

Adoption of a Radiused Hopper Knuckle: Recommendations for Design and Fabrication.

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ABSTRACT

The adoption of a radiused or bent hopper knuckle with no offset between the longitudinal girder and the knuckle line (aligned hopper knuckle) was proposed by DAEWOO Shipbuilding and Marine Engineering as a design alternative to a conventional welded hopper knuckle for a large VLCC. Extensive numerical and experimental studies were carried out within Phase I of a Joint DSME/Lloyd's Register Project to ensure good fatigue performance of the aligned hopper knuckle.

KEY WORDS: Welded hopper knuckle; radiused hopper knuckle; fatigue tests; finite element analysis.

INTRODUCTION

The approval of a radiused hopper knuckle will increase productivity due to the fast fabrication process during construction and will provide easy maintenance in service. The work described in this paper was carried out to confirm that an equivalent fatigue standard to that normally achieved could also be assumed.

FINITE ELEMENT STUDY ON THE EFFECT OF OFFSET OF THE LONGITUDINAL GIRDER FROM THE KNUCKLE LINE

The objective of the study was to identify the effect of an offset of the longitudinal girder from the knuckle line on the hot spot stress at the critical location. The position of the knuckle line in relation to the longitudinal girder for a radiused hopper knuckle is shown in Fig. 1.

Analysis Scheme

A numerical study on the effect of an offset of the longitudinal girder from the knuckle line was carried out. Three types of hopper knuckle were considered: welded knuckle, radiused hopper knuckle with zero offset between the longitudinal girder and the knuckle line (referred to

hereafter as aligned radiused hopper knuckle) and radiused hopper knuckle with offset between the longitudinal girder and the knuckle line (referred to hereafter as eccentric radiused hopper knuckle).

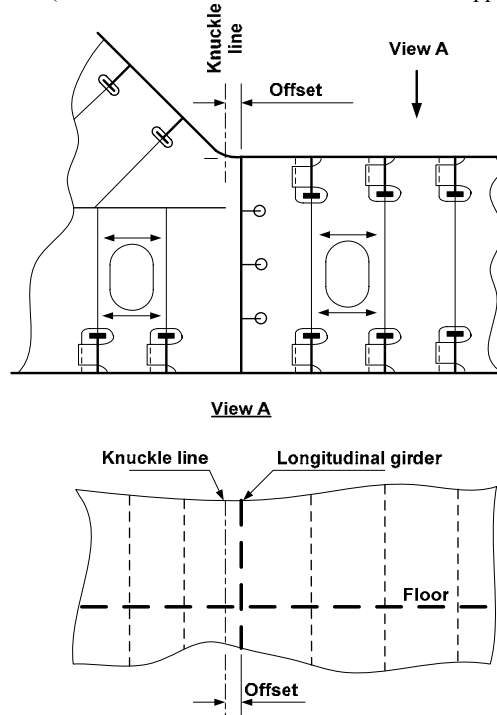


Fig. 1 Position of the knuckle line in relation to the longitudinal girder for radiused hopper knuckle .

The three types of hopper knuckle design are shown in Fig. 2. Numerical analyses were performed for a 300,000 DWT double hull VLCC. Three levels of finite element analysis were carried out as shown in Table 1. The global finite element model is shown in Fig.3. First and second level zoom models are shown in Fig.4.