船舶工程专业英语

（第2版）

黄德波 编

国防工业出版社
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船舶工程专业英语

Speciality English for Fundamentals and Concepts in Shipbuilding Engineering

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·北京·

内 容 简 介

本书内容包括船舶设计、原理、结构、生产建造、造船经济等方面。读者通过对本书有关造船学主要方面的英文文献的学习，可提高相关专业英语的阅读、理解及运用水平。本书可作为高等院校船舶与海洋工程专业学生的专业英语教材，也可作为相关专业工程技术、研究人员的培训或自学材料。

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再 版 前 言

21 世纪是海洋世纪，作为海洋大国的中国，要成为海洋强国，需要大力提高相关科技水平，船舶工程学是所需重要相关学科。为了新知识与信息的获取、国际技术的交流，除了基本英语的掌握之外，良好的专业英语的阅读、理解和运用能力对于目前与将要从事船舶工程有关科学与建造技术的人员是不可或缺的；有关教学与自学需要专业读本，本书是为此目的而编写。

本书的第一版发行多年，因常有需要，已重印多次；现应要求再版。编者对原版作部分增删和修订，加入部分更新内容，并附上书中 A-Z 生词和术语解释，希望能满足读者要求。

船舶工程学是一个较大系统，涉及船舶等水面与水中载体及结构物的力学性能、设计与建造等多方面学科，内容广泛，其有关专业英语的基本内容无法在此面面俱到；编者尽力从描述专业基础知识、基本原理概念、历史发展等较经典的文献中选材，择其要义，加上主要生词与术语的解释，编成本书。

书中主要内容涵盖船舶设计（概念，船舶分类，船型主尺度，船形及参数，船级社等）；船舶基本原理（稳性，阻力，推进，运动与操纵，船模试验等）；船舶结构（结构部件的功能，结构性能与线型的关系，船舶强度，结构应力，结构完整性等）；船舶生产建造（造船过程，计划与进度制订，船厂与设施，船舶 CAD 与 CAM 等）；并涉及少量造船经济（造船工业现状，成本估算与合同管理等）。

编者相信，通过学习本书，读者能掌握有关船舶工程专业英语的基本词汇和句法，相关专业英语的水平会有显著提高。本书主要是为有关专业本科生作为教材编写；教师可按具体专业要求和教学时数安排，适当选择其中内容进行教学，并鼓励学生阅读其中的“课后阅读”部分。本书也可供从事船舶与海洋工程方面的科技专业人员作为自学读物。

编者水平有限，书中难免有错漏，望读者指正。

编　者

2013 年 5 月

于哈尔滨工程大学

PREFACE

Introduction of Naval Architecture

Naval architecture is an engineering discipline dealing with the design, construction, maintenance and operation of marine vessels and structures. Naval architecture involves basic and applied research, design, development, design evaluation and calculations during all stages of the life of a marine vehicle. Preliminary design of the vessel, its detailed design, construction, trials, operation and maintenance, launching and dry — docking are the main activities involved. Ship design calculations are also required for ships being modified (by means of conversion, rebuilding, modernization, or repair). Naval architecture also involves formulation of safety regulations and damage control rules and the approval and certification of ship designs to meet statutory and non—statutory requirements.

1. Main subjects

The word "vessel" includes every description of watercraft, including non—displacement craft, WIG craft and seaplanes, used or capable of being used as a means of transportation on water. The principal elements of naval architecture are:

1) Hydrostatics

Hydrostatics concerns the conditions to which the vessel is subjected to while at rest in water and its ability to remain afloat. This involves computing buoyancy, displacement and other hydrostatic properties

Trim-The measure of the longitudinal inclination of the vessel.

Stability-The ability of a vessel to restore itself to an upright position after being inclined by wind, sea, or loading conditions.

2) Hydrodynamics

Hydrodynamics concerns the flow of water around the ship's hull, bow, stern and over bodies such as propeller blades or rudder, or through thruster tunnels.

Resistance-resistance towards motion in water primarily caused due to flow of water around the hull. Powering calculation is done based on this.

Propulsion-to move the vessel through water using propellers, thrusters, water jets, sails etc. Engine types are mainly internal combustion. Some vessels are electrically powered using nuclear or solar energy.

Ship motions-involves motions of the vessel in seaway and its responses in waves and wind.

Controllability (maneuvering)-involves controlling and maintaining position and direction of the vessel.

3)Structures

Involves selection of material of construction, structural analysis of global and local strength of the vessel, vibration of the structural components and structural responses of the vessel during motions in seaway.

4)Arrangements

This involves concept design, layout and access, fire protection, allocation of spaces, ergonomics and capacity.

5)Construction

Construction depends on the material used. When steel or aluminium is used this involves welding of the plates and profiles after rolling, marking, cutting and bending as per the structural design drawings or models, followed by erection and launching. Other joining techniques are used for other materials like fibre reinforced plastic and glass—reinforced plastic.

2. Science and craft

Traditionally, naval architecture has been more craft than science. The suitability of a vessel's shape was judged by looking at a half—model of a vessel or a prototype. Ungainly shapes or abrupt transitions were frowned on as being flawed. This includes rigging, deck arrangements, and even fixtures. Subjective descriptors such as ungainly, full, and fine were used as a substitute for the more precise terms used today. A vessel was, and still is described as having a 'fair' shape. The term 'fair' is meant to denote not only a smooth transition from fore to aft but also a shape that was 'right'. Determining what is 'right' in a particular situation in the absence of definitive supporting analysis encompasses the art of naval architecture to this day.

Modern low-cost digital computers and dedicated software, combined with extensive research to correlate full-scale, towing tank and computational data, have enabled naval architects to more accurately predict the performance of a marine vehicle. These tools are used for static stability (intact and damaged), dynamic stability, resistance, powering, hull development, structural analysis, green water modelling, and slamming analysis. Data is regularly shared in international conferences sponsored by RINA, Society of Naval Architects and Marine Engineers (SNAME) and others. Computational Fluid Dynamics is being applied to predict the response of a floating body in a random sea.

(摘自 Wikipedia, the free encyclopedia,2013)

Words and Phrases

vessel 船,舰,运输器,容器
stability 稳性
hull 船体
bow/stern 艏/艉
propelle blades 螺旋桨叶片
rudder 舵
thruster 推力器
tunnel 隧道
propulsion 推进
water jet 喷水推进器
internal combustion 内燃
seaway 水道,航道
maneuver 操纵
global 总体的,全球的
local 局部的,当地的
strength 强度
trial 试验,实船试验
WIG (Wing In Ground) 地效应船
arrangement 布置
concept design 概念设计
layout 安排,布放
fibre-reinforced plastic 纤维强化塑料
glass-reinforced plastic 玻璃强化塑料
access 访问,接近
ergonomics 人类工程学
capacity 舱容,载运能力
craft 技艺,船舶
to be more craft than science 与其说是科学,不如说是技艺
prototype 雏形,原型
ungainly 难看的,粗陋的
flawed 有缺陷的
rigging 索具,起重装置
full, and fine 丰满,与纤细的
correlate 相关
static stability (intact and damaged) 静稳性(完整与破损)
green water 甲板上浪
slamming 抨击,拍击
RINA (英)皇家造船工程师学会
Society of Naval Architects and Marine Engineers (SNAME) 船舶与海洋工程学会
random 无规则的,杂乱的

Contents

Chapter 1 Ship Design

Lesson 1 Introduction

1.1 Definition

The term basic design refers to determination of major ship characteristics affecting cost and performance. Thus, basic design includes the selection of ship dimensions, hull form, power (amount and type), preliminary arrangement of hull and machinery, and major structure. Proper selections assure the attainment of the mission requirements such as good seakeeping performance, maneuverability, the desired speed, endurance, cargo capacity, and deadweight. Furthermore, it includes checks and modifications for achievement of required cargo handling capability, quarters, hotel services, subdivision and stability standards, freeboard and tonnage measurement; all while considering the ship as part of a profitable transportation, industrial, or service system.

Basic design encompasses both concept design and preliminary design. It results in the determination of major ship characteristics, permitting the preparation of initial cost estimates. In the overall design process, basic design is followed by contract design and detail design. Contract design, as its name implies, develops plans and specifications suitable for shipyard bidding and contract award. Well prepared contract plans and specifications will be clear and in sufficient detail to avoid costly contingency items and protect bidders from obscure or inadequate description of requirements. Detail design is the shipyard's responsibility for further developing the contract plans as required to prepare shop drawings use d for the actual construction of the vessel.

An understanding of the entire design sequence is essential to anyone seeking to develop a basic design. The four steps involved are illustrated in the Design Spiral, Evans (1959)1 as an iterative process working from mission requirements to a detail design, Figure 1.1. These steps are amplified further below:

1. Concept Design

The very first effort, concept design, translates the mission requirements into naval architectural and engineering characteristics. Essentially, it embodies technical feasibility studies to determine such fundamental elements of the proposed ship as length, beam, depth, draft, fullness, power, or alternative sets of characteristics, all of which meet the required speed,

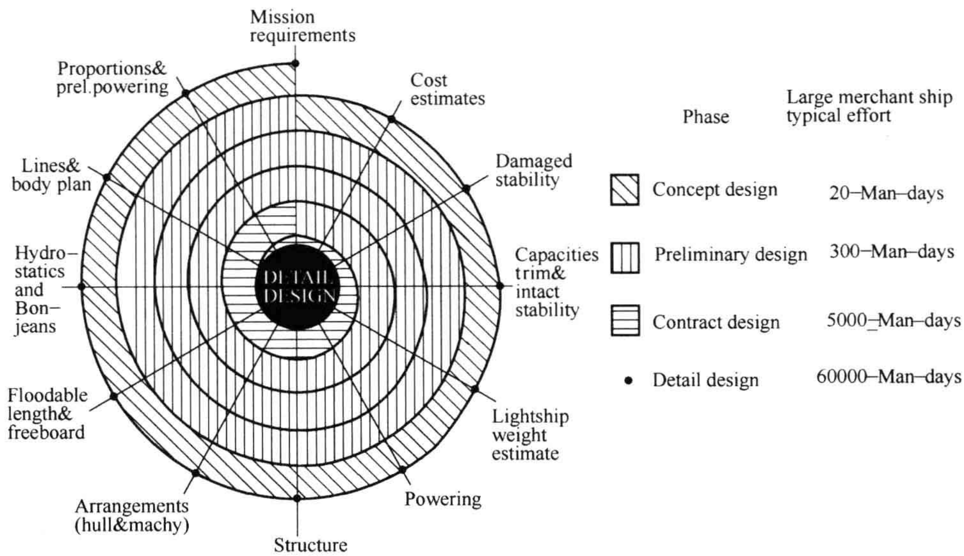

Figure 1. 1 Basic design spiral

range, cargo cubic, and deadweight. It includes preliminary light ship weight estimates usually derived from curves, formulas, or experience. Alternative designs are generally analyzed in parametric studies during this phase to determine the most economical design solution or whatever other controlling parameters are considered determinant. The selected concept design then is used as a talking paper for obtaining approximate construction costs, which often determine whether or not to initiate the next level of development, the preliminary design.

2. Preliminary Design

A ship's preliminary design further refines the major ship characteristics affecting cost and performance. Certain controlling factors such as length, beam, horsepower, and deadweight would not be expected to change upon completion of this phase. Its completion provides a precise definition of a vessel that will meet the mission requirements; this provides the basis for development of contract plans and specifications.

3. Contract Design

The contract design stage yields a set of plans and specifications which form an integral part of the shipbuilding contract document. It encompasses one or more loops around the design spiral, thereby further refining the preliminary design. This stage delineates more precisely such features as hull form based on a faired set of lines, powering based on model testing, seakeeping and maneuvering characteristics, the effect of number of propellers on hull form, structural details, use of different types of steel, spacing and type of frames. Paramount, among the contract design features, is a weight and center of gravity estimate taking into account the location and weight of each major item in the ship. The final general arrangement is also developed during this stage. This fixes the overall volumes and areas of cargo, machinery, stores, fuel oil, fresh water, living and utility spaces and their interrelationship, as well as their relationship to other features such as cargo handling equipment, and machinery components.

The accompanying specifications delineate quality standards of hull and outfit and the anticipated performance for each item of machinery and equipment. They describe the tests and trials that shall be performed successfully in order that the vessel will be considered acceptable.

Table 1. 1 shows a typical list of plans developed in the contract design of a major ship. Smaller, less complex vessels may not require every plan listed for adequate definition, but the list does provide an indication of the level of detail considered in contract design. Table 1B is a list of the typical sections covered in a commercial ship specification.

Table 1. 1 – Typical Plans Developed During Contract Design Stage

Outboard Profile, General Arrangement
Inboard Profile, General Arrangement
General Arrangement of All Decks and Holds
Arrangement of Crew Quarters
Arrangement of Commissary Spaces
Lines
Midship Section
Steel Scantling Plan
Arrangement of Machinery – Plan Views
Arrangement of Machinery – Elevations
Arrangement of Machinery – Sections
Arrangement of Main Shafting
Power and Lighting System – One line Diagram
Fire Control Diagram by Decks and Profile
Ventilation and Air Conditioning Diagram
Diagrammatic Arrangements of all Piping Systems
Heat Balance and Steam Flow Diagram – Normal Power at Normal Operating Conditions
Electric Load Analysis
Capacity Plan
Curves of Form
Floodable Length Curves
Preliminary Trim and Stability Booklet
Preliminarty Damage Stability Calculations

4. Detail Design

The final stage of ship design is the development of detailed working plans. These plans are the installation and construction instructions to the ship fitters, welders, outfitters, metal workers, machinery vendors, pipefitters, etc. As such, they are not considered to be a part of the basic design process. One unique element to consider in this stage of design is that up to this point, each phase of the design is passed from one engineering group to another. At this stage the interchange is from engineer to artisan, that is, the engineer's product at this point is no longer to be interpreted, adjusted, or corrected by any other engineer. This engineering product must unequivocally define the desired end result and be producible and operable.

In summary, this chapter considers basic design as that portion of the overall ship design process which commences with concept design and carries preliminary design to the point where there is reasonable assurance that the major features have been determined with sufficient dependability to allow the orderly development of contract plans and specifications. This development will form a basis to obtain shipyard prices within a predetermined price range that will result in an efficient ship with the requisite performance characteristics.

1.2 General Aspects

The late 1960's and 1970's saw a number of major new developments which in one way or another had an impact on the general basic design problem. Among the most significant was the computer. While the computer affects how basic design is performed, other changes have impacted on what constitutes the basic design problem. For example, one revolutionary development was the change from breakbulk to containerized cargos in the liner trades. Other developments in other ship types created similar new considerations. For tankers, size mushroomed; the increasing demand for petroleum and other raw materials by the industrialized nations of the world has necessitated ever larger tankers and bulk carriers to meet the enormous demand at acceptable costs.

Man is looking increasingly to the sea for all major resources; offshore drilling for oil and gas has burgeoned from a small industry located mainly in the shallow areas of the Gulf of Mexico to a worldwide colossus moving into deeper water and more severe sea conditions (Durfee et al, 1976). These developments have caused a revolution in the design of offshore drilling rigs/ships/units and the entire support fleet necessary for such a challenging undertaking. This includes crew boats, offshore supply boats, high powered towing vessels, pipe laying barges/ships, and countless other specialized craft. Future developments cannot be foretold, but it seems certain that other minerals will be sought from the sea necessitating entire new fleets of vessels designed for tasks not yet known.

Thus, the difficulty of basic ship design will vary with the degree of departure from past practice. Some ship operating companies are closely tied to successful previous designs, and they will permit little variation from these baselines in the development of replacement vessel designs. If the prospective mission appears to parallel existing operations, this may be a sound approach. Consequently, in such situations, basic design may be limited to examination of minor modifications to dimensions, powering, and arrangements.

At the other extreme, totally new seagoing missions, such as the ocean transportation of liquified natural gas (LNG), when first introduced, caused the designer to begin with a blank piece of paper and proceed through rational design engineering with crude assumptions subject to frequent and painstaking revision and development.

(摘自《Ship Design and Construction》, R. T. Taggart, The SNAME, One World Center, New York, 1980)

Additional reading

1. General Considerations

In such general comparisons and categorizations it is necessary to return to a practical perspective. It is all very well to arrange type categories with respect to the common denominator of supporting force or mission, but the question of relative significance in harder terms must ultimately be answered. The graphic comparisons in Figure 2. 1 convey the great variation in relative performance and capability as a function of ship category based on type of support.

How many ships of each of these categories can justify themselves in terms of economic support and environmental capabilities? How many are purely experimental? What can be expected of their future? Where these questions apply to the problems faced by the ship designer, an attempt has been made in the following chapters to provide the background for adequate evaluation.

A more detailed discussion of these comparative factors can only be made after the technical presentations of this book has been absorbed. But it must be emphasized here that most of this book will deal with the physical nature of displacement ships, simply because almost all of the ships on the world's oceans are and probably will be of this type. They carry the raw materials of world commerce and a nation's military strength to most parts of the globe. Without them the civilized industrialized world would quickly collapse.

The ships of recent years have noticeably progressive features in their external configuration. The old stacks or funnels have been replaced by raked, streamlined stacks or transverse pairs of slim diesel funnels. Superstructures have become crisp and uncluttered. Hulls of tankers and bulk carriers have become monstrous in volume. Fast cargo carriers and naval vessels have acquired new grace in their sheer and flare. Below the waterline, improved hydrodynamic knowledge has resulted in bulbous forefoot extensions and improved rudder configurations. There are a multitude of internal developments provided by modern technology, including the less visible changes in strength and performance allowed by improved metals and other materials.

2. The Systems Approach

The greatest change in new ships, however, is not very evident in their structure. This is because designers, planners, and operators recognize that a ship is an extremely complex but integrated total system.

It is increasingly difficult to design and build a ship without regard to the systems engineering approach. Because of the rapidly mushrooming technology of this century, there has been growing specialization within the engineering professions. This has led to the need for a way to deal with complex assemblies made up of many specialized components. If they are to be capable of optimum performance, such complex assemblies as the Trident submarine or the nuclear aircraft carrier must be designed in an orderly manner. This integrated approach is ordinarily referred to as systems engineering.

Systems engineering is employed in the design of all naval vessels and most commercial craft today, and the student of ship design should become familiar with it early in his engineering education. We might define the approach as a process for achieving significant objectives, allocating resources, and organizing information so that all major aspects of a problem can be precisely determined and coordinated according to a plan. Systems engineering supplies the bridge between what is needed and what is technically feasible.

Systems in Ships — Systems engineering, whether it is applied to a large ocean transport ship, a warship, or a very small vessel, implies total integration of all subsystems to provide a functional unit that achieves the basic mission of the ship. This means that ship control must function through the internal and external communications systems, and the machinery and propulsion systems must react to control, signaling their responses on display instruments at the central control station. The weapons systems of a warship must function on order with simultaneous execution and respond to all safety and protective systems. Systems engineering includes all automatic control systems as well as a multitude of engineering and electronic subsystems that maintain order and perform daily living and emergency functions. In the last century or more of successful mechanical propulsion, the ship has undergone fundamental changes; no longer is she merely a large floating vessel with a relatively isolated power plant, isolated cargo holds and living quarters, and a lonely navigation bridge with its crude mechanical or sound-signaling device to the engine room. In a sense, the ship of century ago was a system too, but her design lacked the systematic, integrated approach demanded for the successful modern ship.

(摘自《Introduction to Naval Architecture》, T. Gillmer & B. Johnson. London, E. & F. N. SPON, 1982)

Words and Phrases

seakeeping performance　耐波性能
maneuverability　操纵性
endurance　续航性
cargo handling　货物装卸
subdivision　分舱
stability　稳性
freeboard　干舷
tonnage　吨位
basic design　基本设计
concept design　概念设计
preliminary design　初步设计
contract design　合同设计
bidder　投标人(者)
iterative process　迭代过程
naval architecture　造船学
feasibility study　可行性研究
beam　船宽，梁
depth　船深
draft　吃水
fullness　丰满度
cargo cubic　货舱舱容，载货容积
denominator　分母
common denominator　共同特性，公分母
alternative　可选择的，交替的，方案
deadweight　载重量(吨)
talking paper　讨论文件
design spiral　推进器
hull form　船形
frame　船肋骨，框架，桁架
fresh water　淡水

living and utility spaces　居住与公用舱室
outfit　舾装
trial　实船试验
major ship　大型船舶
detail design　详细设计
ship fitter　船舶装配工
welder　焊工
metal worker　金属工
machinery vendor　机械(主机)卖方
outfitter　舾装工
pipe fitter　管装工
artisan　技工
shipyard　船厂
breakbulk　件杂货
containerized　集装箱化
liner trade　定期班轮营运业
tanker　油轮
bulk carrier　散装货船
offshore drilling　离岸钻井
drilling rig　钻架
pipe laying barge　(海底)铺管驳船
fleets of vessels　船队
outboard profile　侧视图
inboard profile　纵剖面图
general arrangement　总布置
hold crew quarters　船舱
crew quarters　船员居住舱
commissary spaces　补给库舱室,粮食库
line　型线
plan views　设计图
midship section　舯横剖面
elevation　高程,高度,海拔,船型线图的侧面图、立视图、纵剖线图
sections　剖面,横剖面
main shafting　主轴系
power and lighting system　动力与照明系统
diagram　图,原理图,设计图,流程图
ventilation and air conditioning diagram　通风与空调敷设设计图
normal operating condition　常规(正常)运作工况
capacity plan　舱容图
curves of form　各船型曲线
floodable length curve　可浸长度曲线
trim　纵倾
damage stability　破损稳性
light ship weight　空船重量
a faired set of lines　经过光顺的一组型线

Problems

1. What kinds of design have been mentioned in the introduction?
2. What is the main purpose of basic design?
3. Should the contract design be completed before bidding for a ship?
4. What kind of cargo ship has gradually become the substitution of breakbulk carrier?
5. Which industry will the shipbuilders like to get involved, in addition to building ships?

Lesson 2 Ships Categorized

2. 1 Introduction

The forms a ship can take are innumerable. A vessel might appear to be a sleek seagoing hotel carrying passengers along to some exotic destination; a floating for tress bristling with missile launchers; or an elongated box transporting tanks of crude oil and topped with complex pipe connections. None of these descriptions of external appearance, however, does justice to the ship system as a whole and integrated unit—self sufficient, seaworthy, and adequately stable in its function as a secure habitat for crew and cargo. This is the concept that the naval architect keeps in mind when designing the ship and that provides the basis for subsequent discussions, not only in this chapter but throughout the entire book.

In order to discuss naval architecture, it is helpful to place ships in certain categories. For purposes of this text, ships are classified according to their means of physical support and their designed purposes.

2. 2 Ships Typed According to Means of Physical Support

The mode of physical support by which vessels can be categorized assumes that the vessel is operating under designed conditions. Ships are designed to operate above, on, or below the surface of the sea, so the air sea interface will be used as the reference datum. Because the nature of the physical environment is quite different for the three regions just mentioned, the physical characteristics of ships designed to operate in those regions can be diverse.

1. Aerostatic Support

There are two categories of vessels that are supported above the surface of the sea on a self - induced cushion of air. These relatively lightweight vehicles are capable of high speeds, since air resistance is considerably less than water resistance, and the absence of contact with small waves combined with flexible seals reduces the effects of wave impact at high speed. Such vessels depend on liftfan's to create a cushion of low-pressure air in an underbody chamber. This cushion of air must be sufficient to support the weight of the vehicle above the water surface.

The first type of vessel has flexible 'skirts' that entirely surround the air cushion and enable the ship to rise completely above the sea surface. This is called an air cushion vehicle (ACV), and in a limited sense it is amphibious.

The other type of air cushion craft has rigid side walls or thin hulls that ext end below the surface of the water to reduce the amount of air flow required to maintain the cushion pressure. This type is called a captured air bubble vehicle (CAB). It requires less lift fan power than an ACV, is more directionally stable, and can be propelled by water jets or supercavitating propellers. It is not amphibious, however, and has not yet achieved the popularity of the ACVs, which include passenger ferries, cross channel automobile ferries, polar exploration craft, landing craft, and riverine warfare vessels.

2. Hydrodynamic Support

There are also two types of vessels that depend on dynamic support generated by relatively rapid forward motion of specially designed hydrodynamic shapes either on or beneath the surface of the water. A principle of physics states that any moving object that can produce an unsymmetrical flow pattern generates a lift force perpendicular to the direction of motion. Just as an airplane with (airfoil) produces lift when moving through the air, a hydrofoil, located beneath the surface and attached by means of a surface piercing strut, can dynamically support a vessel s hull above the water.

Planing hulls are hull forms characterized by relatively flat bottoms and shallow V - sections (especially forward of amidships) that produce partial to nearly full dynamic support for light displacement vessels and small craft at higher speeds. Planing craft are generally restricted in size and displacement because of the required power to weight ratio and the structural stresses associated with traveling at high speed in waves. Most planing craft are also restricted to operations in reasonably calm water, although some 'deep V' hull forms are capable of operation in rough water.

3. Hydrostatic Support

Finally, there is the oldest and most reliable type of support, hydrostatic support. All ships, boats, and primitive watercraft up to the twentieth century have depended upon the easily attained buoyant force of water for their operation.

This hydrostatic support, commonly recognized as flotation, can be explained by a fundamental physical law that the ancient philosopher mathematician Archimedes defined in the second century B. C. Archimedes Principle states that a body immersed in a liquid is buoyed up (or acted upon) by a force equal to the weight of the liquid displaced. This principle applies to all vessels that float (or submerge) in water—salt or fresh. And from this statement the name of the ships in the category are derived; they are generally called displacement hulls.

Although this ship type is very familiar, its subcategories warrant special discussion. For example, in some vessels reasonably high speed must be combined with the ability to carry light cargo or to move more comfortably in rough water than a planing hull. High speed planning hull characteristics can be modified to produce a semi - displacement hull or semi - planing hull. These compromise craft, of course not as fast as full planing hulls but faster than conventional displacement hulls, must have more power and less weight than the latter. Such types are obviously the result of 'tradeoffs'.

The example cited above lies between clear - cut physically defined categories—it is not a good example of a variation of a true displacement type ship. The latter must be recognized primarily as a displacement vessel, and its variations depend primarily on the distribution of buoyant volume—the extent of the depth and breadth of the hull below the water.

The most ubiquitous type of displacement ship can be generally classified as the common carrier, a seagoing vessel. It may be employed for passenger service, light cargo carrying,