船舶艏結構抗撞能力快速評估法

Rapid Assessment for the Crashworthiness of a Ship's Bow Structure

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摘要

船舶碰撞爲常見之海事事故，船艏又是碰撞事件中最易涉入之船體結構。目前多數商船皆具有球形艏以減少興波阻力，球形艏內部結構之佈置需滿足局部強度之要求，在寸法決定的同時，也決定了該部位之抗撞特性。目前船舶抗撞能力並非船級協會強制要求，僅有少數船級協會爲其入級船提供抗撞能力評估之選擇性船級符號。本研究針對一艘具有球形艏之散裝船，以有限元素分析評估當其船艏正面碰撞碼頭時之抗撞能力，得到碰撞力量與結構壓潰距離之關係，由此可決定在一給定之碰撞能量下結構之壓潰距離，進而評估結構損傷範圍是否在容許程度內。然而有限元素分析建立船艏細網格模型非常耗時，因此本研究採用 Amdahl [1]提出之簡化法進行船艏壓潰力量評估，與有限元素結果比較後，再提出使用簡化法應做之三種修正。最後認爲可以使用修正之簡化法對船艏進行快速之抗撞能力評估，避免耗時之有限元素分析。

關鍵詞：船艏結構，碰撞，抗撞能力

Abstract

Ship collisions are common marine incidents, and a ship bow is the most possible part that would involved in a collision. Most commercial vessels are fitted with bulbous bows in order to reduce wave-making resistance, and the structural arrangement inside a bow should meet the local strength requirements. Upon the decision of scantlings of bow structures, the crashworthiness of the bow is simultaneously defined. Crashworthiness of a ship is not a compulsory requirement of classification societies, but a few classification societies provide an optional class notation for a ship's crashworthiness. This research employed FEAs to assess the bow crashworthiness which was collided with a pier for a bulk carrier fitted with a bulbous bow. The relation between collision force and crushing distance was obtained, such that for a certain collision energy the crushing distance could be determined. Then the structure damage extent could be assessed for its permissibility. Construct a fine mesh bow FEA model is highly time-consuming, so this research employs Amdahl's simplified method [1] to assess the bow crushing force, compares with the FEA results and proposes three types of modification that should be introduced. Finally, this research regards the use of the modified method for rapid assessing bow crashworthiness is feasible, and some time-consuming FEAs could be waived.

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