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COMPARATIVE STUDY ON FATIGUE DAMAGE ASSESSMENT OF A STRUCTURE MEMBER IN A BULK CARRIER USING VARIOUS ENVIRONMENTAL CONDITIONS

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ABSTRACT

Specific design life could be identified by using fatigue damage assessment in the structure engineering field as well as in the maritime sector. Fatigue assessment is one of the assessments to be conducted during review of ship structure design. Fatigue assessment of ship structural member is mainly conducted based on specific environmental condition. In general, specific environmental condition, which is provided by Classification Society rules, is a long term sea-state data of North Atlantic Ocean. The wave scatter diagram presents the tabulation of a long term data of sea state history in the specific ocean. Therefore, a realistic encounter of wave scatter diagram is essential to simulate the variation of wave loadings applied on the ship structure in determination of fatigue design life.

Since the application of North Atlantic ocean environmental condition is commonly used by major Classification societies, this condition might give the substantial deterioration on the fatigue design life of the ship that specially operate only in specific ocean area, i.e. South East Asia area. In this work, the wave scatter diagram of various environmental conditions is chosen and the statistical characteristic is compared. The wave load sequence that is used on the fatigue damage assessment are generated by using the concept of storm model, so that the changing nature of sea state could be emulated as in real ocean. Fatigue damage of a structure member of 220 meter Bulk Carriers is calculated based on various environmental conditions.

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Keywords: wave scatter diagram, North Atlantic Ocean, Indonesian waterways, storm model, fatigue damage assessment.

NOMENCLATURE

H_W	significant wave height in m
T_W	wave period in s
P_{EX}	exceedance of probability
CS	classification society
ΔSa	individual stress range in each i-cycle
FD	cumulative fatigue damage
FL	Fatigue life in years

1 INTRODUCTION

Classification society's rules are commonly developed based on the principles of limit state design in order to evaluate the possible failure modes of ship structure members. The example of application of limit state design is explained in the IACS Common structural rules for Bulk Carriers and Oil Tankers [1]. They describe four limit states that should take into account during the assessment of Bulk Carriers and Oil Tankers structures. There are ultimate limit state (ULS), fatigue limit state (FLS), serviceable limit state (SLS) and Accidental limit state (ALS). One of four limit states is used to confirm the acceptance of ship structure to comply with assumed ship design life. Generally, the FLS is applied with assumption that the ship has 25 (twenty-five) years [2] or 20 (twenty) years ([3], [4]) service life. In both of service lifes (25 years or 20 years) the ship trading is assumed based on the North Atlantic ocean environmental condition for its entire service life.

Generally, FLS of ship structure is evaluated based on cumulative fatigue damage (FD) that is formulated by using