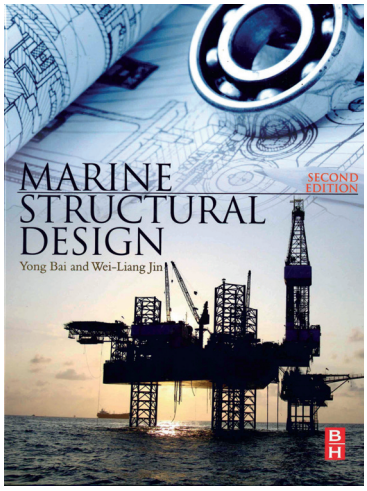
Review

This is an excellent general technical introduction to the issues facing the shipping and offshore industries, concludes Paul Frieze, but not detailed enough for more serious insights into the multifarious technological challenges that really exist.

Marine Structural Design (2nd ed.)



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This second edition of *Marine Structural Design* is a weighty tome – 50 chapters compared with 34 for the first edition – laid out as:

- Part 1 – Structural Design Principals (Chapters 1–14)
- Part 2 – Ultimate Strength (Chapters 15–23)
- Part 3 – Fatigue and Fracture (Chapters 24–30)
- Part 4 – Structural Reliability (Chapters 31–37)
- Part 5 – Risk Assessment (Chapters 38–44)
- Part 6 – Fixed Platforms and FPSO (Chapters 45–50)

Part 1

Part 1 goes well beyond the boundaries of its title as it is broken down into: Introduction, Marine Composite Materials and Structure, Green Ship Concepts, LNG Carrier, Wave Loads for Ship Design and Classification, Wind Loads on Offshore Structures, Loads and Dynamic Response for Offshore Structures, Scantling of Ship's Hulls by Rules, Ship Hull Scantling Design by Analysis, Offshore Soil Geotechnics, Offshore Structural Analysis, Development of Arctic Offshore Technology, Limit-State Design of Offshore Structures, and Ship Vibrations and Noise Control.

Each chapter is an inconsistent mix of generalities and details. For example, Chapter 1 introduces limit state design, ultimate strength criteria (while managing to include the Euler buckling equation) and fatigue (while presenting S-N curves, damage accumulation and the basis of fracture mechanics). The composites chapter ignores their labour-intensive and other construction challenges. Chapter 4 (LNG Carrier) discusses the various containment systems in some detail before addressing ultimate limit state design of the hull, but contains odd editorial errors, e.g. °C to indicate compass headings. The need of effective sections (buckling and shear lag, as appropriate) in girder flexural properties is ignored. Chapter 5 (Wave Loads) mixes spectral representation of the sea surface with design by classification, i.e. by Class Society rules. Chapter 6 (Wind Loads) describes the basic make-up of wind before including profiles, turbulence, spectra and loads, but computational fluid dynamics is given scant attention. Several pages are devoted to wind loads on ships, while those on offshore platforms receive less attention; a major omission is reference to ISO 19901-1, the offshore structures standard for metocean design and operating requirements.

Chapter 7 seems to duplicate Chapters 5 and 6, with an emphasis on ship loading and little concern for offshore structures. Strangely, some detailed equations are presented for jack-ups but these are of little use to a designer. Chapter 8 deals with scantling of a ship's hulls by rules – an approach familiar to naval architects but completely foreign to structural engineers as it refers to the "cookbook" approach to ship design embedded in Class Society rules.

Chapter 10 (Offshore Soil Geotechnics) just introduces the topic while also offering some detailed equations for square or rectangular jack-up spudcans,

quite inappropriate for the widely used near-circular form. Why the equations do not match those found in the relevant international standard ISO 19905-1 is far from clear. Chapter 11 (Offshore Structural Analysis) begins identifying relevant regulations, guides and standards, many of which are out of date, and the absence of a list of ISO offshore structures standards is a major omission. Chapter 12 presents various aspects of arctic offshore technology in the middle of which is a figure of a non-arctic offshore structure.

Part 2

Part 2 opens by addressing ultimate strength of beam-columns. Some classical solutions (Perry–Robertson, Johnson–Ostenfeld) are summarised, along with a brief introduction to plastic hinge theory. Chapter 16 concerns buckling and local buckling of tubular members. This addresses some relevant experimental and numerical techniques in some detail, including the development of plasticity through the cross-section and the presence of local dents. Ultimate strength of plates and stiffened plates are considered in Chapter 17. It draws heavily on DNV approaches to plate buckling, while stiffened plate buckling is almost ignored. The ultimate strength of cylindrical shells is addressed in a little more detail in Chapter 18, but still of little use to designers.

Chapter 19 presents considerable detail on non-linear finite-element analysis, some of which would be of possible use to researchers, particularly the section on plasticity constitutive equations. Collapse analysis of ship hulls is addressed in Chapter 20. It provides a useful summary of some simplified techniques adopted for this complex topic, together with a complete reproduction of a 1993 paper by the first author on an advanced simplified approach. A similar approach is used in Chapter 21 for the analysis of offshore structures under impact loads while also accounting for dynamic effects – again a 30-year-old paper is reproduced. Part 2 ends with a brief summary of some dated papers on ship collision and grounding.

Part 3

Part 3 devotes seven chapters to fatigue and fracture, addressing basic fatigue topics from both loading and resistance perspectives, simplified and spectral fatigue analyses, fracture assessment using BS 7910-type procedures, and material selection. The information is a mixture of textbook and code material, with some useful examples covering both ships and offshore structures, but is a little dated, the latest reference being 2002.

Part 4

Structural Reliability, Part 4, consists of six chapters covering basics, uncertainty theory, ship structure reliability, reliability-based design, code calibration, fatigue reliability, and probability- and risk-based inspection planning. Again some basic textbook material is presented, a few examples particularly for floating production, storage and offloading (FPSO) units, as well as summaries of pre-2002 technical papers – except for the chapter on uncertainty theory where far more recent papers are included. Unfortunately, this particular effort is devoted to one approach which takes considerable reading.

Part 5

Part 5, comprising Chapters 38–44, concerns risk assessment and is all based on pre-2002 papers, so has not been updated since the first edition. As with many articles addressing risk, the material presented is primarily qualitative and covers risk-based decision-making; risk assessment applied to offshore structures, the shipping industry, and field development economics; and human reliability assessment. Offshore structure risk draws heavily on the lessons learnt from the 1988 Piper Alpha disaster. Economic risk includes a potentially useful brief appendix on net present value and internal rate of return, but this is marred by some poor notation editing. The final chapter considers risk-centred maintenance, an approach devoted to equipment and out of place in a book on structures.

Part 6

The final part addresses fixed platforms and FPSOs, with chapters entitled Structural Reassessment of Offshore Structures (45), Time-Dependent Reliability Assessment of Offshore Jacket Platforms (46) (why is this not in Part 4?), Reassessment of Jacket Structure (47) (why is this not included in Chapter 45?), Risk and Reliability Applications to FPSO (48), Explosion and Fire Response Analysis for FPSO (49), and Asset Integrity Management (AIM) for FPSO (50).

This is an odd collection of technical papers. Chapter 45 addresses corrosion and cracking effects in container ships, not offshore structures; Chapter 46 addresses corrosion effects in a jacket using the same corrosion model as for ships; while Chapter 47 examines corrosion effects on a jacket but adopts a different corrosion model than used in Chapter 45. Chapter 47 also confusingly adopts definitions not consistent with those in ISO standards for offshore structures; in particular, reserve strength ratio (RSR) is determined by increasing wave heights in excess of the 100-year return period environmental loading pattern: it should be calculated by increasing the scaling factor on the 100-year pattern.

Chapter 48 considers some of the benefits of adopting a risk-based approach to inspection and demonstrates how reliability is influenced in such cases. It appears to draw heavily on the corresponding American Bureau of Shipping (ABS) provisions for FPSOs and so might not be very relevant for fixed offshore structures. Chapter 49 considers accident causes and then management of fire and explosion risks. Good examples of explosion and fire events on FPSO topsides are presented. Chapter 50, despite its title, actually addresses risk-based management of FPSOs, which was effectively addressed in Chapter 37, and then turns to reliability-centred maintenance, which was dealt with in Chapter 44.

In summary, this is an excellent book for those seeking a general technical introduction to the issues facing the shipping and offshore industries, but not detailed enough for more serious insights into the multifarious technological challenges that really exist.

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Dr Frieze gained a PhD from Imperial College London, lectured at the University of Glasgow, Department of Naval Architecture & Ocean Engineering for six years, before returning to London to several positions in the offshore industry. He specialises in steel-plated structures and structural reliability analysis. He has developed ISO offshore structures standards for over 20 years.