Summary

Because of the European integration the several national standards are rewritten to new European standards. For the design of cranes, the old NEN 2018 and NEN 2019 are replaced by the new CEN/TS 13001 and the Eurocode (EN 1993). There is a need for a comparison between those three standards according to fatigue of welded joints. The goal of this report is to compare the fatigue design and the fatigue calculations for the welded joints as described in NEN 2019, CEN/TS 13001-3-1 and EN 1993-1-9.

The design of a welded joint has a dominant effect on fatigue life. It is therefore necessary to ensure that a structure that will experience fatigue loading in the individual joints has adequate strength. The design of components subject to fatigue loading are incorporated in several design rules. The basis of all the rules is a system whereby various joint designs are assigned a 'classification' related to the joint's fatigue performance. The same or similar methods will be found in other application standards. To make a comparison between the different standards the fatigue design of welded joints are described in this report by their characteristic values, quality and classification.

The numerical values of the different weld details in each standard are represented in the tables of Annex A. These numerical values of the different weld details can be compared between NEN 2019, CEN/TS 13001-3-1 and EN 1993-1-9. For this purpose, the weld details can be divided in different categories represented in tables and graphs.

The methods for fatigue calculation used in the different standards can be compared selecting three different components of a crane. By performing a fatigue calculation at one typical welded joint in these components a comparison can be made. For this fatigue calculation, a simulation model is used in order to specify load combinations and stress histories necessary for the fatigue calculations.

It can be concluded that the definition of the fatigue strength in CEN/TS 13001-3-1 is basically in accordance with the relevant part of Eurocode 3 (EN 1993-1-9). In comparison to NEN 2019, CEN/TS 13001 and EN 1993 contain some new features: the limit state method and a new classification system.

The difference between the types of usage of classes in CEN/TS 13001 and NEN 2019 is first of all the accuracy and distribution of the several classes. Secondly, there are more classes used in CEN/TS 13001 and the way they are used give major differences.

In CEN/TS 13001 and EN1993 the classification process is not used in to determine the several load factors, but is utilized in the determination of class S. This factor can be concluded from tables or from simulation and is used in permissible stress calculations for fatigue.

The comparison of the numerical values shows a considerable difference of the prescribed detail categories between the codes. There are differences in weld categories, numerical values and diversity of represented welds in the different standards. Furthermore, in contrary to NEN 2019, the values of CEN/TS 13001 and EN 1993 are based on stress range instead of allowable stresses.

With respect to the required weld quality, Eurocode 3 (EN 1993-1-9) does not classify different quality levels.

In fatigue calculations, there are some differences too. First of all, the fatigue analysis of CEN/TS 13001 and EN 1993 is based on stress range, and is independent of the ratio between minimum and maximum as in NEN 2019. Furthermore, although both CEN/TS 13001 as EN 1993 use a characteristic reference value for a weld, their fatigue verification is not exactly the same. It also can be concluded that the direct use of s(m=3) in CEN/TS 13001 gives more accurate results of limit design stress as for direct use of the S class in CEN/TS 13001.

Finally, in order to come to more accurate fatigue calculations, some assumptions have been rethought.