international market. So 1/8" to 1 ft. becomes 1 to 96; 1/16" is 1:192 and 1/4" is 1:48. For simplicity, model manufactureres of plastic and metal "waterline" models round this scale out to the nearest 1/100th. Hence 1:96 becomes 1:100; 1:192 is 1:200 etc. with 1:600 and 1:1200 becoming also very common.

Also important in this formula is converting tons to pounds and even ounces in the case of small plastic models. Apparently long tons (2240 lbs.) is used vice short tons (2000 lbs.). Let's take, as an example, Al Lheureux's model of the USS MISSOURI (BB-63) which he built in 1/8" to 1 ft. scale. If 1/8" = 1 ft., then 1" = 8 feet, and 12" or 1 ft. = 96 feet (12"X 8'), hence 1:96. IOWA class battleships originally displaced 45,000 tons, so:

$$\frac{\text{(Tonnage displacement)}}{\text{(Scale: }(1/96)^3\text{)}} = \frac{45,000}{96 \times 96 \times 96} \text{ or } \frac{45,000 \times 2240}{884,736} = 113.9 \text{ lbs.}$$

So much for "cube of the scale."

Now let's consider the second method, "volume times "block coefficent." Block coefficient is really nothing more than a ratio of the underwater body of a ship or model, compared to a rectangular "block" of that body. The overall lenth of USS MISSOURI is 887 feet, however, the waterline length if 861 ft. with a 108 ft. beam and 29 ft. draft. Dividing each of these by 8 (1/8"= 1 ft.), we come up with:

107.6" x 13.5" x 3.6" = 5,229.36 cubic inches

The "block coefficient" for a battleship is .63, so:

5,229.36 x .63 = 3,294.5 cubic inches

A cubic foot of salt water weighs 64 lbs; fresh water = 62.5 lbs. Mr. J.B. King, in an accompanying article states a cubic inch of water weighs .0363 lbs.

So: 3,294.5 x .0363 = 119.6 lbs.

Between the two methods we have a 5.7 lb. difference, easily corrected by ballast (more or less??). As a check one could take the dimensions of the actual ship,(861'x108'x29')= 2,696,652 cu. feet times .63 = 1,698,890.7 x 64 lbs divided by 2240 = 48,539 tons. We originally used 45,000 tons, not 48,539, so the "block coefficient" for battleships must have at least a slight error in this case. (cont.)

" . . . the recoil of a properly constructed gun, however miniaturised, can be calculated taking the cube root of the value of . . ."

Since battleships' beams were limited to the Panama Canal width, over the years (1911 to 1941) their beams remained nearly constant while length increased. (NEVADA and OKLAHOMA had 108 ft. beams, but their waterline lengths were 286 feet shorter than the IOWAs designed 30 years later.) So the "block coefficienct" method is but a rough calculation, depending upon the type hull/model being built.

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<u>PURSERS' REPORT:</u>

Bob BECKER sent in the following report for 1977 stating further that we had a balance of $27.14 remaining in the club's checking account. Here's how it went:

Income:	Expenses:	
$ 165.00 - Membership dues	Newsletter (May-Dec)	$
78.00 - Donations	Membership Cards	
21.00 - Rebate on Calif. Cruise	Half-model donation	
	Service charges	
	May postage	
$ 264.00	Stationary supplies	
	Printing & Copy	
	Coffee & Supplies	
		$/redacted/

Needless to say, it's time to collect dues again if we want to stay solvent. Our sincere thanks to those anonymous making up the $/redacted/ in donations.

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<u>LOCAL MEDIA PUBLICITY:</u>

The San Diego Evening Tribune on Monday, December 26, featured a neat series of modelling pictures showing Bill BENSON and Bob CRAWFORD in action. The spread, which was on the front page of the "B" section (local news), consisted of five pictures in an 8" x 16" framework and is unfortunately to large to copy in our newsletter. The lower caption (for the benefit of you morning paper subscribers) read as follows:

> "CLOSE DETAIL -- Bob Crawford and Bill Benson, who operate the Gray Whale Ship Shop on Shelter Island, have a hobby of building scale model ships. At top, Crawford works on a model of the battleship Arizona, while, center left, Benson works on the rigging of a sailing ship. At center right is a cross-section model of the mainmast of Lord Nelson's flagship Victory. At lower left, Benson shows his model of the steam yacht Medea, and Crawford puts finishing touches on Star of India model.-Photos by George Smith"

Congratulations, Bill and Bob; the pictures and models were superb.

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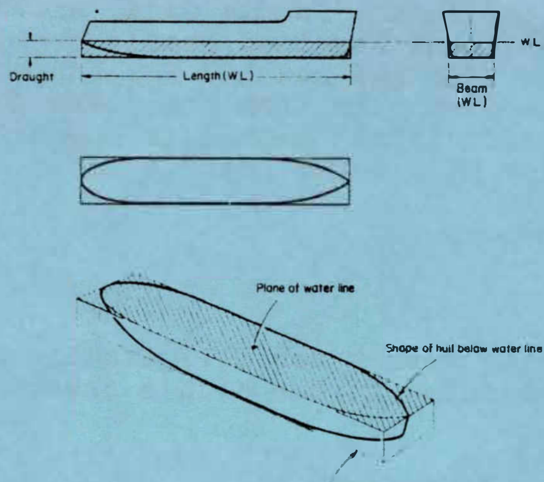
 (from "MODEL BOATS") July 1974 p 262



"Block" volume = Length (WL) x Beam (WL) x Draught

Starting to build?

(or mathematics made easy)

A look at some of the problems facing the model shipbuilder when contemplating a new model – By J. B. King

THE other day I was discussing with a friend his proposed new model which was to be a stern wheeler paddle boat of the Mississippi type.

However, after a few calculations it was obvious that if he built the model to the size he was proposing, the displacement would not be enough to carry the motor, accumulators, radio gear etc. It occurred to me, being quite quick on the uptake, that many newcomers to modelling might be interested in how I go about the planning of a new model.

Let's face it, it's a good idea if the ignominy of spending two years building a boat that floats too low in the water or rolls over and sinks can be avoided. It has been known for blokes to seek the contemplative life and enter a monastery (or should it be a convent?) when that happens.

The two basic aspects of modelling to be discussed here are:

1) How big?
2) How shall I power the darn thing?

Unfortunately these two aspects are to some extent interconnected – there's nothing easy in this life.

Taking No. 1 first, the size is often determined by the plans, as unless they are redrawn or reproduced to a different size building to different dimensions is going to be difficult. My method of photographing the plans and tracing off a projected image I described in *Model Boats*, November 1973.

However, let us assume the size of the model has been decided upon. The next step is to calculate (I know it's a horrible word but do pray continue, the process is painless, I assure you) how much water the model will displace when floating to the correct water-line.

If you recall, the Greeks found out that the weight of the water displaced by a floating body equal'ed the weight of that body. Archimedes did a streak from his bath when he discovered this fact, remember? Today he would have got a £10 fine and bound over to keep the peace.

In practice this means find the volume of the hull *below* the water-line in say cubic inches, multiply this by the weight of one cubic inch of water and you will have the total weight of the model; if it's to float to its correct water-line.

At first sight calculating the volume of a complicated shape such as a boat hull seems difficult but this is where a bit of low cunning comes in, known as the Block Coefficient.

This is the ratio of the volume of a given hull to the rectangular 'Block' of size: water-line length x water-line beam x draught (depth to water-line) and even *you* can calculate that! See diagram.

Block Coefficients for various hulls are:

Destroyer appx.	0.51
Cruiser	0.55
Battleship	0.63
Liner	0.64
Trawler	0.64
Tug	0.60
Tanker	0.80
Cargo vessel	0.65–0.84
Motor Cruiser	0.55

This table from 'Radio Control Model Boats', MAP publication. page 31.

Nothing like a practical example to illustrate the method.

Let us assume a destroyer model of 36 in. long (WL) by beam 4 in. (WL) by draught $1\frac{1}{2}$ in. Then the volume of a block of this size will be:

36 in. x 4 in. x 1.5 in. = 216 cub. in.

The actual volume of the hull will be this figure multiplied by the appropriate Block Coeff. (Block Coeff. for destroyers 0.51 see table)

216 x 0.51 = 110.16 cub. in.
Say 110 cub. in.

Now this is the volume in cubic inches of the part of the model in the water, i.e. the volume of water it will displace. The weight of this volume of water will also be the weight of the model.

As 1 cubic inch of water weighs 0.0363 lb. the weight will be equal to:

110 x 0.0363 = 3.993 lb.

Let's not be funny, say 4 lb. This figure should be within about 10 per cent of the actual weight.

This then is the total weight of the model, so we can now prepare a list of estimated weights – trying not to forget anything – remember that contemplative life!

Weight of hull	2 lb.
,, ,, superstructure	$\frac{1}{4}$ lb.
,, ,, motor(s)	1 lb.
,, ,, batteries	1 lb.
,, ,, radio gear	$\frac{3}{4}$ lb.
,, ,, ballast	1 lb.
Total	6 lb.

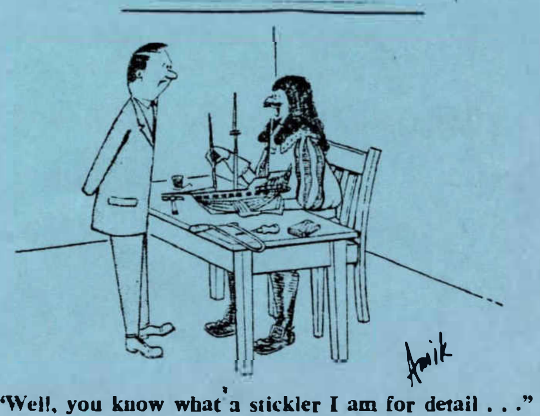
Problem: The calculated displacement is 4 lb. but the model weight is estimated at 6 lb.!

Don't forget the ballast – narrow beamed vessels such as destroyers are likely to require more than, say, a flat bottomed craft such as a stern wheeler.

Today's chuckle

Thanks to the present price of gasoline, oil tankers should be called clipper ships.

(from "MODEL BOATS" Sept 1966 page 383) →



"Well, you know what a stickler I am for detail . . ."

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SAN DIEGO SHIP MODELERS GUILD

Elected Officers

CAPTAIN: WILLIAM D. "Bill" BENSON /redacted/

LOGKEEPER/
EDITOR : FRED FRAAS

PURSER: BOB BECKER

STEERING
COMMITTEE: VIC CROSBY - DOUG MCFARLAND - AL LHEUREUX

MEETINGS: 3rd Friday of each month aboard the BEREKELY

MEMBERSHIP
DUES: $3.00 per year (Membership in the Maritime Musuem of San Diego is very highly encouraged.)

Prospective members are entitled to two visits as a guest of a member. After two visits, dues must be paid for further participation in the activities of the Guild.

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Starting To Build (Cont.)

If the boat, on completion, floats too high, more ballast can of course be added. Some of these weights can be accurately determined from makers' catalogues, of course, but some will have to be estimated, which is a posh word for guessed. For instance, the weight of the hull and superstructure will be most difficult but past experience, if any, will be invaluable here – otherwise try other modellers, if you know any.

All this will now give you a very fair idea if the model is feasible. If the total of the list is greater than your displacement calculation, as in our example, you are in trouble. Either you must make the model larger or look at 'The List' again with a view to trimming something. A point to remember here is that you can always make the draught of the model larger, i.e. out of scale, and with some models this may be essential. The paddle steamer that I am building at present has 7/16 in. extra draught, as paddle steamers were always very lightly built.

In this case either work backwards from your list to get the extra depth or decide on a likely figure and rework the weight calculation.

However, and this is where the interconnection previously mentioned comes in, what motor and batteries are you going to use? Most scale models are perhaps best driven by electric power and a reasonable life say 1 to 1½ hours running is required. Electric motors are quite reasonably efficient and produce no heat to distort or damage the model, so electric power it almost must be – although for very large models steam is a possibility, you might say a necessity for steam addicts!

Remember you are not usually interested in great speed so very powerful motors are not required, nor are expensive cells of the silver-zinc variety. I have found the small lightweight lead acid accumulator is ideal although the current drain should be kept to say below 1.5 amps if a reasonable 'pond life' of say 1½ hours is required.

Selection of motor size can be helped by perusing the makers' advertisements, but again experience helps.

My 36 in. Oakley lifeboat – a very chunky hull – worked quite well with one Decaperm driving two screws through a simple gearbox. It worked much better with two Decaperms driving a screw each.

My present paddle steamer is 50 in. long and is driven by one Decaperm, but through a Pile gearbox and a chain drive to keep the paddle speed down. I would have fitted a Hectoperm but the beam was too narrow.

Which brings me nicely to my next point, and that is checking your guesses (?) as soon as possible.

Once the hull is finished I fit the power plant and get it into the water. Don't worry about getting everything lashed down and Bristol fashion, or installing the radio gear. Just do the barest to get it into the water, roughly ballast up and try it – in the bath first if you like.

Several things can now be *positively* checked for the first time.

1) Does the weight of the hull agree with your list? If lighter in actuality then you have something extra in hand. Conversely if the hull is heavier than expected something else must be trimmed – but at least some decision can be taken based on fact.

2) Is the drive OK – i.e. speed of the model satisfactory? The size and effectiveness of the rudder can also be checked at this stage if desired.

3) Power consumption tests can be done by fitting a simple ammeter in series with the motor. It may be necessary to change the size of the propeller – e.g. smaller if the amperage is too high.

4) The amount of ballast required will give a very good indication of the amount of weight that can be taken by the superstructure etc. Remember the ballast does not have to be in the bottom of the hull; you can distribute it around anywhere you like. Put some of it above deck level to get some idea of whether the boat will be 'tender' (slow to recover from rolling) or 'stiff' (very stable).

All this should enable you to get an excellent idea whether it will prove a viable model. At least if anything is wrong decisions as to possible solutions can be made and tried out (?) and if the model is abandoned then you have only a hull to throw away! Or you could make a glass-case model?

One last point. I find that inevitably you collect a fair bit of paper work, catalogues, photos, even correspondence with other blokes similarly cursed with your complaint, so I keep a file and stick everything in it – it doesn't build the model but it helps by saving time hunting bits of paper; time that should have been spent at the bench.

Some models of course do not really require these calculations: it is obvious plenty of buoyancy exists – tugs, for example – but other vessels, as I have mentioned, destroyers and paddle steamers, among others, require care to avoid mistakes. In any case these calculations are easy to do and will give you an idea of what you can get away with.

Easy, that is, if you learnt your tables. Here's to good calculating!

from "MODEL BOATS" April 1970

MODEL BOATS

MEASURING SHIPS

Informative notes by W. Featherston

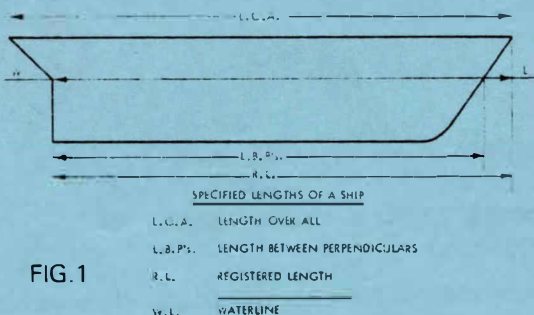


FIG.1

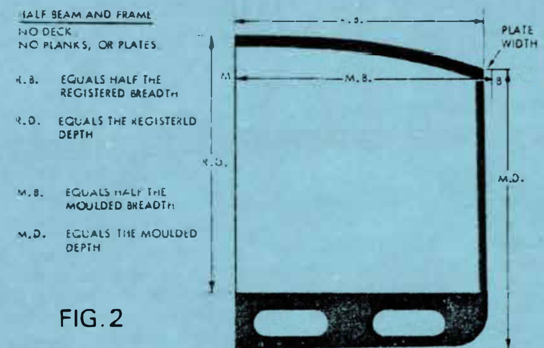


FIG. 2

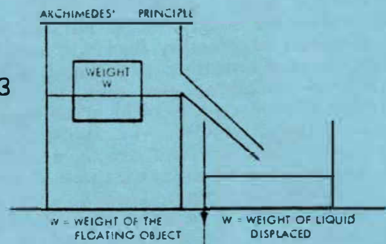
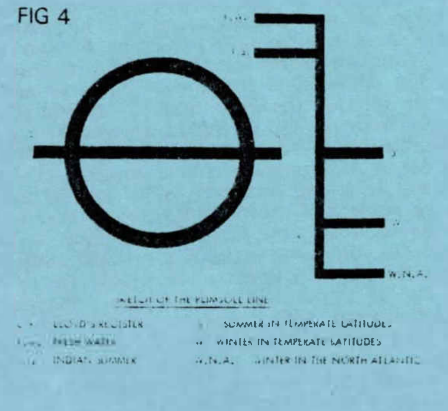


FIG. 3

FIG 4



DUES were levied on imports and exports carried in ships in early days; Tonnage and Poundage was exacted in the 14th Century and was not abolished until the period of the Restoration. Even Tyne Keels were not exempt, for in 1422 there was a levy of 2d. per chaldron on coal carried down the shallow Tyne to Shields to waiting collier brigs. A levy was exacted from the sailing colliers according to the 'number of keels of coal' they carried.

A chaldron was the name of the waggon which carried the coal to the keels. The coal was not weighed, but the size of the chaldron was fixed, and the keels were measured and registered to carry 8 chaldrons only; a chaldron of coal weighed about 53 cwts., hence the keels all carried about 21 tons. The unit was essentially the volume of the chaldron.

In 1694 an Act of Parliament was passed which stated that the taxable tonnage of a ship had to be calculated from the following formula:–

$$\text{Tonnage} = \frac{\text{Length} \times \text{Breadth} \times \text{Depth}}{94} \qquad \text{formula 1}$$

In 1773 a new formula was substituted for the above.

$$\text{Tonnage} = \frac{(\text{Length} - \frac{3}{5}\text{Beam}) \times \frac{(\text{Beam})^2}{2}}{94} \qquad \text{formula 2}$$

Formulae 1 & 2 are basically volumes, and each numerator is a volume.

Formula 2 became the basis of Maritime Law and became known as B.O.M., i.e. Builders' Old Measurement; it unfortunately produced many unseaworthy types which were often lost at sea as a result of the omission of 'depth' from the formula. The rule produced ships of great depth with flat bottoms merely for private gain, and things got to such a bad state that an Admiralty Commission was set up in 1821, though it was unable to make any recommendations.

Another similar commission was set up in 1835, and this one abolished formula 2 entirely and presented the Tonnage Act, which became known as Builder's New Measurement, B.N.M. in short. This new act measured the internal cubic capacity under a ship's deck, and this has been the basis of all subsequent legislation right up to date. Very soon builders took advantage of the loophole and fo'castles, poops and deck houses began to appear *above* deck; technically, these were known as 'erections'. This loophole was closed in 1849 and the volume of all erections above deck was added to the volume below deck.

The name Moorsom is closely associated with this

FIG 5

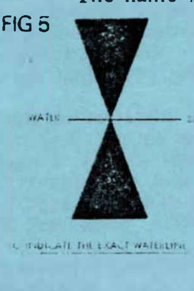
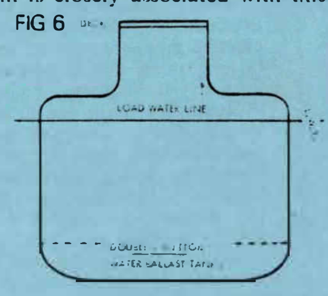


FIG 6



latter piece of legislation, which became Maritime Law for many nations and still exists to this day as the Merchant Shipping Act of 1854.

Due to the Moorsom system all ships have two important measurements, viz:–

No. 1. *Gross tonnage*, which is the total volume of all spaces below and above deck.

No. 2 *Net tonnage*, which is less than the above because it excludes occupied space taken up by engines, boilers, crew space and cabins, above or below the deck.

To get the tonnage, gross or net, the volume is divided by 100 because 100 cubic feet of air is considered to be equal to one ton.

One more tonnage must be mentioned here, viz. *Registered Tonnage*, but this concerns H.M. Customs, who enter on the ship's Certificate of Registration what are called registered measurements, and the Registered Tonnage, which is really the Net Tonnage. This certificate is a most important ship's document which *must* be produced when a change of ownership occurs; it is really the ship's identification.

Naval vessels have no need for any of the above because the level of the waterline only varies very slightly, whereas a cargo ship may be fully or partially loaded, in ballast, or light of cargo and ballast.

Long ago Archimedes discovered that a ship will float if the weight of water it displaces is equal to the total weight of the ship (Fig. 3). The deadweight of the ship, i.e. its total weight, is counterbalanced by the weight of the water displaced; the deadweight of a naval vessel is called its *displacement*. The deadweight of *all* ships is known before they are launched because everything that goes into them during their building is carefully weighed.

A naval architect can calculate a ship's displacement if he has the ship's lines and the draught.

$$\textit{Displacement (in tons)} = \frac{\text{Volume of water displaced (cubic feet)}}{35}$$

Ship measurements are all clearly defined and are taken in a certain way, e.g.

Registered Length is measured from the top of the stem to the after edge of the stern post measured horizontally.

Registered Breadth is taken wherever it is greatest, to include the thickness of strakes or plates.

Registered Depth is measured from a point amidships from the underside of the deck to the top of the double bottom if it exists, if not, to the top of the floor plates, vertically.

Length between Perpendiculars. See Fig. 1. This length is measured on the Load Water Line (L.W.L.) between the point where the stem enters the water to the after edge of the stern post if one exists, if not, to the centre of the rudder stock.

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MEASURING SHIPS (*continued from page 159*)

When L.B.P.'s is used the breadth and depth are given as

Moulded Breadth, which is the widest breadth between strakes or plates, and

Moulded Depth, which is measured from the underside of the deck to the top of the keel.

Here are the particulars of H.M.S. *Bulldog*, built recently.

Length between perpendiculars ...	168 ft. 6 in.
Moulded breadth	37 ft. 6 in.
Moulded depth	19 ft. 9 in.
Draught	11 ft. 6 in.

The marking of the safe loading level on a ship's sides became compulsory by Act of Parliament in 1876. The line is marked by a Lloyd's agent, and it is called the Plimsoll Line, named after the member who introduced the Bill. The line alters according to the prevailing density and provision is made for this by a series of lines to which the ship can be loaded for various densities. See Fig. 4.

I conclude this short article, which may clear some doubtful points for those interested, with a diagram (5) which indicates very accurately a waterline. Racing yachts generally display it on their topsides amidships, because the length of the waterline is fixed for certain classes; it is exceedingly accurate and also indicates if the yacht has a list either to port or starboard.

Ship measurement is an extensive subject and the measurements are made by ship surveyors and H.M. Customs; now, no fortunes are made by overloading, for the Plimsoll Line makes this too obvious and the penalties are severe. I can only think of one attempt at legitimate evasion which I know of, and this occurred in this century when turret ships were built; they were ugly and soon dropped. Fig. 6. Turret steamers were cargo tramps evolved by Doxford's shipyard at Sunderland to avoid a portion of the Suez Canal dues which were on *deck area*. The cross section I have drawn clearly shows how this area was considerably less than that of normal types.

This advantage was soon nullified by altering the method of fixing the dues on net tonnage only, and this sealed the doom of turrets. No replacements were built when their normal lives ended. When completely loaded with a bulk cargo such as wheat, turrets became very 'tender' and some of them overturned completely. Hatches in the deck were very narrow and in harbour decks were nearly impassable.