

**CURRENT POSITION (PROOF REQUIRED)**

PhD-, MSc-students, Postdocs

**Costs (EUR)**

850 euro

Professors / academic professionals

1300 euro

Professionals from industry

2550 euro

**THE COST FOR THE COURSE 2015 INCLUDES**

✓ Lecture material consists of a USB-stick containing all slides in PDF as presented during the course, literature, practical examples, a copy of the basic software that will also be used during the practical sessions.

✓ Lunch and refreshments during the day

✓ One course dinner

**PAYMENT INFORMATION**

Please follow the following payment procedure:

Make an online registration on the MMC website ([www.mmc.citg.tudelft.nl](http://www.mmc.citg.tudelft.nl)).

**Cancellation policy**

For written cancellations received before 1st September 2015, registration fees will be fully refunded. For written cancellations received after 1st September 2015 no refund will be made.

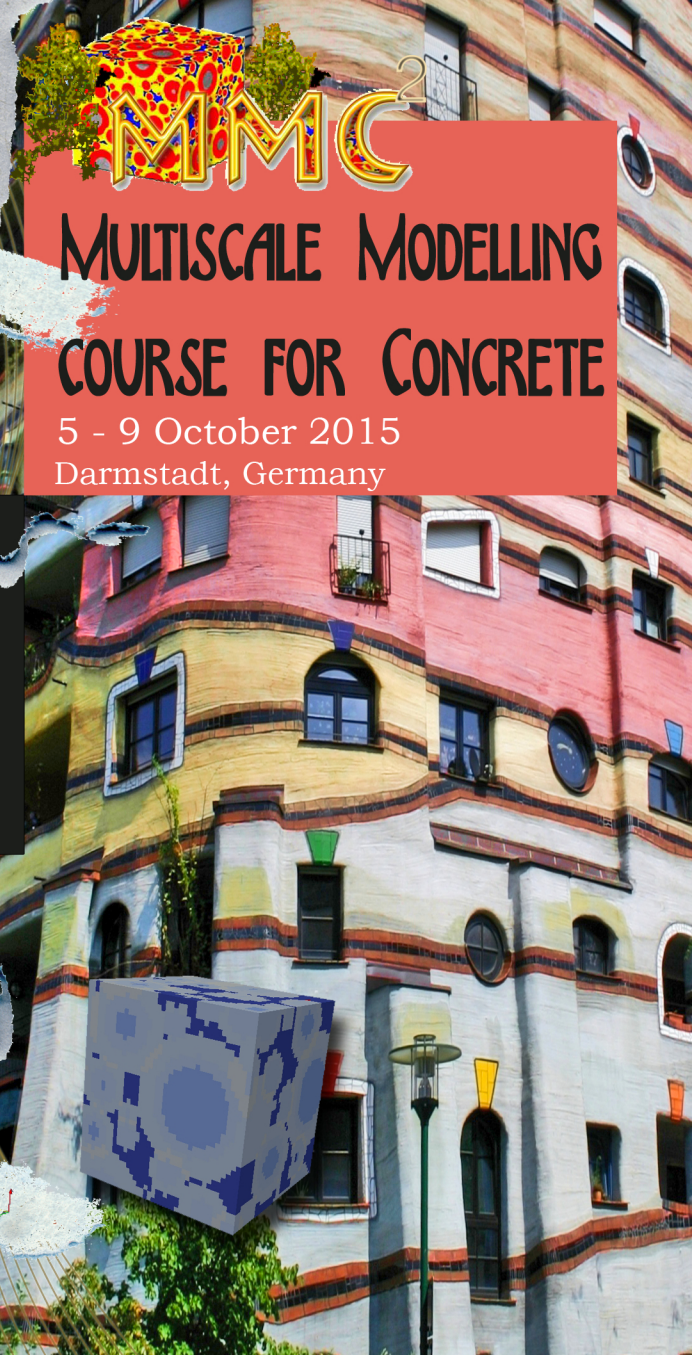
**TU Darmstadt**RILEM MMC<sup>2</sup> 2015

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# SCOPE

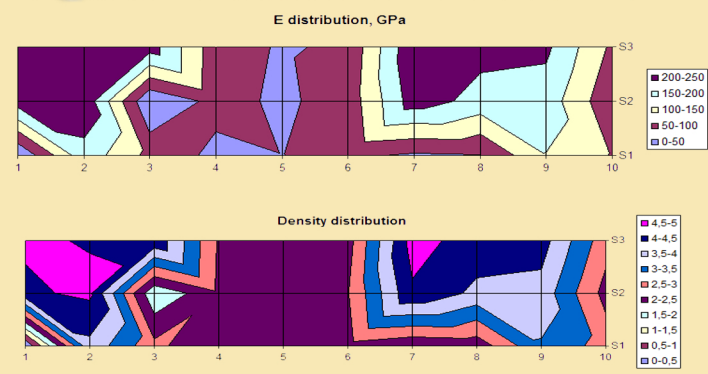
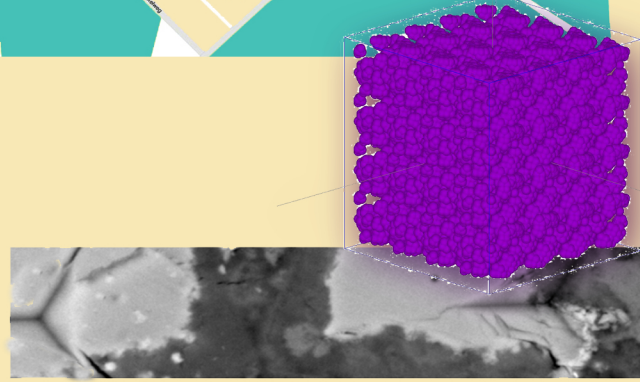
THE RILEM MULTI-SCALE MODELLING COURSE FOR CONCRETE (MMC<sup>2</sup>) PROVIDES THE OPPORTUNITY FOR PARTICIPANTS TO BECOME FAMILIAR WITH MODELLING CEMENTITIOUS MATERIALS AT FOUR DIFFERENT LEVELS OF DETAIL. DIFFERENT WAYS OF SCHEMATIZATION AND NUMERICAL APPROACHES ARE CONSIDERED TO SIMULATE THE CHEMICAL, PHYSICAL AND MECHANICAL BEHAVIOUR OF CEMENTITIOUS MATERIALS. THE MAIN BACK-BONE OF THE COURSE ARE THE DIFFERENT MODELLING LEVELS AT WHICH HETEROGENEOUS AND COMPOSITE CEMENTITIOUS MATERIALS CAN BE SCHEMATIZED AND HOW THESE DIFFERENT LEVELS CAN COMMUNICATE BY MEANS OF PARAMETERS PASSING METHODS OR THROUGH UPSCALING MODELS. THE MODELLING LEVELS THAT WILL BE TAUGHT IN THIS COURSE ARE THE MACRO-, MESO-, MICRO-, AND NANO-LEVEL. THE COURSE EMPHASIZES THE DIFFERENT MODELLING APPROACHES FOR EACH SCALE LEVEL AND SHOWS A COUPLE OF CONCEPTUAL TECHNIQUES ON HOW NUMERICAL GAPS BETWEEN SCALE LEVELS CAN BE BRIDGED. THE COURSE IS COMMENCING AT THE MACRO-SCALE LEVEL WHERE EMPHASIS IS ON EARLY-AGE TEMPERATURE AND STRESSES DEVELOPMENT OF HARDENING CONCRETE, AND HOW COMMERCIAL FEM SOFTWARE CAN BE APPLIED. THE MESO-LEVEL DEALS WITH FRACTURE MECHANICS AND BRITTLINESS WITH EMPHASIS ON THE LATTICE MODEL, FOLLOWED BY THE MICRO-LEVEL WHICH IS ON THE HYDRATION AND MICROSTRUCTURE PROPERTIES USING PIXEL AND VECTOR-BASED APPROACHES, AND FINALLY, THE NANO-LEVEL DEALING WITH THE BACKGROUNDS CSH GEL USING MOLECULAR DYNAMICS AND AB INITIO SCHEMES.

FOR THE COURSE PARTICIPANTS, THE MMC<sup>2</sup> COURSE PROVIDES A CHANCE TO ACQUIRE A GLANCE OF THE VARIETIES OF NUMERICAL POSSIBILITIES IN AN INTENSIVE COURSE WEEK OF LECTURES AND WORKSHOPS. THE COURSE IS SETUP IN SUCH A WAY THAT THEORETICAL LECTURES AND PRACTICAL WORKSHOPS ALTERNATE DAY BY DAY AND, BESIDES THIS, COURSE PARTICIPANTS ARE ALSO INVITED TO PRESENT THEMSELVES AND THEIR OWN WORK DURING AN ELEVATOR PITCH TALK. THERE WILL BE A MIX OF EVENTS AND TOPICS CENTRED AROUND THE THEME OF MULTI-SCALE MODELLING THAT MAKES THE COURSE VERY DYNAMIC.

FOLLOWING THE SUCCESS OF THE PAST SEVEN MMC<sup>2</sup> COURSES ORGANIZED SO FAR (DELFT 2008, NANJING 2009, BILBAO 2010, DELFT 2011, NANJING 2012, DELFT 2013, BEIJING 2014), THIS YEAR THE COURSE WILL BE ORGANIZED IN DARMSTADT, NEXT TO FRANKFURT. THE COURSE WILL BE CO-ORGANIZED BY THE MICROLAB OF DELFT UNIVERSITY OF TECHNOLOGY AND THE TECHNICAL UNIVERSITY OF DARMSTADT. LECTURERS WILL BE PROVIDED BY TEACHERS FROM DELFT UNIVERSITY OF TECHNOLOGY (MACRO, MESO AND MICRO), TECNALI SPAIN (NANO MODELING), AND THE TECHNICAL UNIVERSITY OF DARMSTADT (MICRO AND TRANSPORT MODELING). THE UPSCALING LECTURES WILL BE A JOINT CONTRIBUTION OF TEACHERS FROM TU DELFT AND TU DARMSTADT. MODELS WILL BE PRESENTED THAT ADDRESS ALL SCALE LEVELS WHICH MAKES THE COURSE A REAL MULTI-SCALE MODELLING COURSE, I.E. FROM MACRO - TO - NANO!

## SUMMARY:

- ADDRESSING LECTURES FOR MACRO- TO NANO- SCALE MODELLING.
- THEORETICAL AND PRACTICAL WORKSHOPS ON MULTI-SCALE MODELLING.
- MODELLING MECHANICAL, PHYSICAL AND CHEMICAL BEHAVIOUR AT DIFFERENT SCALE LEVELS.
- EMPHASIZING DIFFERENT APPROACHES OF MODELLING AND HOW NUMERICAL GAPS CAN BE BRIDGED.



## THE MMC<sup>2</sup> COURSE IS DESIGNED FOR:

- GRADUATE STUDENTS (PHD, MSc STUDENTS AND POSTDOCS)
- PROFESSORS AND OTHER ACADEMIC PROFESSIONALS
- PROFESSIONALS FROM INDUSTRY

THE COURSE IS INTENDED FOR PEOPLE WORKING IN AREAS WHERE MODELING KNOWLEDGE OF CEMENT BASED MATERIALS CAN GIVE YOU THE EDGE IN UNDERSTANDING PROBLEMS AND FINDING SOLUTIONS.

THE COURSE LEVEL IS SUITED FOR PHD CANDIDATES.

NO SPECIAL PRELIMINARY OR INITIAL TRAINING IS REQUIRED FOR THIS COURSE, ALTHOUGH IT IS PRESUMED THAT THE PARTICIPANT HAS BASIC KNOWLEDGE OF CONCRETE AND CONCRETE COMPOSITION.

IN OCTOBER 2015 THE ANNUAL FALL COURSE MULTISCALE MODELLING FOR CONCRETE WILL BE HELD FOR THE 8<sup>TH</sup> TIME. THE COURSE IS SCHEDULED FROM 5 - 9 OCTOBER 2015

## VENUE:

MMC<sup>2</sup> 2015 WILL BE HELD ON THE LICHTWIESE CAMPUS OF TECHNICAL UNIVERSITY OF DARMSTADT. DARMSTADT IS A "CITY OF SCIENCE" WHICH IS SITUATED IN THE SOUTH OF THE FEDERAL STATE OF HESSEN, NEARBY THE RIVERS RHEIN, MAIN AND NECKAR. TU DARMSTADT IS A WELL-RESPECTED AND INTERNATIONALLY RECOGNIZED UNIVERSITY BY TRADITION. AS ONE OF THE UNIVERSITIES IN GERMANY WITH THE HIGHEST NUMBER OF FOREIGN STUDENTS TU DARMSTADT FOLLOWS ITS AMBITIOUS INTERNATIONALIZATION STRATEGY IN ORDER TO ENHANCE THE INTERNATIONAL AND INTERCULTURAL SKILLS OF THE STUDENTS AND ATTRACT INTERNATIONAL MASTER'S STUDENTS AND FOREIGN SCIENTISTS.

