

Interactive determination of fatigue behaviour of reinforcing steel

Abstract

The up to now standard procedure for axial cyclic testing of reinforcing bars results in distinct varying characteristic fatigue strength curves (S-N curves). Usually S-N curves are determined on the basis of experimental investigations using the number of cycles to failure (N) for constant stress ranges ΔS on different stress levels. In general this approach results in indeterminate statistical distributions for the number of cycles to failure, in particular in the field of the fatigue endurance limit. This complicates a reliable statistical analysis.

By the use of a new developed research method – the Interactive Procedure – the characteristic fatigue strength curve (e.g. 5%-quantile was obtained at a 90% level of confidence) was directly determined by new test results.

The new experimental investigations on reinforcing steel are carried out testing in air as well as embedded in concrete. In the experiments the lower stress level was kept constant according to the usual design situation.

Investigations of testing in air were carried out in the context of the BAST research project (MAUER, BLOCK, DREIER, 2008).

For the development of a complete S-N-curve for steel tested in air 5 static and 25 cyclic tests had been required. The specimens with a diameter of 20 mm were taken from 5 charges during the use of one roller.

5 tests for reinforcing bars embedded in concrete had also carried out during the above-mentioned research studies.

In context of the DIBt research project further 15 samples of reinforcing steel embedded in concrete were tested so that it was possible to generate a complete function for fatigue resistance also for this case.

The results of both series had been compared. The result shows that the value of the fatigue endurance limit of the embedded reinforcing steel is 13% higher than the value for testing in air.

Subsequently it is presented that the determined fatigue resistance can be used to assess the parameters of the S-N curve according to DIN 1045-1 (fig. 52 and tab. 16).

In addition to the design method acc. to DIN 1045 the use of the Goodman-diagram is recommended to consider the combined effects of the static and fatigue loading.