

A novel methodology of calculating general SCF for fatigue analysis of overlapped leg joints in offshore structures

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Abstract

For fatigue analysis of simple joint without brace overlap in offshore structures, hot spot stress caused by brace loading is calculated as brace nominal stress multiplied by SCF (stress concentration factor). However, this meets some problem when applied to an overlap joint, due to the load interactions between overlapping braces. For example, in Figure 1, although the main brace nominal stress is 0, hot spot stress at main brace can be high because the side brace loadings can be transferred to main brace hot spots through the overlap part of the joint. In this situation it is obvious that main brace hot spot stress cannot simply be calculated as main brace nominal stress, which is 0, multiplied by a SCF. Therefore, a methodology is needed for overlap joint fatigue analysis to take account for load carry-over effects between overlapping braces.

This paper proposes a methodology for overlap joint fatigue analysis, which uses an additional short beam to model the overlap part of the joint, and assigns short beam general SCF for fatigue calculation. Flowchart of the proposed methodology is shown in Figure 2. There are two key points in the proposed method: (1) It is proposed that in the global beam model, a short beam is used to model the overlap part of the joint. Nominal stresses of the short beam depend on both main brace and side brace loadings, so it is expected that the short beam is able to capture the load carry-over effects between overlapping braces. (2) Fatigue calculation is based on the short beam nominal stress and its SCF. Therefore it is crucial that the short beam SCF is properly calculated and assigned. It is proposed that the short beam SCF is derived based on basic joint load cases, rather than actual cases. In this way the short beam has a “General SCF” which is applicable to various actual cases, excluding the need of looking into each actual case.

It is concluded that the fatigue model with short beams and General SCF provides equivalent fatigue results in actual cases for the overlap joints in offshore structures.

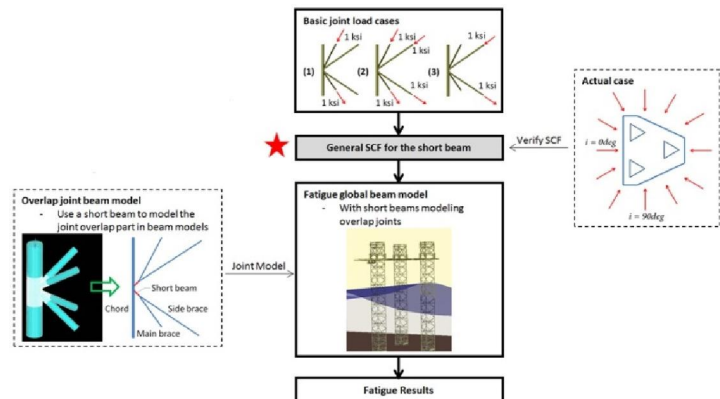
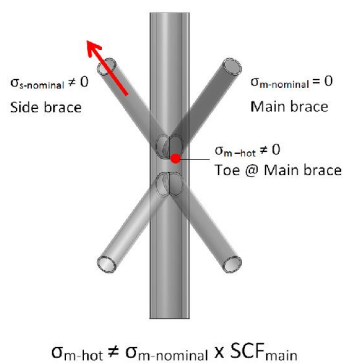


Figure 1 Load carry-over at an overlap joint

Figure 2 Flowchart for jack-up overlap joint fatigue Analysis

Keywords: Fatigue; Overlap Joint; Offshore Structures; Jack-up; Stress Concentration Factor.

References

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