

Reason Prestressed concrete girders failed due to fractures of prestressing steel.

Objective was the development of the Remanent Magnetism Method (ReMBO method) to detect fractures of prestressing steel bars in an early stage of damage inside a metal sheathing. It is a non-destructive testing method which locates the characteristic stray field due to fractures of magnetized prestressing steel bars.

Working Plan, Implementation The electromagnets to perform the magnetization and the sensor unit to measure the magnetic flux density have been developed. The magnetization process was optimized in respect to a defined magnetization of the tendons. Different magnetic states of the reinforcement can be generated to set fracture signals apart from disturbing signals due to normal reinforcement. In the test series the following parameters were examined: the concrete cover, the location of the fractures in a cross-section of the tendon, the number of fractures in a cross-section of the tendon, the screening effect of the metal sheathing, the fracture width, the distance of single fractures along the tendon axis (superposition effects of fracture signals) and the magnetic properties of different kinds of prestressing steel and reinforcement.

Techniques of numerical processing of the measurement data have been developed. Laboratory work was complemented by applications of the method on full size units.

Results Fractures of single prestressing steel bars are detected by the ReMBO method. The concrete cover of the tendon and the intensity of the disturbing signals determine the threshold of detection. Single fractures of remanent magnetized steel bars are detectable in most cases up to a concrete cover of twenty times the diameter of the bar. The metal sheathing does not influence the interpretation of the measurement data. The amplitude of the fracture signal is proportional to the loss in cross-sectional area of prestressing steel and also depends on fracture width. The measurement data do not include any information about the fracture width. It has to be estimated to evaluate the extent of damage (loss in cross-sectional area). Magnetoelastic influences on the remanence of the prestressing steel are taken into account for signal interpretation. To carry out the application on full size units trained staff is required, the evaluation of the measurement data still requires a specialist.