Jeom Kee Paik, Ship-Shaped Offshore Installations: Design, Construction, Operation, Healthcare and Decommissioning, Second Edition, Cambridge University Press, Cambridge, UK, 2022

Preface to the Second Edition

Advances in human civilisation have led the development of various types of engineered structures. The ship-shaped offshore installation is a type of engineered structure that uses the space and resources of the ocean to develop energy. Ship-shaped offshore installations are exemplified by floating, storage and offloading (FSO) units; floating, production, storage and offloading (FPSO) units (for the development of offshore oil or gas); floating power plants (fuelled by liquefied natural gas or nuclear reactors) and floating, storage and regasification units (FSRUs).

In the offshore oil and gas industry, fixed offshore platforms have been used in relatively shallow waters but are unsuitable for use in developing oil and gas fields in deep and ultra-deep areas (depth >1,000 m). Instead, floating offshore installations such as FPSO units are preferred for developments in remote and/or deep and ultra-deep areas, where they perform multiple functions in the production, storage and offloading of oil or gas. These installations enable these energy resources to be transported to shore via shuttle tankers, thus obviating the need for pipeline infrastructure and facilitating fast-track functionality. FPSOs are also preferred for use in marginal fields where the reservoirs are not necessarily abundant.

Floating power plants fuelled by liquefied natural gas or nuclear reactors are used to generate electrical power at sea. Uniquely, these plants can provide electricity and heat to remote, relatively inaccessible sites. FSRUs are floating offshore installations that are used as near-shore liquefied natural gas terminals, with functions such as storage and regasification. FSO units are also utilised near onshore oil terminals.

Ship-shaped offshore installations have been used since the late 1970s, and their complexity and size have been gradually increasing. Many engineering challenges associated with structural safety and tolerance to extreme conditions and accidents and with economics and financial expenditures in design, construction and operation, remain to be solved. Safer end-of-life decommissioning is essential to ensure the health and safety of the environment, as aged installations have substantial accumulations of structural damage due to natural deterioration or accidents.

Ship-shaped offshore installations are similar to trading tankers in terms of structural geometry, but differ in terms of their design, construction, operation, lifetime care and decommissioning. For example, the different design loads require substantially different structural design concepts. Trading tankers can avoid rough weather or alter their heading while in operation, whereas ship-shaped offshore installations have fixed locations and thus are continuously exposed to site-specific environmental conditions. In addition, unlike trading tankers, ship-shaped offshore installations typically cannot be periodically dry-docked for inspection and maintenance, meaning that the designs must enable greater long-term durability and reliability. Furthermore, ship-shaped offshore installations are likely to be subjected to significant environmental actions during loading and offloading, whereas trading tankers are typically loaded and unloaded under still-water harbour conditions. Finally, for historical reasons, the design return period of a ship-shaped offshore installation is typically 100 years, while that of a trading tanker is considered to be 25 years.

Despite significant efforts, accidents invariably occur at every stage of the design, construction, operation, lifetime care and decommissioning of a ship-shaped offshore installation, and these may have catastrophic effects on personnel, assets and the environment. Thus, there is an obvious need for a textbook on the safety engineering of ship-shaped offshore installation structures that provides an exposition of the emerging technologies and industry practices. This book is therefore intended as a comprehensive text and handy guide to the first principles, current practices, recent advances and cutting-edge trends in safety

engineering for ship-shaped offshore installations, with a focus on extreme conditions and accidents. This book represents an extensive update of the first edition (with Dr A. K. Thayamballi) published in 2007, as it covers the latest advances in the field and comprehensively examines new approaches to structural safety intended to minimise accidents and the effects of extreme conditions.

I hope that this book will be useful for practising engineers and will increase their awareness and use of advanced and sophisticated technologies, in addition to existing industrial practices, in the safety engineering of ship-shaped offshore installations. Because of its coverage of the fundamentals and principles of individual technologies, this book will also be useful for university students at all levels of study. Readers are also recommended to refer to my sister textbooks, *Ultimate Limit State Analysis and Design of Plated Structures*, Second Edition, John Wiley & Sons, 2018 (ISBN: 978-1-119-36779-6) and *Advanced Structural Safety Studies with Extreme Conditions and Accidents*, Springer, 2020 (ISBN: 978-981-13-8244-4), as the first describes the fundamentals and detailed derivations of theories, and the second presents industrial practices and applications.

I gratefully acknowledge all of those who have helped to make this book possible. Most of all, I am grateful to Dr A. K. Thayamballi (formerly senior technical advisor of Chevron Shipping Company), who was the co-author of the first edition, and Dr G. Wang (formerly principal surveyor of American Bureau of Shipping) and Dr I. Lotsberg (specialist engineer of DNVGL), who provided valuable and comprehensive comments that greatly improved this book. Finally, I thank my wife, Yunhee Kim (a sculptor), my son, Myunghoon Paik, Esq. (an international lawyer), and my daughter, Yunjung Paik (a product designer), for their unfailing patience and support.