船舶工程专业英语

Fundamentals and New Concepts for Shipbuilding Engineering

黄德波 主编

哈尔滨工程大学出版社

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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的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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前　言

21 世纪是走向海洋的世纪，蓬勃发展中的我国船舶与海洋工程，将在更深广的范围融入世界。正在或将要从事船舶与海洋工程专业的人员亟需掌握有关的专业英语的运用能力，作为新知识和信息的获取与交流的必要手段；不少中青年技术骨干对此体会更深。有感于此，正值学校教学急需，本人受嘱编写船舶工程方面的专业英语教材。

造船学是一较大系统，涉及船舶的设计，水动力与结构性能，生产建造等广泛内容，因教学大纲、篇幅以及编者能力所限，难以面面俱到；编者尽力从描述专业基础知识、原理概念、历史发展等较新、较经典的原文资料中选择较恰当的部分，加上术语解释，编成此书。本书具体内容为船舶设计（概述，船舶分类，主尺度，船形及参数，船级社等）；船舶基本原理（稳性，阻力，推进，运动与操纵性，船模试验等）；船舶结构（结构性能与型线的关系，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）和少量造船经济（造船工业状况，成本估算与合同管理等）。

相信通过学习本书，读者对有关专业英语水平会有所提高。

此书可用作本科生教材，建议安排 36 学时讲授，教师可按各课的难度和长短适当调节内容与进度，部分内容可作为课后阅读资料。应鼓励读者在阅读或教师讲授之前先浏览每课后的问题。也可供从事船舶工程专业人员阅读。读者若能努力回答各课后问题，可望有更好的收效。

感谢邓三瑞教授于百忙中审阅初稿，并提出宝贵意见。

编者能力不足，又兼时间紧迫，书中必有错漏，望读者指正。

编者

2001.8

目　录

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 used 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, Fig.1.1. These steps are amplified further below:

***a*. *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, 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.

***b*. *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

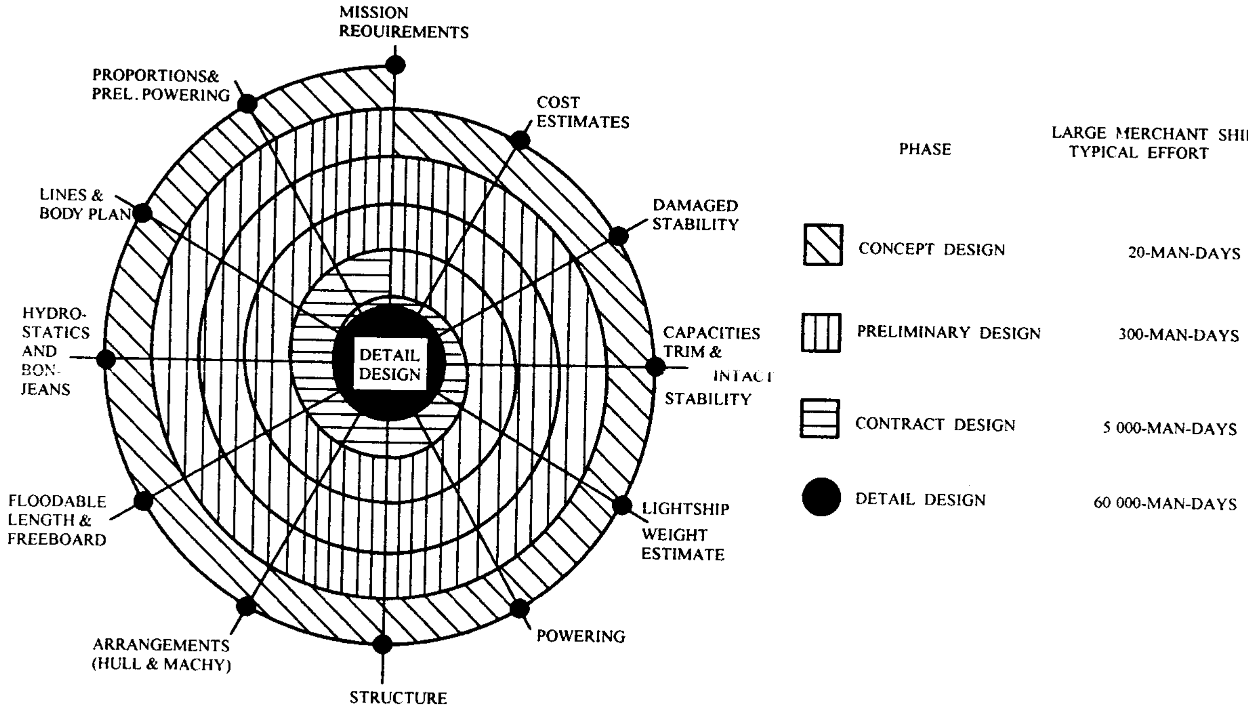

Figure 1.1 Basic design spiral

development of contract plans and specifications.

c. ***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.

d*. *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 specifictions. 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.

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

（摘自＜Ship Design and Construction＞, R. T. Taggart, The SNAME. One World Center, NewYork, NY, 1980）

课外阅读

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.

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.

Additional reading 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 presisely 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)

术语解释

sea keeping performance	耐波性能
maneuverability	操纵性
endurance	续航力,全功率工作时间
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
design spiral	设计螺旋循环方式
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