The Fatigue Behavior of Steel Structures under Random Loading

Fatigue damage accumulation in steel structures under random loading has been studied in a number of investigations at the Technical University of Denmark. The fatigue life of welded joints has been determined both experimentally and from a fracture mechanics analysis. In the experimental part of the investigation, fatigue test series with a total of 540 fatigue tests have been carried through on various types of welded plate test specimens and full-scale offshore tubular joints. The materials that have been used are either conventional structural steel or high-strength steel. The fatigue tests and the fracture mechanics analyses have been carried out using load histories, which are realistic in relation to the types of structures studied, i.e. primarily bridges, offshore structures and chimneys. In general, the test series carried through show a significant difference between constant amplitude and variable amplitude fatigue test results. Both the fracture mechanics analysis and the fatigue test results indicate that Miner’s rule, which is normally used in the design against fatigue in steel structures, may give results, which are unconservative, and that the validity of the results obtained from Miner’s rule will depend on the distribution of the load history in tension and compression.

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