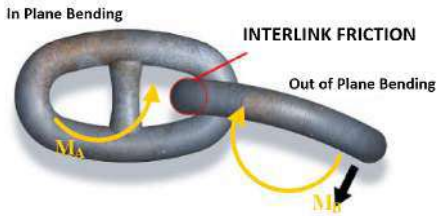
Fatigue analisys methodology of mooring chains subjected to out-of-plane bending

Victor Aleff P. S. Nascimento (victornascimento@lccv.ufal.br)
Michele A. de L. Martins, Eduardo N. Lages

Research & Development Activity
Duration: 24 months (In progress)
Partners: CENPES/PETROBRAS, Funding: CENPES/PETROBRAS

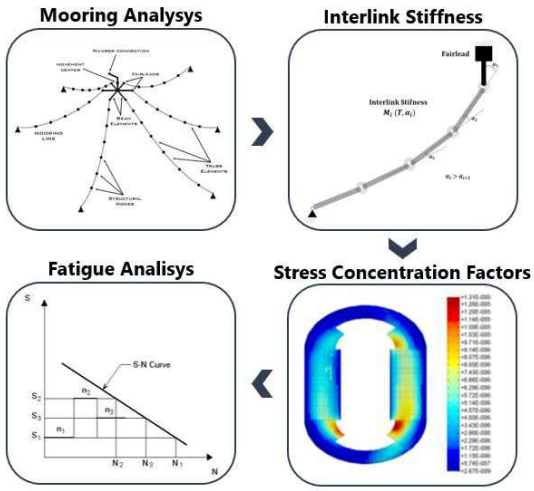
Introduction

In spite of the improvement of the mooring system design methodologies, the high occurrence of premature failure of mooring lines, observed in recent years, confirms and highlights the need to review such methodologies. Among the main causes of failure, the out-of-plane bending (OPB) stands out, a phenomenon in which a mooring link undergoes bending out of its main plane of symmetry. Although neglected by industry-leading standards and recommendations, the OPB is considered common and exclusive to the first articulated links of the top chain after the fairlead, and is also a potential cause of fatigue failures.



Methodology

The methodology of this work is based on the Bureau Veritas Guidance Note NI 604, the only normative recommendation issued which provides specific guidelines on how to evaluate the fatigue of mooring lines under combined tension and bending loads. Such document restricts the evaluation of the top chain (20 first links after fairlead), according to the following script: initially the global dynamic mooring analysis is performed, then the bending moments of the links are obtained by the proper application of a interlink stiffness law; local tension and bending stresses are estimated by the application of Stress Concentration Factors and finally the fatigue life is estimated according to the classic Stress-Life (S-N) method. The rest of the line is evaluated in the conventional way.



Results

Keeping in sight the initial evaluation of the influence of OPB on fatigue lifetime of mooring lines, it was studied a case of a floating platform moored by 12 lines, in a water depth of 650 m and subjected to the metocean conditions of Santos Basin. For such case study, the expected fatigue life of one of the lines, considering combined loads of tension and bending, was 16.8% of the one obtained by the conventional analysis methodology, which considers only tension loads. Therefore, it is concluded that OPB has high influence on fatigue life of mooring lines and must be considered in design.