ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

This report is a guide for the design of flexural concrete members in buildings post-tensioned with unbonded tendons. Suggestions for revisions and additions to ACI 318 regarding this subject are presented. Consideration is given to determination of fire endurance, design for seismic forces, and design for catastrophic loadings, in addition to design for gravity and lateral loads. Recommendations concerning details and properties of tendons, protection against corrosion, and construction procedures are presented.

Keywords: anchorage (structural); beams (supports); bond (concrete to reinforcement); concrete construction; concrete slabs; cover; cracking (fracturing); earthquake-resistant structures; fire resistance; flat concrete plates; flat concrete slabs; joints (junctions); loads (forces); post-tensioning; prestressed concrete; prestressing; prestressing steels; shear properties; stresses; structural analysis; structural design; unbonded prestressing.

CONTENTS

Chapter 1—Introduction, p. 423.3R-2
1.1—General
1.2—Objective
1.3—Scope
1.4—Notations and definitions

Chapter 2—Design considerations, p. 423.3R-2
2.1—General
2.2—Continuous members
2.3—Corrosion protection
2.4—Fire resistance
2.5—Earthquake loading

Chapter 3—Design, p. 423.3R-6
3.1—General
3.2—One-way systems
3.3—Two-way systems
3.4—Tendon stress at factored load
3.5—Prestress losses
3.6—Average prestress
3.7—Supporting walls and columns
3.8—Serviceability requirements
3.9—Design strength
3.10—Anchorage zone reinforcement

Chapter 4—Materials, p. 423.3R-15
4.1—Tendons
4.2—Protection materials

ACI 423.3R-05 supersedes ACI 423.3R-96 and became effective June 14, 2005. All rights reserved including rights of reproduction and use in any form or by any means, including the making of copies by any photo process, or by electronic or mechanical device, printed, written, or oral, or recording for sound or visual reproduction or for use in any knowledge or retrieval system or device, unless permission in writing is obtained from the copyright proprietors.
4.3—Protection of anchorage zones
4.4—Concrete cover

Chapter 5—Construction, p. 423.3R-16
5.1—Construction joints
5.2—Closure strips
5.3—Placement of tendons
5.4—Concrete placement and curing
5.5—Stressing operations
5.6—Form removal and reshoring
5.7—Welding and burning
5.8—Protection of tendons

Chapter 6—References, p. 423.3R-18
6.1—Referenced standards and reports
6.2—Cited references

CHAPTER 1—INTRODUCTION

1.1—General
This report is an update to the previous ACI-ASCE Committee 423 report entitled “Recommendations for Concrete Members Prestressed with Unbonded Tendons (ACI 423.3R-96).” Since the publication of that report and the four previous reports that it replaced, many previous recommendations have been incorporated into ACI 318-02. These recommendations have been prepared to provide a comprehensive guide for design, materials, and construction for concrete members prestressed with unbonded tendons. Suggested revisions and additions to ACI 318 are also included in this report.

1.2—Objective
This report presents recommendations for design, materials, and construction for concrete structures prestressed with unbonded tendons that are commensurate with the safety and serviceability requirements of ACI 318-02. This report is a guide, and practitioners should use their judgment when applying its recommendations. This report is generally not intended for reference in a specification or a code.

1.3—Scope
The recommendations pertinent to design with unbonded tendons considered in this report include the design of beams, girders, slabs, continuous members, and details and properties of tendons and anchors and their protection from corrosion during construction and throughout the life of the structure.

The recommendations in this report are not intended for unbonded construction stages of elements using bonded tendons; for multistrand unbonded tendons used as external tendons; members subject to direct tension, such as tiebacks, cable stays, arch ties, or circumferential tendons for containment structures; or ground-supported post-tensioned slabs for light residential construction (PTI 2004).

1.4—Notations and definitions
Symbols are defined in the text. Definitions of terms as used in this report follow.

anchorage—a mechanical device comprising all components required to anchor the prestressing steel and permanently transfer the post-tensioning force from the prestressing steel to the concrete.
bonded tendons—tendons in which prestressing steel is bonded to concrete either directly or through grouting and, therefore, are not free to move relative to the concrete.
coupler—a device designed to connect ends of two strands together, thereby transferring the prestressing force from end to end of the tendon.
post-tensioning coating—material used to protect against corrosion and reduce friction between prestressing steel and sheathing.
prestressing steel—high-strength steel, most commonly a seven-wire strand, used to impart prestress forces to concrete.
sheathing—a material encasing prestressing steel to prevent bonding of the prestressing steel with the surrounding concrete, provide corrosion protection, and contain the corrosion-inhibiting coating.
tendon—in post-tensioned applications, the tendon is a complete assembly consisting of anchorages, prestressing steel, and sheathing with coating for unbonded applications or ducts with grout for bonded applications.
unbonded tendon—tendon in which the prestressing steel is prevented from bonding to the concrete and is free to move relative to the concrete. The prestressing force is permanently transferred to the concrete at the tendon ends by the anchorages only.

CHAPTER 2—DESIGN CONSIDERATIONS

2.1—General
Strength and serviceability limitations (including stresses) should conform to the provisions of ACI 318-02, but some recommendations are offered that differ from ACI 318 or relate to areas not covered by ACI 318-02.

2.2—Continuous members
2.2.1 One-way members—For slabs or beams continuous over two or more spans with one-way prestressing only, a loading condition or fire exposure that causes failure of all the tendons in one span will lead to a loss of prestress and much of the load-carrying capacity in the other spans. Consideration should be given to the consequence of such a catastrophic failure in any specific span to the overall stability of the structural system. ACI 318-02 has responded to this concern and to other considerations, such as crack width limitation, in Section 18.9.2. This section specifies minimum bonded reinforcement equal to 0.40% of the area of that part of the cross section between the flexural tension face and the center of gravity of the gross section. Grade 60 (Grade 420) reinforcement should be used for this purpose. This amount of bonded reinforcement is approximately equal to the minimum reinforcement requirement for nonprestressed slabs (Section 10.5.4 of ACI 318-02).

One-way slabs can also incorporate unbonded partial length tendons, lapped tendons, or tendons with intermediate anchorages that would serve to limit the extent of the loss of load-carrying capacity. The Uniform Building Code (UBC) required an alternate load-carrying capacity provided by bonded reinforcement of \( D + 0.25L \), with a strength reduction of...