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Studies were made of factors affecting the corrosion of steel in prestressed concrete bridges and of possible methods of minimizing the corrosion dangers. This book details the theory and applications of finite element (FE) modeling of post-tensioned (PT) concrete structures, and provides the updated MATLAB code (as of 2019). The challenge of modeling PT prestressed concrete structures lies in the treatment of the interface between the concrete and prestressing tendons. Using MATLAB, this study develops an innovative nonlinear FE formulation which incorporates contact techniques and engineering elements to considerably reduce the need of computational power. This FE formulation has the ability to simulate different PT frame systems with fully bonded, fully unbonded or partially bonded tendons, as well as actual sliding behavior and frictional effects in the tendons. It also allows for the accurate simulation of anchor seating loss. This report provides practical tests to identify and measure residues (e.g., rust, lubricants used in manufacturing processes, or corrosion inhibitors) on the surface of steel prestressing strands and to establish thresholds for residue types found to affect the strength of the strand's bond to concrete. Key products presented here are four test methods suitable for use in a quality assurance program for the manufacture of steel prestressing strand. This reference work will focus on the corrosion of steel in concrete, the main cause of deterioration of reinforced concrete structures. A survey on well-established mechanisms and concepts is given, but the main emphasis lies on new methods and materials for preventive measures, condition assessment and repair. The revised edition of this hallmark text is updated with the recent developments in design, construction and maintenance of Prestressed Concrete Structures. It incorporates the integrated limit state concepts in design with emphasis on the practical aspe. Concerns have been raised regarding the durability of galvanized prestressing steels in contact with cementitious grout, and regarding the use of galvanized ducts for grouted tendons or galvanized inserts or components in contact with prestressing steel inside concrete. These concerns are mainly based on the assumption that the hydrogen formed on the zinc surface when exposed to the fresh cementitious grout for a short period of time represents a risk of hydrogen induced stress corrosion for the prestressing steel. Basic research has demonstrated that hydrogen induced stress corrosion may indeed occur with prestressing steels which are sensitive to hydrogen induced stress corrosion. The use of galvanizing for high strength steels exposed to atmosphere is less controversial. However, under certain conditions hydrogen may develop also and potentially damage the high strength steel. This report provides a summary and evaluation of the relevant parameters on the corrosion behaviour of high strength wires, strands and bars when in contact with zinc with and without the presence of fresh cementitious grout or concrete. Both, tendons made of prestressing steels used in structural concrete and cables under atmospheric conditions are considered. The main groups of applications discussed in the report are: A Zinc-coated high strength steel for applications in atmospheric corrosion conditions B Zinc-coated prestressing steel embedded in fresh cementitious grout or concrete C Bare prestressing steel (no zinc coating) embedded in fresh cementitious grout or concrete in direct contact with, or indirect contact in the immediate vicinity of galvanized components embedded in the grout or concrete (e.g. galvanized ducts, galvanized reinforcing steel, galvanized fastenings / dowels, etc). This report is a review of selected failures in concrete structures in which prestressing steels break in a brittle way due to stress corrosion cracking. Most cases are from the German experience over a period of about 30 years. Analysis of these failures shows that they are often due to an accumulation of causes such as poor design, errors during construction, careless detailing and, in some cases, use of unsuitable materials. This report will have achieved its purpose if it serves to avoid these past errors and encourages the development of new ways to protect, test and regulate prestressing steels. The report is complemented with comments on the properties and corrosion behaviour of different types of prestressing steels. The goal of the study is to provide objective arguments for the discussion of failures that have occurred due to corrosion induced failure of prestressing steel. In such a way the general regulation given in DIN with respect to reinforcement for robustness may eventually be proven inappropriate. The general building authority approval for prestressed hollow filler block floors already supports such an idea. It is well known that the hollow block floor industry works without any reinforcing steel. The regulations in the standards should not limit in particular the use of these types of prestressing steel (cold-formed wires, strands) which have proven not associated with any substantial failures cases reported in the last 35 years. The report reviews the historical development with respect to corrosion induced failure of prestressing steel. Concerning the circumstances of the failure examples, this review partly reflects a specific problem in Germany. Also reviewed are other known interregional examples of failure which are incorrectly attributed to the prestressed construction method. All cases considered are discussed and the failure reasons thoroughly evaluated, also with reference to the results of most recent research. Another question addressed is whether one should be concerned over corrosion induced retarded failure even when using new generation prestressing steel with correct corrosion protection. Finally a contribution to the following very important question is presented: Do the future prestressed structures possess enough safety against structural failure if they are constructed without reinforcement for robustness but otherwise comply completely with the design standards? To aid a better understanding of this short report on typical failure cases and their origins, the main conditions are set out for corrosion-induced failure of prestressing steel in technical applications. The properties of different types of prestressing steel and their application limits are given in a special section dealing with the influence of building materials on damage development. This report will be of interest to all involved in the construction process. Fundamental scientific discussion has been avoided by reference to well accredited detailed information in the technical literature. The long-range objective of the research summarized in this report is the development of a practical nondestructive (NDE) method for detecting deterioration in the reinforcement of prestressed concrete bridge structural members in situ. A detailed definition of the problem is presented and the technical approach is summarized. The basis for selecting and assessing fifteen NDE methods is reviewed, and the results of a limited laboratory investigation of the magnetic method prior to developing inspection equipment are summarized. Development of a preliminary magnetic inspection equipment is described and many records are presented from laboratory evaluations using a 20-ft. (6m' section of Texas Type "C" beam and from field evaluations on the Sixth South Street Viaduct at Salt Lake City, Utah. Similarities between laboratory and field inspection signatures are indicated; other prominent anomalous, signatures are shown which correlated with steel elements neither known to be present nor shown on the plans; still other field signatures are shown which indicated the stirrup configuration in the post-tension girders was not in accordance with the plans. Correlation investigations are described which illustrate promising electronic signature enhancement and recognition methods for discriminating between steel artifacts and deterioration. Recommendations for further development are outlined.

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