



# RILEM 252-CMB-SYMPOSIUM BRAUNSCHWEIG, GERMANY SEPTEMBER 17 – 18, 2018

CHEMO MECHANICAL CHARACTERIZATION OF BITUMINOUS MATERIALS

FourSide Hotel  
Braunschweig, Germany  
September 17 – 18, 2018

**Final Program**



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## WELCOME

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The symposium chairs and co-chairs would like to welcome the participants and thank all active members of the TC for their continuous support through participation, supply of materials and discussions during the TC activities.

The RILEM Technical Committee 252 CMB on Chemo-Mechanical Characterization of Bituminous Materials was launched in Stockholm in June 2013 by Niki Kringos and Lily Poulikakos. The TC was active for 5 years (2013-2018) and intended to combine chemical and mechanical characterization of bituminous materials in order to gain a better understanding of the behavior of this complex material. Through the cooperative effort facilitated through RILEM, it was possible to bring more visibility to this field of research which, in a traditional construction field, is not always easy to achieve.

Applying Chemo-Mechanics allows us to gain a better understanding of the long-term behavior of traditional and new materials such as mixtures containing a high amount of RAP and prepared at a lower temperature. Having a fundamental understanding of the combined chemo-mechanical properties can greatly enhance the tools used to improve the material's sustainability and functionality.

As it is apparent by the wide range of topics that are presented in the contributions of this symposium, chemo-mechanical characterization is gaining more acceptance within our community. The inputs were divided among 7 themes. Bitumen Aging Mechanisms and Characterization is the topic of Part I. Part II addresses Chemo-Mechanical Coupling. In Part III Low, Intermediate and High Temperature Behavior is discussed. Part IV addresses Microstructure and Micro-Mechanics. Part V covers the topic of Recycling and Rejuvenation. In Part VI Multiphase Analysis of Binders is discussed and Part VII is devoted to other topics in the field. Looking into the future, as conventional materials become scarce, using alternative materials is inevitable and we hope that this type of characterization will continue to flourish in the asphalt field.

The Chair Committee





## COMMITTEES

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### CONFERENCE CHAIRS

Lily Poulikakos (Chair)  
Empa, Switzerland

Laurent Porot (Co-Chair)  
Kraton, The Netherlands

Hervé Di Benedetto (Co-Chair)  
Université de Lyon, France

Augusto Cannone Falchetto (Chair)  
TU Braunschweig, Germany

Bernhard Hofko (Co-Chair)  
TU Wien, Austria

Michael P. Wistuba (Co-Chair)  
TU Braunschweig, Germany

### INTERNATIONAL SCIENTIFIC COMMITTEE

Airey, Gordon - The University of Nottingham, UK  
Baaj, Hassan - University of Waterloo, Canada  
Biligiri, Krishna Prapooma - Indian Institute of Technology Tirupati, India  
Birgisson, Björn - Texas A&M University, USA  
Canestrari, Francesco - Università Politecnica delle Marche, Italy  
Cannone Falchetto, Augusto - TU Braunschweig, Germany  
Chailleux, Emmanuel - IFSTTAR, France  
Di Benedetto, Hervé - University of Lyon, ENTPE, France  
Fini, Elham - North Carolina A&T State University, USA  
Fu, Zhen - Chang'an University, China  
Guo, Meng - Beijing University of Technology, China  
Han, Yuejie - Chang'an University, China  
Hofko, Bernhard - TU Wien, Austria  
Hu, Chichun - South China University of Technology, China  
Loría Salazar, Luis Guillermo - Universidad de Costa Rica, Costa Rica  
Lu, Xiaohu - Nynas, Sweden  
Ma, Feng - Chang'an University, China  
Ma, Wangyu - West Texas Paving Inc., USA  
Marasteanu, Mihai - University of Minnesota, USA  
Moon, Ki Hoon - Korea Expressway Corporation, South Korea  
Pei, Jianzhong - Chang'an University, China  
Porot, Laurent - Kraton Corporation, The Netherlands



## COMMITTEES

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Poulikakos, Lily - EMPA, Switzerland

Qin, Yu - CREEC, China

Sauzéat, Cédric - University of Lyon, ENTPE, France

Soenen, Hilde - Nynas Belgium, Belgium

Tsai, Yichang - Georgia Institute of Technology, USA

Tsantilis, Lucia - Politecnico di Torino, Italy

Wang, Di - TU Braunschweig, Germany

Wang, Hainian - Chang'an University, China

Wang, Hao – Rutgers, The State University of New Jersey, USA

Wang, Weina - Chongqing Jiaotong University, China

Wistuba, Michael P. - TU Braunschweig, Germany

Zofka, Adam - Road and Bridge Research Institute (IBDiM), Poland



## KEYNOTE LECTURE

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**Title:**

Physics, Chemistry and Mechanics of the “Dark Matter” That Holds Our Roads Together

**Lecturer:**

Dr. Amit Bhasin  
Civil, Architectural and Environmental Engineering  
The University of Texas at Austin, U.S.A.

**Abstract:**

Bitumen is literally the glue that holds most of our roadway infrastructure together and by extension has a critical social and economic impact. A challenge faced by our industry is to produce binders that are consistent in quality and tailored for different pavement applications while using a raw material that constantly changes with time and source. This challenge is amplified by the increasing demand to use more recycled asphalt binder from old roadways and/or extend it using other sustainable and eco-friendly materials. Overcoming this challenge requires an integration of theoretical and experimental tools from various disciplines such as materials science and mechanics. This talk explores some of the recent work done to better understand the relationship between the chemical composition of the asphalt binder, its microstructure and engineering properties. This talk also lays out an inter-disciplinary framework that not only aims to advance specific areas of science and engineering but also help advance the state of practice in pavement materials engineering.

**BIO:**

Dr. Bhasin is a faculty member in the Dept. of Civil, Architectural and Environmental Engineering and Director of the Center for Transportation Research (CTR) at The University of Texas at Austin. His research and teaching interests are in the area of infrastructure materials. Dr. Bhasin has led several research projects sponsored by public and private entities from within and outside of the United States. He is actively involved in several national and international organizations and committees pertaining to research in the area of pavements and materials. He is currently serving as the President for the Academy of Pavement Science and Engineering, which is an international organization of academics involved in this area. His research and teaching have been recognized through several different awards and honors including the National Science Foundation CAREER award and the American Society for Civil Engineers (ASCE) Walter L. Huber Research Prize.



## PROGRAM OVERVIEW

Location	FourSide Hotel Braunschweig		
Time	Monday, September 17	Time	Tuesday, September 18
07:30	Registration		
09:00	Opening	09:00	Session V
09:30	Session I		
10:30	Break & Poster	10:30	
11:00	Exhibitors Presentations	11:00	Keynote Lecture
12:00	Session II	12:00	Session VI
13:15	Lunch & Poster	13:15	Lunch & Poster
14:30	Session III	14:30	Session VII
16:30	Break & Poster	16:30	Break & Poster
17:00	Session IV	17:00	Session VIII
18:30	Free	18:00	Closing Session
19:30	RILEM Dinner		

# RILEM 252-CMB FINAL PROGRAM MONDAY, SEPTEMBER 17, 2018



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CHEMO MECHANICAL CHARACTERIZATION OF BITUMINOUS MATERIALS

## 09:00 OPENING SESSION

Welcome (Room: Burj Khalifa)

### **Michael Wistuba**

Professor and head of the Braunschweig Pavement Engineering Centre at Technische Universität Braunschweig and co-chair of the RILEM 252-CMB Symposium

### **Thomas Siefer**

Dean of the Faculty of the Department of Architecture, Civil Engineering and Environmental Sciences at Technische Universität Braunschweig

### **Lily Poulikakos**

Senior scientists at EMPA, Deputy chair of the RILEM Technical Committee 252-CMB and chair of the RILEM 252-CMB Symposium

## 09:30 SESSION I: Chemo-Mechanical Characterization of Bituminous Materials: Multiphase Analysis of Binders (Room: Burj Khalifa)

Session Chair: Jean-Pascal Planche, Western Research Institute, US

### **Effect of Recycled Materials on Intermediate Temperature Cracking Performance of Asphalt Mixtures**

Wei Cao, Louay Mohammad, Peyman Barghabany

### **Qualitative Detection of the Presence of Gilsonite in the Bituminous Blends based on thin Layer Chromatography**

Michalina Makowska, Terhi Pellinen

### **Resistance to Moisture-Induced Damage of Asphalt Mixtures and Aggregate-Binder Interfaces**

Jorge Lucas Júnior, Lucas Babadopulos, Jorge Soares

### **Study on Effects of Aging on SBS Modified Asphalt Based on GPC and Rheological Methods**

Daisong Luo, Meng Guo, Yiqiu Tan, Yafei Li

## 10:30 Break and Posters

## 11:00 Exhibitors Presentation



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**12:00 SESSION II: Chemo-Mechanical Characterization of Bituminous Materials:  
Other Approaches (Room: Burj Khalifa)**

**Session Chair: Hilde Soenen, Nynas, Belgium**

**Kinetic Analysis of the Thermal Behavior of the Sap of the Petroleum Plant for Producing Bio-Binders**

Gondim Lilian Medeiros, Soares Sandra de Aguiar, Barroso Suelly Helena de Araújo

**Machine Learning Technique for Interpretation of Infrared Spectra Measured on Polymer Modified Binders**

Adam Zofka, Krzysztof Błażejowski

**Meso- to Macroscale Homogenisation of Hot Mix Asphalt Considering Viscoelasticity and the Critical Role of Mortar**

Johannes Neumann, Jaan-Willem Simon, Stefanie Reese

**Peat as an Example of a Natural Fiber in Bitumen**

Hilde Soenen, Patricia Kara De Maeijer, Johan Blom, Wim Van den bergh

**Promotion of Bitumen-Impregnated Cellulose Fibres from Lightweight Roofing Tiles in Stone Mastic Asphalt**

Clara Tamburini, Layella Ziyani, Anne Dony, Christophe Rohart, Emanuele Toraldo

**13:15 Lunch and Posters**

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## MONDAY, SEPTEMBER 17, 2018

### 14:30 SESSION III: Chemo-Mechanical Characterization of Bituminous Materials: Recycling and Rejuvenation (Room: Burj Khalifa)

Session Chair: Laurent Porot, Kraton Corporation, the Netherlands

#### **A new Green Rejuvenator: Evaluation of Structural Changes of Aged and Recycled Bitumens by means of Rheology and NMR**

Cesare Oliviero Rossi, Paolino Caputo, Valeria Loise, Saltanat Ashimova, Bagdat Teltayev, Cesare Sangiorgi  
(by title only)

#### **A Rheological Study on Rejuvenated Binder Containing very high Content of Aged Bitumen**

Marco Pasetto, Andrea Baliello, Giovanni Giacomello, Emiliano Pasquini

#### **An Examination of Property Changes of Repeatedly Recycled Asphalt Bitumen using Rejuvenator with High Aromatic Content**

Atsushi Kawakami, Yoko Kawashima, Hiroyuki Nitta, Masayuki Yabu

#### **Effects of Rejuvenator on Reclaimed Asphalt Binder: An Exploratory Study of the RILEM TC 264-RAP Task Group 3**

Augusto Cannone Falchetto, Laurent Porot, Chiara Riccardi, Martin Hugener, Gabriele Tebaldi, Eshan Dave

#### **New Binders using Natural Bitumen Selenizza**

Edith Tartari

#### **Rejuvenated Binders, Reclaimed Binders and Paving Bitumens, are they any Different?**

Tomas Koudelka, Pavel Coufalik, Michal Varaus, and Iva Coufalikova

#### **Study on the Mechanical Properties of Waste Cooking Oil Modified Asphalt Binder**

Xin Qu, Dawei Wang, Quan Liu, Markus Oeser, Chao Wang

#### **The Effect of the Nature of Rejuvenators on the Rheological Properties of Aged Asphalt Binders**

Raúl Tauste, Fernando Moreno-Navarro, Miguel Sol-Sánchez, M<sup>a</sup> Carmen Rubio-Gámez

### 16:30 Break and Posters

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**17:00 SESSION IV: Chemo-Mechanical Characterization of Bituminous Materials:  
Microstructure and Micro-Mechanics (Room: Burj Khalifa)**

**Session Chair: Lily Poulikakos, EMPA, Switzerland**

**Analysis of Bitumen and PmB Using Fluorescence Spectroscopy and Microscopy**

Johannes Mirwald, Hinrich Grothe, Bernhard Hofko, Daniel Maschauer, Daniel Steiner

**Chemical Composition and Microstructure of Bitumen – a Matter of Terminology?**

Bernhard Hofko, Daniel Maschauer, Daniel Steiner, Hinrich Grothe, Johannes Mirwald

**ESEM Microstructural and Physical Properties of Virgin and Laboratory Aged Bitumen**

Peter Mikhailenko, Changjiang Kou, Hassan Baaj, Lily Poulikakos, Augusto Cannone Falchetto, Jeroen Besamusca, Bernhard Hofko

**Precision of Iatroskan Method for Assessment of SARA Compounds in Bitumen**

Diana Simnofske, Konrad Mollenhauer

**Visualization and Chemical Analysis of Bitumen Microstructures**

Xiaohu Lu, Peter Sjövall, Hilde Soenen, Johan Blom, Martin Andersson

**19:30 RILEM Dinner**

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## TUESDAY, SEPTEMBER 18, 2018

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### 09:00 SESSION V: Chemo-Mechanical Characterization of Bituminous Materials: Low, Intermediate and High Temperature Behavior (Room: Burj Khalifa)

Session Chair: Kamilla Vasconcelos, University of São Paulo, Brazil

#### **Effect of Morphology on High-Temperature Rheological Properties of Polymer-Modified Bitumen**

Jiqing Zhu, Xiaohu Lu

#### **Experimental Investigation of Rutting in the Different Phases of Asphalt Mixtures**

Chiara Riccardi, Augusto Cannone Falchetto, Michael P. Wistuba

#### **Investigation on the Effect of Physical Hardening and Aging Condition on Low-Temperature Properties of Asphalt Binder based on BBR**

Di Wang, Augusto Cannone Falchetto, Chiara Riccardi, Michael P. Wistuba

#### **Laboratory and Field Experience with PMMA/ATH Composite in Asphalt Mixtures**

Marjan Tušar, Mojca Ravnikar Turk

#### **On the Use of a Novel Binder-Fast-Characterization-Test**

Johannes Schrader, Michael P. Wistuba

#### **Use of Microencapsulated Phase Change Materials in Bitumen to Mitigate the Thermal Distresses in Asphalt Pavements**

Muhammad Rafiq Kakar, Zakariaa Refaa, Jörg Worlitschek, Anastasia Stamatou, Manfred N. Partl, Moises Bueno

### 10:30 Break and Posters

### 11:00 Keynote Lecture

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### 12:00 SESSION VI: Chemo-Mechanical Characterization of Bituminous Materials: Bitumen Aging Mechanisms and Characterization (Room: Burj Khalifa)

Session Chair: Hassan Baaj, University of Waterloo, Canada

**A Mechanism Based Reaction-Diffusion Model for Spurt Oxidation of Bitumen**  
Uwe Mühlich

**Aging Characterization of Biobinder Produced from Renewable Sources**  
Ingrid Gabrielle do Nascimento Camargo, Liedi Légi Bariani Bernucci,  
Kamilla L. Vasconcelos

**Comparing Field Ageing to Laboratory Ageing using Black Space Graphs**  
Diederik Q. van Lent, Greet A. Leegwater, Dave van Vliet, Cecile Giezen,  
Steven D. Mookhoek

**Viennese Aging Procedure – Behavior of Various Bitumen Provenances**  
Daniel Maschauer, Daniel Steiner, Johannes Mirwald, Bernhard Hofko, Hinrich Grothe

### 13:15 Lunch and Posters

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## TUESDAY, SEPTEMBER 18, 2018

### 14:30 SESSION VII: Chemo-Mechanical Characterization of Bituminous Materials: Bitumen Aging Mechanisms and Characterization (Room: Burj Khalifa)

*Session Chair: Jeroen Besamusca, KPR&T, the Netherlands*

#### **Comparison of Short Term Laboratory Ageing on Virgin and Recovered Binder from HMA/WMA Mixtures**

Gilda Ferrotti, Hassan Baaj, Jeroen Besamusca, Maurizio Bocci, Augusto Cannone-Falchetto, James Grenfell, Bernhard Hofko, Laurent Porot, Lily Poulikakos, Zhanping You

#### **Effect of Artificial Ageing on Two Different Bitumen of Different Origin but Same Performance Grade**

Alexandre Rogeaux, Alan Carter, Daniel Perraton, Abdeldjalil Daoudi

#### **Evaluation of Viscoelastic Properties and Cracking Behaviour of Asphalt Mixtures with Laboratory Aging**

Runhua Zhang, Jo Sias Daniel, Eshan V. Dave

#### **Microstructural Investigation of Reclaimed Asphalt Binder with Bio-Based Rejuvenators**

Maria Chiara Cavalli, Martins Zaumanis, Lily Poulikakos

#### **Recommendations of RILEM TC 252-CMB on the Effect of Short Term Aging Temperature on Long Term Properties of Asphalt Binder**

Lily D. Poulikakos, Bernhard Hofko, Augusto Cannone Falchetto, Laurent Porot, Gilda Ferrotti, Peter Mikhailenko

#### **Rheology and Bituminous binder, a Review of Different Analyses**

Laurent Porot

#### **Short Term Aging - Influence of Mixing Time at Laboratory Specimen Production**

Daniel Steiner, Daniel Maschauer, and Bernhard Hofko

### 16:30 Break and Posters

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## TUESDAY, SEPTEMBER 18, 2018

### 17:00 SESSION VIII: Chemo-Mechanical Characterization of Bituminous Materials: Chemo-Mechanical Coupling (Room: Burj Khalifa)

Session Chair: Bernhard Hofko, TU Wien, Austria

#### **Ageing Effect on Chemo-Mechanics of Bitumen**

Ruxin Jing, Aikaterini Varveri, Xueyan Liu, Athanasios Scarpas, Sandra Erkens

#### **Chemo-Mechanical Characterization of Bitumen Binders with the Same Continuous PG Grade**

Jean-Pascal Planche, Michael D. Elwardany, Jeramie Adams

#### **Field Aging Evaluation of Asphalt Binders by Chemical and Rheological Characterization**

Marcia Midori Takahashi, Kamilla L. Vasconcelos, Margareth Carvalho Coutinho Cravo, Liedi Léji Bariani Bernucci

#### **Modifying Surface Properties of Model and Pavement Aggregates with Silanes**

Gabriel Orozco, Cédric Sauzéat, Jules Galipaud, Hervé Di Benedetto

### 18:00 CLOSURE

#### **Augusto Cannone Falchetto**

Assistant Professor at Technische Universität Braunschweig  
and Chair of the RILEM 252-CMB Symposium

#### **Hervé Di Benedetto**

Professor at University of Lyon – ENTPE, Convener of the RILEM Cluster F. Bituminous  
Materials and Polymers and co-Chair of the RILEM 252-CMB Symposium



## LIST OF POSTERS BY TOPIC

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### **Multiphase Analysis of Binders**

#### **Investigation of the Calculation Modeling of Asphalt Binder Surface Energy based on the Atomic Force Microscope (AFM)**

Rong Chang, Erhu Yan, Jian Xu, GaoChao Wang

### **Other Approaches**

#### **How to Evaluate with Relevance the Compactability of Warm Mixes Using the Gyratory Compactor (GC)**

Abdeldjalil Daoudi, Anne Dony, Layella Ziyani, Nicolas Picard, Julien Buisson

#### **Hybrid Approach to Characterize Reflective Cracking in Airport Pavements**

Tirupan Mandal, Mesbah Ahmed, and Hao Yin, Richard Ji

#### **Novel Application of the Falling Weight Deflectometer Test: Detection of Surface and Subsurface Distresses**

A. Chatterjee, Y. Tsai

### **Microstructure and Micro-Mechanics**

#### **Investigation of the Asphalt Binder Sample Preparation Methods based on AFM**

Zhijun Wang, Rong Chang, Zhenyu Zhou, Yongchun Qin, Gaochao Wang

### **Bitumen Aging Mechanisms and Characterization**

#### **Chemomap Imaging Microscopy use to in Situ Assess Oxidative Ageing in Compacted Asphalt Mixtures**

S. Vassaux, V. Gaudefroy, L. Boulangé, A. Pévère, V. Mouillet



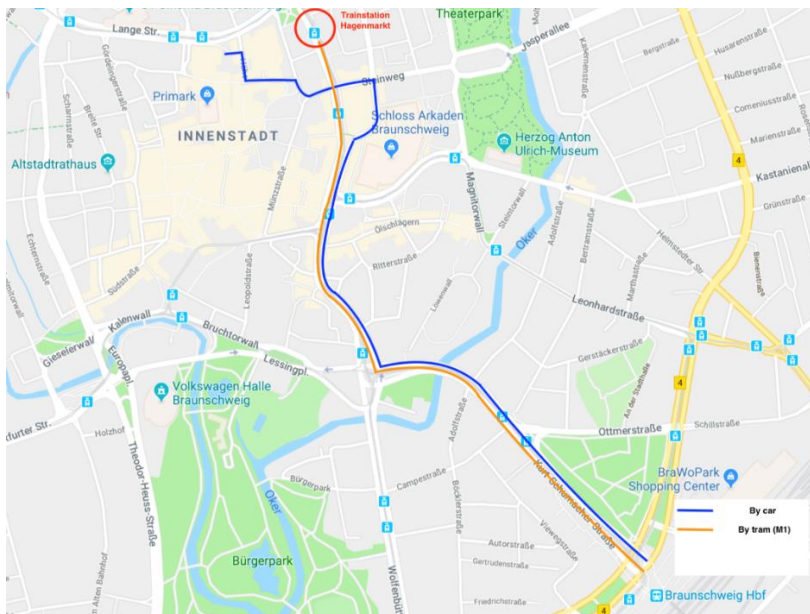
## VENUE INFORMATION

### FourSide HOTEL

The RILEM 252-CMB Symposium will be held in the FourSide Hotel on September 17 - 18, 2018.



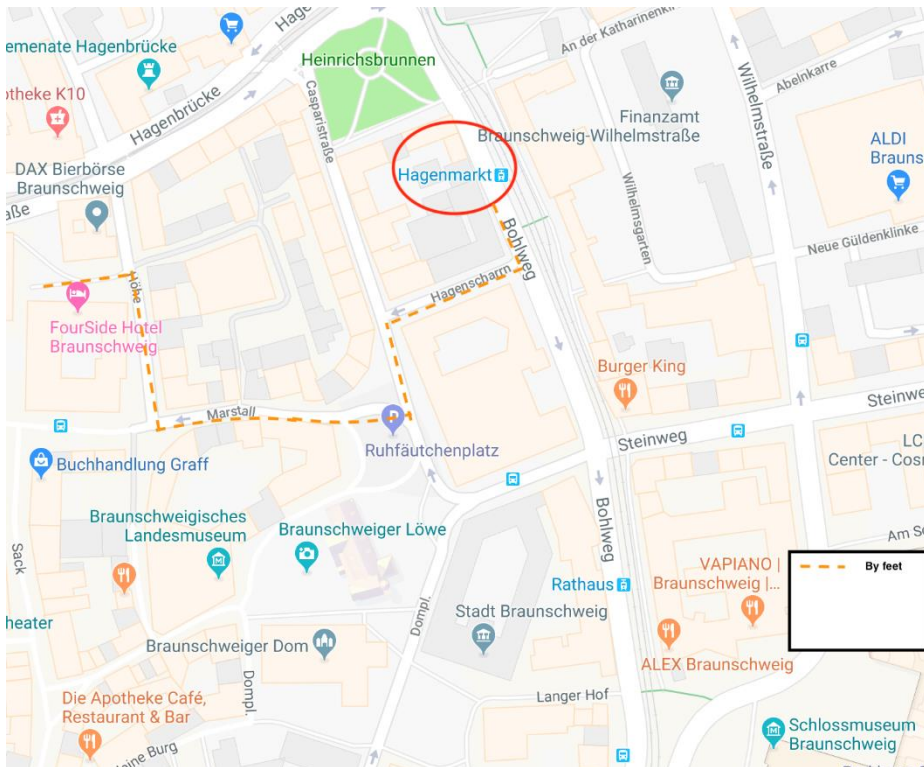
The location of the hotel is Jöddenstraße 3, 38100 Braunschweig. You can reach the hotel by car or by tram M1 / M2 (drop off station Hagenmarkt):





## VENUE INFORMATION

If you go by tram, you can walk to the hotel from the tram station Hagenmarkt (about 5 minutes):



### RILEM DINNER

The dinner of the RILEM 252-CMB Symposium will be held in the FourSide Hotel on Monday September 17, 2018. You will receive the Dinner voucher during registration.