International Union
of Laboratories and Experts
in Construction Materials,
Systems and Structures

2022
2023

TECHNICAL REPORT

rilem

About RILEM

The International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM, from the name in French – Réunion Internationale des Laboratoires et Experts des Matériaux, systèmes de construction et ouvrages) was founded in June 1947 in Paris, France, with the aim of promoting scientific cooperation and to stimulate new directions for research and applications, thus promoting excellence in construction worldwide.

This mission is achieved through the collaboration of leading experts in construction science and practice, including academics, researchers, industrialists, testing laboratories, and authorities.

Become a member

If you are interested in joining RILEM, please consult our website www.rilem.net to become a member.

Membership benefits are listed on the following page!

Individual fees in 2023

Young Member	€ 25	Retired Member	€ 75
Senior Member	€ 375		

Corporate fees in 2023

Institutional Member	€ 2,205	Industrial Member	€ 4,050
Associate Member	€ 1,165		

Note that special discounts of between 40% and 60% on membership fees apply depending on your country of residence:

• 40%: Algeria; Albania; Angola; Argentina; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Chile; Colombia; Croatia; Dominican Republic; Ecuador; Egypt; Estonia; Hungary; Islamic Republic of Iran; Jordan; Kazakhstan; Latvia; Lebanon; Libya; Lithuania; Macedonia; Malaysia; Mauritius; Mexico; Montenegro; People's Republic of China; Peru; Poland; Republic of Costa Rica; Romania; Russian Federation; Serbia; South Africa; Thailand; Tunisia; Turkey; Ukraine; Uruguay; Venezuela.

• 60%: Bangladesh; Burkina Faso; Cambodia; Cameroon; Congo; Cuba; Ethiopia; Federal Republic of Nigeria; Georgia; Ghana; Guatemala; India; Indonesia; Iraq; Ivory Coast; Kenya; Lesotho; Malawi; Morocco; Mozambique; Nepal; Pakistan; Paraguay; Philippines; Republic of Moldova; Senegal; Sri Lanka; Syrian Arab Republic; Togo; United Republic of Tanzania; Viet Nam; Yemen, Zimbabwe.

Membership categories

RILEM is composed of corporate members and individual members, including scientists and engineers, research and testing laboratories and companies.

Corporate Members

- **Associate Members** are smaller research, academic or building organisations or companies.
- **Institutional Members** are research and testing organisations of national renown, universities, international or national standards organisations.
- **Industrial Members** are large firms or associations in the materials of construction sectors.

Individual Members

- **A Senior Member** is an experienced scientist or professional/ practitioner, having reached a position of responsibility and recognised expertise in a public or private organisation or company concerned with testing or research in the field of building materials and structures.
- **A Young Member** (previously Student and Affiliate categories) is a post-graduate student (including PhD students) or a young research scientist or engineer who is at the early stage of his career, and who is under the age of 35 during the membership year.
- **A Retired Member** is a member who has retired.

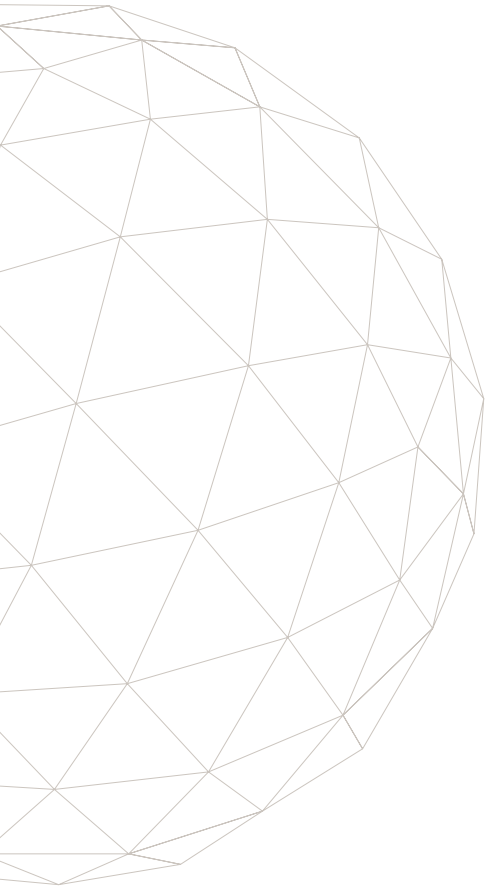
Benefits

Benefits for all members (individual and corporate members included):

- Membership in the RILEM Technical Committees, allowing *i)* to participate in the Technical Committee meetings, *ii)* to be listed as author of the Technical Committee outputs/publications and as a member on the RILEM website, and *iii)* to have the possibility to directly propose a new Technical Committee to the Secretariat General.
- **Opportunity to publish** selected articles as free Open Access papers in *Materials and Structures* and in *RILEM Technical Letters*.
- **Free subscription to the online version of *Materials and Structures* journal** hosted by Springer (access to the current issues and to archives since 1968).
- **Access to online RILEM Proceedings and Reports, and to SPRINGER proceedings,** and benefit of a 20% discount on all SPRINGER e-books.
- **Access to RILEM online Directory of Members.**
- **Reduced fees for RILEM events** (in general 10%, subject to decision of local organisers).

Corporate members additional benefits:

- **A certain number of staff members can enjoy the RILEM member benefits.** Please refer to the info reported on this page: https://www.rilem.net/membership.
- **Logo of the company displayed on RILEM presentation and RILEM Annual Report.**
- **Logo and short description of the company** displayed on the RILEM Website, with a link to the corporate member website, for a better visibility.
- New **Free advertisement of vacancies in the RILEM Newsletter BITS&BOBS.**



Editorial

by RILEM TAC Chair Enrico Sassoni

It is always with great pleasure that I write the editorial of the RILEM Technical Report, which has arrived at its 5th issue this year! The 2021-2022 report has been downloaded almost 4000 times, 500 times more than its previous edition, confirming the success and the usefulness of this document where readers learn about the activities of the RILEM Technical Committees (TCs) and of RILEM in general.

This 2022-2023 report is another edition full of publications and events by the 46 RILEM Technical Committees. In the last 12 months, 6 new TCs have been established and 8 have terminated their activities.

TAC, the Standing Committee of RILEM that recommends the approval of new TCs and coordinates the progress, completion and dissemination of the work of TCs, has recently been very busy.

During the latest meeting, TAC members agreed to highlight once again the importance that TC outputs be published by RILEM, thus in the journals *Materials and Structures* and *RILEM Technical Letters*. Publication in the RILEM journals guarantees a straightforward and transparent process that ensures that all TC members (including non-authors) are informed about new papers and can comment on them before publication, so that the final article can indeed be called a “TC publication” and addressed as a collective work. For this reason, TAC members decided to remind TC Chairs, Deputy Chairs and TC members about the importance of publication in RILEM journals, which is not a new rule but an existing policy that in the past was sometimes overlooked. In case a TC decides to publish a paper in another journal, then RILEM and/or the TC name cannot be mentioned in the title nor in the paper, as the involvement of all TC members cannot be ensured. These papers will not be considered as TC outputs and thus will not be advertised by RILEM.

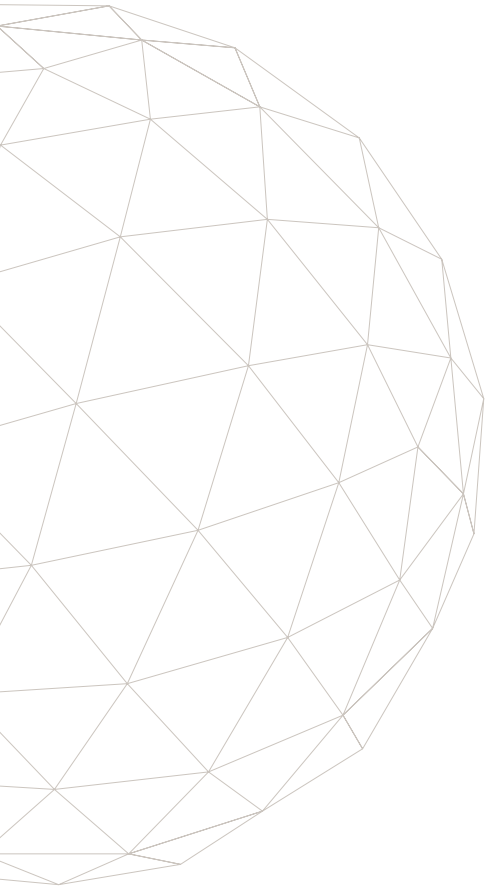
To summarize and facilitate the process of submission of TC outputs to *Materials and Structures* and *RILEM Technical Letters*, TAC has recently approved revised guidelines, with the aim of providing a checklist to be followed by the TC Chairs for submission of TC papers; on this regard, please, see page 15 of this report.

Something new decided by TAC was the addition of the TC Deputy Chairs as members of the Editorial Advisory Committee of *Materials and Structures* during the lifespan of the TC. TC Chairs are already members of this Committee.

The topical collections launched by *Materials and Structures*, collecting the papers published by a particular TC, have reached six in number. This recently introduced way of presenting the output of the work of a TC has been welcomed and enjoyed by TC members. You can read more about this in the following pages of this report, in the chapter “Publications”.

As always, RILEM highlights and supports the activities of its young members. This Technical Report will put the spotlight on the activities of the RILEM Youth Council to promote strategic research topics and the participation of young members in the activities of a RILEM TC. You will furthermore learn about the recently created “RILEM Young Scientists - Corrosion group”.

Last but not least, a sincere acknowledgement goes to ALL TC members. TCs are the heart of RILEM. Without the work of these TC members, there would not be any publication, any event, any Technical Report. TC members are academics and professionals from around the world that contribute to the advancement of science and its diffusion, on a voluntary basis. To all of them, THANK YOU!



Contents

An overview of the 2023 RILEM Spring Convention & the 4th International Congress on Materials & Structural Stability (CMSS23)

5-10 March 2023, Rabat, Morocco

The 2023 RILEM Spring Convention & 4th International Congress on Materials & Structural Stability (CMSS23) officially started on Sunday 5th March, at the Faculty of Science of the University Mohammed V in Rabat, Morocco, with the first of many Standing Committee meetings, the EAC.

Standing Committee EAC

The discussion focused on the review of the ROC&TOK webinars, i.e. the performance of the past events and the schedule of upcoming ones, and the assessment of the past and future RILEM Youth Council (RYC) activities.

Some moments of the EAC meeting on Sunday 5th March. Images courtesy of D. Ciancio.

The agenda of **Monday 6 March** was busier than Sunday, with the meetings of the Standing Committees DAC and TAC, and those of the RILEM Technical Committees PHC : Performance testing of hydraulic cements (kick-off meeting), 282-CCL : Calcined Clays as Supplementary Cementitious Materials , and 303-PFC : Performance requirements and testing of fresh printable cement-based materials

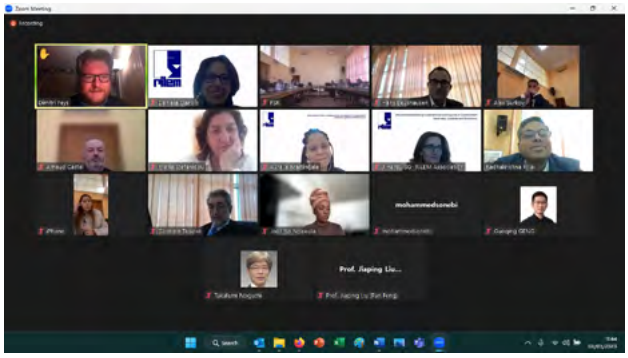
Standing Committee DAC

The membership of some DAC members is coming to an end:

- Dr Hiroyuki Miyauchi, DAC Expert, will be replaced by Prof. Paulina Faria.
- Prof. Eduardo M.R. Fairbairn, Brazil National Convener, will be replaced by Prof. Romildo D. Toledo Filho.

RILEM would like to thank Dr Miyauchi and Prof. Fairbairn for their commitment and dedication within RILEM. Other replacements will be discussed at the 77th RILEM Annual Week.

Other items that were examined were the RYC initiatives, and some financial and internal management matters. Two RYC members, Dr Rouba JOUMBLAT, RYC representative for the Middle East and North Africa, and Alexandr SURKOV, RYC representative for East Europe and Central Asia, attended the DAC meeting for the first time, together with Joanitta NDAWULA, RYC Chair. On this matter, stay tuned as DAC approved the proposal to launch a RYC symposium!

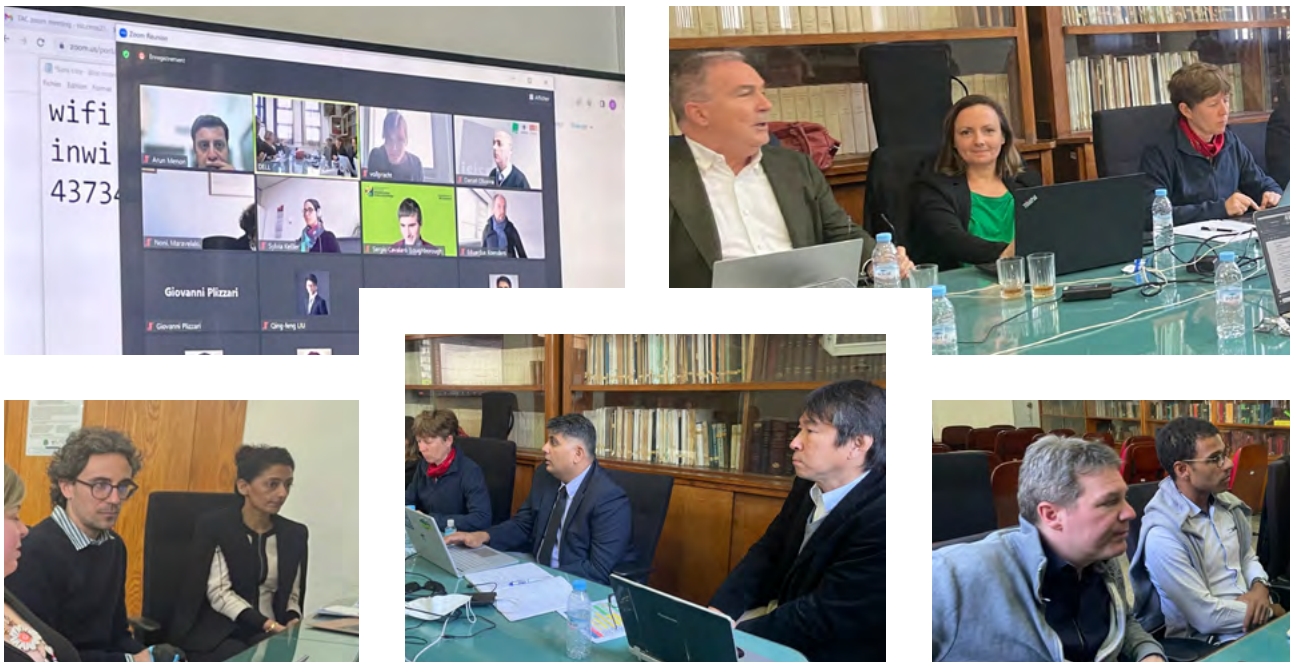


Some moments of the DAC meeting on Monday 6 March. The meeting was held in hybrid mode. Images courtesy of D. Ciancio

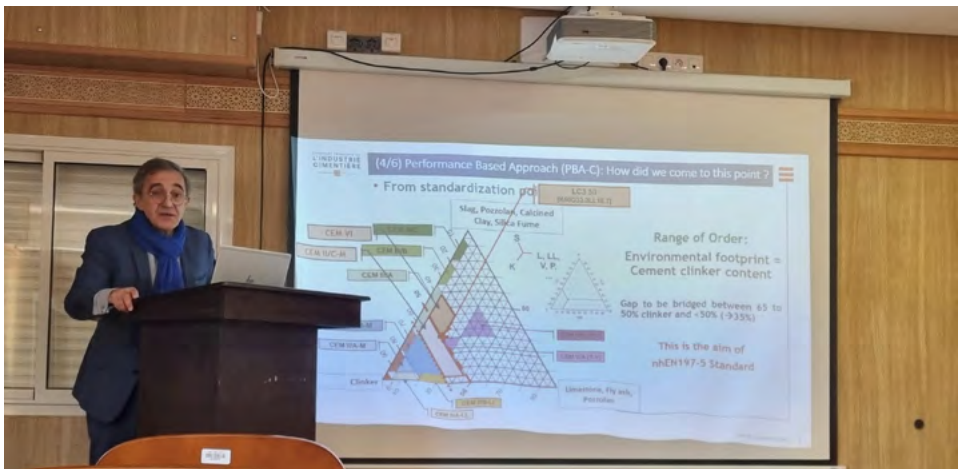
Standing Committee TAC

Some TCs were closed as they terminated their activities and others were assigned a number. Two new RILEM TC proposals were approved:

- TC RCC : Rolled compacted concrete for pavement applications, chaired by Christian Paglia, Cluster C
- TC ACP : Active Control of Properties of Fresh and Hardening Cementitious Materials, chaired by Geert De Schutter, Cluster A.



Some moments of the TAC meeting on Monday 6 March. The meeting was held in hybrid mode. Images courtesy of D. Ciancio.



Laurent Izoret Deputy-Chair of the TC PHC during the Kick off meeting of this TC. Images courtesy of W. Schmidt.

Tuesday 7 March was another busy day with the Development meeting, Bureau meeting, and the meeting of the following TCs: 304-ADC : Assessment of Additively Manufactured Concrete Materials and Structures, MAE : Mechanical performance and durability assessment of earthen elements and structures, 305-PCC : Pumping of concrete, and BEC : Bio-stabilised earth-based construction: performance-approach for better resilience.

RILEM Bureau meeting

Probably the main item in the agenda was the election by RILEM subscribing members of the recommending committee members, who will have the role of selecting the candidates for the next RILEM Vice President to be elected by the members of the RILEM General Council during the 2024 RILEM Annual Week. Prof. Liberato Ferrara presented some details of the 2024 RILEM Spring Convention, which will take place in Milan, Italy. Also, Dr Alexandra Bertron described the preliminary program and details of the 78th RILEM Annual Week,

in Toulouse, France, in 2024. Dr Salman Soleimani-Dashtaki gave feedback on the ongoing organization of next RILEM Week, in Vancouver, in September 2023.

Finally, on **Wednesday 8 March,** the 4th International Congress on Materials & Structural Stability (CMSS23) kicked off. The numbers of CMSS23 are the following: 12 plenary lectures (30 min), 20 key-note lectures (15 min), 540 delegates from 52 countries, 370 of them attending in person and 170 online), 453 accepted abstracts, 150 oral communications and 140 displayed posters. In the morning, the official opening was chaired by Prof. Abdeljebbar Diouri, conference Chair.

Opening of CMSS23 on Wed 8 March 2023. From the left: Prof. Abdeljebbar Diouri (Conference Chair, ASMATEC President), Prof. Mohammed Regragui (Dean of the Faculty of Science of Rabat), Prof. Farid El Bacha (President of the Mohammed V University in Rabat), Prof. Hassan Mahmoudi (Director of the Mohammadia School of Engineers, Rabat), Prof. Mohammed Sonebi (Scientific Committee Chair), Dr Nicolas Roussel (RILEM President). Image courtesy of CMSS23.

Delegates of CMSS23 in the Belmahi Amphitheatre, at the Faculty of Sciences of the Mohammed V University, Rabat, Morocco. Image courtesy of CMSS23.

The morning proceeded with two plenary lecturers by Prof. Karen Scrivener on “Strategy to reduce CO_2 emissions from concrete fast and at scale” and Prof. Nele De Belie on “Understanding the carbonation of concrete with supplementary cementitious materials”,

followed by the lectures of the 2023 RILEM Colonnetti medallists: Dr Franco Zunino presenting "Physical chemistry of building materials - Ultra-Green concrete project" and Prof. Guoqing Geng presenting "How does new experimental method benefit our cement & concrete study".

Prof. Enrico Sassoni, RILEM TAC Chair (in both pictures) presenting Dr Franco Zunino (picture on the left) and Prof. Guoqing Geng (picture on the right) the RILEM Colonnetti medals and certificates. Image courtesy of CMSS23.

In the afternoon, the conference sessions continued at the Mohammadia School of Engineers, while simultaneously two more TCs held their meetings: PEM: Processing of earth-based materials and DCS: Data-driven concrete science. SCMM23 offered many more plenary, keynote and oral presentations until **Friday 10 March.** A detailed schedule of all the lectures is available here and the online abstract proceedings here.

Two workshops were also offered to the young delegates of the conference:

1. RILEM PhD and Post-doc workshop on 3D printing with concrete, chaired by Dr Nicolas Roussel and Prof. Rob Wolfs.
2. Springer workshop on publishing scientific research, chaired by Natalie Jacobs, Executive Editor at Springer.

The participants of the RILEM PhD and Post-doc workshop on 3D printing with concrete, chaired by Dr Nicolas Roussel, RILEM President, and Prof. Rob Wolfs. Image courtesy of I. Mai.

The gala dinner was offered at the palace Kabbaj, a majestic palace with the splendour of a royal mansion. The delegates were entertained by some musicians playing local traditional music and enjoyed some delicious Moroccan cuisine.

On the left: the RILEM Presidency together with the members of the CSMM23 organising committee; On the right, the venue of the CSMM23 gala dinner and the musicians in the background. Images courtesy of D. Ciancio.

This RILEM Spring convention was also the opportunity to present Prof. Konstantin Kovler the certificate of RILEM Honorary member and Dr Wolfram Schmidt the one of RILEM Fellow.

On the left: Dr Nicolas Roussel, RILEM President, presenting Prof. Konstantin Kovler the certificate of RILEM Honorary member; on the right, Prof. Hans Beushausen, DAC Chair, presenting Dr Wolfram Schmidt the certificate of RILEM Fellow. Images courtesy of D. Ciancio.

On **Saturday 11 March**, the delegates enjoyed a cultural excursion that took them through Volubilis up to Fes.

Delegates of CSMM23 enjoying the cultural visit on Saturday 11 March of Chellah, the oldest human settlement in Rabat. Image courtesy of CSMM23.

The next RILEM event will be the 77th Annual Week which will take place in Vancouver, Canada, from 4 to 8 September 2023. See you then, “inshallah”!

RILEM Young Scientists - Corrosion group

RILEM Young Scientists - Corrosion

Recently, the RILEM Young Scientists – Corrosion group has been established, to promote the networking of young scientists in the field of corrosion, as well as the active participation of young members in RILEM.

RILEM is very supportive of letting PhD students and young researchers join its Technical Committees. As students and young researchers are the target user group of many of the recommendations and reports, they can play an important role within the committees. They often have a clear idea of what information is currently missing in existing literature, information they need to conduct their research. Attracting young RILEM members and motivating them to actively join in TC work is challenging, however. As a beginning researcher, it can be a big step to join a community with experts that sometimes have been working in the field for decades. Often, they join a committee to 'gain experience', not realising the active role they can, and are supposed to, play. To promote the participation of young members in RILEM activities, RILEM created the RILEM Youth Council (RYC). Its main tasks include attracting young RILEM members and involving them in the RILEM community, e.g., by participation in TAC and EAC activities, and to create networks between emerging researchers.

Within this framework, recently RILEM has endorsed a proposition for a trial of a new format for a permanent young scientists group, that has the ability to create a young community, can promote and motivate active participation in the RILEM community and increase the visibility of RILEM for emerging researchers: the RILEM Young Scientists - Corrosion group.

The group bases its foundation in an existing young scientist network, formed in the currently active 296-ECS: Assessment of electrochemical methods to study corrosion of steel in concrete to encourage the participation of the PhD students in the activities of this TC. This group has met (online) after each main TC meeting, to discuss debate points that came up during the main meeting

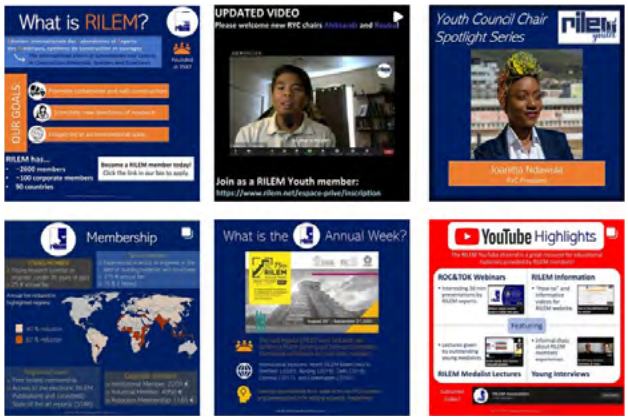
and to collect feedback that was supplied back to the TC. The open and low-pressure environment encouraged the young members to freely share their opinion and motivated members to actively participate in the TC work, such as in the writing of chapters for the recommendations. Additionally, these meetings created a community of young researchers in the field of corrosion of steel in reinforced concrete, that were eager to share their research and knowledge. This community has steadily grown to now include around 15 actively participating members, of which more than one third are at universities outside of Europe, in South America, Asia and Africa.

The main aim of the "RILEM young scientist – corrosion group" is to build a young community in the field of corrosion of materials in construction, where members are able to exchange and obtain knowledge, to the benefit of their research and personal development. To create this community, the "RILEM young scientist corrosion group" has the following objectives:

- Share experience, both theoretical and practical (through share your research events)
- Learn from experts in the field (through workshops and seminars)
- Promote networking of its members with peer-to-peer activities
- Promote networking of its members with experts thanks to educational activities
- Motivate members to participate in TAC activities
- Raise awareness of RILEM events
- Attract young scientists in the field to the young community and RILEM.

The group regularly organises free online peer-to-peer and educational events. To become officially a member of this group, sign up with this google form. The group uses this page to show its activities, to promote upcoming events & attract new members to the group.

RILEM Youth Council activities



Since its establishment by the very end of 2020, the RILEM Youth Council has been extremely busy and active!

The group has successfully organised a series of webinars, called "Peer-to-peer", held once every two months, and hosted in turn by one of the Council members.

The speakers of the Peer-to-peer webinars are researchers in the early stage of their careers. The webinar series is intended to offer a platform for knowledge exchange and collaboration between young RILEM members and other emerging researchers.

Since May 2022, these have been the events:

Regional area hosting the event	Subject	Date
South Asia	Sustainability Through Durability	May-22
Pacific	3D Printing and Nanotechnology for Sustainable Construction	Jul-22
Europe	Non-conventional materials for sustainable con-structions, a focus on earth and bio-based solutions	Sep-22
Sub-Saharan Africa	Locally available alternative materials for sustaina-ble construction	Nov-22
Pacific	Carbonation of Concrete: Opportunities for Net Zero CO_2 by 2050 and Research Needs	Jan-23
Latin America	Development of sustainable building materials in Latin America	Mar-23
Middle East and North Africa	Revolutionizing Infrastructure and Materials: A Webinar on Highways, Active Travel, and Natural Fiber-Reinforced Cement Paste	May-23
East Asia	Past, present, and future of cement-based materials: from the strength origin of cement hydrate to the mechanical behaviors of advanced concrete structures incorporating hybrid nanomaterials	Jul-23

There are generally two speakers who have a time slot of 20 min each to present their research, and a slot of 10 min each to answer the questions from the audience. The webinars, the videos of which are all available for free on the RILEM YouTube channel, have given the opportunity to present specific research topics with an emphasis on the issues and features of the regional area hosting the event. More than this, the webinars have also been an opportunity to establish new collaborations or enforce existing ones with other institutions, like the Concrete Institute of Australia (CIA) and the American Society of Civil engineers (ASCE) Student Chapter at Beirut Arab University.

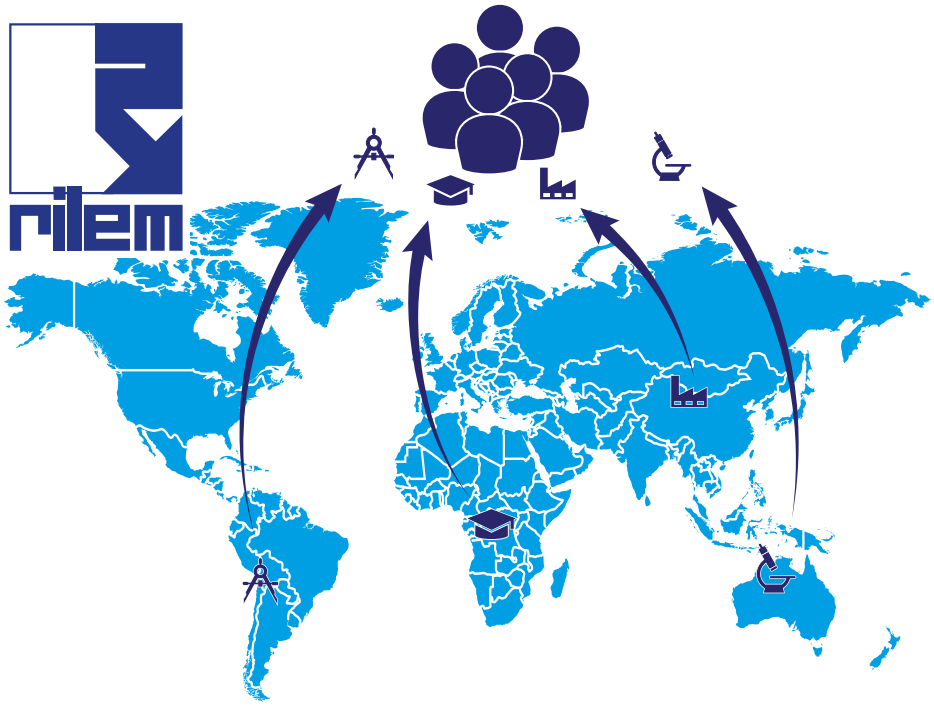
A brand-new 2023 initiative is the series "RILEM Youth Council Pacific Webinar". This series of webinars is framed with 4 speakers, presenting for 15 min each, and a Q&A session of 20 min after the 4 presentations. The first event took place in April with the subject "Viability of LC3 in Australia, recent innovations in geopolymers and ultra high performance concrete.

The Council is currently looking at implementing activities to strengthen the collaboration with other young groups around the world, like the recently established Institute of Concrete Technology (ICT) Students and Young Professionals Network (SnYPN), and the young members of the American Concrete Institute (ACI).

This never-sleeping group of active young minds is also preparing some new initiatives, so please stay tuned!

Do you want to know more about the members of the Council? Check out this video here! On this Instagram page you can read more about the activities of the Council and you can find out how to join a RILEM TC and be part of the network of RILEM. Any questions? Feel free to contact the RYC representative of the regional area where you reside to ask any question!

Technical Committees (TCs): the heart of RILEM



A Technical Committee is a group of international experts around the world working together in a particular field.

WHAT IS A RILEM TC?

A group of international experts working together in a particular field in order to:

- Assemble and evaluate research data.
- Harmonise testing methods.
- Suggest new topics for research (also research not to be directly undertaken by RILEM TCs).
- Promote their conclusions.

Each RILEM TC is of utmost importance to the organisation, since the building of scientific and technical expertise, and dissemination of recent results and development, form the core of RILEM's mission.

HOW IS A RILEM TC CREATED?

An application is filled and signed by the proposed TC Chair, who has to be a RILEM Individual Member. This form is sent to the RILEM General Secretariat that forwards it to the members of the RILEM Technical Activities Committee (TAC) for comments and discussion. If needed, a revised proposal might be drafted by the proposed TC Chair to fulfil the TAC recommendations.

After recommendation by TAC and approval by the RILEM Bureau/

General Council, which verifies that the terms of reference of the proposed TC fit into the technical programme of RILEM, the TC is officially created. Although a TC proposal can be received any time of the year, the final discussion and approval happens twice a year, usually in March (RILEM Spring Convention) and September (RILEM Annual Week), when TAC meetings are held.

ROLE OF RILEM CLUSTERS

Each RILEM TC is in direct connection with a RILEM Cluster that has the role of co-ordinating and monitoring the activities of its TCs and advising TAC. Each Cluster is chaired by a Cluster convener. The 6 fields of activities currently treated by active RILEM TCs are:

- Cluster A. Material Processing and Characterization (Convener: Daman Panesar)
- Cluster B. Transport and Deterioration Mechanisms (Convener: Josée Duchesne)
- Cluster C. Structural Performance and Design (Convener: Giovanni Plizzari)
- Cluster D. Service Life and Environmental Impact Assessment (Convener: Anya Vollpracht)
- Cluster E. Masonry, Timber and Cultural Heritage (Convener: Arun Menon)
- Cluster F. Bituminous Materials and Polymers (Convener: Eshan Dave)

LIFESPAN OF A TC

The TC duration is usually limited to 5 years. Under certain circumstances, the lifespan of a TC might be stretched but it cannot be any longer than 7 years.

CAN I JOIN A TC?

Yes! Anyone is welcome to join a RILEM TC. RILEM values the contribution of everyone, no matter if you are a young PhD student, an experienced researcher, or an industry practitioner. You do not need to be a fee-paying member, as you can join a RILEM TC as a free registered user. Please note that, in this latter circumstance, certain limitations apply for the authorship of the TC outputs.

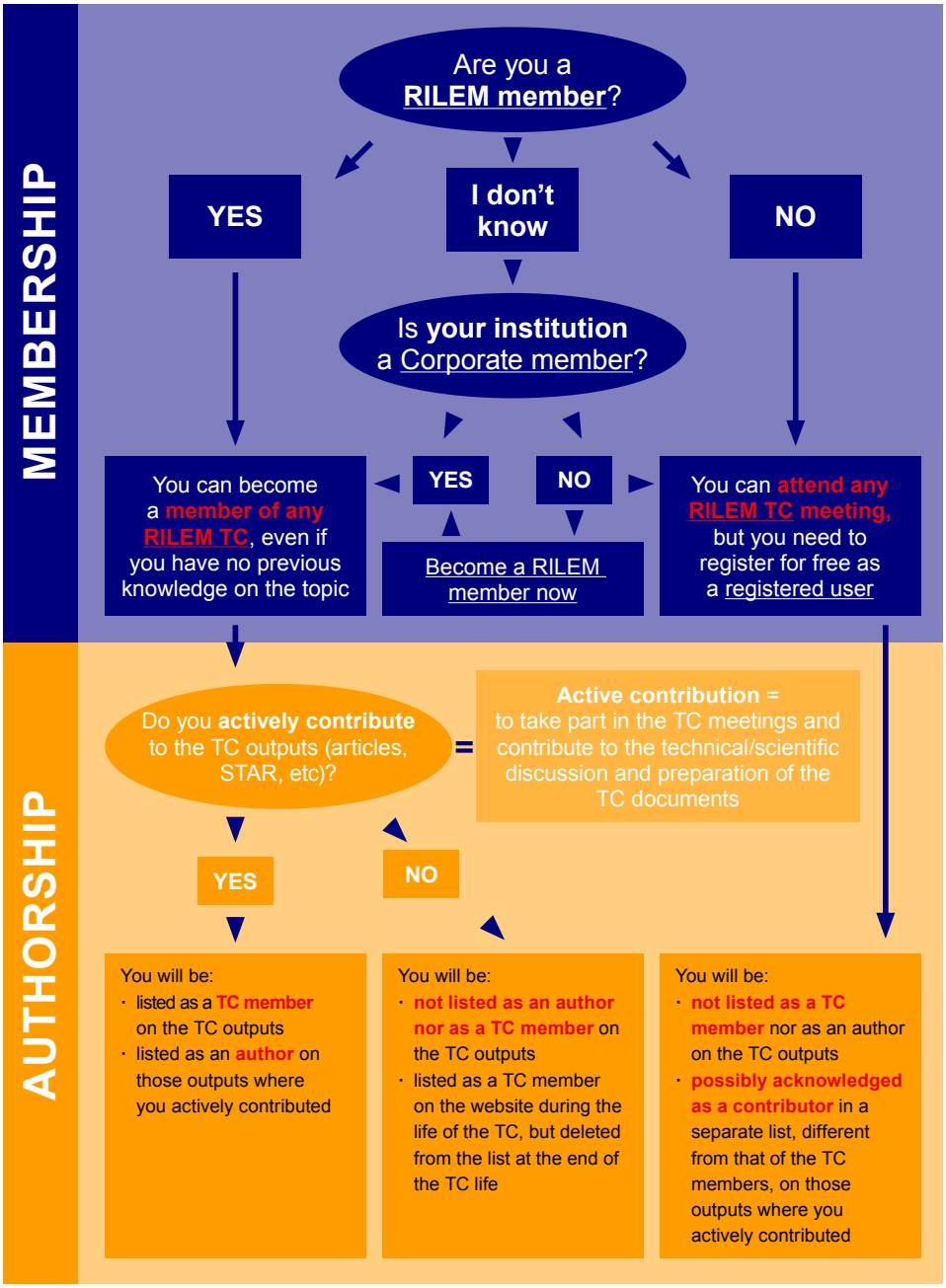
Membership & authorship

1. If you are a RILEM subscribing member who actively contributes to the TC activities and outputs (articles, TC reports, STARs, etc), you are listed as a TC member and as author of the TC publications.

2. If you are not a RILEM subscribing member, you need to become a registered user by clicking on “CREATE YOUR FREE ACCOUNT” here. This step does not involve any cost/payment.

As a registered user, you are welcome to join the TC meetings, to receive the produced documentations[1], and to be part of the activities of the TC. However, you will not be listed as a TC member nor as an author of any TC output. You could possibly be acknowledged as a contributor in a separate list for those outputs where you actively contributed.

The membership fee gives access to many benefits, amongst which the rights to TC membership and authorship. It is not an "entrance fee" for being allowed to contribute to the TC work.



Scheme of TC membership and TC publications authorship.

1. Confidentiality Clause: None of the working documents of the TC should be circulated, duplicated, or copied by any means, or published on any web page, journal, proceedings of conferences, etc. Any TC member and participant is bounded by this mandatory rule. Any publication of RILEM TC working documents is subjected to the rules defined by RILEM. Until official publication by RILEM, such working documents should remain confidential.

Background and age

TC chairs should be inclusive and not refuse any request from anyone (RILEM members and not) wishing to become part of their TC; this also applies when the TC has been running for a few years (unless it is about to close), or if the person interested in joining is considered to have no background on the topic. This spirit aims to encourage as many minds as possible to engage in new topics and contribute to the research. RILEM would like to remind that young researchers, like PhD students, are strongly encouraged to join a TC.

HOW CAN I JOIN A RILEM TC?

You can submit the registration form available on the RILEM website.

REWARDS FOR TC MEMBERS AND PARTICIPANTS

Joining a RILEM TC offers many valuable rewards. For young researchers, belonging to a TC means being in touch with the most knowledgeable experts of the areas of research covered by the TC and therefore working in a nourishing and stimulating environment. It also means creating an important network of contacts that can only be advantageous for their career. For senior members, the TC is also an opportunity to work with the best scientists in their field of expertise, to mentor younger people, to put their experience and knowledge at the service of a wider community and to share expertise for the benefit of the society.

OTHER BENEFITS WHEN JOINING A TC

Beside the above-mentioned benefits, joining a RILEM TC also means:

1. For RILEM subscribing members:
    - Access to agendas and minutes of the TC. Those can be accessed through the private directory if uploaded by the TC Chair and/or Deputy-Chair.
    - Access to any other document produced by the RILEM Technical Committee.
    - Access to the Directory of Members.
2. For non-RILEM members:
    - Access to the documents produced by the RILEM Technical Committee, if sent by email.

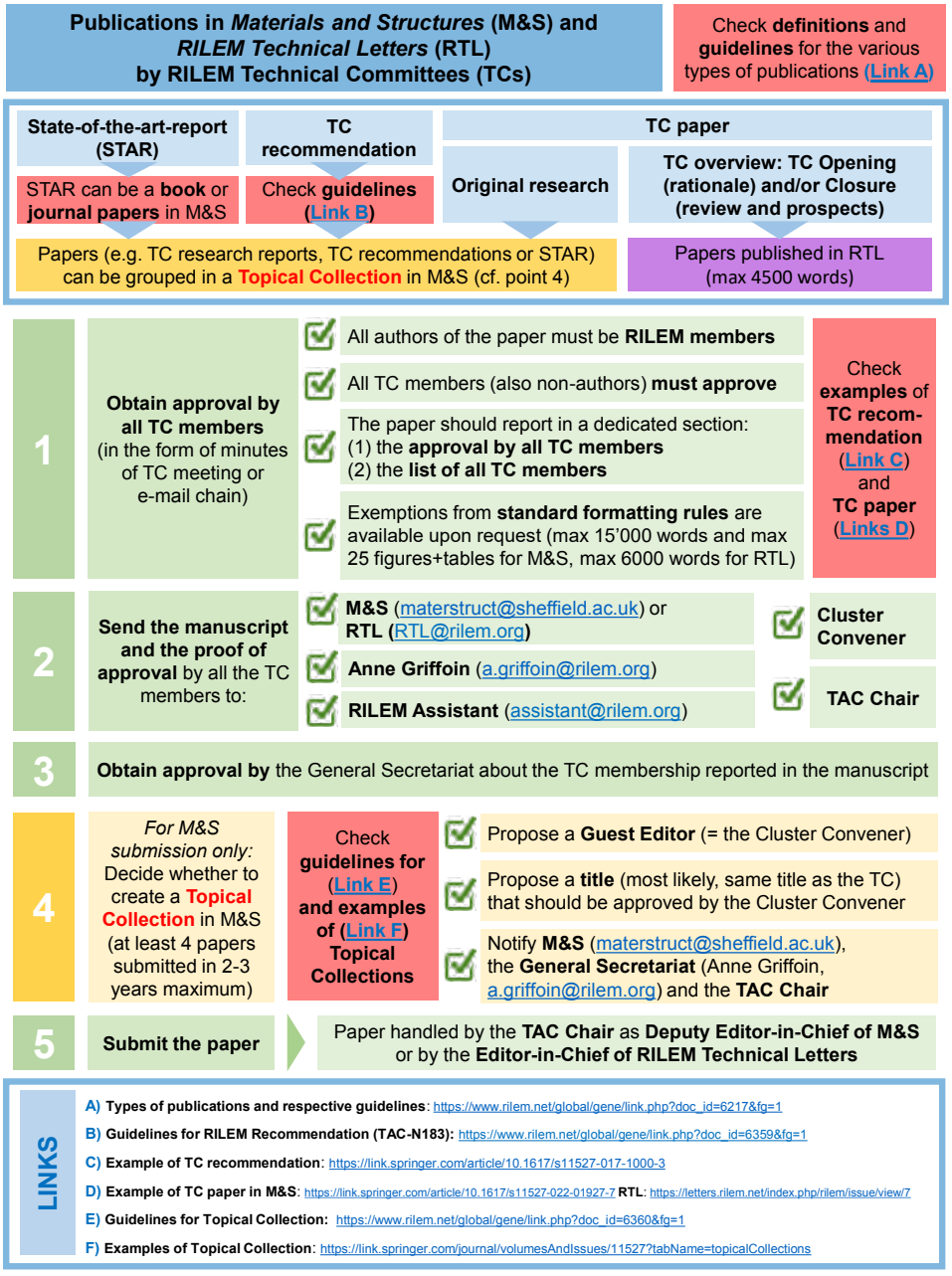
EXPECTED ACHIEVEMENTS (DELIVERABLES) OF A TC

Each TC might produce at the end of its lifespan one or some of the following:

- A state-of-the-art report (STAR).
- One or more recommendations for test methods or construction practice.

▸ Conference or workshop proceedings, if organised by the TC.
▸ Technical reports and other educational material.
For more details, see chapter “RILEM Publications” in the following pages on this report.

TC outputs are the result of the collective effort of the TC members. To make sure that the publication reflects the view of the TC, the approval from all TC members must be obtained. This and other regulations are explained in the scheme “Guidelines for submission of TC papers".

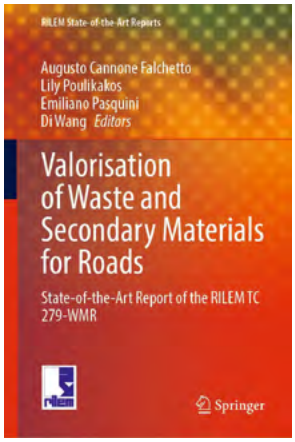


Guidelines for submission of TC papers.

RILEM PUBLICATIONS

RILEM Publications showcased at the 76th RILEM Annual Week and International Conference on Regeneration and Conservation of Structures (ICRCS 2022), in Kyoto, Japan, in 2022. Image courtesy of D. Ciancio.

The mission of RILEM is "to advance scientific knowledge related to construction materials, systems and structures and to encourage transfer and application of this knowledge worldwide". This mission is achieved through the outstanding work of the RILEM Technical Committees and the dissemination of their outcomes in the form of RILEM publications.



Cover of STAR of RILEM TC 279-WMR. Courtesy of Springer.

State-of-the-Art reports (STAR)

These reports constitute a critical appraisal of current knowledge on a specific research subject. They often identify gaps in knowledge, thereby contributing to the development of strategies and scenarios for future research. Since 2009, RILEM State-of-the-Art reports are published by Springer and they are indexed by SCOPUS, Google Scholar and SpringerLink.

Anyone can download for free from the RILEM web page the unedited version of each RILEM STAR, as PDF «unedited version»

Recently, RILEM has initiated the series of STARs in a Nutshell. These documents should not be considered as a summary of the exhaustive work of the RILEM Technical Committees, but more like a brief overview of the contents available in the STAR. The purposes of these "STARs in a Nutshell" are: 1) to provide some initial guidance to a non-expert reader, 2) to inspire more comprehensive reading of the STAR and 3) to clarify the relevance of the contents before downloading or purchasing the full document for further details.

Recommendations

Over 200 RILEM Technical Recommendations have been produced by the RILEM Technical Committees. Many of these recommendations have been adopted in research and practice, and are used by international standardisation bodies, as a basis for their work. In the last few years, RILEM recommendations have been published in the form of journal papers in *Materials and Structures*. They are free to be downloaded for all.

RILEM TC Recommendation | Open Access | Published: 26 May 2023

Recommendation of RILEM TC 271-ASC: New accelerated test procedure for the assessment of resistance of natural stone and fired-clay brick units against salt crystallization

B. Lubelli, I. Rörig-Dalgard, A. M. Aguilar, M. Aškrabić, K. Beck, C. Bläuer, V. Cnudde, A. M. D'Altri, H. Derluyn, J. Desarnaud, T. Diaz Gonçalves, R. Flatt, E. Franzoni, S. Godts, D. Gulotta, R. van Hees, I. Ioannou, A. Kamat, T. De Kock, B. Menendez, S. de Miranda, C. Nunes, E. Sassoni, N. Shahidzadeh, H. Siedel, Z. Slížková, M. Stefanidou, M. Theodoridou, R. Veiga & V. Vergès-Belmin

Show fewer authors

Materials and Structures 56, Article number: 101 (2023) | Cite this article

Recommendation of RILEM TC 271-ASC. Courtesy of Springer.

Proceedings

RILEM has been organising symposia and workshops since its foundation, with more than 100 proceedings published by RILEM Publications S.A.R.L. A quick glance at the RILEM website shows the diversity, importance and international scope of the topics.

All proceedings published by RILEM Publications S.A.R.L. can be downloaded for free (even by non-RILEM members) from the RILEM website. Non-RILEM members need to create a "registered user" account (free of charge).

The proceedings that are not published by RILEM Publications S.A.R.L. are published by Springer and they can be purchased online. There are currently 45 volumes in this RILEM Bookseries, available here. They are also available for RILEM members through their profile.

Cover page of 4 Springer Proceedings released in 2023. Courtesy of Springer.

Cover page of RILEM flagship publication "*Materials and Structures* / Matériaux et Constructions" (MAAS). Courtesy of Springer.

Materials and Structures

Materials and Structures, the flagship publication of RILEM, provides a unique international and interdisciplinary forum for new research findings on the performance of construction materials.

A leader in cutting-edge research, the journal is dedicated to the publication of high-quality, original papers examining the fundamental properties of building materials, their characterization and processing techniques, modeling, standardization of test methods, and the application of research results in building and civil engineering. *Materials and Structures* also publishes comprehensive reports and recommendations prepared by the RILEM's Technical Committees. This journal publishes the articles of the RILEM L'Hermite Medallists. RILEM members enjoy a free subscription to the online version of *Materials and Structures* hosted by Springer (access through private profile to the current issues and to archives since 1968).

Topical collections in *Materials and Structures*

Recently, TC members have been given the choice of publishing the outcomes of their TC in the form of a minimum of 4 papers grouped in a Topical Collection. The papers must be submitted in a short time frame of 2-3 years maximum. *Materials and Structures* presents at the moment 6 Topical Collections for the following TCs:

- RILEM TC 258-AAA, Recommendations for Avoiding Alkali Aggregate Reactions in Concrete – Performance Based Concept (7 articles)
- RILEM TC 265-TDK, development and assessment of a RILEM Recommendation: Testing methods for determination of the double-K criterion for crack propagation in concrete (4 articles)
- RILEM TC 281-CCC, Carbonation of concrete with supplementary cementitious materials (4 articles)
- RILEM TC 282-CCL, Calcined Clays as Supplementary Cementitious Materials (7 articles)
- RILEM TC 266-MRP, Round-Robin Rheological Tests on high performance mortar and concrete with adapted rheology (Bethune, France, 2018) (2 articles)
- RILEM TC 267-TRM, Development and Validation of Tests for Measuring the Reactivity of Supplementary Cementitious Materials (3 articles).

Logo of *RILEM Technical Letters*. Courtesy of RILEM Publications S.A.R.L.

RILEM Technical Letters

RILEM Technical Letters Journal was launched in March 2016 as a sister journal of RILEM's flagship, the 50-year old *Materials & Structures* journal, published by Springer/Nature. *RILEM Technical Letters journal* is published as a Diamond Open Access journal available online free of charge. The articles are submitted on invitation by the Editorial Board but the journal has recently also

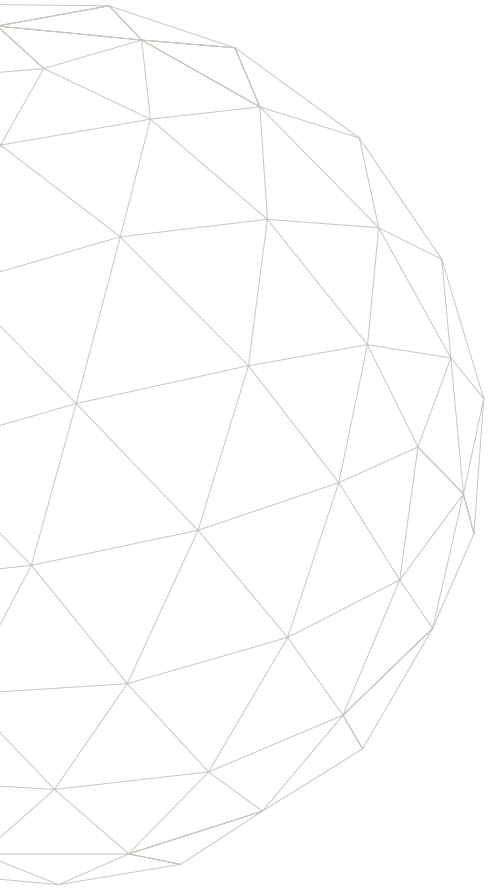
opened the possibility of submitting spontaneous contributions. Many articles are technical reports of the activities of the RILEM TCs. *RILEM Technical Letters* is indexed in Scopus and in the Directory of Open Access Journals. This journal publishes the articles of the RILEM Colonnetti Medallists. It has recently featured some special regional papers, describing and detailing the state of the art of a topic in a certain geographical area. So far, the following papers have been published:

1. Schmidt, W.; Otieno, M.; Olonade, K. .; Radebe, N.; Van-Damme, H.; Tunji-Olayeni, P.; Kenai, S.; Tetteh Tawiah, A.; Manful, K.; Akinwale, A.; Mbugua, R.; Rogge, A. Innovation Potentials for Construction Materials With Specific Focus on the Challenges in Africa. *RILEM Tech Lett* **2020**, 5, 63-74.

2. Villagrán-Zaccardi, Y.; Pareja, R.; Rojas, L.; Irassar, E. F.; Torres-Acosta, A.; Tobón, J.; John, V. M. Overview of Cement and Concrete Production in Latin America and the Caribbean With a Focus on the Goals of Reaching Carbon Neutrality. *RILEM Tech Lett* **2022**, 7, 30-46.

3. Sonebi, M.; Abdalqader, A.; Amziane, S.; Dvorkin, L.; Ghorbel, E.; Kenai, S.; Khatib, J.; Lushnikova, N.; Perrot, A. Trends and Opportunities of Using Local Sustainable Building Materials in the Middle East and North Africa Region. *RILEM Tech Lett* **2022**, 7, 127-138.

4. Scrivener, K.; Ben Haha, M.; Juilland, P.; Levy, C. Research Needs for Cementitious Building Materials With Focus on Europe. *RILEM Tech Lett* **2023**, 7.



Cluster A

Material Processing and Characterization

Foreword

► **from Cluster A Convener,**

Daman K. PANESAR

There are currently thirteen RILEM Technical Committees that fall in Cluster A: *Material Processing and Characterization*. The Technical Committees in Cluster A advance knowledge and applications in the fields of emerging material processing technologies, characterization of composites, cement-based materials, aggregates, polymers and expansive agents. In the last 12 months, TC 266-MRP Measuring Rheological Properties of Cement-based Materials completed its activities while three new TCs were established: ACP Active Control of Properties of Fresh and Hardening Cementitious Materials, MBC Magnesia-based Binders in Concrete, and PHC Performance Testing of Hydraulic Cements.

The specific focus areas of the technical committees in Cluster A include: hydrothermal behaviour of bio-aggregate building materials as well as durability behaviour of bio-aggregate based composites (TC 275-HBD); properties of calcined clay (TC 282-CCL); reactive MgO-based expansive agents to reduce the risk of crack formation (TC 284-CEC); use of agro-based materials as cementitious additions in concrete and cement-based materials (TC 291-AMC); assessment of electrical materials to study corrosion of steel in concrete (TC 296-ECS); carbon based nanomaterials for multifunctional cementitious matrices (TC 302-CNC); performance requirements and testing of fresh printable cement-based materials (TC 303-PFC); assessment of additively manufactured concrete materials and structures (TC 304-ADC); pumping of concrete (TC 305-PCC); mineral carbonation of construction materials (TC MBP); investigation of active control of properties of fresh and hardening cementitious materials (TC APC); assessment of magnesia-based binders in concrete (TC MBC); and performance testing of hydraulics cements (TC PHC).

Each TC has an average of 65 members, but some TCs have up to 170 members! The leadership and membership of these committees reflects an international representation. Meetings, workshops, and doctoral courses organized by the Technical Committees have been held around the world online, in person and in hybrid mode, and have enabled engagement, knowledge transfer, and networking opportunities for design engineers, industry professionals, research scientists, students and is also a starting point to attract new RILEM members.

Research outcomes are disseminated to the broader community through the publication of: state-of-the-art reports (STAR), RILEM recommendations, topical collections in *Materials and Structures* journal, results of round-robin tests, proceedings from international RILEM conferences, RILEM PhD course materials, and dissemination in journals including *RILEM Technical Letters* and others. Outcomes of the Technical Committee work is also used by standardization bodies to facilitate the development of codes and standards in the field of material processing and characterization.

I have had the honour to serve on the RILEM Technical Activities Committee (TAC) since 2018 and have been the Convenor of Cluster A since 2019, previously held by Professor Barzin Mobasher.

Current TCs in Cluster A

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
ACP Active Control of Properties of Fresh and Hardening Cementitious Materials	Geert DE SCHUTTER Jay SANJAYAN	**NEW** Spring 2023
MBC Magnesia-based binders in concrete	Paivo KINNUNEN Ellina BERNARD	**NEW** Fall 2022
PHC Performance testing of hydraulic cements	Karen SCRIVENER Laurent IZORET	**NEW** Fall 2022
275-HDB Hygrothermal behaviour and Durability of Bio-aggregate based building materials	Sofiane AMZIANE Florence COLLET	2016
282-CCL Calcined Clays as Supplementary Cementitious Materials	José Fernando MARTIRENA-HERNANDEZ Manu SANTHANAM	2018
284-CEC Controlled expansion of concrete by adding MgO-based expansive agents taking the combined influence of composition and size of concrete elements into consideration	Jiaping LIU Ole Mejlhede JENSEN	2018
291-AMC Use of Agro-Based Materials as Cementitious Additions in Concrete and Cement-Based Materials	Said KENAI Mike B. OTIENO	2018
296-ECS Assessment of electrochemical methods to study corrosion of steel in concrete	Sylvia KESSLER Ueli ANGST	2020
302-CNC Carbon-based nanomaterials for multifunctional cementitious matrices	Florence SANCHEZ Marco Lieb-scher	2021
303-PFC Performance requirements and testing of fresh printable cement-based materials	Nicolas ROUSSEL Dirk LOWKE	2021
304-ADC Assessment of Additively Manufactured Concrete Materials and Structures	Viktor MECHTCHERINE Freek BOS	2021
305-PCC Pumping of concrete	Dimitri FEYS Geert DE SCHUTTER	2021
MCP Accelerated Mineral Carbonation for the production of construction materials	Ruben SNEL-LINGS Thomas MATSCHEI	2022

New

ACP Active Control of Properties of Fresh and Hardening Cementitious Materials

Chair Geert DE SCHUTTER
Deputy Chair Jay SANJAYAN
Activity started in 2023

Monitoring and control of concrete pumping. Image courtesy of G. De Schutter.

Significance

Active Control of Concrete Properties is a recently identified subfield within concrete technology. The new concept of Active Control of concrete properties is based on the application of external signals to trigger an intended response in the material. Several challenges remain, like the stability and functioning of the responsive material in a cementitious environment, the applicability of the control signal in a cementitious material, and the cost, logistics and safety of a control system on a construction site or in precast industry. Finding solutions to these challenges will lead to marvellous opportunities in general, and for concrete 3D printing more particularly.

Relevance

- While pumping, active rheology control could help reducing the pumping pressures for a given discharge rate, by controlling the bulk rheology and/or the properties of the lubrication layer.
- In case of 3D concrete printing, active stiffening control could help improving the buildability, turning the material from more flowable (pumpable) to more stiff while passing through the nozzle.
- The outcomes of this TC are targeted towards two groups of users: industry and academia.

Goals

- To create a State-of-the-art report on Active Control of Properties of Cementitious Materials, not only focussing on rheology but also on other properties in fresh state and during hardening; a first draft is anticipated to be ready in 2026. Based on the STAR, the recommendations could be created in 2026 or 2027.
- To clearly define and describe basic methodologies and vocabulary, so that the subfield has a sound basis for further actions, reports and publications.

Methodology

- The committee work will focus not only on rheology but also on other properties in fresh state and during hardening.
- It will not focus on active control in hardened state, but major hardened material characteristics will be referred to as potentially influenced by active control in fresh and hardening state.
- RILEM TC ACP will study the control options, without entirely reviewing pumping and 3D concrete printing (as this is the topic of RILEM TCs working in parallel).
- The following topics will be reviewed: traditional methodologies, active control based on responsive particles, active control based on responsive polymers.

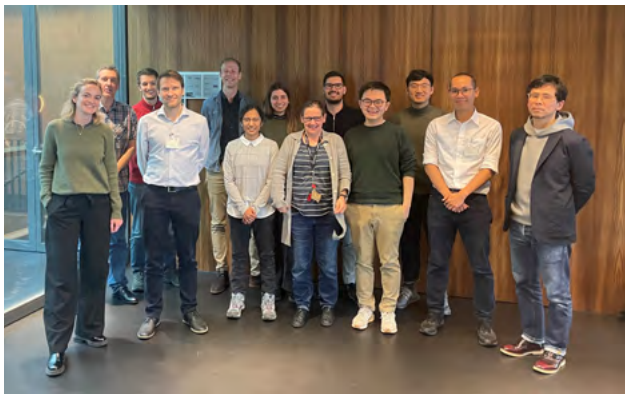
Progress

RILEM TC ACP has been approved by the RILEM Technical Activities Committee (TAC) in Spring 2023. Its kick-off meeting is taking place in September 2023, during the 77th RILEM Annual Week.

New

MBC Magnesia-based binders in concrete

Chair Paivo KINNUNEN
Deputy Chair Ellina BERNARD
Activity started in 2022



Kick-off meeting of TC MBC in Switzerland, in March 2023. Image courtesy of P. Kinnunen.

Significance

Magnesia-based cements and binders are relatively unstudied systems. MgO is found as magnesium silicates in Earth's crust, and therefore constitutes a potentially zero-CO_2 raw material for its uncarbonated form. The scientific as well as technological viability and scalability related to the MgO-based binders' utilization are still open questions to a large degree. The understanding of the potential of these binders is still in its infancy and the research is scattered and relatively uncoordinated.

Relevance

- Building sector is responsible for roughly 40% of the global greenhouse gas emissions, of which cement is a major source. Carbon capture and storage/utilization in concrete is a viable option to tackle the emission generated by the clinker process; MgO-based binders offer a novel route.
- Academics, industrialists, and general public will benefit from the outcomes of this TC.

Goals

This TC aims to:

- achieve improved knowledge related to magnesia-based binders.
- connect researchers working in the field of MgO in cement and concrete.
- harmonize definitions and terminology for the rapidly developing field of MgO-based binders.
- publish TC output as a series of review articles in *Materials and Structures*.
- provide research roadmap to initiate the applications of MgO-based binders in construction industry.
- initiate further TC on the MgO-based binders.

Methodology

- TC MBC will deal with the fundamental of the reaction kinetics, formation, and stability of different Mg-bearing phases (such as M-S-H and HMCs) as well as their mechanical and hydric properties. MgO-based binders in this context refer to all relevant inorganic binders based on Mg-bearing phases, which harden and develop strength via different routes including hydration and carbonation.
- The work will imply bibliographical reviews including the transport and mobility of Mg in aqueous environment, the rheology, the reactivity and kinetics of the raw materials but also the stability and durability including thermodynamic databases review and the microstructure.

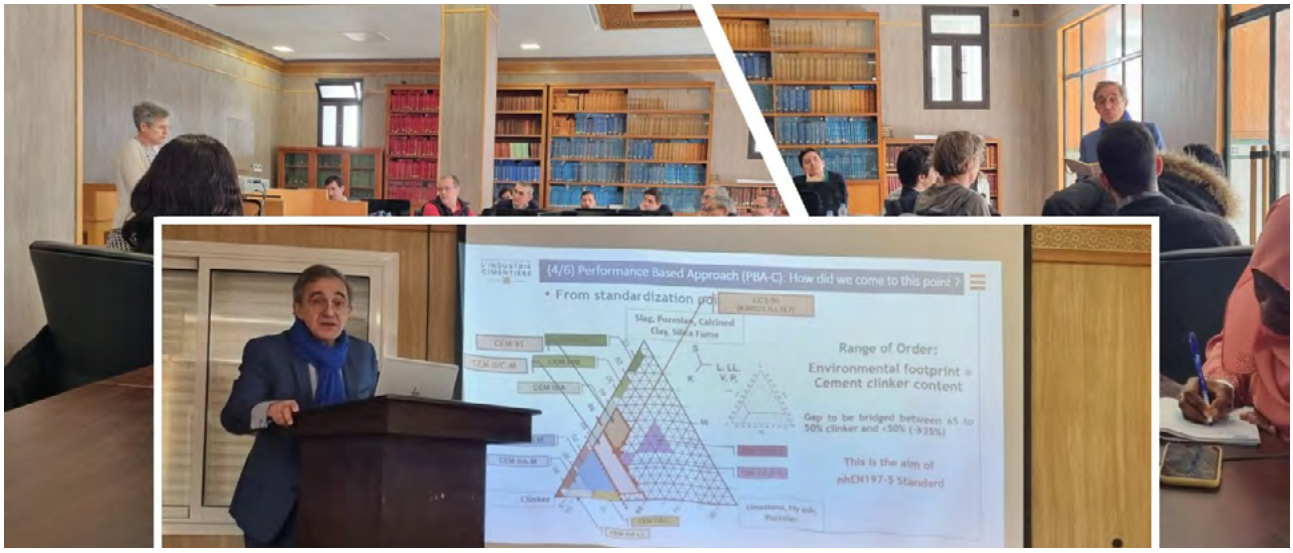
Progress

RILEM TC MBC has been approved by the RILEM Technical Activities Committee (TAC) in Fall 2022. Its kick-off meeting took place in Switzerland (hybrid mode) in March 2023.

New

PHC Performance testing of hydraulic cements

Chair Karen SCRIVENER
Deputy Chair Laurent IZORET
Activity started in 2022



Kick-off meeting of TC PHC during the 2023 RILEM Spring Convention in Rabat, Morocco. Image courtesy of W. Schmidt.

Significance

To accommodate new "blended" or "composite" cements, the current "prescriptive" cement standards are getting more and more complex. In view of the diversifying range of cementitious constituents and their expanding levels of incorporations, the number of combinations as cements is bound to exponentially increase if current prescriptive approaches are maintained. Moving away from specifications based on cement composition to a performance-based approach could rigorously resolve the issue, align with policy expectations and enable a more rapid introduction of new sustainable cements. The aim of this committee will be to prepare the way for performance approaches to defining cements suitable for application and look at existing and new test methods of performance.

Relevance

The work of this committee will be critical to preparing standards which are suitable world-wide and not just based on practice in Europe or North America. The work will be extremely important to the specification of cements in the countries where most construction will occur in the coming decades, such as Africa, and making sure that the CO_2 emissions of cement can be lowered as much as possible while ensuring adequate performance. Testing laboratories, practitioners, academics, and industrialists will benefit from the outcomes of this TC.

Goals

- The main benefit will be to establish a sound and commercially neutral scientific basis for the development of performance-based standard for cements.
- The main output will be test methods and recommendations.
- Subsidiary outputs will be educational materials and perhaps state of the art reports.
- The main events will be educational, e.g. ROC&TOK webinars and PhD courses before a RILEM Annual week.

Methodology

The Committee will have 3 main work streams, which will be pursued in parallel:
Strength Testing
Criteria to avoid poor performance (apart from classic durability), e.g. dimensional stability
Durability related criteria.

Progress

RILEM TC ACP has been approved by the RILEM Technical Activities Committee (TAC) in Fall 2022. Its kick-off meeting took place in March 2023, during the RILEM Spring Convention.

275-HDB Hygrothermal behaviour and durability of bio-aggregate based building materials

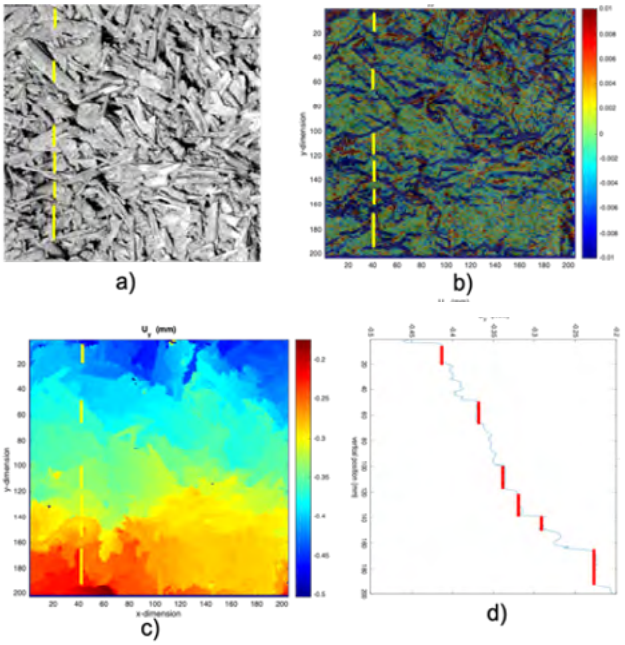
Chair Sofiane AMZIANE
Deputy Chair Florence COLLET
Activity started in 2016

Significance

The preservation of the environment is one of the principal features of sustainable development. Bio-based building materials has proven to have both viability and marketability in the construction industry, despite its relative infancy, but limited research has been carried out. Their natural abilities to absorb carbon dioxide and to act as good thermal and acoustic insulator are the motivations for further research.

Progress

- Special session organised during RILEM conference Synercrete'23 in Milos, Greece.
- Organisation of ICBBM 2023 at TU Wien from 21 to 23 June 2023.
- Presentation of TC outcomes in September 2022 at the 76th RILEM Annual Week in Kyoto, Japan.
- Planning to publish in *Materials and Structures* a topical collection of 4 articles addressing the following topics: 1- Overview RRT-Hygrothermal , capillary behaviour of hemp concrete; 2- RRT- thermal conductivity hemp concrete; 3- RRT – moisture buffer value of vegetal concrete; 4- RRT-capillary of vegetal concrete.



Vegetal aggregate participation:
a) picture of hemp concrete of the RRT; b) superposition with vertical strain; c) vertical displacement field; d) section along the yellow line. Image courtesy of É. Toussaint.

282-CCL Calcined clays as supplementary cementitious materials

Chair José F. MARTIRENA-HERNANDEZ
Deputy Chair Manu SANTHANAM
Activity started in 2018

Significance

The scarcity of common Supplementary Cementitious Materials (SCMs) like fly ash and slag and the great pressure that the cement industry is receiving on reducing GHG emissions, has prompted the use of calcined clays as an alternative to traditional SCMs. However, practical implementation demands for further information for companies and government bodies to adapt existing standards to the new product and tackle the yet remaining gaps in the knowledge.

Progress

- Topical Collection "Calcined Clays as Supplementary Cementitious Materials" in *Materials and Structures*, containing the following papers:
  - > Zunino, F., Dhandapani, Y., Ben Haha, M. et *al.* Hydration and mixture design of calcined clay blended cements: review by the RILEM TC 282-CCL. *Mater Struct* **55**, 234 (2022).
  - > Joseph, S., Dhandapani, Y., Geddes, D.A. et al. Mechanical properties of concrete made with calcined clay: a review by RILEM TC-282 CCL. *Mater Struct* **56**, 84 (2023).
- 3 papers currently under review.
- Organization of the 4th International Conference on Calcined Clays for Sustainable Concrete, 15-18 May 2024, Nanjing, China.

Some examples of common kaolinitization environments: a) Kaolinite vein due to hydrothermal alteration of rhyolites (eastern region, Cuba). b) Sampling trench in redeposited clay deposits (plains in western region, Cuba). c) Weathering crust over gabbros (eastern region, Cuba). *Materials and Structures* (2022) 55:139, https://doi.org/10.1617/s11527-022-01972-2

284-CEC Controlled expansion of concrete by adding MgO-based expansive agents taking the combined influence of composition and size of concrete elements into consideration

Chair Jiaping LIU
Deputy Chair Ole Mejlhede JENSEN
Activity started in 2018

Significance

MgO-based expansive agents have proven to be effective in compensating shrinkage and mitigating cracking of concrete. In addition to the characteristics of MgO itself, the composition and size of concrete element also have strong influence on expansion of concrete with MgO-based additives, which is still not fully understood.

Group photo of members of TC 284-CEC attending the 4th TC meeting in September 2021. Image courtesy of TC 284-CEC.

Progress

- Small group meeting held on July 7 2022 online for the revision of STAR. Next annual TC meeting will be held hybrid in September 2023, at the 77th RILEM Annual Week.
- Revised draft of STAR "MgO expansive additive (MEA) and concrete containing MEA" is planned to be completed in 2023.
- 1st RRT on hydration reactivity, restraint expansion of MEA has been completed in 2021, 2nd RRT on restraint and unrestraint expansion of MEA is underway.
- Papers including the round-robin tests results on hydration reactivity and expansion of MEA will be circulated for approval before December 2023.
- Guidelines for quality control of MEA are under preparation (planned to be completed in 2024).

291-AMC Use of agro-based materials as cementitious additions in concrete and cement-based materials

Chair Said KENAI
Deputy Chair Mike OTIENO
Activity started in 2018

Significance

Agro-based materials are renewable materials that can reduce the construction industry greenhouse emissions and negative impact on the environment. However, there is currently a shortage of industrial applications.

Some moments of the ACM meeting in Senegal in Dec 2022. Image courtesy of W. Schmidt.

Progress

- STAR expected to be finalized by the end of 2023.
- TC meeting held in person in Dec 2022 in Dakar, Senegal.

296-ECS Assessment of electrochemical methods to study corrosion of steel in concrete

Chair Sylvia KESSLER
Deputy Chair Ueli ANGST
Activity started in 2020

Significance

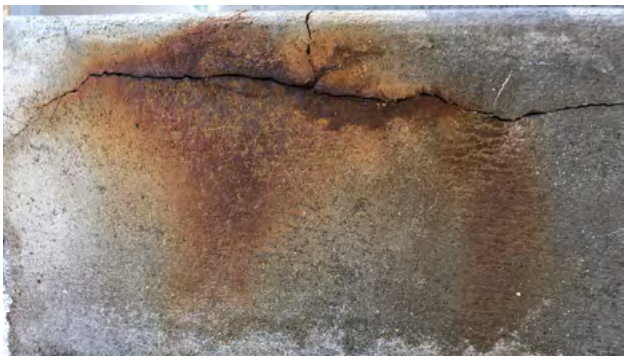
Corrosion of steel in concrete is major reason for deterioration of concrete structures. The corrosion process of the reinforcement itself is of electrochemical nature. Therefore, electrochemical measurements are an essential tool in order to be able to assess and scientifically study the corrosion behaviour of metal-concrete-systems. Besides the assessment of the corrosion behaviour, electrochemical measurements form the basis to predict/ model the time of corrosion initiation and the propagation period.

Progress

Two recommendations in preparation:

- Recommendation on the design of lab test setups for electrochemical measurements of steel in concrete.
- Recommendation on measuring electrochemical impedance spectroscopy of steel in concrete.

TC outcomes to be presented during the 78th RILEM Annual Week in 2024.



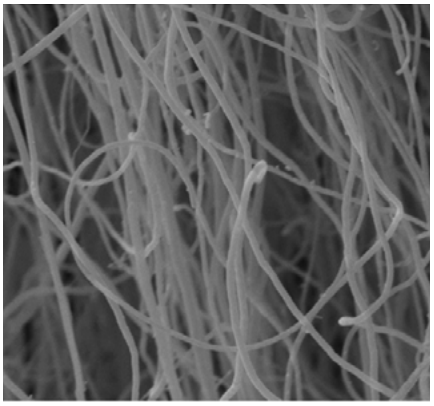
Damage produced by the corrosion of the steel reinforcement in concrete elements. Images courtesy of U. Angst.

302-CNC Carbon-based nanomaterials for multifunctional cementitious matrices

Chair Prof. Florence SANCHEZ
Deputy Chair Marco LIEBSCHER
Activity started in 2021

Significance

Carbon-based nanomaterials - such as graphene, carbon nanotubes or carbon black - have gained recently a significant interest in research and development for civil engineering applications.
When successfully dispersed in cementitious matrices, they have shown to improve strength, ductility, and fracture resistance; reduce cracking; decrease permeability; and increase durability, while providing innovative properties such as electrical and thermal conductivity. However, despite a large number of research activities, the application of nanocarbon modified cementitious matrices in concrete construction remains to date limited in part due to challenges related with scale-up implementations and a lack of a clear understanding of usually multiple, overlapping mechanisms.



Electron micrograph of entangled Multi-Walled Carbon Nanotubes. Courtesy of M. Liebscher.

Progress

- Special session organised during RILEM conference Synercrete'23 in Milos, Greece.
- 2 online meetings held in the last 12 months.
- Currently working on a comprehensive state-of-the-art report.
- Planning to organize a one-day workshop in June 2024.

303-PFC Performance requirements and testing of fresh printable cement-based materials

Chair Nicolas ROUSSEL
Deputy Chair Dirk LOWKE
Activity started in 2021

Significance

3DCP (3D Concrete Printing) is an Additive Manufacturing process. The geometric quality of manufactured parts is not only affected by the precision of the printing but also by the deformation under self-weight during manufacture. Fresh material must initially remain fluid enough to facilitate deposition and inter-layer bonding, but materials that are too fluid can lead to buckling and collapse of structures.
The importance of these mechanisms has driven significant efforts in: determining the rheological requirements of the fresh material; quantifying buildability; and predicting structural failure. Being able to measure, assess and benchmark process and material performance using standardised and internationally accepted approaches is therefore essential for the industrial future of the technology.

Delegates of the 3rd RILEM International Conference on Digital Fabrication with Concrete. Image courtesy of R. Buswell.

Progress

- Several meetings organised in the last 12 months.
- TC has attracted around 170 members.
- TC presentation scheduled at the 80th RILEM Annual Week in 2026.
- Organization of 4th RILEM International Conference on Digital Fabrication with Concrete in 2024.
- Cement and Concrete Research Special Issue containing papers of the Digital Concrete 2022 conference.

304-ADC Assessment of Additively Manufactured concrete materials and structures

Chair Viktor MECHTCHERINE
Deputy Chair Freek BOS
Activity started in 2021

Significance

Additive manufacturing (AM) of concrete structures is taking the world by storm due to its potentials of efficient use of materials, architectural freedom as well as high automation and productivity. The products made by AM typically show a considerable degree of anisotropy which can be traced back to the nature of their layer-by-layer manufacturing process. This and some other specifics of AM require a critical revisiting of all relevant test methods of materials characterisation towards establishing new, generally acceptable standards.

Progress

- TC meeting at the 2023 RILEM Spring Convention in Rabat, Morocco; 2 more online in 2023.
- 2 interlaboratory studies are underway, with more than 30 laboratories participating. Publication of results expected by end of 2023.
- Co-organizing the 4th RILEM International Conference on Concrete and Digital Fabrication (Digital Concrete 2024).

3-point bending testing of a 3D printed concrete specimen. Image courtesy of T. Neef.

305-PCC Pumping of concrete

Chair Dimitri FEYS
Deputy Chair Geert DE SCHUTTER
Activity started in 2021

Significance

- Current international documents on pumping of concrete are substantially aged and need modifications to incorporate the results on modern concrete mixtures.
- With the further development of specialty, flowable and high-performance concrete, this knowledge is crucial to be spread to the industry to maintain the competitive advantage of concrete in the construction industry.
- The need exists to create a State-of-the-art report on pumping of concrete, incorporating the developments made in the last 20 years.
- To the knowledge of the proposers, there is no such document available which includes the latest developments.

Progress

- Fifth TC meeting held at the 2023 RILEM Spring Convention in Rabat, Morocco.

On the left: concrete pumping on a small construction site. On the right: large-scale concrete pump test on a major construction site. Image courtesy of G. De Schutter.

- Table of contents of STAR determined.
- Chapters are being developed.
- RILEM Technical Letter on current state of the art on pumping expected in July 2023.
- STAR submission and publication expected around 2025.
- Publication of recommendations and other TC reports expected in 2026-2027.

MCP Accelerated Mineral Carbonation for the production of construction materials

Chair Ruben SNELLINGS
Deputy Chair Thomas MATSCHEI
Activity started in 2022

Significance

- The conversion of CO_2 into solid, stable mineral carbonates (mineral carbonation) as a means to produce construction materials is an innovative and rapidly developing field that is expanding in various application domains.
- There is a need for sharing experiences and understanding and develop best practices that build a common knowledge base. There is also a lack of commonly accepted terminology, material characterisation test methods and reliable process impact data and assessments.

Progress

- Kick-off Meeting held in hybrid mode together with a workshop and preceded by site visits, on 21-22 Sept 2022, in Genk, Belgium.
- All four WGs started their activities in Dec 22 and Jan23.
- TC meeting during the Synercrete conference in Greece, 14th of June 2023.
- Future TC meetings: 16th ICCC in Sept 2023, Bangkok, Thailand; 1st International Conference on Mineral Carbonation for Cement and Concrete in Germany in April 2024; ACI Concrete Convention in Nov 2024, Philadelphia, USA.

TC members during the kick-off meeting of TC MCP. Image courtesy of R. Snellings.

- TC outcomes to be presented at the 79th RILEM Week in 2025 or the 80th in 2026.
- 4 review papers in progress, to be part of a Topical Collection in *Materials and Structures*.
- Alignment with NIST initiative on measurement of CO_2 uptake; may lead to new ASTM initiative.

Transport and Deterioration Mechanisms

Foreword

▶ from Cluster B Convener, Josee Duchesne

Cluster B on Transport and Deterioration Mechanisms is related to the properties of the construction materials and their chemical, physical, mechanical and durability behaviour. The use of traditional and novel construction materials is conditioned by their properties. The service life of the structures is conditioned by these properties in addition to the environmental and exposure conditions.

Many innovative materials are being studied in these TCs, such as recycled building materials, alkali-activated materials, organic coating materials, etc. Durability aspects and combinations of actions are also studied. These technical committees are mainly related to cement-based materials, pastes, mortars, and concretes.

Currently, Cluster B has 7 active TCs dealing with different aspects of traditional and novel construction materials, their properties, and the durability behaviour. During the last TAC meeting in Fall 2022, a new TC was established under Cluster B: MMS Modelling and experimental validation of moisture state in bulk cementitious materials and at the steel-concrete interface ; TC FTC *"Durability and Service Life of Concrete under the Influence of Freeze-Thaw Cycles combined with Chloride Penetration"* completed its activities and it is now closed.

I am the Convenor of Cluster B since 2020, previously coordinated by Esperanza Menendez Mendez.

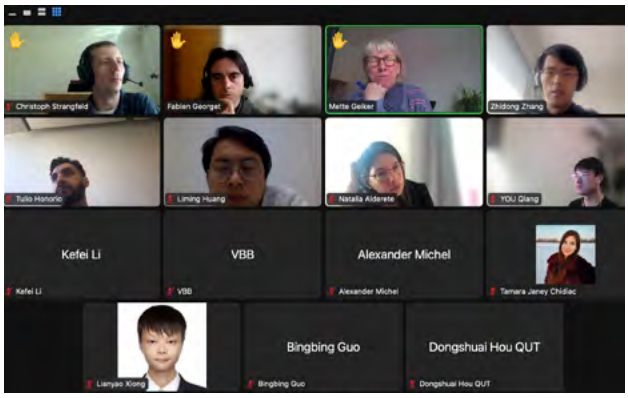
Current TCs in Cluster B

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
MMS Modelling and experi-mental validation of mois-ture state in bulk cementi-tious materials and at the steel-concrete interface	Zhidong ZHANG Chunsheng ZHOU	**NEW** Fall 2022
281-CCC Carbonation of concrete with supplementary cementitious materials	Nele DE BELIE Susan BERNAL LOPEZ	2017
283-CAM Chloride transport in alkali-activated materials	Arnaud CASTEL Shishir MUNDRA	2018
285-TMS Test method for concrete durability under combined role of sulphate and chloride ions	Changwen MIAO Geert DE SCHUTTER	2018
286-GDP Test Methods for Gas Diffusion in Porous Media	Bruno HUET Philippe TURCRY	2019
297-DOC Degradation of organic coating materials and its relation to concrete durability	Takafumi NOGUCHI Kei-Ichi IMAMOTO	2020
298-EBD Test methods to evaluate durability of blended ce-ment pastes against delete-rious ions	William WILSON Prannoy SURANENI	2020

New

MMS Modelling and experimental validation of moisture state in bulk cementitious materials and at the steel-concrete interface

Chair Zhidong ZHANG
Deputy Chair Chunsheng ZHOU
Activity started in 2023



Screenshot of the kick-off meeting in March 2023. Image courtesy of Z. Zhang.

Significance

Various scientific studies found that the key parameter controlling the corrosion rate of steel in carbonated concrete is the water content at the steel surface; other showed that only when water front reached the steel surface, the measured corrosion rate became significant. This implies that, by controlling the "right" water condition at the steel surface, the risk of steel corrosion can be kept low. The consequence of this is that the moisture ingress through the (carbonated) concrete cover becomes a highly important mechanism to ensure corrosion resistant structures. Methods to measure and model this process at the engineering level are thus needed. A prevailing key question is the identification of moisture transport models that can capture the key features of moisture transport and moisture state that are directly related to steel corrosion, while keeping the degree of complexity such that needed input parameters can be measured or otherwise made available in engineering practice.

Relevance

- The targeted group of users is researchers and engineers from research institutes and industry, in particular for those who are willing to need the practical moisture transport models for the prediction of durability of concrete structures.
- Overall, ensuring durability and safety of engineering structures has various socio-economic benefits for society, especially for our future generations, and is well in agreement with the mission of RILEM.

Goals

- Review moisture transport models in terms of transport mechanisms and their application conditions; identify the key features that require experimental calibration.
- Summarize and compare experimental methods for obtaining the calibration and validation data.
- Compare simulation and prediction models based on the accuracy of validation results.
- Review and compare simulation and experimental methods to determine moisture condition at the SCI.
- Model suggestions for engineering practice (simplified) and academic research.

Methodology

Round Robin tests may be part of the TC depending on the working progress.
The data collection work will be one the main work of this TC. Most data reported in the scientific literature were obtained from laboratory experiments. We are interested in data from field survey and on-site measurements on real concrete structures, which are important supplementary to the laboratory experiments.

Progress

RILEM TC ACP has been approved by the RILEM Technical Activities Committee (TAC) in Fall 2022. Its kick-off meeting took place in March 2023 at the RILEM Spring Convention.

281-CCC Carbonation of concrete with supplementary cementitious materials

Chair Nele DE BELIE
Deputy Chair Susan BERNAL-LOPEZ
Activity started in 2017

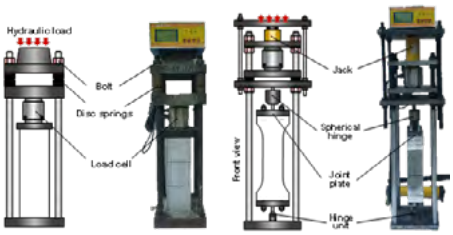
Significance

SCM-containing concrete exhibits high carbonation susceptibility. As carbonation is believed to cause corrosion of embedded steel bars, a deeper understanding of chemical and transport phenomena in such concrete is needed. Furthermore, prediction models for carbonation induced corrosion need to be adapted for concrete containing SCMs.

Progress

- WG1-2: inter-laboratory comparison with 22 participating labs is completed.
- WG3: Created a follow-up TC (286-GDP: Test Methods for Gas Diffusion in Porous Media).
- WG4: study on the effect of loading on the carbonation performance of concrete with SCMs is done; a recommendation is submitted.
- WG6: Constructed a database on concrete based on blended cements with a high volume of SCM.
- Gluth, G.J.G., Ke, X., Vollpracht, A. et *al.* Carbonation rate of alkali-activated concretes and high-volume SCM concretes: a literature data analysis by RILEM TC 281-CCC. *Mater Struct* **55**, 225 (2022).
- Yao, Y., Wang, L., Li, J. et *al.* Report of RILEM TC 281-CCC: effect of loading on the carbonation performance of concrete with supplementary cementitious materials — an interlaboratory comparison of different test methods and related observations. *Mater Struct* **56**, 110 (2023).
- Yao, Y., Wang, L., Li, J. et *al.* Recommendation of RILEM TC 281-CCC: Test method to determine the effect of uniaxial compression load and uniaxial tension load on concrete carbonation depth. *Mater Struct* **56**, 121 (2023).

Members of TC 281-CCC at the TC meeting in Milos, Greece, in June 2023 for the Synercrete Conference. Images courtesy of S. Bernal.



Loading rigs to test the combined action of carbonation and load. Image courtesy of WG4 of TC 281-CCC.

283-CAM Chloride transport in alkali-activated materials

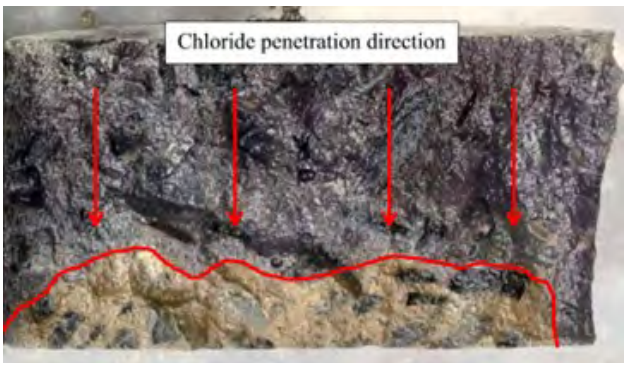
Chair Arnaud CASTEL
Deputy Chair Shishir MUNDRA
Activity started in 2018

Significance

Alkali-Activated Materials (AAMs) are a sustainable alternative to Portland cement. The lack of standard specification is one of the main barriers for Alkali-Activated Materials (AAMs) adoption by the industry.

Progress

- TC meetings in: 2022, at the 76th RILEM Annual Week, and in 2023, during the Synercrete conference. Experimental results collected from different teams relating to WG1 and WG2 were presented and discussed.
- Inter-laboratory tests are now complete.
- Based on the experimental results collected, the TC will submit one technical recommendation related to RCPT test for alkali-activated materials.



Chloride penetration depth measurement after conducting the chloride migration test NT Build 492. A. Noushini et al. *Materials and Structures* (2021) 54:57.

- Special TC 283-CAM session organised within Synercrete conference, in June 2023.
- Target date for completion of TC work (including final documents): late 2023.

285-TMS Test method for concrete durability under combined role of sulphate and chloride ions

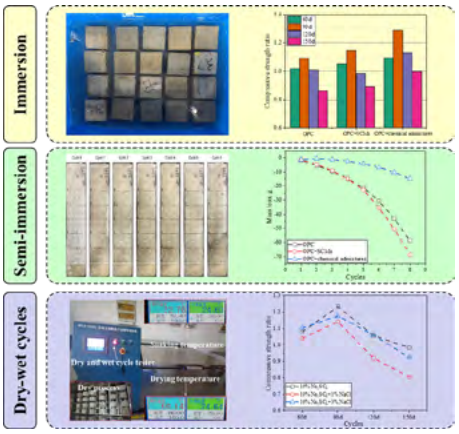
Chair Changwen MIAO
Deputy Chair Geert DE SCHUTTER
Activity started in 2018

Significance

Deterioration processes of combined sulphate and chloride attack are rather complex for reinforced concrete. Under the combined role of sulphate and chloride ions, service life of reinforced concrete structures can be shortened considerably.

Progress

- Currently drafting State-of-the-Art Report and updating literature review on degradation mechanisms of cement-based materials.
- A TC general meeting is planned at the 77th Annual RILEM Week 2023, in Vancouver, Canada, in September 2023.
- Paper on "Laboratory and field evaluations of concrete under the coupling action of sulphate and chloride' is in the pipeline, to be submitted to *Materials and Structures*.



Laboratory experiments and partial experimental results of concretes under the coupling action of sulphate and chloride. Image courtesy of Mu Song.

- Ongoing pioneering laboratory experiments: compare the effect of cementitious material on sulphate resistance of concrete; three series: 1) OPC; 2) OPC with SCMs; 3) OPC with SCMs and chemical admixtures. Field Exposure Test: Zhangye (semi-buried-dry, strong wind, saline soils).

286-GDP Test methods for gas diffusion in porous media

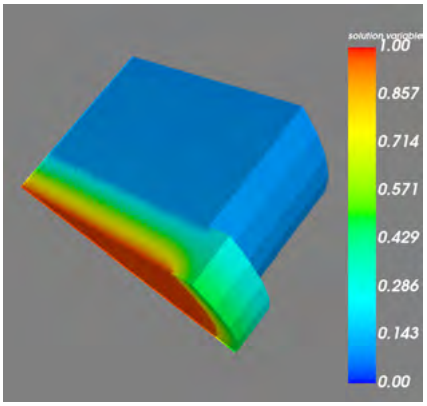
Chair Bruno HUET
Deputy Chair Philippe TURCRY
Activity started in 2019

Significance

Rebar corrosion and other detrimental phenomena for concrete are linked to oxygen, carbon dioxide and water vapor mass transfer. The gas diffusion coefficient is a general indicator of the resistance to gas transfer. Different methods for measuring gas diffusion coefficient of cementitious materials have been developed but no technical consensus exists on those methods.

Progress

- State of the art report will be published through a Topical Collection in *Materials and Structures* (MAAS). The following papers are planned:
  1: "Diffusion mechanisms": almost ready for submission to MAAS
  2: "Diffusion sets up and procedures": writing well advanced
  3: "Gas diffusion in cement materials": on-going writing
  4: "Gas diffusion in other porous materials": on-going writing
  5: "Carbonation assessment of cement-based materials with gas diffusion": on-going writing
  6: "Corrosion and Oxygen diffusion": on-going writing
  7: "Modelling moisture transport in porous media": writing well advanced
  8: "Radon diffusion in buildings materials": on-going writing
  9: "Modelling gas diffusion in porous media": to be confirmed
- Inter-laboratory tests (benchmark): Test campaign almost finished.
- Numerical benchmark: 1D and 2D tools are used to analyse the limits of 1D analytical solution of gas diffusion.



3D - Oxygen concentration map during a diffusion test to illustrate transient effect in sample and in downstream volume as well as side effects because of sealing joints. This work contributes to defining the right analytical solution for interpreting gas diffusion test results. Image courtesy of B. Huet.

297-DOC Degradation of organic coating materials and its relation to concrete durability

Chair Takafumi NOGUCHI
Deputy Chair Kei-Ichi IMAMOTO
Activity started in 2020

Significance

Coating materials contributes to extend the lifetime of concrete structures by acting not only as texture of a building but also as protection of reinforced concrete structures from harmful substances. Organic coating material such as multi-layer coating material will degrade by ultraviolet light and/or heat and its barrier effect might be reduced. The effect of coating materials to prevent the ingress of CO_2 have been extensively verified throughout accelerated tests in laboratory conditions. However, the degradation of coating materials under real environmental conditions and its relation to concrete durability still need further investigation.

Progress

- TC meeting held in person at the 76th RILEM Annual Week, in Kyoto, Japan, and special session on "Special Session on Surface Coating" organised within this event.
- Tentative STAR contents currently under discussion.

Technician spraying a waterproofing organic coating layer on a concrete roof. Image courtesy of Creamer Media.

298-EBD Test methods to evaluate durability of blended cement pastes against deleterious ions

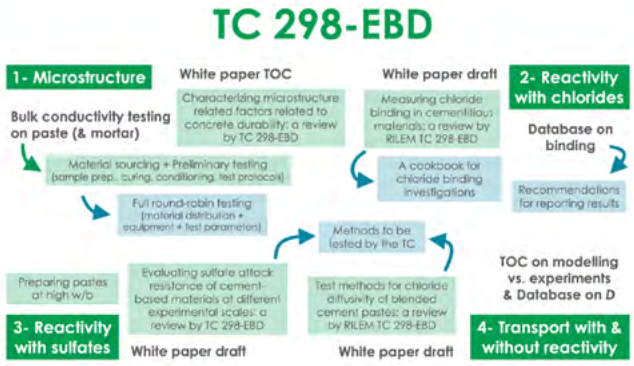
Chair William WILSON
Deputy Chair Prannoy SURANENI
Activity started in 2020

Significance

The CO_2 reduction targets of the cement industry necessitate the development of alternative supplementary cementitious materials (SCMs) to reduce the global clinker factor of cements. The adoption of novel SCMs requires efficient and reliable test methods to investigate the effect of SCMs on long-term concrete durability. As long-term concrete durability tests are laborious and time consuming, this TC focusses on paste-level durability tests for chloride and sulfate.

Progress

- Full TC meeting in May 2023. TC meeting during the Synercrete conference in Greece, June 2023, with a special Session focusing on RILEM TC 298-EBD activities and outcomes organised within the event.



Schematics of the working programme of TC 298-EBD. Image courtesy of W.Wilson.

- Analysis and synthesis of data from literature is ongoing; bulk resistivity testing for cement pastes and mortars is ongoing as part of round-robin effort.
- Multiple working documents are in progress. We expect to submit 1-2 journal publications, with at least one being submitted to *Materials and Structures*.

Structural Performance and Design

Foreword

► from Cluster C Convener, Giovanni PLIZZARI

Material and structural behaviour are closely connected since the optimization starts from structural performance which significantly depends on material behaviour. Indeed, structural behaviour should carefully look at material performance as well as material behaviour to be oriented to a better structural response.

For this reason, RILEM activated Cluster C, which coordinates the activities of the Technical Committees (TCs) dealing with "Structural Performance Design". A close collaboration with *fib* and their impressive work on drafting the *fib*-model code 2020 is also materialised through the cluster.
Currently, in the Cluster, eight TCs are active in: early age and long-term crack width analysis in RC structures (287-CCS), impact and explosion (288-IEC), mechanical characterization and structural design of textile reinforced concrete (292-MCC), mechanical properties of alkali-activated concrete (294-MPA), concrete during fire - reassessment of the framework (306-CFR), on-site corrosion condition assessment, monitoring and prediction (OCM), and the recently (Spring 2023) approved TC RCC Rolled compacted concrete for pavement applications.

Structural behaviour should be supported by reliable numerical models that are particularly useful for better understanding structural performance as well as structural design. Therefore, TCs active in "numerical modelling" of materials and structures are an important component of Cluster C as it may use experimental data to better predict structural performance.

The first TC belonging to Cluster C was established in 1996 and it was *"175-SLM: Computer bases on service life methodology"*. Since then, 24 TCs have worked under the coordination of the convener of Cluster C, a service that I have the honour to have held since 2018 after Prof. Takafumi Noguchi.

Current TCs in Cluster C

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
RCC Rolled compacted concrete for pavement applications	Christian PAGLIA Corey ZOLLINGER	**NEW** Spring 2023
269-IAM Damage Assessment in Consideration of Repair/ Retrofit-Recovery in Concrete and Masonry Structures by Means of Innovative NDT	Tomoki SHIOTANI Dimitrios AGGELIS	2016
287-CCS Early age and long-term crack width analysis in RC Structures	Miguel Ângelo Dias AZENHA Fragkoulis KANAVARIS	2019
288-IEC Impact and Explosion	Marco DI PRISCO Ezio CADONI	2018
292-MCC Mechanical Characterization and Structural design of Textile Reinforced Concrete	Barzin MOBASHER Flávio DE ANDRADE SILVA	2019
294-MPA Mechanical properties of alkali-activated concrete	Guang YE Frank DEHN	2019
306-CFR Concrete during Fire - Reassessment of the framework	Pierre PI-MIENTA Robert JANSSON MC NAMEE	2022
OCM On-site Corrosion Condition Assessment, Monitoring and Prediction	Carmen ANDRADE Pedro CASTRO BORGES	2022

New

RCC Rolled compacted concrete for pavement applications

Chair Christian PAGLIA
Deputy Chair Corey ZOLLINGER
Activity started in 2023

Procedure of application of rolled compacted concrete. Image courtesy of C. Zollinger

Significance

In the last decade, roller compacted concrete has been increasingly applied for heavy duty pavements, rather than for exclusively gravity dams. Despite the existing application guides, most of the knowledge is still strongly based on field experience without a systematic scientific approach. Moreover, a wide, constant and well-structured sharing of the knowledge in the topic is missing.

Relevance

- The experiences gathered in this TC will improve a promising and sustainable construction practice by conducting laboratory and field applications and by elaborating new recommendations.
- The outcomes of the TC will mainly be addressed to academics, concrete producers, waste treatment plants, construction and demolition as well as paving industries.

Goals

The main goal of the technical committee is to gather the worldwide experience gained so far in the field, in real applications, but also within the laboratories. A main task is to review the scientific publications and knowledge produced in the recent past concerning the pavement applications, to critically assess the results, and to evaluate the implementation potential of this material and the technique for a more widespread paving of urban roadways.

Methodology

- The work will be structures into 3 parts: Part I-literature review; Part II-Laboratory tests; Part III-Real field tests on site.
- The different part of the work (I, II, III) will be gradually achieved by means of regular meeting (presence / online). After completing Part I, the discussions should lead to the implementation of factors to be tested with laboratory mix-design and durability tests. Subsequently, after deep discussion and sharing of the results of part II, chosen mixes with a limited extended surface will be applied on site.

Progress

RILEM TC ACP has been approved by the RILEM Technical Activities Committee (TAC) in Spring 2023.

269-IAM Damage assessment in consideration of repair/retrofit-recovery in concrete and masonry structures by means of innovative NDT

Chair Tomoki SHIOTANI
Deputy Chair Dimitrios ANGELIS
Activity started in 2016

Significance

Worldwide infrastructure is aging. By 2030 more than half of road and bridges will be older than 50 years. Proper condition evaluation and maintenance are essential. There is an urgent necessity to change maintenance from "reactive" to "proactive" as the latter requires less budget.

Progress

- 11th TC meeting held at the 76th RILEM Annual Week.
- 12th TC meeting held during the SMARTINCC'23 conference.
- Outcome from TC (planned): 2 RILEM Recommendations will be published.

TC meeting on 6th of Sep 2022 @ Kyoto Research Park, Kyoto, JP. Image courtesy of MEMC-VUB.

- TC outcomes presented at the 76th RILEM Annual Week and International Conference on Regeneration and Conservation of Structures (ICRCS 2022). Video of the presentation available on the RILEM YouTube channel.

287-CCS Early age and long-term crack width analysis in RC structures

Chair Miguel AZENHA
Deputy Chair Fragkoulis KANAVARIS
Activity started in 2019

Significance

Cracking due to restrained shrinkage and thermal effects is still an ongoing serviceability issue in concrete structures. Understanding and improving current approaches require a strong element of interdisciplinarity, focusing on the interplay between materials science and structural engineering. This entails the need to adequately combine the fundamental material behaviour of concrete since casting with experimental substantiation and advanced numerical and analytical modelling of cracking in structures.

Progress

- TC 287-CCS has attracted interest from both academia and industry and the number of participants has reached 88.
- Organization of Synercrete conference in Greece, June 2023: many TC members engaged in this organisation and the event offered the opportunity to other RILEM TCs to hold their TC meetings.
- TC meeting held during the Synercrete conference in Greece, June 2023; several "smaller" intermediate meetings held between members in several chapter working groups.

Some moments of the TC meeting held during the Synercrete conference in Greece in June 2023. Images courtesy of F. Kanavaris.

- Book chapter leaders actively co-ordinate the progress of corresponding book chapters.
- Research studies / white papers are being prepared by corresponding working groups in complementarity to the book chapter drafting.

288-IEC Impact and explosion

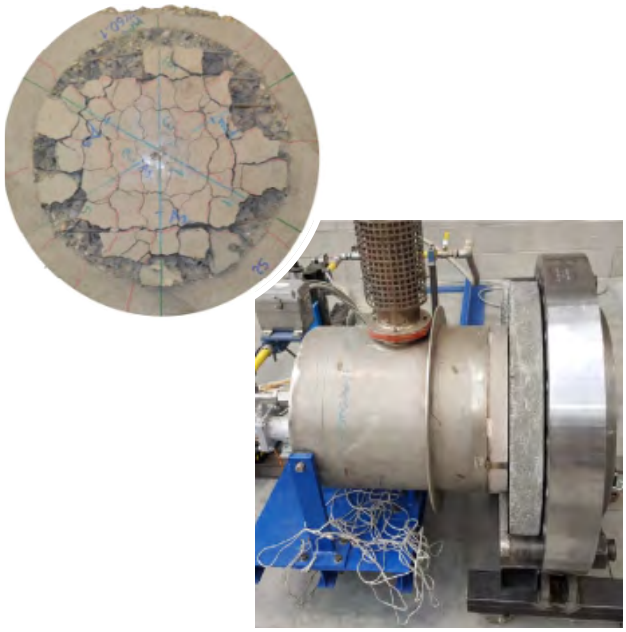
Chair Marco DI PRISCO
Deputy Chair Ezio CADONI
Activity started in 2018

Significance

In the framework of impact and explosion, there are many specific experimental devices all over the world, which have never been thoroughly compared and connected. There is the need to develop a stronger link between the worldwide existing experimental laboratories that have specific devices, often not fully used. A joint committee RILEM-*fib* working on the chapter "Impact and Explosion" of the fib Model Code 2020 can contribute to revitalize the RILEM association as "Labs link" and not only as "Experts link", fully rediscovering its original mission. In the two following years, the Committee will achieve the last three main objectives.

Progress

- First draft of a fib bulletin as framework reference of the Model Code 2020 is ready.
- TC meeting and discussion at the fib Symposium 2023 in Istanbul, Turkey.



Structural response of RC slabs subject to combined fire and blast; on the left: Experimental setup; on the right: state of the sample after the test. Image courtesy of TC 288-IEC.

292-MCC Mechanical characterization and structural design of textile reinforced concrete

Chair Barzin MOBASHER
Deputy Chair Flávio DE ANDRADE SILVA
Activity started in 2019

Significance

Textile reinforced concrete (TRC) materials have the potential to be used as structural components taking tensile, flexural, cyclic and impact loads. The advancements in the textile technology specifically directed at their use in cement-based materials has led to composites with an order of magnitude higher in strength and two orders of magnitude higher in ductility than fiber reinforced concrete (FRC). The common areas of application of TRC, such as ultra-high performance concrete, UHPC, 3D printing, FRCM and repair of infrastructure to mention a few, are in urgent need to develop and implement design tools and applications for strain hardening cement composites.

Progress

- Online meetings are being organized on a monthly or bi-monthly basis.
- A TC meeting and special session on TRC organised during the CICE 2023 event, in Brazil in July 2023.
- A TC meeting is also planned: 1) during the ACI Convention in Boston, USA, in Nov 2023; and 2) during the RILEM Spring Convention in Milan, Italy, in April 2024.

Carbon reinforced concrete house CUBE in Dresden, Germany. Image courtesy of S. Gröschel.

- State-of-the-art-report: first draft document to be ready by July 2023.
- Draft of a literature review paper on sustainability (WG 5) of TRC has been submitted.
- A draft of the literature review paper on bond mechanisms of TRC by WG1 is ready for submission and is currently undergoing the full committee review.
- Kromoser, B., Butler, M., Hunger, M. et al. Article of RILEM TC 292-MCC: life cycle assessment (LCA) of non-metallic reinforcement for reinforcing concrete: manufacturing, durability, dismantling, recycling and reuse: a review. Mater Struct 56, 126 (2023).

294-MPA Mechanical properties of alkali-activated materials

Chair Guang YE
Deputy Chair Frank DEHN
Activity started in 2019

Significance

Alkali-activated concrete is considered as an environment-friendly construction material with a great potential for construction. However, at this moment it is not fully clear whether existing design codes for structural concrete can be fully applied in case of alkali-activated concrete.
Although short term behaviour (28 days) might be similar, this might not be the case for the long-term behaviour and simply applying existing codes for conventional concrete to design alkali-activated concrete structures could be problematic. Another key point of focus is creep and shrinkage of alkali-activated concrete as the application of traditional creep and shrinkage laws has not still been defined suitable.

Some members of TC 294-MPA. Image courtesy of G. Ye.

Progress

- The 7th TC meeting was held online during the 76th RILEM Annual Week in Sept 2022.
- The 1st TC Workshop was held in hybrid mode in February 2023, during DuRSAAM 2023.
- 3rd draft (main content) of STAR finalised in June 2023; draft of completed STAR expected in December 2023 and its revision completed in March 2024.

306-CFR Concrete during Fire - Reassessment of the framework

Chair Pierre PIMIENTA
Deputy Chair Robert JANSSON MCNAMEE
Activity started in 2022

Significance

No real assessment of the whole framework "concrete at high temperature" has been done in the last decades. This new committee will:

- review the existing framework based on the Eurocode regarding prediction of real behaviour of concrete elements and structures during fire exposure,
- make a detailed study of one or two reference mixes from material characterization and modelling to real behaviour during fire exposure,
- create a database with fire spalling of concrete test results.

Progress

- 2nd TC meeting held in Berlin, Germany, in October 2022, during the 7th International Workshop on Concrete Spalling due to Fire Exposure.
- 3rd TC meeting held in March 2023 in Lund, Sweden, at the Research Institutes of Sweden (RISE).

TC members at the 2nd TC meeting in Berlin, October 2022. Image courtesy of TC members.

OCM On-site Corrosion Condition Assessment, Monitoring and Prediction

Chair Carmen ANDRADE
Deputy Chair Pedro CASTRO BORGES
Activity started in 2022

Significance

- Reinforcement corrosion is one of the major causes of the deterioration of structural concrete. Nevertheless, its assessment in real structures still lacks standardized procedures.
- A comprehensive approach for the corrosion condition assessment has not been found yet. A procedure of the implementation of this approach into the actual trend is also missing.
- The prediction of evolution of the corrosion in different environments and the calculation of the remaining life until the ad-hoc structural limit state are not contained in present Codes. A gap exists which needs pre-normative documents which could be used to gain experience with the aim to have rules incorporated into the future structural codes.

Progress

- Kick-off meeting held in virtual mode in October 2022 with 24 participants: General presentation of the goals and the content of the new TC.
- Currently the TC has more than 60 members.
- 3 TC meetings held in the last 12 months.
- Revision of the old recommendations on on-site corrosion has started and its end is scheduled by the beginning of 2024.

Corrosion damage in structural elements of transport infrastructure made of reinforced concrete. Images courtesy of C. Andrade.

Service Life and Environmental Impact Assessment

Foreword

► **from Cluster D Convener,**
Anya VOLLPRACHT

Cluster D coordinates the activities of the Technical Committees (TCs) dealing with "Service life" and "environmental impact" of structures, mainly reinforced concrete structures. Currently, Cluster D comprises seven TCs. The most recent one is TC UMW Upcycling Powder Mineral "Wastes" into Cement Matrices, established in fall 2022.

One major topic in Cluster D is alkali-silica reaction (ASR), which is explored in two committees from different perspectives (TC 300-ARM and TC 301-ASR). Other service life aspects are stress corrosion and hydrogen embrittlement (TC 293-CCH) and the durability of marine structures (TC 289-DCM). With respect to the environmental issues, TC 299-TES investigates different methods to store thermal energy in order to improve the energy efficiency of buildings and TC UMW focuses on the use of mineral wastes in cement matrices, including the recycling of these new concretes. The TC DCS aims to gather, analyze and present the state-of-the-art on the use of AI algorithms (machine learning and deep learning) in concrete structures.

The first TC belonging to Cluster D was established in 1998 and it was *"183-MIB Microbial impacts on building materials – weathering and conservation"*. Since then, 27 TCs have worked under the coordination of the convener of Cluster D, a title that I have the honour to hold since September 2021. I took over the role previously filled by Dr Alexandra Bertron.

The first recommendation published by this Cluster dates back to 2000, *"RILEM TC 191-ARP 'Alkali-reactivity and prevention - Assessment, specification and diagnosis of alkali-reactivity' AAR-5: Rapid preliminary screening test for carbonate aggregates"*. Nine state-of-the-art-reports (STARs) have been published over the life span of Cluster D and at least four STARs are under preparation or nearly finalised. In addition, numerous journal papers and conference contributions are planned to transfer the knowledge and increase the visibility of RILEM.

Current TCs in Cluster D

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
UMW Upcycling Powder Mineral “Wastes” into Cement Matrices	Antonis KANEL LOPOULOS Theodore HANEIN	**NEW** Fall 2022
289-DCM Long-term durability of structural concretes in marine exposure conditions	Kefei LI Junjie ZENG	2019
293-CCH Stress Corrosion Cracking and Hydro-gen Embrittlement of Concrete-Reinforcing Steels	Javier SANCHEZ MONTERO Alvaro RIDRUEJO	2016
299-TES Thermal energy storage in cementitious composites	Jorge SÁNCHEZ DOLADO Antonio CAGGIANO	2020
300-ARM Alkali-aggregate reaction mitigation	Esperanza MENENDEZ MENDEZ Leandro SANCHEZ	2020
301-ASR Risk assessment of concrete mixture designs with alkali-silica reactive (ASR) aggregates	Jason H. IDEKER Klaartje DE WEERDT	2020
DCS Data-driven concrete science	Sandra NUNES Moncef NEHDI	2022

New

UMW Upcycling Powder Mineral "Wastes" into Cement Matrices

Chair Antonis KANELLOPOULOS
Deputy Chair Theodore HANEIN
Activity started in 2022

Experimental set-up and processing procedures for characterising and upcycling mineral wastes. Image courtesy of S. Maruthupandian.

Significance

Mineral wastes are typically rich in SiO_2, Al_2O_3, CaO, MgO, and Fe_2O_3, making them very attractive candidates to be used in the production of cementitious materials. In the last several years there is a growing interest in utilising such wastes in the manufacture of cement-based composites, particularly alkali-activated binders. Mineral wastes can offer a natural solution to the need to switch to alternative raw materials and at the same time be diverted from landfill while their own environmental impact is mitigated. Upcycling such wastes in the production of cements is the most promising way to improve resource efficiency and material circularisation while maintaining our natural reserves of raw materials.

Relevance

- The target audience of the committee are academics, researchers, PhD students, industrialists, policy makers, and practitioners.
- The outcomes of the work of the proposed TC will enable standardisation bodies to develop appropriate documentation for the upcycling of mineral wastes in cementitious binders. This, in turn, will increase the confidence of practitioners hence leading to significant upcycling of such wastes.

Goals

- The purpose of this new RILEM Technical Committee (TC) is to compile the plethora of available information and knowledge on the reuse and upcycling of all mineral wastes in cementitious matrices.
- A topical collection in *Materials and Structures* on the upcycling of mineral wastes in cementitious matrices, an international workshop, and technical and practical are also outcomes of the work of this TC.

Methodology

The work of this committee will be organised in working groups (WG):

- WG1 – Develop mineral wastes inventory/maps and classification (Lead: Arne Peys).
- WG2 – Utilisation of mineral wastes in clinker-derived cementitious matrices (Lead: Liberato Ferrara).
- WG3 – Utilisation of mineral wastes in alkali and acid activated cements (Lead: Luca Valentini).
- WG4 – Pre-processing, Separation, and Environmental considerations (Lead: Jose Luis Galvez).

Progress (May 2023)

- The kick-off meeting took place virtually in March 2023 with 63 participants. The chair provided an overview of the TC, and the WG leaders introduced the respective working groups.
- Since March 2023, the committee has grown to a total of 110 members.
- During the first meeting, it was decided that the TC will have its first face-to-face meeting/workshop at the RILEM Spring Convention in Milan, in April 2024.

289-DC Long-term durability of structural concretes in marine exposure conditions

Chair Kefei LI
Deputy Chair Junjie ZENG
Activity started in 2019

Significance

Data collection from exposure stations is rather intuitive, and a systematic format for data collection/presentation is missed.
The standardized of data presentation will greatly increase the added value of exposure data. The interpretation of exposure data through apparent chloride diffusivity is not enough, and the research community is ready to investigate more practical indicators through advanced modelling.

Progress

- TC general meeting in Nov 2022: 17 members + guests.
- Li, K., Zeng, J., Tang, L. et al. Long-term field exposure of structural concretes in marine environment: state-of-the-art review by RILEM TC 289-DCM. Mater Struct 55, 205 (2022).

Exposure site in Cayo Santa-Maria, Cuba. Image courtesy of J. F. Martirena Hernández.

- "RILEM Recommendation from TC 289-DCM: Guideline for designing and operating long-term marine exposure sites" being finalised for submission to *Materials and Structures*.
- State-of-the-art report (STAR): preparation started.

293-CCH Stress corrosion cracking and hydrogen embrittlement of concrete-reinforcing steel

Chair Javier SANCHEZ MONTERO
Deputy Chair Alvaro RIDRUEJO
Activity started in 2016

Significance

Many structural components made of steel, including pretensioned and post-tensioned concrete structures fail due to stress corrosion cracking (SCC) and hydrogen embrittlement (HE). The coupled chemical, mechanical and physical mechanisms of SCC and HE have not been satisfactorily explained yet. Understanding the chemical and physical interactions involving crack propagation by SCC and hydrogen inside the iron lattice would help to understand, control, and prevent the catastrophic mechanical failure of steel. There is no general agreement on testing methods for the study of SCC. Over the last years, the advent of new modelling tools have greatly boosted the predictive power of computer simulations. Making these tools accessible to a wider audience will reduce cost and improve the safety of many structural components.

Progress

- State-of-the-art report (STAR): assembling the first version of the book for review by all the authors, completion expected by the end of 2023.

Steel sample that has suffered hydrogen embrittlement. Image courtesy of J. Sanchez Montero.

- TC meetings: only bilateral meetings between STAR authors in the last 12 months.
- Final TC plenary meeting after the editing of the STAR chapters.
- Final presentation of TC: RILEM Spring Convention in 2024.

299-TES Thermal energy storage in cementitious composites

Chair Jorge SANCHEZ DOLADO
Deputy Chair Antonio CAGGIANO
Activity started in 2020

Significance

Energy supply is a vital issue, with special concerns of the public regarding the emission of greenhouse gases and the need to reduce the use of fossil fuels. Energy consumption in EU buildings counts with almost 40 percent of the total demand. Energy efficiency and novel technologies are considered the key pillars for limiting the high consumption for the new and existing building stock. The main challenge of most renewable energies (wind, solar, etc.) is to find appropriate energy storage devices to correct the mismatch between the supply and demand of energy. Concrete and cement-based materials present themselves as good solid material for Thermal Energy Storage (TES) applications, as they are abundant, cheap and have relatively good thermal capacities for such a purpose.

Progress

- TC meeting and Workshop held during the Net Zero Carbon Buildings | Energy Neutral and Sustainability in Construction and Building Materials, in Dec 2022.

Members of TC 299-TES at the TC meeting in Milos, Greece, in June 2023 for the Synercrete Conference. Images courtesy of A. Caggiano.

- TC meeting held during the Synercrete conference in Greece, June 2023, with a special Session focusing on RILEM TC 299-TES activities and outcomes.
- STAR will be replaced by a topical collection in *Materials and Structures*, on reviewing of Experimental techniques and Numerical methods.

300-ARM Alkali-aggregate reaction mitigation

Chair Esperanza MENENDEZ MENDEZ
Deputy Chair Leandro SANCHEZ
Activity started in 2020

Significance

Alkali-aggregate reaction (AAR) is one of the most harmful distress mechanisms affecting the durability and serviceability of aging structures worldwide. Several approaches, recommendations, and test procedures have been developed to assess the potential alkali-reactivity of concrete aggregates and the efficiency of preventive measures prior to AAR development in the field. There is currently no consensus about the most efficient method(s) that should be implemented, and when, for the mitigation of AAR-induced damage. This situation is extremely critical for some structures whose AAR-associated risks are extremely high since they cannot be easily rehabilitated nor replaced such as dams, nuclear power plants, tunnels, bridges, etc.

Progress

- TC plenary meeting held online in Jan 2023; WPs meet every 2 – 3 months.

Dam of Santa Luzia affected by ASR. Technical visit of ICAAR – Lisbon, June 2022. Image courtesy of I. Fernandes.

- Special session at the International Conference on Alkali-Aggregate Reaction (ICAAR) in Concrete, in May 2024, Canada.
- STAR is taking shape.
- Activities will be completed by fall 2025.

301-ASR Risk assessment of concrete mixture designs with alkali-silica reactive (ASR) aggregates

Chair Jason H. IDEKER
Deputy Chair Klaartje DE WEERDT
Activity started in 2020

Significance

Alkali-silica reaction (ASR) is a well-known concrete durability problem. However, the industry needs clear guidance on how to design and specify concrete mixtures that are resistant to ASR. The TC will develop a framework for risk assessment of mixture designs for concrete prone to ASR. This framework would allow the user to determine a pathway for mixture designs with reduced risk for deleterious ASR.

Progress

- WP1 activities: Review on Current AAR Assessment Schemes; Review on ASR Test Methods (first draft, co-authors reviewing); Review of Exposure Block Studies.
- WP2 activities: Verification of ARA in AAR10 (proof of concept); Develop pore solution database (~70% complete); Thermodynamic Modeling of Impact of Pore Solution on Silica Dissolution from Aggregate.

TC 301-ASR members at the TC meeting in Reykjavik Iceland (11-12 May 2023). Image courtesy of B. J. Wigum.

- WP3: Review on Modelling ASR on Material Scale (in progress); Database Containing Key Data for ASR Assessment Framework (in progress).
- TC meetings planned: 27-28 Nov 2023 at VDZ Düsseldorf Germany; 19 May 2024 in connection to the ICAAR, Ottawa, Canada.

DCS Data-driven concrete science

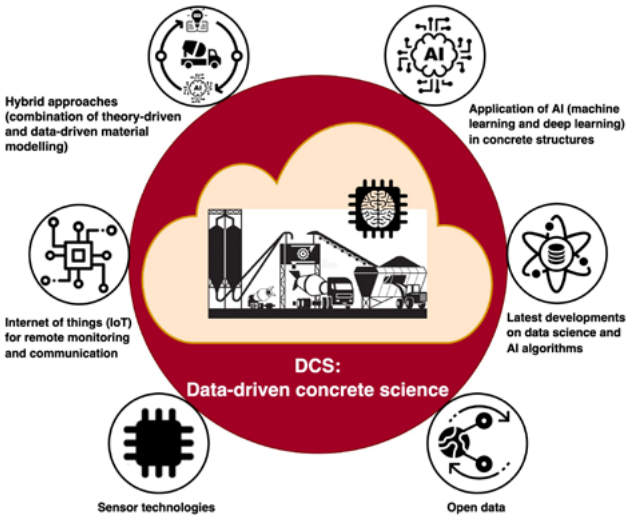
Chair Sandra NUNES
Deputy Chair Moncef NEHDI
Activity started in 2022

Significance

The concrete industry is increasingly in need of intelligent tools to further develop and use concrete in important structures. It also needs more advanced simulation tools for concrete performance validation and uncertainty quantification. Such requirements are well aligned with recent developments in data-driven models based on artificial intelligence (AI).
A better use of existing data, as well as the availability of more structured and validated information of the materials and components, are essential for the ability to reliably simulate options and make sound decisions. Open data sharing among the concrete research community is still in its infancy and actions at various levels are required.

Progress

- This TC was approved in Spring 2022 and its kick-off meeting took place in September 2022.
- Since then, TC has attracted more than 70 members.



Schematics of the work programme of TC DCS. Image courtesy of W. Taffese.

- TC (hybrid) meeting held during the 2023 RILEM Spring Convention in Rabat, Morocco.
- Plans to organize the 1st International RILEM Symposium on "Data-Driven Concrete Science" no later than December 2027.

Masonry, Timber and Cultural Heritage

Foreword

► **from Cluster E Convener,**
Arun MENON

Cluster E coordinates the activities of the Technical Committees (TCs) dealing with “Masonry, Timber and Cultural Heritage”. At the moment, it comprises six TCs, working repair mortars (277-LHS), masonry reinforcement (290-IMC), timber joints (TPT), and on earthen-materials (BEC, MAE and PEM).

Several of these topics have been addressed by RILEM TCs since a long time, but only recently was a dedicated Cluster established. In fact, the first recommendations on masonry date back to 1988, on timber to 1990, on rammed earth to 1997 and on historic mortars to 2000.

As a general trend, the aim of the TCs has moved from the characterization of the historic substrates (e.g., mortar, masonry, timber) to the development of testing methods to assess the performance of conservation and reinforcement strategies for these substrates (e.g., repair mortars, composite materials applied to masonry and timber). To evaluate the suitability of the new conservation strategies, not only their effectiveness is addressed, but also their compatibility with the historic substrates, their durability over time and their environmental sustainability are gaining increasing attention by the TCs. The recent decision to establish a Cluster specifically dedicated to the building materials constituting our Cultural Heritage has a twofold meaning. On the one hand, it is an important recognition of the value that RILEM attributes to research on these historic materials and to the urgency to develop successful strategies for their conservation. On the other hand, it highlights the importance that the research and the practice of cultural heritage conservation be carried out with the same rigorous scientific approach that RILEM applies to all the other fields of building materials and structures.

I have been Convener of Cluster E since September 2021, when I took over the role previously filled by Dr Enrico Sassoni, (University of Bologna, Italy).

Current TCs in Cluster E

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
277-LHS Specifications for testing and evaluation of lime-based repair materials for historic Structures	Ioanna PAPAYIANNI Jan VALEK	2017
290-IMC Durability of Inorganic Matrix Composites used for Strengthening of Masonry Constructions	Antonietta AIELLO Catherine PAPANICOLAOU	2019
BEC Bio-stabilised earth-based construction: per-formance-approach for better resilience	Ana BRAS Céline PERLOT	2022
MAE Mechanical performance and durability assessment of earthen elements and structures	Antonin FABBRI Christopher BECKETT	2022
PEM Processing of earth-based materials	Emmanuel KEITA Arnaud PERROT	2022
TPT Tests methods for a reliable characterization of resistance, stiffness and deformation properties of timber joints	Jorge BRANCO Andreas RINGHOFER	2021

277-LHS Specifications for testing and evaluation of lime-based repair materials for historic structures

Chair Ioanna PAPAYIANNI
Deputy Chair Jan VALEK
Activity started in 2017

Significance

The current trend in repairing Historic Structures (HS) is the use of Lime-Based Materials L-b-M. However, test procedures for repair mortars/grouts follow standards established for cement-based mortars/grouts. It is important to adapt/modify standard procedures for testing basic properties of L-b-M.

Progress

- Maravelaki, PN., Kapetanaki, K., Papayianni, I. et al. RILEM TC 277-LHS report: additives and admixtures for modern lime-based mortars. Mater Struct 56, 106 (2023).
- Groot, C., Veiga, R., Papayianni, I. et al. RILEM TC 277-LHS report: lime-based mortars for restoration–a review on long-term durability aspects and experience from practice. Mater Struct 55, 245 (2022).
- Veiga, R., Faria, P., van Hees, R. et *al.* RILEM TC 277-LHS report: properties of lime-based renders and plasters—discussion of current test methods and proposals for improvement. *Mater Struct* **56**, 70 (2023).

International RILEM Workshop Lime based materials for repairing historic structures. Image courtesy of TC 277-LHS.

- Pavia, S., Veiga, R., Hughes, J. et *al.* RILEM TC 277-LHS report: How hot are hot-lime-mixed mortars? A review. *Mater Struct* **56**, 87 (2023).
- Papayianni, I.; Hughes, J. Testing Properties Governing the Durability of Lime-Based Repair Mortars. RILEM Tech Lett 2019, 3, 135-139.
- Participation of TC 277-LHS members in the 6th Historic Mortars Conference (HMC2022) was very good and attendance very active.

290-IMC Durability of inorganic matrix composites used for strengthening of masonry constructions

Chair Maria Antonietta AIELLO
Deputy Chair Catherine PAPANICOLAOU
Activity started in 2016

Significance

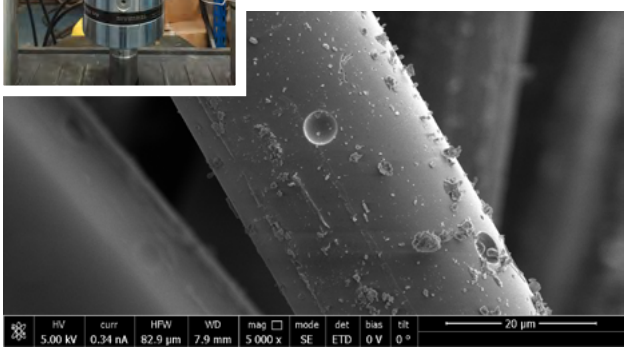
Fiber Reinforced Polymer (FRP) materials do not always provide an efficient strengthening solution for masonry structures. Inorganic Matrix Composites (IMC) have been studied as an affordable solution, especially for historical masonry.
The study of the long-term behaviour, currently missing, is necessary in order to provide complete design guidelines for practitioners.

Progress

Testing is ongoing; the campaign will be concluded early 2024.

- A TC paper has been decided to be drafted covering for the main lessons learnt during the test campaign.
- STAR "Strengthening of masonry structures with IMC: Durability aspects/structural implications": final Springer formatted drafts checked by editors.

◂ Tensile test on glass FRCM. Image courtesy of University of Roma Tre.



▾ SEM Microscopy on glass fibers after moderate alkaline exposure. Image courtesy of University of Salento.

BEC Bio-stabilised earth-based construction: performance-approach for better resilience

Chair Ana BRAS
Deputy Chair Céline PERLOT
Activity started in 2022

Significance

- The main weakness of earth-based construction materials is their sensitivity to water. To overcome this, the materials could be reinforced through stabilisations methods.
- The most frequent hydraulic binders (lime or cement) are used as chemical stabilisers, but they have the disadvantage to increase the carbon footprint of the earthen materials.
- Alternative bio-sourced methods with low environmental impact are increasingly used.
- There is no fully established classification of bio-additives and bio-stabilisation methods.

Progress

- TC meetings held in the last 12 months: November 2022: meeting in Lyon, France (hybrid mode); March 2023 during the 2023 RILEM Spring Convention in Rabat, Morocco.
- An online webinar on 5 June was organised around scientific presentations by 12 PhDs. 42 people took part. The 3 best presentations were awarded.
- Particular attention is paid to the coordination of this TC with the other two RILEM TCs on earthen materials, PEM and MAE: meetings of the 3 Chairs and 3 Deputy Chairs held regularly.
- Organisation of the Second International RILEM Conference on Earthen Construction, in Edinburgh in July 2024, and the doctoral school at the beginning of July, part of which will focus on TC BEC themes.

Screen shot of the online kick-off meeting of TC BEC, that was held in June 2022. Image courtesy of C. Perlot.

MAE Mechanical performance and durability assessment of earthen elements and structures

Chair Antonin FABBRI
Deputy Chair Christopher BECKETT
Activity started in 2022

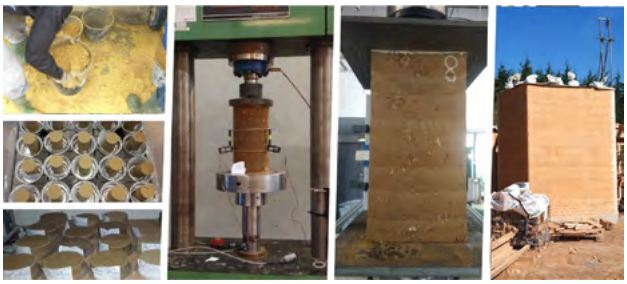
Significance

The relevance of building with earth in the 21st century has already been shown in showcase examples built in Switzerland (by Martin Rauch), France (by Nicolas Meunier) and China (by Lu Wenyu and Wang Shu - 2012 Pritzker Prize). However, the prospects of earthen and bio-based materials of entering mainstream construction, and a fortiori as the main structural materials, are limited notably due to the lack of knowledge on the assessment of their performance and durability.

A good understanding of the behaviour of crude earth is also crucial to develop proper methodologies for the rehabilitation and maintenance of buildings constructed more than 50 years ago.

Progress

- TC meetings held in the last 12 months: Kick-off in June 2022, online; in Lyon, France (hybrid mode), in Nov 2022; in March 2023 during the 2023 RILEM Spring Convention in Rabat, Morocco.
- Organisation of the Second International RILEM Conference on Earthen Construction (ICEC2024), in Edinburgh, UK, in July 2024.
- Previous TC 274-TCE : Testing and characterisation of earth-based building materials and elements involved 9 labs in RRT campaign. Expect the same 9 labs to contribute, along with new partners.
- Working Groups: defined.



From the left to the middle: preparation and testing of earth-based material samples. On the right: full size (unscaled) rammed earth test wall. Image courtesy of A. Fabbri.

PEM Processing of earth-based materials

Chair Emmanuel KEITA
Deputy Chair Arnaud PERROT
Activity started in 2022

3D printing of earth-based materials. Image courtesy of A. Perrot.

Significance

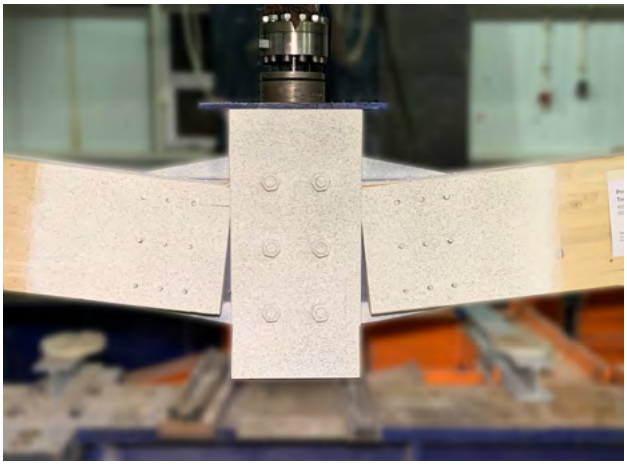
- The building sector contributes by a significant share to the entropic carbon emissions. In this context, earth appears as a promising solution for low carbon emission, recycling, and reuse in the construction field.
- In recent years, various rheometric and characterisation tests have been developed for earth-based building materials. However, some large scope aspects are often lacking.
- There is a need to understand the underlying physics behind the additives effect in order to have mix-design strategies not only based on trials and errors or empirical methods.
- This TC will deal with the behaviour of earth-based material in its fresh state and during hardening.

Progress

- TC meetings held in the last 12 months: Kick-off meeting in Sept 2022, online; hybrid meeting in Lyon, France in Nov 2022; in March 2023 during the 2023 RILEM Spring Convention in Rabat, Morocco.
- Identification of potential labs/tests for round robin exercise: RRTs planned for comparison of methods for the determination of the fresh state behaviour of earth based materials.
- WP1- Rheophysics; WP2- Rheometry; WP3-Curing & Drying; WP4-New processes.

TPT Tests methods for a reliable characterization of resistance, stiffness and deformation properties of timber joints

Chair Jorge BRANCO
Deputy Chair Andreas RINGHOFER
Activity started in 2021



Laboratory testing of a timber joint. Image courtesy of J. Branco.

Significance

- Existing test standards and protocols on timber joints are limited to the very simplistic nature of traditional connections.
- Although experimental campaigns provide important information on the mechanical behaviour of modern connections, the non-standardization of the test procedures often precludes the comparison between the obtained results.
- In order to allow for a better future evaluation and reusability of experimental data, existing testing protocols for timber joints should be discussed and reviewed.
- Reliable and well-established assessment methods are required, to support the safe and economic design of timber joints.

Progress

- TC meetings held in the last 12 months: online meetings on 20th December 2022 and 16th April 2023; in-person meeting on 22nd June 2023.
- Sub-groups formed: (a) Dowel type fasteners; (b) Self tapping screws (SFS); (c) Glued in roads (GiR).
- State of the Art workshop within the World Conference on Timber Engineering (WCTE) in June 2023, in Oslo, Norway. During the workshop, new members have demonstrated interest to join the TC.
- A discussion has started on how to proceed with the round-robin test.

Cluster F

Bituminous Materials and Polymers

Foreword
▸ from Cluster F Convener,
Eshan DAVE

Since the late 1960s RILEM activities in the field of Bituminous Materials and Polymers have been focusing on design and technical development of bituminous pavement infrastructures, that are mainly built from natural aggregate and asphalt binders derived from crude oils. Use of non-petroleum-based binders and additives as well as recycled asphalt materials in bituminous pavement infrastructures is also on a steady rise.

Facing the need for increased sustainability and resilience for road infrastructure, around 24 Technical Committees have been treating the challenging objectives to characterize and steadily develop the complex performance of these materials as well as to optimize design, construction, rehabilitation and recycling technologies to achieve most sustainable life cycles and to adapt to climate change. Currently, Cluster F, chaired by Eshan V. Dave, University of New Hampshire, USA, engages approximately 150 experts from 25 countries, and is composed of 5 Technical Committees (TCs).

These committees are and have always been most efficient research and development platforms for connecting professionals from all over the world in the field of bituminous materials research to share their expertise, to develop recommendations on testing and evaluation approaches and to publish state-of-the-art reports and papers in the RILEM Journal of *Materials and Structures*. Activities under the umbrella of RILEM have contributed a lot to strengthen the asphalt research community, and to steadily remind all members of being united people, researching together for a prosperous and sustainable future.

RILEM and ISAP - International Society for Asphalt Pavements have been partners for a long time. To strengthen the collaboration between these institutions, RILEM have co-sponsored the ISAP annual conferences during which some meetings of Cluster F TCs take place, further, there have been co-sponsored workshops and other knowledge dissemination and technology transfer activities.

Current TCs in Cluster F

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN
280-CBE Multiphase characterisation of cold bitumen emulsion materials	Andrea GRAZIANI Alan CARTER	2017
295-FBB Fingerprinting bituminous binders using physico-chemical analysis	Bernhard HOFKO Katerina VARVERI	2020
307-PPB Physicochemical effects of polymers in bitumen	Hinrich GROTHE Ayse KOYUN	2021
308-PAR Performance-based Asphalt Recycling	Gabriele TEBALDI Eshan V. DAVE	2022
FEE Fume Emissions Evaluation for Asphalt Materials	Johan BLOM Laurent POROT	2021

280-CBE Multiphase characterisation of cold bitumen emulsion materials

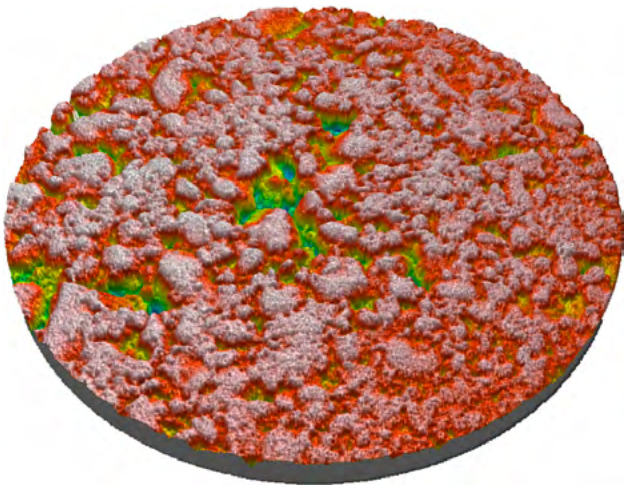
Chair Andrea GRAZIANI
Deputy Chair Alan CARTER
Activity started in 2017

Significance

Cold bitumen emulsion technologies are proven sustainable solutions for pavement construction and rehabilitation. A lack in fundamental knowledge on the long-term behaviour of structural and non-structural cold bitumen emulsion materials limits their usage. TC 280-CBE will develop a consistent experimental framework for characterizing the mix design and performance properties of cold microsurfacings.

Progress

- Experimental activities completed, TC leaders are preparing two Recommendations and STAR.
- Final event: workshop on 15 June 2023 during the EATA conference in Gdansk.



3D model of a textured asphalt concrete core prior to applying a Cold Bituminous Microsurfacings. Image courtesy of F. Balzano and C. Sangiorgi.

295-FBB Fingerprinting bituminous binders using physico-chemical analysis

Chair Bernhard HOFKO
Deputy Chair Aikaterini VARVERI
Activity started in 2020

Significance

Bitumen is an organic material and as such it is prone to aging. Oxidative aging causes an increase of brittleness and stiffness, resulting in higher risk for cracking. We need to track bitumen oxidation to ensure long-lasting and sustainable road infrastructure. Enhanced long-term performance can also be achieved by modifying bitumen with various polymers, rejuvenators or other additives. However, simple and standardized analysis methods to detect these additives in bitumen are missing.

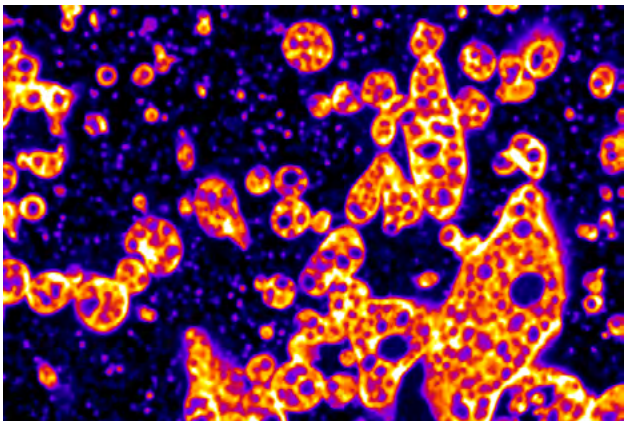
FTIR device to detect chemical composition of bituminous samples. Image courtesy of J. Mirwald.

Progress

- TG1: Phase 1 - First results (measurement of 1 unaged binder and reference material) is completed and discussed among the analysis group; Phase 2: Finalizing the round robin testing of the remaining 8 binders until March 2023. Continuous troubleshooting throughout the year by individual labs and TG leader. First journal publication on the TG1 round-robin test results planned for 2023.
- TG2: Two focus groups working on systematic reviews on: 1) Review of the Promising Elemental Analysis Techniques as Diagnostic Tools to Detect Additive Presence in Bituminous Binders ; 2) Dynamic Scanning Calorimetry for Fingerprinting of Bituminous Binders from Different Sources: A Systematic Review.
- High level of interest in academia and industry, which leads to fruitful discussions among members.

307-PPB Physicochemical effects of polymers in bitumen

Chair Hinrich GROTHE
Deputy Chair Sayeda NAHAR
Activity starting in 2021



Fluorescence micrograph of phase separation in highly polymer-modified. Image courtesy of M. Miljković

Significance

The spectroscopic and microscopic techniques (like infrared and fluorescence spectroscopy and microscopy, atomic force microscopy, and scanning electron microscopy) are increasingly getting into the focus of scientists because they are able to characterise the chemical and microstructural changes of bitumen from a more intrinsic aspect. The goal of this TC is to identify and compare available methods for fingerprinting and quantification of certain additives and judge their benefits.

Progress

This TC was approved in Fall 2021 and had its kick-off meeting in March 2022 via Zoom. Since then, three further zoom meetings and an in-person meeting in Palermo, Italy, in September 2022 were organized. The following progress has been made so far:

- An integral interlaboratory testing program has been developed and is undergoing implementation.
- Both Task Groups (TGs) started to work on a literature review of the theoretical background with an aim to publish a review article on the fundamental knowledge in physicochemical effects of polymers in bitumen.
- The TC members have agreed to expand the work on numerical modelling of polymer-bitumen systems in accordance with the interlaboratory testing.

308-PAR Performance-based Asphalt Recycling

Chair Gabriele TEBALDI
Deputy Chair Eshan V. DAVE
Activity started in 2022

Photo of the kick-off meeting of TC PAR in June 2022. Image courtesy of E. Dave.

Significance

Although the significant efforts underway to develop and implement balanced mix design tools for bituminous mixtures that adopt performance related laboratory tests to support proportioning of mixture, there is a lack of consensus on the selection of laboratory tests as well as their thresholds.

The outcomes of this TC will have balance between fundamental developments and knowledge disseminations to aid in improved mixture design methods and use of life-cycle analysis tools.

Progress

- TC meeting during Cluster F annual week in Palermo, Italy, in Sept 2022.
- Activities:
  - TG-1: Working with industry partners to identify trial sections for use by TG.
  - TG-2: Testing work plan has been finalized and participant labs have been identified.
  - TG-3: Core group working on refine objectives and workplan. Starting with 264-RAP : Asphalt Pavement Recycling outcomes and analysis
  - TG-4: More than 6 meetings held, interlaboratory study has been launched
  - TG-5: More than 4 meetings held, expert panel on EPD/PCR was held in February 2023
- 2023 TC Industrial Workshop in Warsaw, Poland, in conjunction with EATA conference.
- Annual TC meeting will be held in Lyon (France) in November 2023.

FEE Fume emission evaluation for asphalt materials

Chair Johan BLOM
Deputy Chair Laurent POROT
Activity starting in 2021

Significance

Bituminous materials are widely used for paving and roofing applications. During the manufacturing elevated temperatures are required. As organic-based material, the bituminous binder emits fumes and emissions, including Volatile Organic Components (VOC). Proper qualification and quantification of fume emissions from asphalt materials are gaining more and more interest today. However, there are various ways to define and quantify fume emissions from asphalt materials, but no standardised methodology has been established so far.

Ion Tiger VOC gas detector using photoionisation (pid). Image courtesy of J. Blom.

Progress

- In 2023, all Technical Groups (TGs) had a meeting. An additional TG meeting will be organized during the 77th RILEM Annual Week in Vancouver, Canada.
- TG-1 focused on an extensive literature review, which will be completed by the end of 2023.
- Alongside this, discussions were initiated within the TG-1 regarding the selection of fume measuring devices, calibration methods, and interpretation of measurements.
- TG-3 administered an industry survey through the European Asphalt Paving Association.

Recently closed TCs

In the last 12 months, the TCs presented in the table below have been officially closed as they completed their work or reached the end of their lifespan.

CODE TITLE	CHAIR DEPUTY CHAIR	TC OPENED IN TC CLOSED IN
273-RAC Structural behaviour and innovation of recycled aggregate concrete	Jianzhuang XIAO Yamei ZHANG	2015 Fall 2022
274-TCE Testing and characterisation of earth-based building materials and elements	Jean-Claude MOREL Antonin FABBRI	2016 Fall 2022
272-PIM Phase and Interphase behaviour of bituminous Materials	Emmanuel CHAILLEUX Christiane RAAB	2016 Fall 2022
266-MRP Measuring Rheological Properties of Cement-based Materials	Mohammed SONEBI Dimitri FEYS	2015 Spring 2023
271-ASC Accelerated laboratory test for the assessment of the durability of materials with respect to salt crystallization	Barbara LUBELLI Inge RÖRIG-DALGAARD	2016 Spring 2023
278-CHA Crack-Healing of Asphalt Pavement Materials	Hassan BAAJ Orazio BAGLIERI	2016 Spring 2023
279-WMR Valorisation of Waste and Secondary Materials for Roads	Lily POULIKAKOS Emiliano PASQUINI	2017 Spring 2023
FTC Durability and Service Life of Concrete under the Influence of Freeze-Thaw Cycles combined with Chloride Penetration	Erik SCHLANGEN Peng ZHANG	2018 Spring 2023

More details of these recently closed TCs can be found in the previous editions of the RILEM Technical Report or by visiting the page "Index of past TCs" on our website. The activities in the last 12 months of these TCs is presented in the following lines:

273-RAC Structural behaviour and innovation of recycled aggregate concrete

- TC outcomes presented at the 76th RILEM Annual Week and International Conference on Regeneration and Conservation of Structures (ICRCS 2022). Video of the presentation available on the RILEM YouTube channel.

272-PIM Phase and Interphase behaviour of bituminous Materials

- Nahar, S., Porot, L. & Apostolidis, P. RILEM TC272-PIM: phase morphology of bituminous binders with liquid additives. *Mater Struct* 55, 239 (2022).

266-MRP Measuring Rheological Properties of Cement-based Materials

- Feys, D., Keller, H., El Cheikh, K. et *al.* RILEM TC 266-MRP: round-robin rheological tests on high performance mortar and concrete with adapted rheology—a comprehensive flow curve analysis. *Mater Struct* **56**, 105 (2023).
- Feys, D., Sonebi, M., Amziane, S. et *al.* RILEM TC 266-MRP: round-robin rheological tests on high performance mortar and concrete with adapted rheology—rheometers, mixtures and procedures. *Mater Struct* **56**, 90 (2023).
- TC outcomes presented at the 76th RILEM Annual Week and International Conference on Regeneration and Conservation of Structures (ICRCS 2022). Video of the presentation available on the RILEM YouTube channel.
- State-of-the-Art Report of the RILEM Technical Committee 266-MRP, Measuring Rheological Properties of Cement-based Materials, Editors: Mohammed Sonebi, Dimitri Feys, RILEM State Art Reports, volume 39.

271-ASC Accelerated laboratory test for the assessment of the durability of materials with respect to salt crystallization

- Lubelli, B., Rörig-Daalgard, I., Aguilar, A.M. et *al.* Recommendation of RILEM TC 271-ASC: New accelerated test procedure for the assessment of resistance of natural stone and fired-clay brick units against salt crystallization. *Mater Struct* **56**, 101 (2023).
- Lubelli, B., Aguilar, A.M., Beck, K. et al. A new accelerated salt weathering test by RILEM TC 271-ASC: preliminary round robin validation. *Mater Struct* **55**, 238 (2022).

278-CHA Crack-Healing of Asphalt Pavement Materials

- TC outcomes presented at the 76th RILEM Annual Week and International Conference on Regeneration and Conservation of Structures (ICRCS 2022). Video of the presentation available on the RILEM YouTube channel.

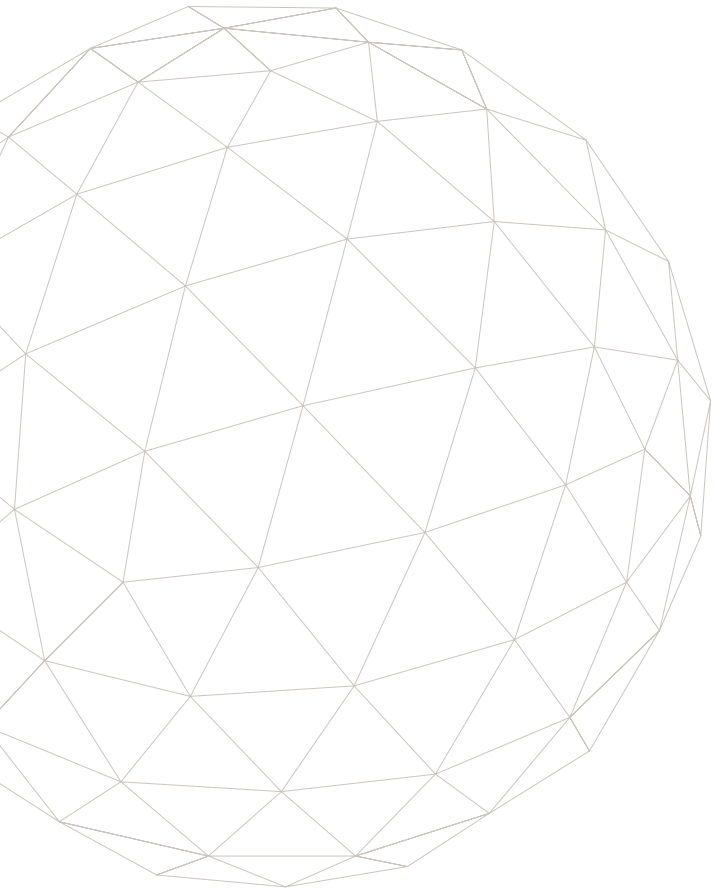
279-WMR Valorisation of Waste and Secondary Materials for Roads

- State-of-the-Art Report of the RILEM TC 279-WMR, Valorisation of Waste and Secondary Materials for Roads, Editors: Augusto Cannone Falchetto, Lily Poulikakos, Emiliano Pasquini, Di Wang, RILEM State Art Reports, volume 38.

A late publication of TC 243-SGM, closed in 2017, has also been released:

243-SGM Specifications for non-structural grouting of historic masonries and architectural surfaces

- Papayianni, I., Bicer-Simsir, B., Jornet, A. et *al.* RILEM TC 243-SGM report: grouting for historic architectural surfaces. *Mater Struct* **56**, 1 (2023).



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Concluding remarks

By the RILEM Presidents

I would like to start these concluding remarks from where the Editorial of this RILEM Technical Report ended: the RILEM members.

The mission of RILEM is to advance scientific knowledge related to construction materials, systems and structures and to encourage transfer and application of this knowledge world-wide. This knowledge is generated during the activities of the RILEM Technical Committees; there would not be any Committee without its members, and without a committee there wouldn't be any activity, any work, and any production and transfer of knowledge. The RILEM members are the foundation of RILEM, and I would like to join TAC Chair, Enrico Sassoni, in thanking them for their continuous and tremendous work.

The "circle of RILEM". Image courtesy of D. Ciancio.

Before the social media era, and more recently the COVID era, RILEM members could feel the warmth of being part of a big family only during a RILEM event. Attending in person a RILEM Annual Week or a RILEM Spring Convention was the occasion to shake hands, meet colleagues and friends, and nourish the professional network that RILEM offers to its members. Nowadays, a RILEM member can get his daily dose of RILEM connections without having to travel. Through its multiple social media channels, its

newsletter and news page, RILEM informs, connects, and updates the scientific community of construction materials and structures on a daily base. For this reason, I feel comfortable to state that one of the first benefits that RILEM offers to its members is the feeling of belonging to a living, diverse and active community.

A very special place inside this community is a Technical Committee, where members are invited to contribute to the discussion, but also to contradict their colleagues. They are open to both RILEM members and free registered users to make sure that everyone's voice is heard.

RILEM members enjoy several other benefits, that I would like to remind to the readers of this report:

1. Publishing open access papers: TC recommendations are open access papers published in *Materials and Structures* at no cost.
2. Publishing STARs with Springer: the State-of-the-Art reports are books edited and published by Springer. The editorial process has no cost.
3. Publishing Proceedings with RILEM Publications and Springer: TC members organising a conference can publish its proceedings at no cost.
4. Publishing articles at no cost in *RILEM Technical Letters,* an Open Access journal 100% financed by RILEM.
5. Accessing the directory of RILEM members and obtaining the contact details of colleagues working in several research areas from different parts of the world.
6. Being offered the possibility to meet in person during the RILEM Spring Convention and the RILEM Annual Week.

For all these reasons, the RILEM general secretariat has been very busy over the last couple of years to clear the rules and the terms of the RILEM membership. The mission of RILEM is achieved through a collective financial and human effort, to maintain and support the association. It is adamant that the benefits are shared amongst those who contributed with their time and their research funds. On this matter, TAC members have elaborated the diagram shown on page 13 that highlights the main differences between the benefits of a RILEM TC member paying her/his membership fee and a free registered user.

To a larger scale, another benefit of the RILEM network is related to the visibility that can be given by RILEM to courses, workshops and events supported by TAC through the RILEM co-sponsorship. RILEM helps these events with an advertising campaign that attracts attendants and delegates. We estimate that RILEM today is reaching out to around 8000 people around the world.

The spirit of RILEM is to welcome EVERYONE to actively contribute to a RILEM TC; this is why RILEM offers some significant discounts for members residing in countries with low to middle GDP per capita.

Finally, I would like to conclude by saying that RILEM has some responsibilities as duties towards the society and towards the planet; for this reason it is initiating a strategic workshop in occasion of the 78th RILEM Annual Week in Toulouse, France, in 2024, where the achievement of the lowest environmental impact, not only in the industry of construction materials, but also in the modus operandi of the association itself, will be discussed. I look forward to seeing you all there and write more about this topic in the next RILEM Technical Report.

Nicolas Roussel, RILEM President, on behalf of the RILEM Presidency (Nicolas Roussel - RILEM President, Nele De Belie – RILEM Vice-President, Ravindra Gettu – RILEM Past-President).

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