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. Ausfertigung

Summary

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Vorhabensbezeichnung	Dauerschwingfestigkeit von Spannstählen unter dynamischer Beanspruchung im eingebauten Zustand
Laufzeit des Vorhabens	01.11.2009 – 30.05.2010
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Fatigue strength of built-in prestressing steels under dynamic loading

The aim of the research project was to give a status report about this subject, including pretensioned prestress. External prestressing and prestressing without bond was not considered in this report, as well as fatigue effects on couplings and anchors and the transfer area of pretensioned prestress.

The test parameters of the considered tests have been collected in a data base. Furthermore, a classification of the existing test results with regard to their significance (usability) and their classification into the scope of application of the national standards (i.e. DIN 1045-1) was carried out.

The results of these investigations shows that, as far as post-tensioning is concerned, there are extensive experimental research results, but there is still some lack of information for high prestressing values (> 0.75 f_{pk}), high concrete strength classes (> C70), a fatigue stress range $\Delta\sigma$ < 100 N/mm², high stress cycles (N > 10^7) and in a fatigue stress range $\Delta\sigma$ > 250 N/mm². There are only a few test results for pretensioned prestress, which only cover single fatigue stress ranges. Quantifiable investigations on deflected pretensioned prestess could not be found in the scope of this research project within Europe, which means that there is still some need for research. The existing international investigations with this regard, indicate a substantial reduction of the fatigue strength under dynamic loading. Furthermore, it has to be pointed out here, that a great deal of the existing investigations for pretensioned prestress have been carried out under loading conditions were the lower loading was below the decompression load or multiple loading stages and fatigue ranges respectively, have been applied to the same test specimen. Due to these single loading stages micro-damages occur in the prestressing steel, which means that the final total damage cannot finally assigned to a certain stress range.

The usable test results were compared with the fatigue strength curves (Wöhler curves) for prestressing tendons according to DIN 1045-1, EC 2 and Fachbericht FB 102. Altogether, the conclusion drawn from this comparison is that the fatigue strength post-tensioned prestessing tendons is relatively well represented – with regard to the existing gap in knowledge - by the existing codes. The investigations carried out for linear pretensioned prestress can be reasonably well described with the specifications in the relevant codes; but no design recommendations could be given for an inclined or deflected pretensioned prestress. The information, design rules and fatigue strength curves in the national codes should be restricted to linear prestressing strands for pretensioned prestress.

Finally, a short assessment of the past test configurations with regard to the practical placing and application conditions was carried out. A transferability of the fatigue strength of unembedded prestressing steel to embedded prestressing tendons is not possible, as the influence of fretting corrosion leads to a reduced fatigue strength. The results from small test specimens with the consideration of fretting corrosion showed a far better agreement with full-scale tests, but these test cannot fully reproduce the real building member behavior as single test parameters, such as bending of the prestressing tendons cannot be reproduced exactly.