

REED'S MARINE ENGINEERING SERIES

5

SHIP
CONSTRUCTION
FOR
MARINE
STUDENTS



Reed
629.81
27874
2010
V. 5
4

REED'S SHIP CONSTRUCTION FOR MARINE STUDENTS

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

CHAPTER	PAGE
1— Ship types and terms	
Passenger ships, cargo liners, cargo tramps, oil tankers, bulk carriers, colliers, container ships, roll-on/roll- off vessels, liquefied gas carriers, chemical carriers. Terms in general use.	1—14
CHAPTER 2— Stresses in ship structures	
Longitudinal bending in still water and waves, transverse bending, stresses when docking, panting and pounding.	15—23
CHAPTER 3— Sections used: Welding and materials	
Types of rolled steel section used in shipbuilding. Aluminium sections. Metallic arc welding, argon arc welding, types of joint and edge preparation, advantages and disadvantages, testing of welds, design of welded structure. Materials, mild steel, higher tensile steels, Arctic D steel, aluminium alloys. Brittle fracture.	24—40
CHAPTER 4— Bottom and side framing	
Double bottom, internal structure, duct keel, double bottom in machinery space. Side framing, tank side brackets, beam knees, web frames.	41—49
CHAPTER 5— Shell and decks	
Shell plating, bulwarks. Deck plating, beams, deck girders and pillars, dis- continuities, hatches, steel hatch covers, watertight hatches.	50—60
CHAPTER 6— Bulkheads and deep tanks	
Watertight bulkheads, watertight doors. Deep tanks for water ballast	

and for oil. Non-watertight bulkheads,
corrugated bulkheads.

61—72

CHAPTER 7—Fore end arrangements

Stem plating, arrangements to resist
panting, arrangements to resist pound-
ing, bulbous bow, anchor and cable
arrangements.

73—81

CHAPTER 8—After end arrangements

Cruiser stern, transom stern, stern-
frame and rudder, fabricated
sternframe, cast steel sternframe,
unbalanced rudder, balanced rudder,
open water stern, spade rudder, rudder
and sternframe for twin screw ship.
Bossings and spectacle frame. Shaft
tunnel. Kort nozzle, fixed nozzle,
nozzle rudder. Tail flaps and rotary
cylinders.

82—98

**CHAPTER 9—Oil tankers, bulk carriers, liquefied gas
carriers and container ships**

Oil tankers, longitudinal framing,
combined framing, cargo pumping and
piping, crude oil washing. Bulk
carriers, ore carriers. Liquefied gas
carriers, fully pressurised, semi-
pressurised/partly refrigerated, semi-
pressurised/fully refrigerated, fully
refrigerated, safety and environmental
control, boil off, operating
procedures. Container ships.

99—122

**CHAPTER 10—Freeboard, tonnage, life saving
appliances, fire protection and
classification**

Freeboard definitions, basis for
calculation, markings, conditions of
assignment, surveys. Tonnage, 1967
rules, definitions, underdeck, gross
and net tonnage, propelling power
allowance, modified tonnage,
alternative tonnage. 1982 rules, gross

and net tonnage calculation. Life saving appliances, lifeboats, davits. Fire protection, definitions, passenger ships, dry cargo ships, oil tankers. Classification of ships, assignment of class, surveys, discontinuities. 123—140

CHAPTER 11— Ship Dynamics

Propellers, wake distribution, blade loading, controllable pitch propellers, contra-rotating propellers, vertical axis propellers. Bow thrusters, controllable pitch thrusters, hydraulic thrust units. Rolling and stabilisation, reduction of roll, bilge keels, fin stabilisers, tank stabilisers. Vibration, causes and reduction. 141—158

CHAPTER 12— Miscellaneous

Insulation of ships. Corrosion, prevention, surface preparation, painting, cathodic protection, impressed current system, design and maintenance. Fouling. Examination in dry dock. Emergency repairs to structure. Engine casing. Funnel. 159—175

Selection of Examination Questions —
Class 2 176—180

Selection of Examination Questions —
Class 1 181—187

Index 188—192

INDEX

- A**
A-class bulkheads 133
Accommodation 12
Active controlled tanks 155
Active fin stabilisers 152
Advantages and disadvantages of welding 31
After end arrangement 82 *et seq.*
After peak 2, 77
Alternative tonnage 129
Aluminium alloy 39, 117, 166
" sections 27
Anchors and cables 79
Angle bar 24
Anodes, sacrificial 165
Arc welding, argon 30
metallic 28
Arctic D steel 38
Argon arc welding 30
Assignment of class 136
- B**
B-class bulkheads 133
Balanced rudder 89
Ballast tanks 2, 41, 68
Beam knees 20, 48
Beams 19, 53
" cant 82
" longitudinal 53
" strong 173
Bending moments 15, 17
" longitudinal 15 *et seq.*
" transverse 19
Bergensfjord, m.s. 166
Bilge blocks 21
" keels 151
" radius 14
" shores 21
Boil-off 119
Bossings 93
Bottom longitudinals 101, 112
" shell 50
Bow height 121
Bow thrusters 146
Bracket floor 44
Breadth extreme 13
" moulded 13
" tonnage 127
Brine trap 161
Brittle fracture 39
Built pillars 54
Bulb angle 25
" plate 25
Bulbous bow 78
Bulk carriers 5, 110 *et seq.*
- Bulkheads** 61 *et seq.*
" A and B-class 133
centreline 69
collision 75
corrugated 71, 103
deep tank 69
longitudinal 4, 101, 110
non-watertight 71
oiltight 103
swedged 72
transverse 61, 103
watertight 61
Bulwark 51
Buoyancy curve 15
Butt strap 137
" welding 30
- C**
Cable gland 64
" lifter 80
" stopper 80
Camber 13
Cant beam 82
" frame 82
Cargo hatch 3, 55
" liner 2
" piping 105
" pumps 105
" tramp 4
Casings, engine 171 *et seq.*
Cathodic protection 165
Ceiling 42
Centre girder 42
Centreline bulkhead 69
Chain locker 2, 79
" pipes 79
Channel bar 26
Chemical carriers 10
Classification of ships 135 *et seq.*
" " societies 135
Coamings, hatch 55
Cofferdams 4, 47
Coffin plate 85
Colliers 6
Collision bulkhead 75
Conditions of assignment 125
Container ships 8, 121, *et seq.*
Continuity of structure 104, 138
Contra-rotating propellers 144
Controllable pitch propellers 143
Corrosion 162, *et seq.*
" bi-metallic 165
" prevention of 164
Corrugated bulkheads 71, 103
Covers, hatch 4, 55
Crack arrestors 137

Crane 173
 " rail support 173
 Crew spaces 12
 Crude oil washing 109
 Cruiser stern 82 *et seq.*

D

Davits 131
 Deadweight 14
 Deck 52 *et seq.*
 " beams 53
 " camber 13
 " girders 53
 " line 125
 " longitudinals 53
 " machinery 54
 " plating 52
 " sheathing 53
 Deep tanks 4, 68
 " " for water ballast 69
 " " for oil 69
 Depth extreme 13
 " moulded 13
 " tonnage 127
 Design and maintenance 167
 " of welded structure 35
 Destructive testing 32
 De-wedging device 65
 Dimensions 12
 Discontinuities 138
 Displacement 14
 Docking brackets 21, 103
 " stresses 21
 Doors, casing 171
 " hinged 68
 " watertight 65
 Double bottom 41 *et seq.*
 " " in machinery space 46
 " " internal
 " " structure 42
 Drainage of insulated spaces 161
 Draught extreme 13
 " moulded 13
 Drydock, examination in 169
 " support of ship in 21
 Duct keel 21, 45

E

Edge preparation 30
 Electrodes 28
 Electrolytic action 162
 Emergency repairs 170
 End connections of
 " longitudinals 100
 Engine casing 171 *et seq.*
 " room crane 173
 Equipment 136
 Examination in dry dock 169

Examination Questions,

Class 1 181 *et seq.*
 " Questions,
 Class 2 176 *et seq.*
 Extra notch-tough steel 37, 99

F

Fabricated sternframe 85
 Faults in welded joints 34
 Fillet welds 30
 Fin stabiliser 152
 Fire protection 133 *et seq.*
 Flame cleaning 164
 Flat plate keel 18, 50
 Floors, bracket 44
 " solid 43
 " watertight 42
 Fore end construction 73 *et seq.*
 " peak 2, 75
 Forecastle 4
 Fouling 167 *et seq.*
 Frames, main 47
 " side 19, 47
 " 'tween deck 48
 " web 49
 Framing, combined 102
 " longitudinal 99
 " transverse 47
 Freeboard 13, 123 *et seq.*
 " conditions of
 " assignment 125
 " markings 125
 " surveys 127
 " tabular 123
 Freeing ports 52
 Fresh water allowance 125
 Fully pressurised tanks 113
 Fully refrigerated tanks 115
 Funnel 174

G

Gangway, longitudinal 4, 126
 Garboard strake 50
 Gas venting system 108
 Girders centre 42
 " deck 53
 " horizontal 69
 " intercostal 43
 " side 42
 Grades of steel 37
 Gravity davit 131
 Gross tonnage 127
 Gudgeons 85

H

Hatches 55 *et seq.*
 " coamings 55
 " covers 56
 " deep tank 58
 " oiltight 104

- Hatches steel 57
 " watertight 58
 " webs 56
- Hawse pipes 79
- Heating coils 108
- Higher tensile steel 38
- Hogging 16
- Holding down bolts 46
- Holds, cargo 2
- Hopper tanks 5, 113
- Hydraulic thrust unit 148
- I**
- Impressed current system 166
- Inerting 120
- Inner bottom 41
- Intercostal girders 43
- Intermittent welding 30
- Internal structure of double bottom 42
- Insulants 159
- Insulated hatch plug 161
- Insulation 117, 159 *et seq.*
 fire 133
- In-water survey 138
- J**
- Joint, types of 30
- Joists 26
- K**
- Keel 18, 50
 " bilge 151
 " blocks 21
 " duct 21, 45
- Kort nozzle 95
 " " rudder 97
- L**
- Lap joint 30
- Length between perpendicularly 13
 " overall 13
 " tonnage 127
- Lifesaving
 appliances 131 *et seq.*
- Lifeboats 131
- Liferafts 131
- Lightening holes 42
- Lightweight 14
- Liquefied gas carrier 9, 113 *et seq.*
- Lloyd's Register of Shipping 135 *et seq.*
- Load diagram 16
- Load Line Rules 123
- Longitudinal beams 53
 " bending 15 *et seq.*
 " bulkhead 4, 101, 110
 " frames 44, 99
 " gangway 4, 126
 " material 18
- Longitudinal strength 15
- M**
- Machinery casings 171
 " space 2
 " space tonnage 128
- Magnetic crack detection 34
- Main vertical zones 134
- Maintenance 167
- Manhole cover 42
- Margin plate 42
- Material, longitudinal 18
 " non-combustible 133
 " transverse 19
- Materials: 37 *et seq.*
 Aluminium alloys 38
 Arctic D steel 38
 Higher tensile steel 38
 Mild steel 37
- Membrane tanks 117
- Metallic arc welding 28
- Midship section, bulk carrier 6, 112
- Midship section cargo vessel 60
 " " chemical carrier 10
 " " collier 8
 " " container ship 121
 " " cylindrical
 tank system 114
 " " liquefied gas
 carrier 11
 " " oil tanker 5, 100, 101
 " " ore carrier 6, 111
 " " prismatic tank
 system 116
 " " showing
 dimensions 12
 " " spherical tank
 system 115
- Mild steel 37
- Mill scale, removal of 164
- Modified tonnage 128
- N**
- Net tonnage 127
- Non-combustible material 133
- Non-destructive testing 33
- Non-watertight bulkheads 71
- Notch-tough steel 37, 99
- Nozzle, Kort 95
- O**
- Oil fuel tanks 2, 41, 69
- Oil tankers 4, 99 *et seq.*
 " " combined framing 102
 " " longitudinal framing 99
- Oiltight bulkhead 103
 " hatch 104
- Open water stern 91
- Ore carriers 5, 110

- P**
- Painting 165
 - Panting 23
 - " arrangements 73
 - Passenger ships 1
 - " fire protection 134
 - Passive tanks 154
 - Peaks 2, 75
 - Pickling 164
 - Pillars 53
 - Pintles 87
 - Piping, main cargo 105
 - Plating, deck 18, 52
 - " shell 18, 50
 - " stem 73
 - Pounding 23
 - " arrangements 72
 - Prismatic tanks 116
 - Profile, bulk carrier 7
 - " cargo liner 3
 - " cargo tramp 3
 - " collier 7
 - " container ship 7
 - " liquefied gas
 - " carrier 11
 - " oil tanker 3
 - " roll-on/roll-off vessel 9
 - " showing dimensions 11
 - Propeller, examination of 170
 - Propellers 141
 - " contra-rotating 144
 - " controllable pitch 143
 - " vertical axis 145
 - Propelling Power Allowance 128
 - Protection, cathodic 165
 - " fire 133 *et seq.*
 - Pump rooms 4, 105
 - Pumping arrangements of oil tankers 105
 - Pumps, cargo 105, 120
 - " stripping 105
- R**
- Racking 20
 - Radiographic testing of welds 33
 - Rails, crane 173
 - Raised quarter deck 8
 - Reduction of roll 151 *et seq.*
 - Refrigerated vessels 2
 - " insulation of 159
 - Repair 170
 - " " insulation of 159
 - Rise of floor 14
 - Rolled steel sections 24 *et seq.*
 - Rolling and stabilisation 150 *et seq.*
 - Roll-on/Roll-off vessels 9
 - Rotating cylinders 98
 - Round of beam—see camber 13
 - Rounded gunwale 18
 - Rudder carrier 88
- Rudders** 84 *et seq.*
 - " balanced 89
 - " Kort nozzle 97
 - " semi-balanced 92
 - " spade 91
 - " unbalanced 85
- S**
- Sacrificial anodes 165
 - Sagging 17
 - Scantlings 137
 - Scuppers 126
 - Seating, winch 54
 - Sections, aluminium 27
 - " steel 24 *et seq.*
 - Self-polishing copolymers 168
 - Self-trimming collier 8
 - Semi-pressurised tanks 114
 - Settling tanks 2
 - Shaft stools 95
 - " tunnel 2, 94
 - Sheathing, deck 53
 - Sheer 14
 - Sheerstrake 18, 50
 - Shell plating 50 *et seq.*
 - Ship types 1 *et seq.*
 - Shot blasting 165
 - Side framing 20, 47, 102
 - " girders 18, 42
 - " shell 18, 50
 - " shores 22
 - Solid floors 43
 - Solid pillars 54
 - Spade rudder 91
 - Spectacle frame 93
 - Sprinkler system 134
 - Stays, funnel 174
 - Steel, extra notch-tough 37, 99
 - " hatch covers 57
 - " sections 24 *et seq.*
 - Stem bar 73
 - " construction 73, 78
 - " plating 73
 - Stern, cruiser 82
 - " transom 84
 - Sternframe, cast 89
 - " fabricated 85
 - " open water 91
 - " twin screws 92
 - Stiffeners, bulkhead 62
 - Still water bending 15
 - Strength, longitudinal 15
 - " transverse 19
 - Stresses 15 *et seq.*
 - Stringer plate 18, 50
 - Stripping pumps 105
 - Strong beams 173
 - Superstructure, aluminium 166
 - Surface preparation 164

Surveys, annual 127, 136
 " in-water 138
 " special 136
 Wedged bulkheads 72

T

T bars 27
 Tabular freeboard 121
 Tailshaft weardown 138, 170
 Tail flaps 98
 Tank margin 42
 " side brackets 20, 47
 Tank stabiliser 154
 " top 2, 41
 Tankers—see oil tankers 99 *et seq.*
 Tanks, deep 4, 68
 " double bottom 2, 41
 " peak 2, 75
 " testing of 42
 Terms in general use 12 *et seq.*

Testing, destructive 32
 " non-destructive 33
 " of tanks 42
 " of welds 32

Tonnage 127 *et seq.*
 " 1967 Rules 127
 " 1982 Rules 129
 " alternative 129
 " deductions 127
 " enclosed spaces 130
 " gross 127
 " mark 129
 " modified 128
 " net 127
 " underdeck 127
 Torsion boxes 122, 140
 Transom floor 85
 " stern 84
 Transverse bending 19
 " bulkheads 61, 103
 " framing 47

Transverse material 19
 " strength 19
 " webs 101, 112

Tumble home 14

Tunnel, shaft 2, 94

Tween decks 2

Types of ships 1 *et seq.*

Type-A ship 121

Type-B ship 122

U

Unbalanced rudder 85
 Ultrasonic testing of welds 34
 Underdeck tonnage 127
 Uptakes, funnel 174

V

Vertical axis propellers 145
 Vibration 156 *et seq.*

W

Water ballast tanks 2, 41, 69
 Water pressure 19, 62
 Watertight bulkheads 61 *et seq.*
 " doors 65 *et seq.*
 Wave bending 18
 Weathering 164
 Web frames 49
 Weight curve 15
 Welded joints 30
 " plate collars 40
 Welding, advantages and disadvantages of 31
 Welding, argon arc 30
 " faults 34
 " metallic arc 28
 " testing 32
 Wood sparring 49

X

X-rays 33

Off 17/15