Official RILEM EAC and TUDa Course

Computational Methods for Building Physics and Construction Materials

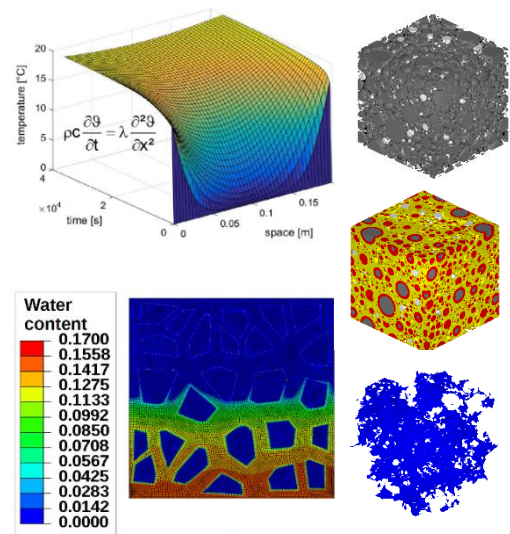**Date: April 6 – 9, 2020**

www.rilem.net

TECHNISCHE
UNIVERSITÄT
DARMSTADT

INSTITUT FÜR
WERKSTOFFE
IM BAUWESEN

Teachers: Prof. Dr. ir. E.A.B Koenders, Dr. chem. Ing. N. Ukrainczyk, Dr. Antonio Caggiano, M.Sc. Ch. Mankel

Course description:

The course contains in-depth lecturing on different computational methods for differential equations, numerical solution strategies, explicit and implicit discretization, finite difference method, method of lines, boundary conditions and implementation of physical processes that frequently occur in construction materials. Emphasis will be on the meso-scale level and on transport processes that are active in porous construction materials such as concrete, geopolymers, insulation materials, etc. Typical problems that will be addressed in this course will be on modelling moisture and/or reactive transport in porous media, heat transport and effect of insulation, coupled moisture - heat systems, and cement hydration kinetics. The course will provide a full solution strategy approach, so from a physical problem, to schematization and discretization, to boundary conditions evaluation, and to a computational solution.

$$\rho c \frac{\partial \vartheta}{\partial t} = \lambda \frac{\partial^2 \vartheta}{\partial x^2}$$

Water content
0.1700
0.1558
0.1417
0.1275
0.1133
0.0992
0.0850
0.0708
0.0567
0.0425
0.0283
0.0142
0.0000

Key topics:

- Steady state problems – discretization and implementation in Excel
- Transient problems – explicit & implicit heat and moisture flow – implementation in Octave/Matlab/FEM
- Coupled systems – heat and moisture flow, discretization and implementation in Octave/Matlab/FEM
- Particle structure formation and hydration kinetics of cementitious systems

Preliminary course program:

CM-2020	Time	Monday	Tuesday	Wednesday	Thursday
Lectures	8.30 - 10.15	Introduction schematization and discretization	Transient discretization problem explicit method in Octave/Matlab	Transient coupled systems, implicit implementation in Octave/Matlab	Particle structure schematization and Kinetics and implementation
	10.15 - 10.45	Coffee break	Coffee break	Coffee break	Coffee break
	10.45 - 12.30	Steady state problem, explicit implementation in Excel	Transient discretization problem, implicit implementation in Octave/Matlab	Transient heat-moisture systems, implicit implementation in Octave/Matlab	FEM - Discretisation and Implementation in Octave/Matlab
	12.30 - 13.30	Lunch	Lunch	Lunch	Lunch
Demos	13.30 - 15.30	Transient discretization problem, explicit method in Excel	Transient discretization problems, boundary conditions evaluation	Demo on coupled heat - moisture systems	Demo on hydration and FEM implementations
	15.30 - 16.00	Coffee break	Coffee break	Coffee break	Coffee break
Exercises	16.00 - 18.00	Demo on steady state Excel implementation Exercises 1	Demo on explicit transient implementations Exercises 2	Exercises 3	Exercises 4
	18.00	City walk	Free	Dinner	Free

Objective:

Objective of the course is to train MSc, PhD and Postdoc students on how to solve common differential equations and what solution strategies can be applied to simulate physical problems in construction materials. After finishing this course, students will be able to use computational methods skills for their own research.

Venue:

The course venue will be at the building of the department of Civil and Environmental Engineering Sciences **L5|01 Room 32** at the **Campus Lichtwiese of the TU Darmstadt.** Darmstadt is a "City of Science" which is situated in state of Hesse, near to Frankfurt. The University is one of Germany's leading TUs.

Costs:

– PhDs and Postdocs 500 Euros
– MSc students from the TU Darmstadt: Free
– MSc students from other Universities: 150 Euros

This includes the course attendance, basic course materials (PDF copy of PPTs, etc), a course dinner, and coffee breaks and lunches during the whole course week. Accommodation is not included.

Accommodation:

For this course accommodation will not be arranged by the organizers. Hotels or Bed and Breakfast options can be found from regular websites.

Contact information:

TU Darmstadt MSc students can register via the TU Darmstadt TUCaN system.

Other MSc, PhD or PostDoc students can register via the following 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	
CP / ECTS:	6 / 6	
Faculty/ Institute:	Building L5|01 Civil and Environmental Engineering Sciences	
Room:	Room 32	
Language:	English	