



Sea Star Surface Craft

Hull Design *Guidelines*

DRAFT



Surface Craft Hull Design Guidelines

Boat hull design is an entire area of study for Naval Architects and Marine & Ocean Engineers. These guidelines are just a starting point for designing the hull of your surface craft. The books referenced below will give you much more detail on how hulls are designed.

Basic Physics:

Center of Gravity (C.G.) and *Center of Buoyancy* (C.B.) are probably the most important concepts in boat design. Their placement will help determine the stability and performance of the boat. While they are closely related, the C.G. and C.B. are not necessarily in the same place.

Hydrodynamics, or the flow of water around and under a boat hull, will effect the efficiency and performance of the hull. *Drag* can be created by things such as surface friction on the hull, drag created by protrusions (rudder, keel, etc.), and drag from the trailing edge (stern shape).

Hull Types:

The *planing hull* and the *displacement hull* are the two most common categories of hulls. Other common types of hulls include: Air cushion hulls, hydrofoils, deep displacement, multi-hull, submarine, and others. Each type of hull has different characteristics and capabilities.

Common hull bottom shapes include: Flat Bottom, V-Bottom, Round Bottom, Multichine Bottom, Planning Hull (many types), Multihull.

Common bow shapes include: Plumb, Raked, Spoon, and Clipper.

Common stern shapes include: Raked Transom, Rocket Ship, Planing with Platform, Long Canoe, Canoe, Fantail, etc.

Important factors

While no design can do everything, here are some things to keep in mind when designing your boat hull. What tradeoffs must be made? Is there an optimal solution?

Specifications - What are the limits you must work within (size, weight, cost, performance, etc.)?

Intended Functions - Are you looking for speed, cargo hauling ability, or other abilities?

Size and Shape - What length and width are best? What are the shape bow, stern and bottom?

Hydrodynamics - How does fluid behavior and movement effect the performance of your hull?

Displacement - How much water does the boat displace? Does it change with speed?

Stability - What size and shape are most stable? How does stability effect performance?

Terminology:

Definition of Hull: Nautical - the frame or body of a ship, exclusive of masts, engines or superstructure.

Names of some common parts of the hull include: Bow, Stern, Transom, Deck, Gunwale, Hold, Waterline, Freeboard, Draft, Stem, and Length Over All (LOA) Beam (width).

Some common categories of boats include:

Sailboat, Powerboat, Cruiser, Hydroplane, Containership, Catamaran, Freighter, Roll On/Roll Off (RO/RO), Tanker, Barge, Tow boat, Trimaran.

Other boating terms include:

Aft, Body Plan, Cargo Hold, Chine, Displacement, Double-ender, Fair hull, Fore, Half-breadth plan, Hydrofoils, Inboard, Jet drive, keel, Length Waterline (LWL), Mono-hull, Outboard, Pitch, Planing hull, Port, Profile Plan, Roll, Rudder, Skeg, Starboard, Sterndrive, Superstructure, Topsides, Trim tabs, Wetted Surface, Yaw.

References:

Brewer, Ted. 1994. *Understanding Boat Design*, Fourth Edition. Camden, ME: International Marine, 147pp.

Devlin, Samuel. 1996. *Devlin's Boatbuilding: How to Build Any Boat the Stitch-and-Glue Way*. Camden, ME: International Marine. 198pp.

Gillmer, Thomas C. and Johnson, Bruce. 1982. *Introduction to Naval Architecture*. Annapolis, MD: United States Naval Institute, 325pp.

Teale, John. 1998. *How to Design a Boat*. Second Edition. Dobbs Ferry, NY: Sheridan House. 156pp.

Trower, Gordon. 1993. *Yacht and Small Craft Design: From Principles to Practice*. Wiltshire, U.K.: The Crowood Press, Ltd. 174pp.