





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 and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by licence or by law, CSA Group reserves 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 S413:21 October 2021

Title: *Parking structures*

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

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

The List ID that you will need to register for updates to this publication is 2429211.

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

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

Canadian Standards Association (operating as "CSA Group"), under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA Group standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

More than 10 000 members indicate their support for CSA Group's standards development by volunteering their time and skills to Committee work.

CSA Group offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, CSA Group regularly and continually audits and inspects products that bear the CSA Group Mark.

In addition to its head office and laboratory complex in Toronto, CSA Group has regional branch offices in major centres across Canada and inspection and testing agencies in fourteen countries. Since 1919, CSA Group has developed the necessary expertise to meet its corporate mission: CSA Group is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

For further information on CSA Group services, write to CSA Group 178 Rexdale Boulevard Toronto, Ontario, M9W 1R3 Canada A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada's economic competitiveness and social wellbeing, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

Standards Council of Canada 600-55 Metcalfe Street Ottawa, Ontario, K1P 6L5 Canada





Cette Norme Nationale du Canada n'est disponible qu'en anglais.

Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users to judge its suitability for their particular purpose.

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

This is a preview. Click here to purchase the full publication.

National Standard of Canada

CSA S413:21 Parking structures



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



Published in October 2021 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>www.csagroup.org/store/</u> or call toll-free 1-800-463-6727 or 416-747-4044.

ICS 91.090 ISBN 978-1-4883-3666-9

© 2021 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.

This is a preview. Click here to purchase the full publication.

Contents

Technica	al Committee on Parking Structures 4	
Preface	7	
0 Intro	oduction 9	
1 Scop	pe 10	
1.1	General 10	
1.2	Structure types 10	
1.3	Repair of existing parking structures 10	
1.4	Reference standards 10	
1.5	Terminology 10	
2 Refe	erence publications 11	
2 Reference publications 11		
3 Defi	3 Definitions 13	
4 Corr	osion and leakage protection 15	
5 Drav	wings and related documents 15	
6 Materials 15		
6.1	Concrete 15	
6.1.1	General 15	
6.1.2	Exposure 16	
6.2	Dissimilar metals 18	
6.3	Guards, vehicle guardrails, exposed hardware, and embedded materials 18	
6.3.1	Exposed materials 18	
6.3.2	Embedded materials 18	
6.3.3	Expansion joints 18	
6.3.4	Connectors 19	
6.3.5	Support of reinforcement 19	
6.4	Welded-wire reinforcement 19	
6.5	Post-tensioning 19	
6.6	Structural steel 19	
6.7	Steel deck 19	
6.8	Sealants 19	
6.9	Fibre-reinforced polymers 19	
7 Desi	gn requirements 20	
7.1	Code and reference standards 20	
7.2	Volume change effects 20	
7.3	Protection systems and concrete cover 20	
7.3.1	Acceptable systems 20	
7.3.2	Alternative systems 20	
7.3.3	Stairs 21	
7.3.4	Normal exposure 21	

1

7.3.5	Severe exposure 21	
7.3.6	Prestressed elements 21	
7.3.7	Hybrid systems 22	
7.3.8	Concrete cover 26	
7.3.9	Membranes 26	
7.3.10	Sealers 27	
7.4	Joints 27	
7.4.1	Construction joints 27	
7.4.2	Expansion joints and sliding joints 27	
7.4.3	Contraction joints in concrete toppings 28	
7.4.4	Balustrades 29	
7.5	Slopes, drainage, and drains 29	
7.6	Services 31	
7.7	Heating cables and heating pipes for snow melting systems 31	
7.8	Precast concrete hollow-core slabs 31	
7.9	Functional layout 32	
8 Additional requirements for cast-in-place, post-tensioned concrete construction 32		
8 Add 8.1	Anchorages and couplers 32	
8.2	Stressing pockets 32	
8.3	Joints 32	
8.4	Proximity to drains 32	
8.5	Qualifications 32	
0.5	Qualifications 32	
9 Additional requirements for steel structures 33		
9.1	Curbs 33	
9.2	Columns, base plates, and anchor bolts 33	
9.3	Steel deck 33	
9.4	Concrete encased structural steel 34	
9.5	Water accumulation 34	
9.6	Painting 34	
9.7	Weathering steel 34	
9.8	Crack control over girders 34	
10 Construction 34		
10.1	Reference standards 34	
10.2	Elevations 34	
10.3	De-icing chemicals 34	
10.4	Bar supports and side form spacers 35	
10.5	Post-tensioning anchorages 35	
10.6	Post-tensioning tendons 35	
10.7	Slab finishing 37	
10.8	Curing and protection 37	
10.9	Form removal and reshoring 37	
10.10	Vehicles 38	
10.11	Acids 38	
10.12	Moisture barriers 38	
10.13	Sealants 39	

11 Inspection and testing 39

12 Maintenance 40

Annex A (informative) — Moisture barriers 43

Annex B (informative) — Cathodic protection 54

Annex C (informative) — Corrosion inhibitors 57

Annex D (informative) — Testing and inspection 67

Annex E (informative) — Maintenance 72

Annex F (informative) — Responsibilities 76

Annex G (informative) — Structural considerations 78

Annex H (informative) — Commentary 91

Chair

Vice-Chair

Vice-Chair

Non-voting

Non-voting

Non-voting

Non-voting

Technical Committee on Parking Structures

D. M. Wint Read Jones Christoffersen Ltd.,

Toronto, Ontario, Canada Category: User Interest

A. Keri Concrete Ontario,

Mississauga, Ontario, Canada Category: Producer Interest

G. Martin Tremco Canada,

Toronto, Ontario, Canada Category: Producer Interest

A. Attar National Research Council of Canada,

Ottawa, Ontario, Canada

B. Ballantyne Brian Ballantyne Specifications,

Oakville, Ontario, Canada

Category: Regulatory Authority/General Interest

P. Belanger Engineering,

Mississauga, Ontario, Canada Category: User Interest

B. Benmokrane Universite de Sherbrooke,

Sherbrooke, Quebec, Canada

R. Burak Canadian Precast/Prestressed Concrete Institute,

Ottawa, Ontario, Canada

S. Chasioti Cement Association of Canada,

Ottawa, Ontario, Canada Category: Producer Interest

P. Cutten Synergy Partners Consulting LTD,

Toronto, Ontario, Canada

V. B. Dhekney Pickering, Ontario, Canada Non-voting

R. Dozzi Canadian BBR Inc., Non-voting

Scarborough, Ontario, Canada

October 2021 © 2021 Canadian Standards Association 4

H. Dutrisac Department of National Defence / Government of Non-voting

Canada,

Ottawa, Ontario, Canada

O. Eissa IES Associates,

Windsor, Ontario, Canada Category: Producer Interest

S. Fasullo Davroc Testing Laboratories Inc.,

Brampton, Ontario, Canada Category: User Interest

P. Hanratty BASF Construction Chemicals LLC,

Mississauga, Ontario, Canada Category: Producer Interest

C. M. Hansson University of Waterloo,

Waterloo, Ontario, Canada

Category: Regulatory Authority/General Interest

M. Hillcoat Entuitive Corporation,

Toronto, Ontario, Canada *Category: User Interest*

R. D. Hooton University of Toronto,

Toronto, Ontario, Canada

Category: Regulatory Authority/General Interest

J. Horst Sealants and Waterproofing Association,

Richmond Hill, Ontario, Canada Category: Producer Interest

J. Kosednar WSP Canada Inc.,

Toronto, Ontario, Canada *Category: User Interest*

A. K. Mehta The Prestressed Group,

Windsor, Ontario, Canada

Non-voting

R. E. Munro Concrete Advice,

Toronto, Ontario, Canada

Category: Regulatory Authority/General Interest

O.S. Ooi Realcrete Consultants Inc.,

Richmond, British Columbia, Canada

Category: User Interest