CACRCS DAYS 2023

4th Edition

www.cte-eventi.com

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13th -15th September 2023

Venue: University of Parma, Parma, Italy

Capacity Assessment of Corroded Reinforced Concrete Structures: from Research to Daily Engineering Evaluation

ORGANIZED BY

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Capacity Assessment of Corroded Reinforced Concrete Structures: from Research to Daily Engineering Evaluation

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Auditorium S. Elisabetta
Via Parco area delle Scienze, 95 Parma

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WITH THE SUPPORT OF

Associazione Italiana Calcestruzzo Armato Precompresso

Associazione Italiana di Metallurgia

Associazione Tecnologi per l'Edilizia

fib Italy Young Members Group

Politecnico di Milano

Università degli Studi di Parma

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For more information about the event, please visit the internet website
www.cte-eventi.com/cacrcs/
www.cte-it.org

TOPIC

CACRCS DAYS 2023 edition will focus on practical engineering applications achieved with consolidated research on corroded reinforced concrete and prestressed concrete structures. The main line of the workshop starts from the analysis of material characteristics, moves to the evaluation of the structural behaviour of corroded members, ending with the prediction of the remaining service life of corroded structures. Case studies of assessment of deteriorated structures are of great interest.

Since 2019 the Workshop has seen the participation of experts in the capacity assessment of corroded reinforced concrete structures. The workshop is open to young researchers, experts and practitioners.

In the CACRCS DAYS context, professional engineers can find a community of people able to assist in practical problem solving and in decision-making procedures for the assessment and maintenance of existing structures. Moreover, a Round Table will be scheduled to stimulate the debate on the analysis of available codes and guidelines for the evaluation of existing structures and on the gaps and future research fields identified on the basis of the contributions submitted to this workshop.

ORGANIZING COMMITTEE

Coordinators: **Beatrice Belletti (University of Parma), Dario Coronelli (Politecnico di Milano)**

Anna Magri (*CTE)*

David Fernández-Ordóñez (f*ib Secretary General)*

Luc Taerwe (*Ghent University, Editor-in-Chief Structural Concrete Journal)*

Marta Del Zoppo, Lorenzo Franceschini, Biagio Calcavecchia, Marco Carlo Rampini, Simone Ravasini (*fib Italy Young Members Group)*

Benoit Bissonnette *(CRIB - Laval University)*, Claude Rospars (*University Gustave Eiffel*), Carmen Andrade (*CIMNE - UPC*), Walter Kaufmann *(ETH Zurich)*, Jesus Rodriguez (*UPM*), Joost Walraven (*Em. TU Delft*), Takumi Shimomura (*Nagaoka University of Technology*)

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CALL FOR ABSTRACTS

The CACRCS DAYS welcome all contributions related to the behaviour of reinforced concrete, fibre reinforced concrete and prestressed concrete structures damaged by corrosion, with both numerical and experimental approaches, and including some recommendations for the daily engineering evaluation of corroded structures.

You can submit abstracts and papers to the website of the CACRCS event, www.cte-eventi.com/cacrcs/*.*

PAPER SUBMISSION

Authors willing to present their work at the CACRCS DAYS 2023 are invited to kindly submit an abstract in accordance with the sessions of the workshop. The abstract should not exceed 750 characters and should include some relevant progress with regard to the present state-of-the-art.

Extended abstracts (4 pages long) will be reviewed and will be included in the Proceedings of the Workshop if they will be accepted. The Authors of selected extended abstracts will be invited to submit a full manuscript to a Special Issue of Structural Concrete. The submission of full manuscripts will undergo the usual peer-review process of Structural Concrete.

In order to promote and facilitate the transfer of knowledge from Research to Daily Engineering Evaluation, the template for extended abstracts contains a paragraph dedicated to a description of the use of the presented results in engineering applications. The template for abstracts and extended abstracts is available on the CACRCS website (www.cte-eventi.com/cacrcs/).

AWARDS

Awards will be conferred to the most outstanding paper presented by a *fib* young member and to the most excellent paper presented in the workshop.

IMPORTANT DATES

abstract submission	**28.11.2022**
abstract acceptance notification	15.01.2023
extended abstract submission	28.02.2023
extended abstract acceptance	30.04.2023
final extended abstract submission	30.06.2023
author's registration	30.06.2023
full manuscript submission for a Special Issue of Structural Concrete	28.02.2024

SPONSORS

Companies interested in supporting the event can contact us by e-mail to cacrcs@cte-eventi.com.

SPONSOR FEES **€1500+VAT**

including

- Conference registration of 1 person.
- Registration of additional attendees at reduced fee of € **300 each**.
- Quoting the logo (in alphabetic order for each sponsoring) on program, and all advertising documents delivered by the conference organizing committee.

REGISTRATION FEES
are VAT exempted and include participation to the workshop, gala dinner and proceedings in electronic format.

Standard fee **€600,00**
(including CTE membership)

Reduced fee for Young People **€530,00**
(valid only for people<30 year and including CTE membership)

Reduced fee for CTE fib Member **€500,00**
(valid only for CTE, *fib,* Member 2023)

You will register directly from the CACRCS website (www.cte-eventi.com/cacrcs/) and make the payment by credit card or bank transfer to CTE.

For Bank Transfer please indicate
Name Surname – CACRCS 2023
CTE – Bank Intesa San Paolo
IBAN IT59C0306909606100000113883
BIC SWIFT: BC IT IT MM

It is necessary to register **no later than May 31, 2023.**

PROFESSIONAL CREDITS - CFP
3+3+3 CFP will be requested to CNI only to Italian Engineering

PRELIMINARY PROGRAM

Special sessions are organised during the workshop. Authors are invited to kindly select the session at which they will present their papers. Each session will include both research and engineering applications focussing on what is needed for the evaluation of corroded structures.
CACRCS DAYS 2023 includes a Round table to promote discussions.
The workshop offers didactic material for engineers, practitioners, scientists, concrete technologists, researchers, and academics to further knowledge about corrosion of reinforced concrete structures.

Wednesday 13 September

Welcome and Introduction
B. Belletti, D. Coronelli, Coordinator Event
Enrico Nusiner, CTE President
David Fernández-Ordóñez, *fib* Secretary General
Luc Taerwe, Editor-in-Chief of Structural Concrete

KEY-NOTE LECTURES

Jesús Rodríguez, UPM, Chairman of the Spanish Mirror Group Eurocode 2, Spain
"New version of Eurocode 2: what is covered for the evaluation of existing concrete structures and how to be enlarged for the structural evaluation of the corroded concrete ones"

Alberto Gennari Santori, ANAS S.p.a. - Centro Sperimentale Stradale di Cesano, Italy
"Identification and evaluation of defects in post-tensioned cables of prestressed concrete bridges"

A1) Derivation of reliable material models for the analysis of corroded structures
The *Session* deals with the critical revision or the promotion of databases and experimental results coming from corroded elements by referring to accelerated tests, corrosion under natural environment, and the use of empirical expressions adjusted to experimental results.

KEY-NOTE LECTURES

Els Verstrynge, KU Leuven University, Belgium
"Overview of experimental approaches and reliability of empirical relations for rebar corrosion assessment"

Veronique Bouteiller, Université Gustave Eiffel, France
Corrosion of reinforced concrete: results from accelerated tests and under natural environment

A2) Models for deteriorated materials: constitutive relationships to be implemented in structural models
The *Session* deals with models for deteriorated materials, their use for structural models and practical applications:

- Reinforcing and prestressing steel:
  - cross section reduction (homogeneous or pitting corrosion)
  - strain reduction at maximum load
  - definition of stress-strain relationships
- Concrete:
  - cracking
  - compressive strength reduction due to different factors, such as cracking
  - cross section reduction due to different factors, such as spalling
- Bond:
  - bond capacity
  - bond-slip relationships
  - anchoring in reinforcing bars (plain and ribbed)
  - transfer length and anchorage of prestressing steel

KEY-NOTE LECTURES

Yasushi Tanaka, Kanazawa Institute of Technology, Japan
"An experimental and numerical study on remaining strength of corroded prestressed concrete girder"

Alberto Meda, University Tor Vergata, **Zila Rinaldi**, University Tor Vergata, **Anna Saetta**, IUAV, Italy
"Design relationships for corroded steel rebars"

Thursday 14 September

B1) Analytical models the capacity assessment of corroded members

The *Session* investigates the suitability of models for new structures when applied to the evaluation of existing corroded structures, the modification and improvement of existing models, based on a-priori hypothesis for new structures for the capacity evaluation of existing corroded structures
Particular attention will be focused on:

- The structural analysis: linear elastic analysis with limited redistribution, plastic analysis, and non-linear analysis.
- The capacity assessment of reinforced concrete and prestressed concrete members, such as beams, columns, slabs, and/or walls by referring on both serviceability and ultimate limit states and taking into account problems related to the spatial variability of the damage induced by corrosion.
- The assessment of corroded concrete members at ultimate limit states by strut-and-tie models
- Case studies showing the application of models to real corroded structures

KEY-NOTE LECTURES

Weiping Zhang, Tongji University, China
"Assessment of fatigue behavior of corroded prestressed concrete beams"

Walter Kaufmann, ETH, Switzerland
"Capturing the global structural impact of local corrosion"

Raoul François, LMDC, INSA, UPS, Université de Toulouse, France, **Rached El Fatmi**, ENIT, Université El Manar de Tunis, Tunisie, **David Garcia**, Corrohm, Labège, France, **Erick Ringot**, LMDC, INSA, UPS, Université de Toulouse, France
«Mechanical re-calculation of reinforced concrete structures taking into account load-redistribution due to both load-induced cracks and corrosion of reinforcement»

B2) NLFE models for the capacity assessment of corroded members

The *Session* deals with the Non-Linear Finite Element Modelling of corroded RC and PC structures. Particular attention will be focused on the calibration of the NLFEM on the basis of reliable test results and reliable input values of material characteristics, and also the use of NLFE for structural assessment of real corroded structures.

KEY-NOTE LECTURES

Beatriz Martín-Pérez, University of Ottawa, Canada
"Numerical modelling of structural concrete members subjected to reinforcement corrosion"

Joško Ožbolt, University of Stuttgart, Germany
"Corrosion of steel reinforcement in concrete: 3D FE modelling & on situ structural measurements"

Hikaru Nakamura, Nagoya University, Japan
"Advanced nonlinear analysis model, Rigid Body Spring Method - Simulation from corrosion crack to bond and structural performance with corroded rebar"

Diego Allaix, TNO, The Netherlands
"Data-informed and NLFEM-based assessment *of concrete structures with corroded reinforcement: challenges and perspectives for future standardisation"*

Friday 15 September

C1) Long-term behaviour of corroded concrete structures and determination of the residual service life

The *Session* deals with the extension of models for the evaluation of the present condition of structural elements or corroded structures to predict the long-term behaviour and remaining service life. Particular attention should be focused on the appropriate prediction of corrosion rate values. Verification of the models in field conditions is of high interest.

KEY-NOTE LECTURES

Sylvia Kessler, Helmut-Schmidt-University, Germany
"Reliability of corrosion detection and its effect on service life prediction"

Dan M. Frangopol, Lehigh University, Pennsylvania, USA, **Mitsuyoshi Akiyama,** Waseda University, Japan
"Life-cycle performance assessment of corroded RC structures using machine learning, experimental evidence, probabilistic analysis and finite element method"

C2) Upgrading of deteriorated structures by reactive and proactive interventions

The *Session* deals with the prolongation of the residual life by reactive and proactive interventions of repairing and strengthening. Studies presenting experiments, modelling, guidelines and application to real structures are of interest.

KEY-NOTE LECTURES

Takumi Shimomura, Nagaoka University of Technology, Japan
"Research and practice in Japan on evaluation of performance of existing concrete structures before and after intervention"

Fabio Biondini, Politecnico di Milano, Italy and **Michel Ghosn,** The City College of New York / CUNY, USA
"Effect of Climate Change on Life-Cycle Performance, Safety, Reliability, and Risk of Structures and Infrastructure Systems: A SEI/ASCE Project"

Round table on identifying the technical gaps for the structural evaluation of corroded concrete structures for future guidelines and code on short and long-term assessment of corroded structures

Since the main objective of this workshop is to move from research to daily engineering evaluation, this final Round Table aims to exchange some views and comments on the pending technical gaps for the structural evaluation of corroded concrete structures, in spite of the contributions to this workshop, in order to promote some guidelines and codes.

CHAIR: **Joost Walraven**, Em. TU Delft