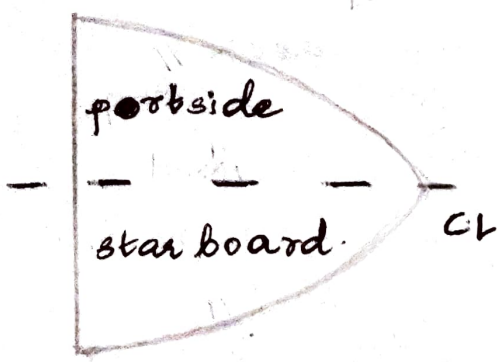
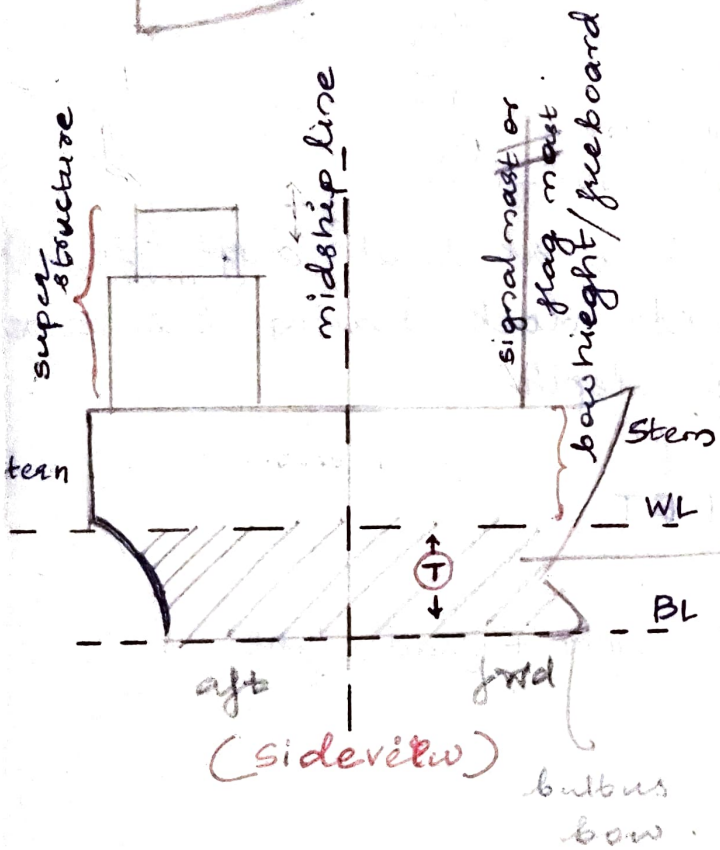
MODULE-I



Part of ship to the right of central line is called Starboard.
That to the ~~right~~ left is called Portside.
In olden times the rudder or steerboard was in right side or starboard side.

Midship, Center line, Base line are the reference lines (just like X, Y, Z axes).



∇ (Volume displaced)

$\nabla \times \rho = \Delta$ { Volume displacement × Density = Mass displacement

Here 'T' is the draft.
T_f is forward draft
T_A is after draft

$T_f = T_{Aft}$ (Ideal) Even keel

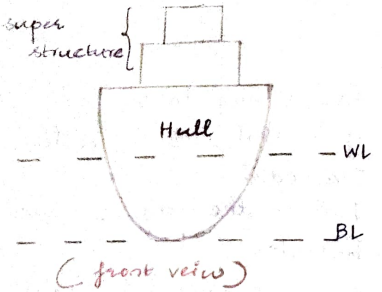
$T_f \neq T_{Aft}$: Trim

Observed with help of FP, AP & Midships

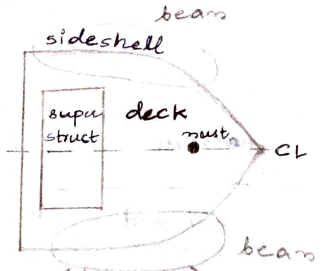
$T_{Aft} > T_f$ (favoured)
↓
Proper propellor immersion is ensured

$T_f > T_{Aft}$ (unfavourable)

A minimum draft is to be ensured



(front view)



(top view)

Block coefficient C_B.

Ratio of volume of displacement at that draft to the volume of a rectangular block having the same overall length, breadth & depth.

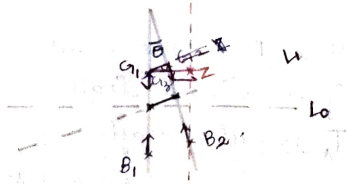
$$C_B = \frac{\text{Submerged volume of ship hull } (\nabla)}{LBT}$$

$\nabla = C_B L B T$, $\Delta =$ Light weight + Deadweight

Section views are taken in ships for closer observation. Sections from 0 to 20 or so are taken for closer watch

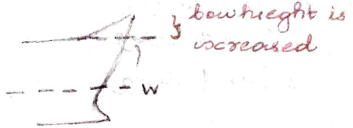
Starboard, Port parts may have inequality in weight distribution. (List)

If its by external factors like wind (Heads occurs)



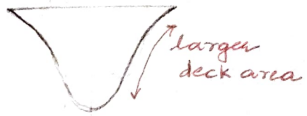
Righting moment & Righting lever.

① Shearing.



Sheer is the upward curve or inclination brought to increase the bow height.

② Flare



Cross sectional area at water line is lower than the deck area. (stability ↑)

③ Camber

Curvature is brought to the main deck is upper direction

④ Tumblehome


Deck area is lower than cross sectional area at the water line

⑤ Rise of floor

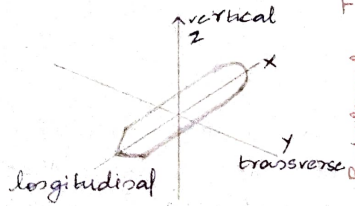

Distance between base line and bottom shell plating of ship.

A ship has 6 degrees of freedom.

3 translational →
3 rotational →

Translational:
- Surge (fwd & back)
- sway (side to side)
- Heave (up & down)

Rotational:
- Roll (about longitudinal axis)
- Pitch (about transeverse)
- Yaw (about vertical)



ship side ലേക്ക് മറിയുന്നത്
- Capsize.

ഉണ്ടാ ചിലവാ മുങ്ങുന്നത്
- Mounting.

* Moulded dimensions:
Dimensions exclusive of hull plating

* Extreme dimension:
Dimensions inclusive of hull plating.

Ship parameters:

* Archimedes principle

Upward bouyant force that is excerted on a body immersed is a fluid, whether fully or partially, is equal to weight of fluid that body displaces

Law of floatation

When body floats in a liquid, the weight of liquid displaced by ofject is equal to weight of the object

Center of Bouyancy & center of gravity act as a couple are helping ship to float

Waves ചെയ്യുന്ന external factors വഴി ഉണ്ടാകുന്ന instability center of bouyancy shift ചെയ്യുന്നതിന് വഴി stable ആകുന്നു. ഒരു safe range of angle ഉണ്ട്. (range of stability

→ Stowage factor

Amount of volume of a unit mass (1 tonne) of a type of cargo will occuppy.

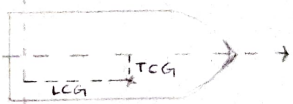
→ TEU (Twenty foot equivalent unit)

General unit for cargo capacity — 8.6ft, 20ft

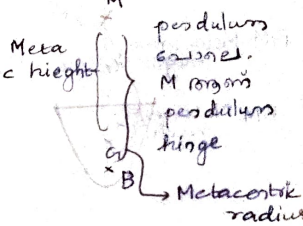
MCT (1cm): Moment required to cause a draft of 1cm
force x distance from center of floatation

LCF is important

Longitudinal, Transverse, Vertical center of gravity (VCG, KG)
Based on reference lines, Center of gravity is located

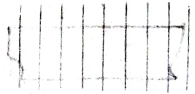


TCG should be noted carefully inorder to prevent list. VCG (KG)

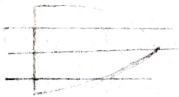


f is the centeroid of the water plane area at the draft at which ship is floating. Point about which ship turns (center of floatation)

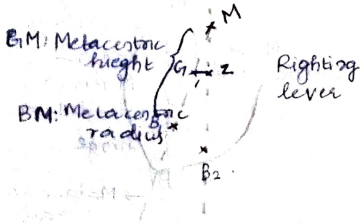
Waterlines



Stations



Buttock lines



GM: Metacentric height

BM: Metacentric radius

Righting lever

* 1 ~~NM~~ kn = 1852 km/h = 0.5144 m/s

knot

1 NM/hr

1 N.M = 1.852 km = 1852 m

Quater astern : The port or starboard quater is the area of ship that is about 45° from the stern on either side of centerline.

Astern : Behind the ship/ toward the stern.
Dead astern means directly behind the ship.

Freeboard : Distance from waterline to main deck

Plimsoll mark : A refrence line on ships hull that indicates the maximum depth at which ship can be safely loaded with cargo

Gross Register Tonnage (GRT)

Measure of total internal volume of ship

Net Register Tonnage (NRT)

Measure of volume available for carrying cargo & passenger

Reserve bouyancy : Volume of ship above waterline and can be made watertight to increase ships bouyancy (Its also a measure of ships ability to sustain damage)

TPC (Tonnes per centimeter)

Amount of weights in tonnes that needs to be added or removed from a ship to change its draft by 1cm

$$= \frac{L \times B \times C_B \times \rho}{100}$$

Fresh water allowance

The change in a ship's draft when it moves from salt water to fresh water

$$FWA_{(mm)} = \frac{\text{displacement}}{4 \times TPC}$$

For box shapped vessels, FWA remains same at all drafts. For other vessels FWA increases with draft

When density changes, volume of displaced water should also change to maintain draft

When density increase, volume of displaced water should decrease & vice versa.

C_m (Midship coefficient)

$$= \frac{\text{Area of midship section}}{\text{area of } \square \text{ with same breadth \& draft}}$$

C_w (Waterplane area coefficient)

$$= \frac{\text{Water plane area}}{\text{Max (length * breadth)}}$$

C_p (Prismatic coefficient)

$$= \frac{\text{Submerged volume}}{\text{length * cross sectional area as of midship reg}}$$

$C_B = C_M \times C_p$

Q. Passenger ship of $L = 24$, $B = 4$, $D = 2.4\,m$ is floating in a draft of $1.25\,m$. Calculate the volume of displacement of vessel if $C_B = 0.67$

$$C_B = \frac{\nabla}{LBT}$$

$$\nabla = C_B LBT$$

$$= \frac{67}{100} \times \frac{6}{24} \times 4 \times \frac{125}{125}$$

$$= \frac{402}{5} = 80.4\,m^3$$

Find mass displacement if $\rho = 1.025$

$$\Delta = \nabla \times \rho$$

$$= 80.4 \times 1.025$$

$$= 82.41$$

Change in draft when moved to freshwater.

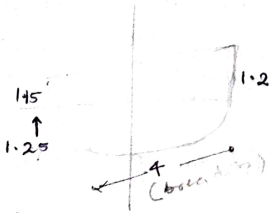
$$\Delta = \nabla \times \rho$$

$$= C_B L B T_1 \times \rho_1$$

$$T_1 = \frac{\Delta_1 - \Delta_2}{\rho_1 L C_B B} = \frac{\Delta'}{\rho' L B C_B}$$

$$\frac{T_2}{T_1} = \frac{\Delta_2}{\Delta_1} \times \frac{\rho_1}{\rho_2} = \frac{82}{80} \times \frac{1}{1.025}$$

Q. Reference from maindeck midship. The portside freeboard is 1.15, starboard is 1.2

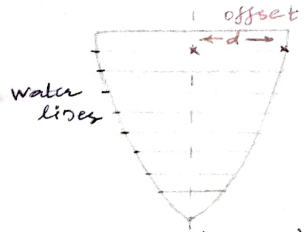


$$\tan\theta = \frac{1.2 - 1.15}{4}$$

$$= \frac{5}{100 \times 4} \times \frac{125}{1000}$$

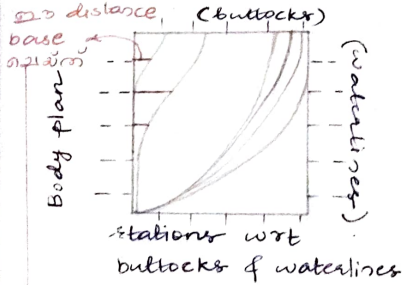
$$= 0.0125$$

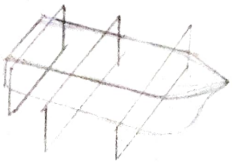
#ILLC
SOLAS
MARPOL
STCW



Transverse plane-ൽ body ഒന്ന cut ചെയ്താൽ, hull-shape study ചെയ്യുന്നു.

wrt (midship & waterlines).

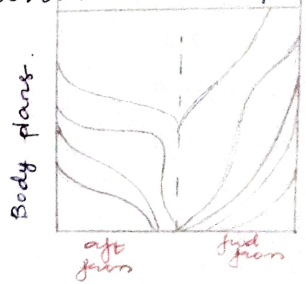




Half breadth wrt buttocks & stations

(profile view or side view)

wrt waterlines & stations



Orthographic projection of all half sections from aft to midship & midship to fwd.

The curve used to calculate a ships stability & resistance at different drafts

: hydrostatic curve

Ship with a higher prismatic coefficient tends to have

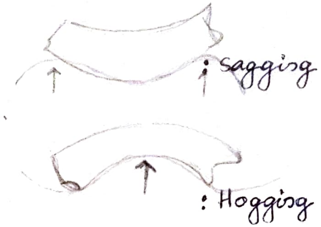
: A greater wave-making resistance.

Low speed & high stability

ഈ 3 lines/plans ചേർത്ത് വച്ചാൽ ship ന്റെ skeleton model കിട്ടും.

	Sheer	Half breadth	Body plan
Buttock	curve	horizont	vertical
Waterlines	~~vertical~~ horizont	curve	horizon
Stations	vertical	vertical	Curve

Diagonals are drawn in body plan & from that offset is collected for each stations & is drawn near half breadth plan.
These diagonals are drawn to check the smoothness



Main phases of ship design.

* Concept design
* Preliminary design.
* Contract design.
* Detailed design.

പല deck ഉണ്ട് (Main deck അല്ലാതെ)

forecastle deck (aft region ൽ അൽപം ഉയർന്ന്