

lieve that the new comparison ratio, when discovered, will contain a factor of, or be based primarily on, the vital matter of proportionate weight.

Undoubtedly the simple power-weight ratio should also be modified by some factor for plane area. I am inclined to hold to the belief that beam is the most direct and reliable indication of effective plane area and that the widest beam, minimizing as it does the load per square foot of bottom, will, within the limits of excess wetted surface, carry its load the fastest. Just how many tons per foot of beam can be properly carried at various speeds has not yet been accurately defined. My own past efforts in this direction I now believe to have been too optimistic on the net loads that can be planed and also too pessimistic about the ability of lightly loaded planes to be safe.

It would appear sensible in all cases to minimize weight but practical limits to which weight can ordinarily be reduced are imposed by the high cost of fine workmanship and light materials, to say nothing of the constant advance of technology which yearly reclassifies more gadgets into everyday necessities.

Our many new materials and some new ways of using old materials have not helped very much in reducing weight. Plywood and plastics are inherently heavy. Steel in small hulls can never approach the lightness of either lapstrake or double-planked construction. Aluminum is expensive but it seems to be the one hope of getting structural weights down to the level of fine, old time Lawley construction. And with this trend away from progress, the equipment necessary today would completely disgust old Nat Herreshoff. Not even modern engines lighten a boat by the full amount of their own lessened weight. We greedily seize upon the added power that can now be packed into a ton or so of cast iron and then proceed to beef up the hull to stand it.

But perhaps this is only transition. We have learned a little about making fat and prosperous boats perform. We definitely know how to make them ride softly although we don't know how to smother spray in a beam wind. But fast cruising hulls do bank inboard on turns, they are remarkably steady and they do hold their high speed in weather that slows displacement craft down to a sickening wallow. And yet they still can't come anywhere near to carrying the loads that beautiful mathematical theory seems to indicate they should. What really happens to all that magnificent lift promised by the slide rule?

Bodily lift with minimum change of trim is a major goal. However, excess lift forward is sometimes an intentional design characteristic, a deliberate use of the rocker bottom to reduce wetted surface. But in this position the hull is not seaworthy. Rough water pounds her flat midsections and beam winds can take charge of that high bow. The choice seems to lie between a little higher speed in smooth water at the expense of heavy weather ability, or a little slower top speed with the ability to hold that speed in any cruising weather.

Probably the extra wetted surface due to flat trim does not cost more than a knot and a half in the 20-25 knot range but the fuss and generally eager appearance of a hull with her whole bow riding high sometimes gives the appearance of much more difference than that.

The correct trim for seaworthy hulls must vary inversely with length. A short hull may trim three or four degrees without showing daylight under its forefoot and without squatting, while a longer hull with similar immersion at bow and stern may run at only two degrees of trim.

Beam-length ratios involve some further compromise. As a hull lifts out to plane, its displacement is reduced and a part of the load is carried by kinetic energy. This energy is, of course, largely imparted at the leading edge of the plane. Short, wide planes are therefore desirable. To what extreme this wide beam ideal can go is limited in a practical way by the necessity for retaining enough proportionate length to form a boat-like shape that will be directionally stable at sea. It is also limited by the fact that the hull must at times run as a displacement type.

In small cruisers a beam-length or "aspect-ratio" of plane

should normally be around .35 for full planing types and nearer to .30 for semi-planing forms. Little outboards can handle aspect ratios up to .40. This ratio is determined by dividing the water line beam by three-quarters of the static water line length. The arbitrary three-quarter length is used simply as a standard approximation of the effective plane length in stepless bottoms. Very light hulls such as sea skiffs may be somewhat narrower since less actual lift is needed.

In general, the hull designed for full planing approaches the monohedron ideal of nearly constant sections aft of midships to achieve straight, parallel buttock lines. Forward sections are deep and slightly convex. The forward chine is high and full. Forward chines which lie practically at the water's edge create slop and spray and usually indicate a bottom which may be cranky at low speeds.

Much discussion has always been occasioned by the troubles which any seagoing hull encounters when running before a following sea. Few boats ever do it well and those few have a priceless quality not fully appreciated by fair weather sailors. What happens is this: the stern is buoyed up by an overtaking swell while amidships the hull is relatively unsupported and the bow plunges deep enough to carry the load which is now bridged between the two ends. A fine bow may easily bury itself to the deck line and more. This deep bow then offers excessive resistance to motion. It is a perfectly good sea anchor and acts as a pivot about which the buoyed-up stern tends to make a disastrous swing.

A full bow, gathering its buoyancy before the plunge is deep, is relatively safer in this following sea situation because it can still be driven ahead at speed. It has not been anchored by tons of water.

An error sometimes seen in semi-planing hulls is the combination of fine entrance with a wide stern, perhaps even emphasized with hard chines aft of midships. Such a hull is not only awkward at low and marginal speeds and wet at high speed but can be hazardous in following seas. In general, the well formed planing hull, highly buoyant at both ends and capable of twenty knots or more, most nearly approaches the safety of the surf board.

There remains now the matter of balance, so important to basic hull design. The lowest possible Center of Gravity is sought in every type of craft, but the planing hull, although inherently more stable than displacement types, adds another compelling reason for low-placed weights. That is to facilitate the banked turn at high speed. Turning across the trough of a heavy sea is a fairly simple maneuver for the fast boat which banks inboard but it can be very uncomfortable, if not actually dangerous, if excess weight aloft forces an outboard bank in the manner of a displacement hull.

As to fore and aft location of the Center of Gravity, the planing hull is again more exacting in its requirements. It is not good practice to accept a C.G. at or forward of amidships and then just fill out the forebody lines to hold it up. It is bad practice because it increases the moment of inertia. The bow must be kept light for fast lifting. The Center of Gravity should usually be between 55 and 60 per cent aft and the arrangement plan must be subordinated to this requirement.

Little cruisers with cabins forward and engines about amidships cannot have good balance. Since cabins apparently must be forward, engines should be mounted well aft and the arrangement worked out accordingly. The big variable weight of fuel and water should go over the Center of Flotation, about 65 per cent aft, and then the hull stays in balance at all times. This also applies to small commercial craft where they like to get the pilot house up forward. If the engine goes up there too, then the boat pushes the ocean ahead of herself when she's light. Vee drive engines seem to be the best solution and this also puts the cargo space where trim is least affected.

The three things I tell my own associates are: Think in terms of seagoing forms, try to keep the weight in its place, and don't be afraid of new ideas.