NAME 323: RESISTANCE & PROPULSION OF SHIPS

3.00 Credit , 3.0 Hours/week

Course Teacher: Dr. Md. Mashud Karim, Professor

Department of Naval Architecture and Marine Engineering

BANGLADESH UNIVERISTY OF ENGINEERING AN D TECHNOLOGY

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A **bulbous bow** is a protruding bulb at the bow (or front) of a ship submerged just below the waterline at design loaded condition.

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The bulb modifies the way the water flows around the hull, reducing drag and thus increasing speed, range, fuel efficiency, and stability.

Large ships with bulbous bows generally have a 12-15% better fuel efficiency than similar vessels without them.

A bulbous bow also increases the buoyancy of the forward part and hence reduces the pitching of the ship to a small degree.

Bulbous bows have been found to be most effective when used on vessels that meet the following conditions:

- the waterline length is longer than about 15 metres (49.2 ft)
- the vessel will operate most of the time at or near its maximum speed

Thus, large vessels that cross large bodies of water near their best speed will benefit from a bulbous bow. This would include naval vessels, cargo ships, passenger ships, tankers and supertankers. All of these ships tend to be large and usually operate within a small range of speeds close to their top speed.

Bulbous bows are less beneficial in smaller craft and may actually be detrimental to their performance and economy. Thus, they are rarely used on recreational craft like powerboats, sailing vessels, tug boats, fishing trawlers and yachts.

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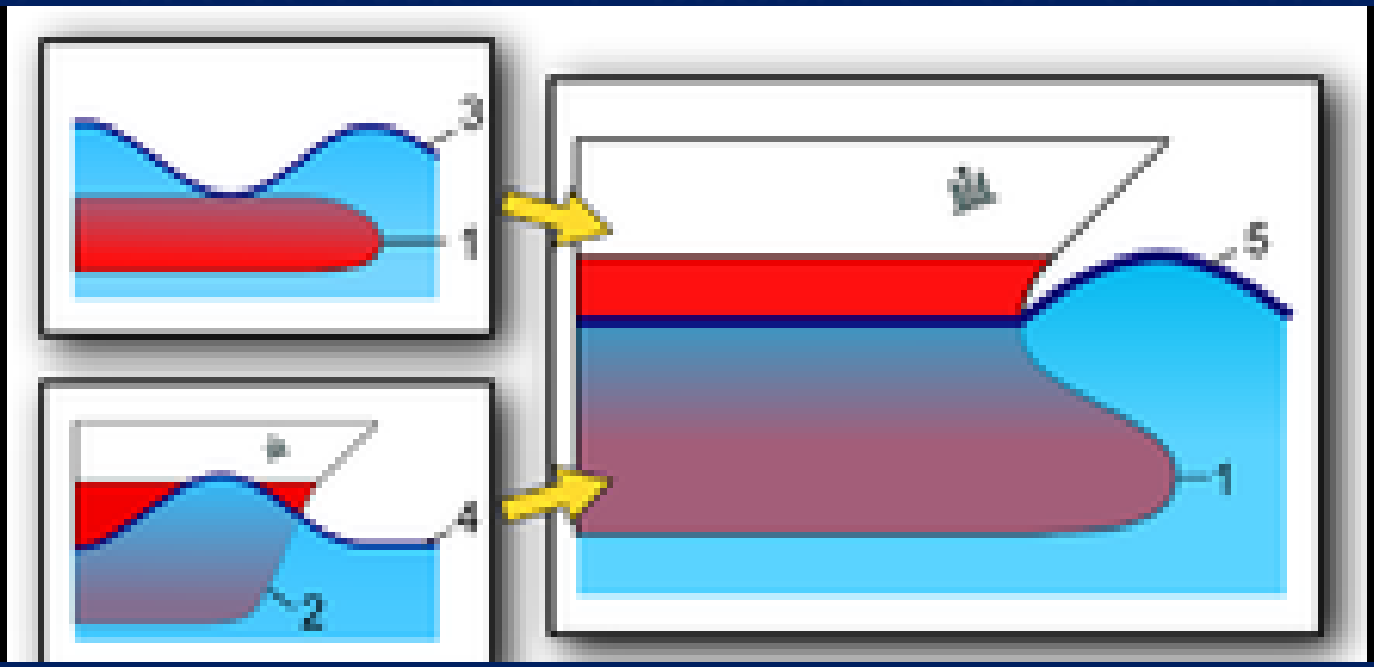
How it works



Graphic demonstrating how the bulbous bow influences water flow In a conventionally shaped bow, a bow wave forms immediately before the bow. When a bulb is placed below the water ahead of this wave, water is forced to flow up over the bulb. If the trough formed by water flowing off the bulb coincides with the bow wave, the two partially cancel out and reduce the vessel's wake. While inducing another wave stream saps energy from the ship, canceling out the second wave stream at the bow changes the pressure distribution along the hull, thereby reducing wave resistance. The effect that pressure distribution has on a surface is known as the form effect.

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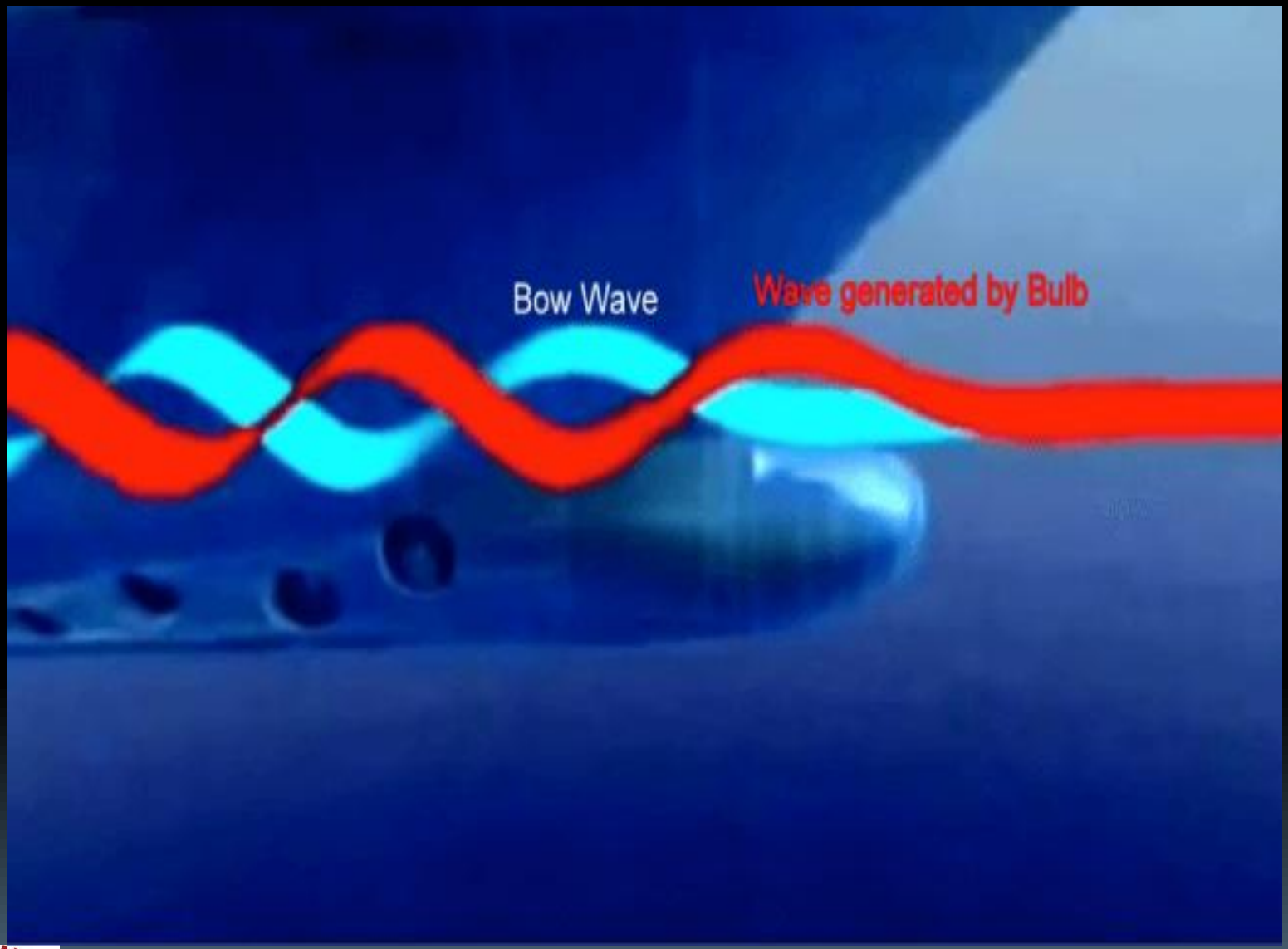

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Ram Bow

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Ram bow with ram far below waterline

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Ram bow close to the waterline

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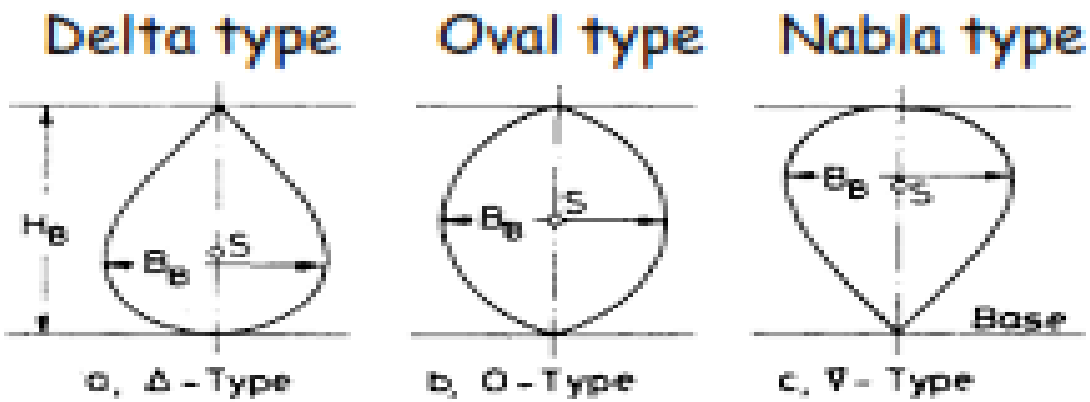
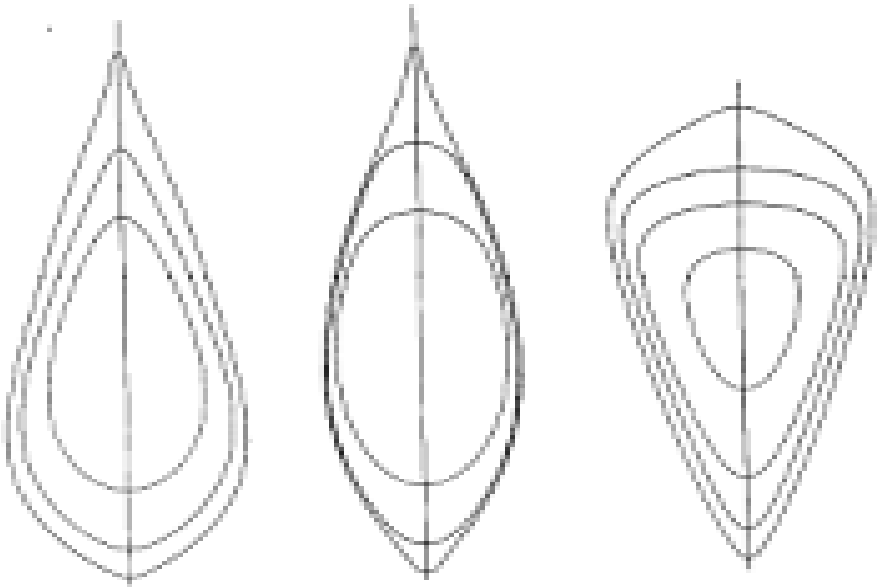
Bulb with a knuckle


Delta type
Oval type
Nabla type
H_B
B_B
S
Base
a, Δ - Type
b, O - Type
c, ∇ - Type



The various types of bulbous bow are as follows -

Δ- type: The figure below shows the drop-shaped sectional area ABT of the delta-type with the center of area in the lower-half part. This shape indicates a concentration of the bulb volume near the base. The Taylor bulb and the pear-shaped bulbs belong to this type.

O- type: The figure below shows an oval sectional area ABT and a center of area in the middle with a central volumetric concentration. All the circular, elliptical, and lens- shaped bulbs as well as the cylindrical bulbs belong to this type.

∇- type: The nabla-type also has a drop-shaped sectional area ABT , but its center of area is situated in the upper-half part, indicating a volume concentration near the free surface, because of its favorable sea-keeping properties, this type is the common type of bulb.

Advantages of bulbous bow:

- Reduces the bow wave, due to the wave generated by the bulb itself, making the ship more efficient in terms of energy.
- Increases the ships waterline length, slightly increasing the ship speed, reducing the installed power requirements and so the fuel oil consumption.
- Works as a robust bumper in the event of collision.
- Allows the installation of the bow thrusters at a foremost position, making it more efficient.
- Allows a larger reserve of flotation or a larger ballast capacity forward.
- Reduces pitch movement.

0.55 is the lowest value that can be obtained by a vessel to get the advantage of bulbous bow.

Procedure to choose bulbous bow

Basic procedures for choosing the bulbous bow are given by Sounders, H.E.1957 as follows:-

1.The most important feature of this pattern was a wave trough just aft of thesphere, which suggested the possibility of partly canceling the bow wave of the hull by locating a sphere below the surface in the neighborhood of thestem.

2.Useful range of speed of bulb is generally from about Fn = 0.24 – 0.57.(Comstock. J.P 1967)

3.The best position for the bulb is with its center at the bow and its nose projecting forward of the hull.

4.The bulb should extend as low as possible, and should be as short aslongitudinal and as wide laterally as possible, consonant with fairness in the lines of the hull

5.The top of the bulb should not approach too nearly at the water surface.
6.It is significant that the most substantial improvement we found in the ballastcondition is when the bulb is near the surface. The draft forward appears to becritical and care should be taken in choosing the ballast operating operation.
7.Cost to build and development of the bulb.
8.The bulb must not be treated nearly as an addition or appendage, but thewhole fore body should be redesigned as fine load waterline being used withhalf-angles of entrance of 5 to 10 deg less than those of a normal trawler, andwith the LCB as far aft as possible.
9.The bulb area should not exceed 5 % in order to avoid risk of slammingdamage.10.Unless the lines (forward) are extremely hollow the best position of the bulbis with its (longitudinal) center at the bow, that is, with its nose projectingforward of the hull.11.The bulb should extend as low as possible consistent with the fairness of the lines of the hull.
12.The bulb should be as short longitudinally and as wide laterally as possible,again having regard to the fairness of the line.13.When considering a bulb bow for a new design it is first necessary todetermine whether the speed range is appropriate to its use.