

Colloquium Final Report

N. 644 – Mechanics, Thermomechanics and Simulation of Short Fibre Reinforced Cementitious Composites

Dates and location: 17/06/2024 - 21/06/2024, Tallin, Estonia

Chairperson **Heiko Herrmann**

Co-Chairperson **Klaus Holschemacher**

Conference fees

- Registration **350.0 €**

What other funding was obtained? **Support in kind by Tallinn University of Technology (TalTech)**

What were the participants offered? **Conference bags containing schedule, book of abstracts, paper, maps; coffee breaks inclusive coffee, tea & snacks; "Ice breaker" dinner on Monday, conference banquet (Tuesday), social dinner (Wednesday), guided walking tour through Tallinn Old Town (Tuesday), tour of the university and civil engineering laboratories (Wednesday), nature walking tour through a bog at the edge of Tallinn (Thursday).**

Number of members of Euromech (reduced registration fee) **1**

Number of non-members of Euromech (full registration fee) **4**

Applicants (members)

- Klaus Holschemacher

Applicants (non members)

- Heiko Herrmann
- Anna Nowacka
- Yuri Ribakov
- Junqi Zhang

Scientific Report

Short Fibre Reinforced Cementitious Composites (SFRCC) are gaining rapidly

PRESIDENT

Professor Marc Geers
m.g.d.geers@tue.nl

VICE PRESIDENT

Professor GertJan van Heijst
g.j.f.v.heijst@tue.nl

SECRETARY GENERAL

Professor Jacques Magnaudet
jacques.magnaudet@imft.fr

MANAGEMENT ADVISOR

Sara Guttilla
sara.guttilla@euromech.org

TREASURER

Stefanie Reese
euromech@ifam.rwth-aachen.de

more importance in civil engineering, most prominently Steel Fibre Reinforced Concrete (SFRC). This composite is already quite extensively employed in the construction industry, for example in floors resting on soil and even in some load-bearing structures, such as ceilings.

Short fibers are added to the composite at the mixing stage and cast together. The fibers are supposed to replace the reinforcement bars and carry the tensile load, thus changing the material properties from brittle to ductile. The challenge is, that the material properties depend on the spatial spreading and orientation distribution of the fibers, which are influenced by the flow into the formwork.

Especially the addition of the short fibers makes the composite stochastically anisotropic and inhomogeneous, since several macro- and meso-scale properties depend on the spatial and orientational distribution of fibers. An important aspect is the micro-structure around the fibers and the adhesion of the matrix to the fibers, which has large influence on mechanical properties.

The goal of the colloquium was to present a platform for the exchange of ideas between participants.

There were altogether 5 participants and 6 presentations; see also the list of participants and programme. Most importantly, each presentation was scheduled for one hour, which is much longer than on typical conferences and offered plenty of time for discussions and to present the topic in detail. Furthermore, informal discussions took part during coffee and lunch breaks as well as during the social program.

Topics that have been discussed recurrently are:

– fiber orientation analysis

One presentation gave a detailed introduction of bending strength experiments and their analysis regarding fiber orientations using computed tomography and image analysis. The results showed that the bending strength varied significantly and in correlation with local fiber amount and more significantly with local fiber orientations.

- numerical simulations of fiber concrete casting

Fluid dynamical simulations of the casting process were shown as part of a presentation, the results demonstrated that this method is viable for explaining fiber orientations found in experiments and also can be used as a tool in planning the casting of fiber concrete to cast in a way that fiber orientations will be beneficial.

– influence of fiber orientations on cracking behavior, crack bridging

Another talk explained how to detect cracks in computed tomography images of fiber concrete reliably and fast. This is important in order to understand the crack bridging of fibers and their influence on the post-cracking strength.

- investigations of creep of steel fiber concrete

Creep in cracked fiber concrete happens more pronounced than in rebar reinforced concrete. Therefore the understanding of a correlation between amount of creep and fiber dosage, orientation and fiber type is very important for sustainable structures.

- numerical simulations of short fiber composites with high resolution based on measured fiber positions and orientations

A participant presented numerical simulations of strength experiments taking into account the fiber placement and orientations based on real samples. These

advanced high resolution simulations are based on an octree refinement of the mesh and a scaled boundary element method to be computationally efficient.

- efficient use of fibers by producing layered elements

High strength concrete and steel fibers are comparably expensive, thus requiring optimal use in order to be economically competitive. The production of layered structural elements with these components in layers where they are most effective is a compelling solution.

- recycling of fiber concrete

Today's relatively new emphasis on sustainability makes it important to think and discuss not only the building cost of a structure, but also its demolition and possible re-use of materials. While concrete and rebars can be separated relatively easily, separating concrete and fibers is more complicated, especially if non-metallic fibers are also considered. This was the topic of another presentation and discussions.

Despite the small number of participants, the colloquium covered a broad selection of connected topics that were interesting for all participants. The discussions were lively and very friendly, based on a real interest in the topics of the other participants.

We thank Euromech for making the meeting possible and for the financial support.

Number of participants from each country

| COUNTRY | PARTICIPANTS |
|----------------|---------------------|
| China | 1 |
| Germany | 2 |
| Estonia | 1 |
| Israel | 1 |
| TOTAL | 5 |

Please send this report in electronic form to the Secretary General of EUROMECH, within one month after your Colloquium.