IN-LB	Inch-Pound Units
SI	International System of Units

Corrosion and Repair of Grouted Post-Tensioning Tendon Systems—Report

Reported by Joint ACI-ASCE Committee 423

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Reported by Joint ACI-ASCE Committee 423

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This report provides general information regarding the evaluation of corrosion damage in structures reinforced with grouted multi-strand and bar tendons. A review of current practices is included along with the historical background. Specific potential problem areas for grouted tendons are discussed for each critical part of the tendon. Current methods for evaluating corrosion damage and typical repair schemes are included.

Keywords: anchorage; bonded; corrosion; duct; durability; grout; post-tensioning; prestressed; repair; strand; tendon.

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CHAPTER 1—INTRODUCTION

1.1—Introduction

The use of grouted high-strength wire, strand, and bar post-tensioning tendons as a viable construction technique began in North America in the 1950s (Post-Tensioning Institute 2006). Components of the standard system have changed significantly from shimmed button-head wire-type systems to bundles of seven-wire strand systems with wedges. Post-tensioning bars may also be used in grouted systems, although they have not changed significantly since their first introduction. The latest generation of post-tensioning systems include multiple layers of corrosion protection due to an increased awareness of the susceptibility of earlier systems to corrosion and the importance of a durable system.

Grout material is used in post-tensioning systems to fill the voids in the ducts, to provide bond between the tendons and the structural element, and to provide corrosion protection for the tendons. Historically, grout consisted of a standard mixture of water and portland cement; sometimes, however, chemical admixtures were included to increase pumpability, to introduce expansion in an attempt to counteract settlement and voids, or to reduce bleeding. In the late 1990s, the discovery of tendon corrosion in several post-tensioned bridges in Florida (Corven Engineering, Inc. 2001) prompted a change in grouting materials, including the introduction of prepackaged grout formulations containing anti-bleed admixtures. Past performance of grouted post-tensioning systems is covered in more detail in 4.1.

The discovery of corrosion problems has also led to the development of various methods for the evaluation and repair of corrosion damage to grouted tendon systems (Hurlebaus et al. 2016). Over the past two decades, many bridges have undergone evaluation and repairs, if required (Schokker and Berg 2012; Sprinkel and Balakumaran 2017). Evaluation methods vary; however, most include nondestructive methods as well as exploratory evaluation for detection of voids, water, or soft grout within the ducts and corrosion of the prestressing steel. Repairs typically consist of removal of water and soft grout followed by filling the voided space within the ducts with grout. If a tendon has lost significant cross section due to corrosion, the tendon may need to be replaced. Chapters 5 and 6 cover evaluation and repair methods in greater detail.

1.2—Scope

This report includes a review and summary of the following:

(a) Guide specifications and training as applied to grouted post-tensioning tendons
(b) Quality control during construction
(c) Potential problem areas in grouted systems
(d) Durability enhancements for each component of the tendon
(e) Evaluation and mitigation of corrosion problems
(f) Repair methods for grouted systems

This report is intended to provide general information on the corrosion and repair of grouted multistrand and bar tendon systems. The information is intended to represent the state of knowledge of the committee in the areas of corrosion prevention in grouted tendons, as well as evaluation and repair. It is not intended as a standard or recommended practice. A strong background in durability of grouted post-tensioning systems, including practical experience and training, is recommended before designing, constructing, evaluating, or repairing these structures.

This report focuses on the unique materials and hardware associated with grouted post-tensioning tendons with a discussion of efforts within the industry to improve durability. This report also provides recent practice with regard to evaluation and repair of grouted post-tensioning systems. General corrosion theory for metals in structural concrete systems is not within the scope of this report. Information on corrosion theory and mechanisms can be found in ACI 222R and ACI 222.2R. Information on inspection and evaluation of unbonded single-strand post-tensioning systems can be found in PTI DC80.3/ICRI 320.6.

1.3—Limitations

This report presents a summary of the typical corrosion-related problems that may occur in grouted post-tensioning systems and includes guidelines for evaluation and repair. The material is general in nature and may not apply to every situation. Due to the uniqueness of each post-tensioned structure, engineering judgment should be used to determine the appropriate action based on experience and the general guidance provided in this document.

This report is not intended to be included as part of a specification document for materials, evaluations, or repairs. Evaluation of grouted post-tensioning tendons is a difficult undertaking, and no single method can be used to fully describe the damage or life expectancy of a tendon. Due to the many changes in materials and equipment since the