



Repair of reinforced concrete in buildings and parking structures



Legal Notice for Standards

Canadian Standards Association (operating as "CSA Group") develops standards through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA Group administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document's fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party's intellectual property rights. CSA Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document's compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

Intellectual property rights and ownership

As between CSA Group and the users of this document (whether it be in printed or electronic form), CSA Group is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA Group's and/or others' intellectual property and may give rise to a right in CSA Group negroes all intellectual property rights in this document.

Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA Group shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

Authorized use of this document

This document is being provided by CSA Group for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF format.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA Group; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



Standards Update Service

CSA S448.1:10 July 2010

Title: Repair of reinforced concrete in buildings and parking structures

To register for e-mail notification about any updates to this publication

- go to store.csagroup.org
- click on Product Updates

The **List ID** that you will need to register for updates to this publication is **2420671**.

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

Visit CSA Group's policy on privacy at <u>www.csagroup.org/legal</u> to find out how we protect your personal information.

CSA S448.1:10 **Repair of reinforced concrete in buildings and parking structures**



*A trademark of the Canadian Standards Association, operating as "CSA Group"

Published in July 2010 by CSA Group A not-for-profit private sector organization 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3

To purchase standards and related publications, visit our Online Store at <u>store.csagroup.org</u> or call toll-free 1-800-463-6727 or 416-747-4044.

ISBN 978-1-55491-417-3

© 2010 Canadian Standards Association All rights reserved. No part of this publication may be reproduced in any form whatsoever without the prior permission of the publisher.

Contents

Technical Committee on Repair of Reinforced Concrete in Buildings vi

Preface viii

- **1 Scope** *1*
- **2** Reference publications 2
- **3 Definitions** 5

4 General requirements 6

- 4.1 Qualifications of personnel 6
- 4.2 Intent of repair programs 6
- 4.3 Structural considerations 6
- 4.4 Materials and equivalents 6
- 4.5 Environmental control 6
- 4.6 Waste management 7
- 4.7 Environmental management 7

5 Materials 7

- 5.1 General 7
- 5.2 Concrete materials 7
- 5.3 Reinforcement 7
- 5.4 Embedded and attached hardware 7
- 5.5 Site-applied epoxy coating 7
- 5.6 Bonding agents 8
- 5.7 Grout 8
- 5.8 Mortars 8
- 5.9 Shotcrete 8
- 5.10 Polymer modified concrete 8
- 5.11 Injection materials 8
- 5.12 Patching compounds 8
- 5.13 Equivalent materials 8
- 5.14 Protection 8

6 Evaluation of existing structure 9

- 6.1 General requirements 9
- 6.1.1 General 9
- 6.1.2 Scope 9
- 6.1.3 Causal factors 9
- 6.2 Evaluation procedures 10
- 6.2.1 General 10
- 6.2.2 Visual survey and monitoring 10
- 6.2.3 Delamination survey 10
- 6.2.4 Coring program 10
- 6.2.5 Test pits 11
- 6.2.6 Corrosion activity measurements 11
- 6.2.7 Covermeter survey 11
- 6.2.8 Reinforcement survey 11
- 6.2.9 In-place tensile tests; impact hammer, ultrasonic, radiographic, and radar penetration surveys; and chemical and petrographic analyses *11*

- 6.2.10 Load testing 11
- 6.3 Evaluation report 12

7 Repair design specifications 12

- 7.1 Objective 12
- 7.2 General requirements 12
- 7.2.1 Design 12
- 7.2.2 Details 12
- 7.3 Technical requirements 13
- 7.3.1 Crack and joint repair 13
- 7.3.2 Localized repair of concrete delamination and spall 13
- 7.3.3 Concrete surface repair 13
- 7.3.4 Partial- and full-depth structural repair and strengthening 14
- 7.3.5 Compatibility 14
- 7.3.6 Certification 14
- 7.3.7 Temporary support 14
- 7.3.8 Protection 15
- 7.3.9 Hazardous materials and areas 15
- 7.3.10 Material substitutions 15
- 7.3.11 Appearance 15

8 Repair 15

- 8.1 General 15
- 8.2 Removal 15
- 8.3 Identification 15
- 8.4 Shoring and falsework 15
- 8.5 Concrete 16
- 8.6 Reinforcement 16
- 8.7 Removal methods 16
- 8.7.1 General 16
- 8.7.2 Impact hammers 16
- 8.7.3 Hydro-demolition 16
- 8.7.4 Sawcutting 16

9 Preparation 16

- 9.1 Concrete surfaces 16
- 9.2 Reinforcement 17
- 9.2.1 Cleaning 17
- 9.2.2 Loss of section 17
- 9.3 Embedded hardware 17
- 9.4 Crack treatment 17

10 Placement, finishing, and curing 17

- 10.1 General 17
- 10.2 Materials 17
- 10.3 Reinforcement 17
- 10.3.1 Materials 17
- 10.3.2 Positioning of reinforcement 18
- 10.3.3 Splices 18
- 10.3.4 Welded splices 18
- 10.3.5 Mechanical splices 18
- 10.4 Bonding agents 18
- 10.4.1 Compatibility 18
- 10.4.2 Timing 18