

Contents

1	General on Ship Design	1
1.1	Conventional and Advanced Marine Vehicles	1
1.2	Maritime Transport—Innovative Design Concepts, Energy Efficiency and Environmental Impact	4
1.3	Introduction to Ship Design	14
1.3.1	Main Approach to Ship Design	14
1.3.2	Main Phases of Ship Design	16
1.3.3	Objectives of Preliminary Design	17
1.3.4	Design Procedure: Design Spiral	19
1.3.5	Owner's Requirements: Statement of Work.....	27
1.3.6	Preliminary Ship Design Methods	34
1.3.7	Basic Design Procedures for Main Ship Categories	59
	References.....	66
2	Selection of Main Dimensions and Calculation of Basic Ship Design Values.....	69
2.1	Preliminary Estimation of Displacement.....	69
2.2	Selection of the Main Dimensions and Form Coefficients.....	73
2.3	Selection of Length.....	76
2.3.1	Effect of Length on Resistance	77
2.3.2	Effect of Length on the Ship's Strength and Structural Weight.....	90
2.3.3	Effect of Length on the Outfitting Weight	98
2.3.4	Effect of Length on the Weight of Propulsion System and Fuel Consumption.....	98
2.3.5	Effect of Length on the Exploitation of Spaces and General Arrangement	99
2.3.6	Other Factors Affecting the Selection of Length	100
2.3.7	Ship Length Estimation Using Empirical Formulas	100
2.4	Slenderness Coefficient $L/\nabla^{1/3}$	114
2.4.1	Influence on the Ship's Resistance.....	114
2.4.2	Effect on the Ship's Structure	115
2.4.3	Approximate Values	115

2.5	Selection of Other Main Dimensions.....	115
2.6	Selection of Beam.....	119
2.6.1	Effect of Beam on the Ship's Stability.....	121
2.6.2	Effect of Beam on the Ship's Resistance.....	124
2.6.3	Effect of Beam on the Ship's Structural Weight.....	127
2.6.4	Other Factors Affecting the Selection of the Beam.....	129
2.7	Selection of the Side Depth.....	132
2.7.1	Effect of Safety Regulations on Side Depth.....	132
2.7.2	Effect of Side Depth on Hold Volume and Arrangement.....	133
2.7.3	Effect of Side Depth on the Ship's Stability.....	133
2.7.4	Effect of Side Depth on the Ship's Structural Weight.....	134
2.8	Selection of the Draft.....	136
2.8.1	Effect of Draft on Resistance and Propulsion.....	136
2.8.2	Effect of Draft on Stability.....	136
2.8.3	Influence of Draft on Seakeeping and Maneuverability.....	137
2.8.4	Influence of Draft on Strength.....	138
2.8.5	Effect of Route Limits.....	138
2.9	Selection of Hull Form Coefficients.....	140
2.10	Selection of Block Coefficient C_B and Prismatic Coefficient C_p	142
2.10.1	Effect of C_p and C_B on the Ship's Resistance.....	144
2.10.2	Effect on the Seakeeping Performance.....	146
2.10.3	Effect on the Construction Cost.....	147
2.10.4	Effect on the Exploitation of Spaces.....	148
2.10.5	Effect on the Stability.....	149
2.10.6	Approximate/Semiempirical Formulas.....	150
2.11	Midship Section Coefficient C_M	151
2.11.1	Effect on Resistance.....	152
2.11.2	Effect on Construction Cost.....	154
2.11.3	Effect on Space Exploitation.....	155
2.11.4	Effect on Stability.....	155
2.11.5	Effect on Seakeeping Performance.....	156
2.11.6	Approximation Formulas.....	158
2.12	Waterplane Area Coefficient C_{wp}	160
2.12.1	Effect on Stability.....	160
2.12.2	Effect on Resistance, Propulsion, and Seakeeping Performance.....	162
2.12.3	Approximation Formulas.....	163
2.12.4	Conclusions.....	164
2.13	Determination of the Main Dimensions Through the Ship Design Equation.....	164
2.14	Preliminary Estimation of Propulsive Power.....	165
2.15	Estimation of Ship Weights.....	175
2.15.1	Definitions of Ship Weight Components.....	175
2.15.2	Initial Estimation of Weights and Their Centroids.....	177
2.15.3	Factors That Affect the Values of the Weight Coefficients.....	178

2.15.4	Structural Weight.....	185
2.15.5	Weight of Equipment and Outfit	214
2.15.6	Weight of Machinery Installation.....	231
2.15.7	Analysis of Deadweight DWT	239
2.16	Verification of Displacement	245
2.17	Verification of Holds' Capacity.....	246
2.17.1	Definitions.....	246
2.17.2	Calculation of Hold Volume.....	251
2.18	Verification of Stability and Trim	255
2.18.1	Vertical Position of Buoyancy Center	256
2.18.2	Metacentric Radius.....	257
2.18.3	Vertical Position of Metacenter	258
2.18.4	Approximation of Stability at Large Inclination Angles	259
2.18.5	Using the Hydrostatic Data of Similar Ships	260
2.18.6	Effect of Changing the Main Dimensions.....	260
2.18.7	Typical Values of Metacentric Height.....	262
2.18.8	Verification of Stability	264
2.18.9	Verification of Trim and Bow Height.....	271
2.19	Freeboard and Sheer	273
2.19.1	Factors Affecting the Freeboard.....	273
2.19.2	Verification of Freeboard	275
2.19.3	Sheer.....	280
2.19.4	Critical Review of the Load Line Regulations.....	289
	References.....	291
3	Ship's Hull Form.....	293
3.1	Distribution of Displacement.....	295
3.1.1	Shape of Sectional Area Curve	295
3.1.2	Longitudinal Centre of Buoyancy (LCB)	297
3.1.3	Parallel Body Length (L_p)	301
3.1.4	Length of Entrance (L_E) and Length of Run (L_R) of the Sectional Area Curve.....	303
3.1.5	Angle of Entrance/Run of Sectional Area Curve	305
3.2	Form of Waterlines.....	307
3.3	Form of Sections	312
3.3.1	Types of Sections	312
3.3.2	Midship Section Form.....	312
3.3.3	Form of Bow and Stern Sections	314
3.3.4	Bow Sections Below Waterline.....	316
3.3.5	Stern Sections Below Waterline.....	317
3.3.6	Form of Sections Above Waterline	321
3.4	Form of Bow	323
3.4.1	Types of Bow	323
3.4.2	Bulbous Bow	331
3.4.3	Parabolic Bow	345

3.5	Form of Stern	347
3.5.1	Forms of Stern.....	347
3.5.2	Elliptic or Elevated Stern	349
3.5.3	Cruiser Stern.....	349
3.5.4	Transom Stern	353
	References.....	357
4	Naval Architectural Drawings and Plans.....	359
4.1	General.....	359
4.2	Ship Lines Plan	360
4.3	Introduction to the Development of Ship Lines Plan.....	370
4.4	Design Based on Data of Systematic Ship Hull Form Series	377
4.5	General Arrangement Plan.....	379
4.6	Capacity Plan	389
	References.....	391
5	Machinery Installation, Propulsion and Steering Devices	393
5.1	Selection of Main Machinery.....	393
5.2	Selection of Propeller.....	407
5.3	Selection of Rudder.....	425
	References.....	437
6	Estimation of Building Cost	439
6.1	Statement of the Optimization Problem.....	439
6.2	Building Cost Analysis	440
6.3	Cost of Built/Processed Steel	442
6.4	Cost of Machinery and Propulsive Installation.....	445
6.5	Accommodation/Equipment/Outfitting Cost	446
	References.....	447
Appendix	449
	Appendix A: Diagrams of Regression Analysis of Basic Design	
	Values for Merchant Ships.....	449
	Bulk Carriers.....	450
	OBO Carriers	459
	Containerships.....	462
	Tankers	472
	Product Carriers	476
	Chemical Carriers	482
	General Cargo Carriers	485
	RO-RO Cargo Ships.....	488
	RO-RO Passenger Ferries.....	493
	Single-Hull Fast Ferries	496
	Car Carrying Catamarans	499

Reefer Ships	501
Passenger/Cruise Ships	505
Offshore Tug/Supply Ships	508
Fishing Vessels	511
References	516
Appendix B: Systematic Hull Form—Model Series	517
Wageningen-Lap Series.....	518
Series 60 Hull Form—Todd et al.	519
FORMDATA Series.....	525
MARAD Series	547
References	560
Appendix C: Determination of Ship's Displacement with the	
Relational Method of Normand	561
Equation of Displacement for Small Deviations.....	562
Displacement Equation for Larger Deviations.....	565
Normand's Number	575
Accuracy of the Displacement Equation.....	580
References	581
Appendix D: Historical Evolution of Shipbuilding	582
Before Christ Era.....	583
Middle Ages—Renaissance	586
Industrial Revolution.....	587
First Half of the Twentieth Century	593
Second Half of the Twentieth Century	595
Contemporary Period	598
Appendix E: Subdivision and Damage Stability of Ships—	
Historical Developments and the Way Ahead.....	610
The Evolution of Deterministic Damage Stability Standards.....	610
Present Status: Probabilistic Assessment	613
Future Developments of International Regulations and	
Concepts: Risk and Goal based standards.....	616
Conclusions	617
References	620
Index	623

<http://www.springer.com/978-94-017-8750-5>

Ship Design

Methodologies of Preliminary Design

Papanikolaou, A.

2014, XIII, 628 p. 575 illus., 145 illus. in color.,

Hardcover

ISBN: 978-94-017-8750-5