

REED'S MARINE ENGINEERING SERIES

# 4

**NAVAL  
ARCHITECTURE  
FOR  
MARINE  
ENGINEERS**



# REED'S NAVAL ARCHITECTURE FOR MARINE ENGINEERS

E A STOKOE

CEng, FRINA, FIMarE, MNECInst

Formerly Principal Lecturer in Naval Architecture at  
South Shields Marine and Technical College



ADLARD COLES NAUTICAL  
London

# CONTENTS

	PAGE
<b>CHAPTER 1—HYDROSTATICS</b> Density, relative density, pressure exerted by a liquid, load on an immersed plane, centre of pressure, load diagram, shearing force on bulkhead stiffeners....	1 — 16
<b>CHAPTER 2—DISPLACEMENT, T.P.C., COEFFICIENTS OF FORM</b> Archimedes' principle, displacement, tonne per cm immersion, coefficient of form, wetted surface area, similar figures, shearing force and bending moment.....	17 — 36
<b>CHAPTER 3—CALCULATION OF AREA, VOLUME, FIRST AND SECOND MOMENTS</b> Simpson's first rule, application to volumes, use of intermediate ordinates, application to first and second moments of area.....	37 — 56
<b>CHAPTER 4—CENTRE OF GRAVITY</b> Centre of gravity, effect of addition of mass, effect of movement of mass, effect of suspended mass.....	57 — 67
<b>CHAPTER 5—STABILITY OF SHIPS</b> Statistical stability at small angles of heel, calculation of BM, metacentric diagram, inclining experiment, free surface effect, stability at large angles of heel, stability of a wall-sided vessel.....	68 — 97
<b>CHAPTER 6—TRIM</b> Change in draughts due to added masses, change in mean draught and end draughts due to density, change in mean draught and end draughts due to bilging	98 — 120
<b>CHAPTER 7—RESISTANCE</b> Frictional, residuary and total resistance, Admiralty Coefficient, fuel coefficient and consumption.....	121 — 135
<b>CHAPTER 8—PROPELLERS</b> Apparent and real slip, wake, thrust, relation between powers, measurement	

of pitch, cavitation, built and solid propellers.....	136 — 148
<b>CHAPTER 9—RUDDER THEORY</b>	
Force on rudder, torque on stock, angle of heel due to force on rudder, angle of heel when turning.....	149 — 158
SOLUTIONS TO TEST EXAMPLES .....	159 — 243
CLASS 2 EXAMINATION QUESTIONS .....	244 — 255
SOLUTIONS TO CLASS 2 EXAMINATION QUESTIONS .....	256 — 295
CLASS I EXAMINATION QUESTIONS .....	296 — 314
SOLUTIONS TO CLASS 1 EXAMINATION QUESTIONS .....	315 — 390
INDEX .....	392 — 393

# INDEX

<b>A</b>	
Admiralty Coefficient .....	127
Angle of loll .....	92, 93
Apparent slip .....	136
Area — blade .....	138
" developed .....	138
" disc .....	138
" projected .....	138
Areas of similar figures .....	28
<b>B</b>	
BM .....	71
BM <sub>L</sub> .....	99
Bending moment curve .....	31
" " on bulkhead	
stiffeners .....	13
Bilging .....	111
Blade area ratio .....	138
Block coefficient .....	24
Brake power .....	141
Buoyancy .....	20, 111
" centre of .....	20
" curve .....	30
<b>C</b>	
Cavitation .....	145
Centre of buoyancy .....	20
" " flotation .....	98
" " GRAVITY .....	57
" " lateral resistance .....	153
" " pressure .....	5
Centrifugal force .....	155
Centroid .....	57
Change in trim .....	98
" " due to bilging .....	113
" " due to density .....	109
" " large masses .....	103
" " small masses .....	98
Class 1 Examination .....	
Questions .....	296
Class 2 Examination .....	
Questions .....	244
Coefficients of form .....	23
Corresponding speeds .....	124
Cross curves of stability .....	89
Curve of statical stability .....	89
<b>D</b>	
Delivered power .....	141
Denny's formula .....	27
Density .....	1
" change in draught .....	106
" change in trim .....	109
" relative .....	1
Developed area .....	138
Disc area ratio .....	138
DISPLACEMENT .....	19
" curve .....	19
Draught, mean .....	98
Dynamical stability .....	90
<b>E</b>	
Effective power .....	125
Efficiency — hull .....	141
" — mechanical .....	141
" — propeller .....	141
" — transmission .....	141
Equilibrium .....	68
<b>F</b>	
First moment of area .....	45
Floating bodies .....	18
Flotation, centre of .....	98
Free surface effect .....	81
Frictional resistance .....	121
Froude, Wm .....	121
" law of comparison .....	124
Fuel coefficient .....	129
Fuel consumption .....	129
<b>G</b>	
GM .....	70
Gravity, centre of .....	57
<b>H</b>	
Hull efficiency .....	141
HYDROSTATICS .....	1
<b>I</b>	
Inclining experiment .....	78
Indicated power .....	141
Intermediate ordinates .....	42
<b>K</b>	
KB .....	21
KG .....	58
KM .....	71
<b>L</b>	
Large angle stability .....	87
Law of comparison .....	124
Liquid pressure .....	2
Load curve .....	30
" diagram .....	8

" on immersed plane .....	4	Rudder theory .....	149
Longitudinal bending .....	30	" area .....	149
centre of .....		" forces .....	149
buoyancy .....	20, 39	" torque .....	150
Longitudinal centre of flotation .....	98	S	
centre of gravity .....	58	Second moment of area .....	45
metacentric height .....	99	Shaft power .....	141
M		Shearing force .....	30
Mean draught .....	98	" in bulkhead .....	
Metacentre, transverse .....	70	stiffeners .....	11
" longitudinal .....	99	Ship correlation factor .....	125
Metacentric diagram .....	75	Similar figures .....	28
" height .....	70	SIMPSON'S RULE .....	37
" height, longitudinal .....	99	Slip — apparent .....	136
Midship section area coefficient .....	23	" real .....	137
Model tests .....	125	SOLUTIONS TO TEST EXAMPLES .....	159
Moment of area — first .....	45	Specific fuel consumption .....	129
" " — second .....	45	Speed — corresponding .....	124
" " force .....	57	" length ratio .....	124
" " mass .....	57	" of advance .....	137
" to change trim 1 cm .....	101	" ship .....	136
Morrishe's formula .....	21	" theoretical .....	136
N		Stable vessel .....	69
Neutral equilibrium .....	70	STABILITY .....	68
P		Stability at small angles .....	70
Permeability .....	112	" large angles .....	87
Pitch .....	136	" curve .....	89
" measurement of .....	143	Suspended mass .....	64
" ratio .....	136	T	
Pitchometer .....	143	Taylor's formula .....	137
Power — delivered .....	141	Theoretical speed .....	136
" — effective .....	125, 141	Thrust .....	139
" — indicated .....	141	" deduction .....	141
" — shaft .....	141	" power .....	139
" — thrust .....	139, 141	" pressure .....	140
Pressure, centre of .....	5	Tonne per cm immersion .....	21
" liquid .....	2	Torque on rudder stock .....	150
" thrust .....	140	Transverse metacentre .....	70
Prismatic coefficient .....	25	TRIM .....	98
Projected area .....	138	Turning — angle of heel .....	155
PROPELLERS .....	136	U	
Propeller efficiency .....	141	Unstable ship .....	70, 92
Propulsive coefficient .....	141	V	
Q		Vertical centre of buoyancy .....	20
Quasi-Propulsive coefficient .....	141	" gravity .....	58
R		Volume of displacement .....	20
Real slip .....	137	Volumes by Simpson's Rule .....	39
Relative density .....	1	" of similar bodies .....	29
Reserve buoyancy .....	111	W	
RESISTANCE .....	121	Wake .....	137
" — frictional .....	121	" fraction .....	137
" — residuary .....	123	Wall-sided ship .....	93
Righting lever .....	69	Waterplane area coefficient .....	23
" moment .....	69	Weight curve .....	30
<i>Off 8/27/15</i>			
		Wetted surface area .....	26