Official RILEM EAC and TUDa Course

Computational Methods for Building Physics and Construction Materials

Hybrid!! April 8 – 12, 2024

NEW! – CPD Credits!

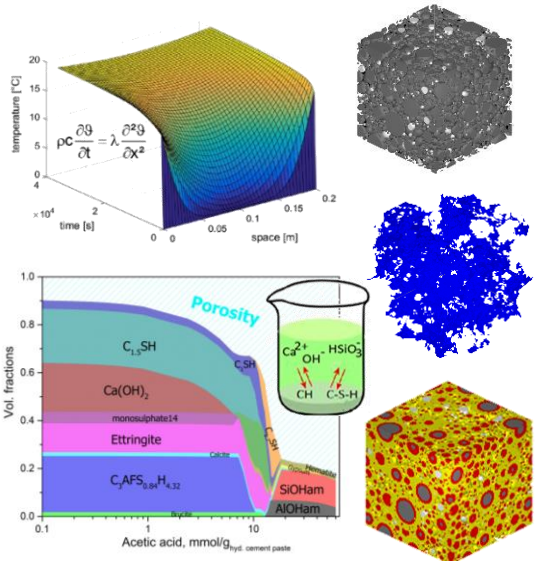
TECHNISCHE UNIVERSITÄT DARMSTADT
INSTITUT FÜR WERKSTOFFE IM BAUWESEN

unite! University Network for Innovation, Technology and Engineering

Teachers: Prof. Dr. ir. E.A.B. Koenders, Dr. chem.-Ing. N. Ukrainczyk
Prof. Dr.-Ing. Th. Matschei (RWTH Aachen), Dr.-Ing. C. Mankel
M.Sc. M. Löher, Dr.-Ing. F. Georget (RWTH Aachen)

Course description:

The course contains detailed lecturing on computational methods covering differential equations, numerical solution strategies, explicit and implicit discretization, Method of Lines, boundary conditions and implementation of physical processes that frequently occur in construction materials. Emphasis will be on the Finite Difference Method applied to transport processes in porous construction materials, such as concrete and insulation materials, and on hydration modelling. Typical problems that will be addressed are thermal, moisture and reactive transport modelling, multi-layer systems, coupled moisture - heat systems, cement particle structure, hydration kinetics and thermodynamic modelling, and the first steps towards high performance computing. The course provides a full solution strategy, starting from a physical problem, to schematization and discretization, to boundary conditions evaluation, implementation and to a computational solution.



Key topics:

- Steady state problems – discretization and implementation in Excel
- Transient problems – explicit & implicit heat and moisture flow – implementation in Octave
- Coupled and multi-layer systems for heat and moisture flow, discretization and implementation in Octave
- Particle structure formation and hydration kinetics of cementitious systems
- Thermodynamic modelling of cement hydration with GEM-Selektor
- High Performance Computing for large multi-core systems
- Demonstrations and exercises with examples for all topics

Course program:

		08. Apr 24	09. Apr 24	10. Apr 24	11. Apr 24	12. Apr 24
CMBPCM	**Time**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
	8.45 - 9.00	**Welcome - introduction RILEM and UNITE!**				
Lectures	9.00 - 10.15	**V1** Introduction schematization and discretization	**V5** Transient implicit implementation in Octave	**V9** Advanced time integrators and coupled systems	**V13** Particle structure schematization for cement microstructures	**V17** Thermodynamic (TD) modelling of cement hydration
	10.15 - 10.45	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
	10.45 - 12.30	**V2** Transient discretization problem, explicit method in Excel	**V6** Implementation of boundary conditions and multi-layer systems in Octave	**V10** Transient heat-moisture systems, implementation in Octave	**V14** Cement hydration kinetics theory	**V18** Demo + Exercise: GEM-Selektor for TD hydration modelling
	12.30 - 13.30	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
Demos	13.30 - 15.30	**V3** Demo on Octave and explicit transient implementations	**V7** Demo on implicit transient implementations	**V11** Demo on coupled heat moisture systems Octave/WUFI	**V15** Demo hydration in Octave and Hymostruc	**V19** High Performance Computing
	15.30 - 16.00	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
Exercise	16.00 - 17.30	**V4** Exercise: Chloride diffusion explicit excel/Octave	**V8** Exercise: Heat diffusion in a multi-layer wall in Octave	**V12** Exercise: Heat-moisture problem in Octave/WUFI	**V16** Exercise: Cement hydration in Octave/Hymostruc	**V20** Demo + Exercise: High Performance Computing

Objective:

Main objective of the course is to train MSc, PhD and Postdoc students, who are beginners or have no modelling experience, on how to solve partial differential equations and to become familiar with numerical solution strategies for common physical/chemical problems in construction materials. After finishing this course, students will be able to use computational methods for their own research and build their own basic computational models.

Venue:

The course will be provided in a hybrid format, where the actual course will take place at the TU Darmstadt and the online streaming will be offered via the platform ZOOM. A ZOOM-link will be sent shortly before every course day.

Registration fee:

Participant situation	Whole week [€]		Per day [€]	
	Online	TU Darmstadt	Online	TU Darmstadt
MSc students from the TU Darmstadt or UNITE! partners	free	free	free	free
MSc students from other Universities	75	150	30	50
PhD students and/or Postdocs	300	500	100	150
Professors or representatives from the industry	600	1000	200	300

Note: The fees already include RILEM discount.

The fee includes online course attendance, basic course materials like a PDF-copy of all PPTs, Octave, programming codes used during lectures and exercises, useful links to freeware, etc. Existing recordings of the full course will also made available for the participants via an online streaming platform until three weeks after the course.

Exam:

Non TU Darmstadt students may also opt for doing the exam. After succesful passing the exam, a formal document confirming the 6 ECTS will be provided by TU Darmstadt. This document can be used for your graduate school.

CPD Credits:

Continuing Professional Development Credits (CPD credits) will be provided by the Institute of Concrete Technology based on the hours of participation per day.

Enrollment:

TU Darmstadt MSc students can enroll via the TU Darmstadt TUCaN system. Other MSc-, PhD-students, PostDocs, Professors, UNITE! partners, or representatives from the industry, can enroll via the following contact information:

Enrollment website: Click here

Contact information:

Institute of Construction and Building Materials
Ms. A. Cevik
E-Mail: info@wib.tu-darmstadt.de
Tel: +49-6151-16-22210

Summary Course Information

Technische Universität Darmstadt
Institute of Construction and Building Materials
Campus Lichtwiese, TU Darmstadt
Address: Franziska-Braun-Straße 3, 64287 Darmstadt

Exam / ECTS: An exam will be provided / 6 ECTS
Room: Will be announced soon
Language: English