01
Topic & Program

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EXPANDING BOUNDARIES

Systems Thinking in the Built Environment

Sustainable Built Environment (SBE)
Regional Conference Zurich 2016

Introduction

Consuming over 40% of total primary energy, the built environment is in the focus of worldwide strategies and measures towards a more sustainable future. To provide resilient solutions, a simple optimisation of individual technologies will not be sufficient. In contrast, whole-system thinking reveals and exploits connections between otherwise disparate parts. Each system interacts with others on different scales (materials, buildings, cities) and domains (ecology, economy, social).

The need for such system thinking is reflected by the current shift in research from the perspective of single buildings to small urban neighborhoods and districts. The expansion of system boundaries opens up vast opportunities for interaction and synergies but also poses challenges due to an increase in complexity.

The SBE Regional Conference Zurich 2016 acted as a platform to discuss this shift between students, researchers and professionals and to foster system thinking in the built environment. The conference took place from June 13 to 17, 2016. SBE16 Zurich formed part of the international SBE series of conferences focusing on a sustainable built environment. It was accompanied by keynote speeches, workshops, and site visits to recent, cutting edge building projects in and around Zurich.

On behalf of the hosts and organisers of this event – the city of Zurich, ETH Zurich, and the Swiss Federal Office of Energy – we would like to thank all participants for joining us in Zurich!

below:
View of Zurich, © Zürich Tourismus.

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A set of key conference topics were defined to prompt paper submissions that cover different aspects and scales of systems thinking. These key topics determined the content and structure of the main conference sessions.

Distributed Energy Systems and Infrastructure
Harnessing local, renewable energy sources is key to facilitate the transition towards low carbon energy systems. Rather than centralized and hierarchical, renewable energy generation will be increasingly decentralized, distributed and stochastic, which implies different strategies for design and operation. This calls for multi-scale modelling, simulation and analysis of different spatial and temporal resolutions, including the assessment of uncertainty and robustness. Understanding occupants and inhabitant's behaviour and comfort requirements leads to improved design and control of energy supply systems. Spatial distribution, local production and storage also demands considering urban morphology, infrastructure networks and potential links to transportation systems.

Life-Cycle Oriented Approaches
The consideration of all phases of the so-called life cycle of a building or a material is required when promoting new solutions for the built environment. Actually, the necessary quantification of the energy and materials needed for the production of products is not sufficient and a life cycle approach, integrating the energy and materials required during their use and demolition has to be considered. System boundaries of the studied objects are expanded from the cradle to the grave of objects, or even cradle to cradle when waste from one system can be used as new resources for a regenerated new one.

Integrated Approaches and Tools for Decision-Making
Systems thinking and integration is key to identify interdependencies and harness synergies between energy systems, material flows, urban form, program, transport and infrastructure. This requires new approaches, methods and tools to design, model and analyse such systems on different scales, from building to urban scale. Resulting tools need to address different stakeholders in design, planning, industry and public bodies.

Innovative Materials and Components
The new approach developed through systems thinking induces a new perception of resources available for construction and operation of our built environment. For instance, the appropriate use of low processed resources allows to develop low environmental impact building materials. But this approach also leads to new material and component needs such as components able to be reused and easily dismantled or new sensors for multi-scale and multi-criteria modelling such as radiant heat measurement.

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SBE16 Zurich Program

Seeking to involve different interested parties, the SBE16 Regional Conference in Zurich offered a varied yet well-coordinated conference program. It addressed students and academic scholars as much as planners, industry leaders and public representatives. The program combined lectures, discussions and tutorials with site visits and informal gatherings.

Workshops

SBE16 Zurich offered half-day, 1-day and 2-day workshops which – each in their own way – grasped the topic of the conference. These workshops took place on June 13-14 and thus represented a practice-oriented beginning of the conference. They aimed to provide an opportunity for students, researchers and professionals for focused debates as well as hands-on experiences and explorations of new methods or technologies. The workshop results were presented following the opening program on Wednesday.

Keynote Speakers

The SBE16 Zurich organising committee invited five renowned scholars and industry leaders to contribute to the conference through keynote lectures and to discuss the topic of sustainability in the context of built environments. Keynote speakers were Koen Steemers, Peter Edwards, Chrisna du Plessis, Serge Salat and Jens Feddern.Their lectures represented the theoretical frame of the conference. They have been recorded and can be viewed online. The individual links to each recording can be found in chapter *03 – Keynote Speakers*.

Poster Presentations

Short Poster Presentations of 1min each allowed to introduce the poster contributions which were on display in the foyer throughout the week.

Conference Sessions

Conference Sessions took place on June 15-17 and were divided into the four main conference topics as described above. Lectures of 15 minutes were followed by 5 minutes of Q/A. A detailed session schedule is provided on the following pages and papers of both poster presentations and conference sessions have been listed in chapter *05 – Conference Papers*.

Panel Discussion

On Friday morning, following the keynote lecture, participants gathered in the main lecture hall for a panel discussion with invited experts from science, industry, planning and public administration. Under the title <Smart humans or smart meters? – The role of human and technology for a future sustainable built environment> each speaker brought his/her individual background to the table.

Site Visits

A range of recent, cutting edge building projects in and around Zurich was selected to accompany the theoretical debate of the conference with practical examples. Conference participants had the choice between five site visits conducted by the respective project leaders or otherwise involved personnel. These visits took place on Thursday and Friday afternoon.

Social Events

In addition to the formal program, the organising committee invited all participants to join the social gatherings on Tuesday and Thursday. The main conference part was kicked off with a Welcome Apéro in the ETH Dozentenfoyer overlooking the city of Zurich while the Conference Dinner at the g27 restaurant was a great opportunity to further discuss the outcome of the conference in a more informal setting.

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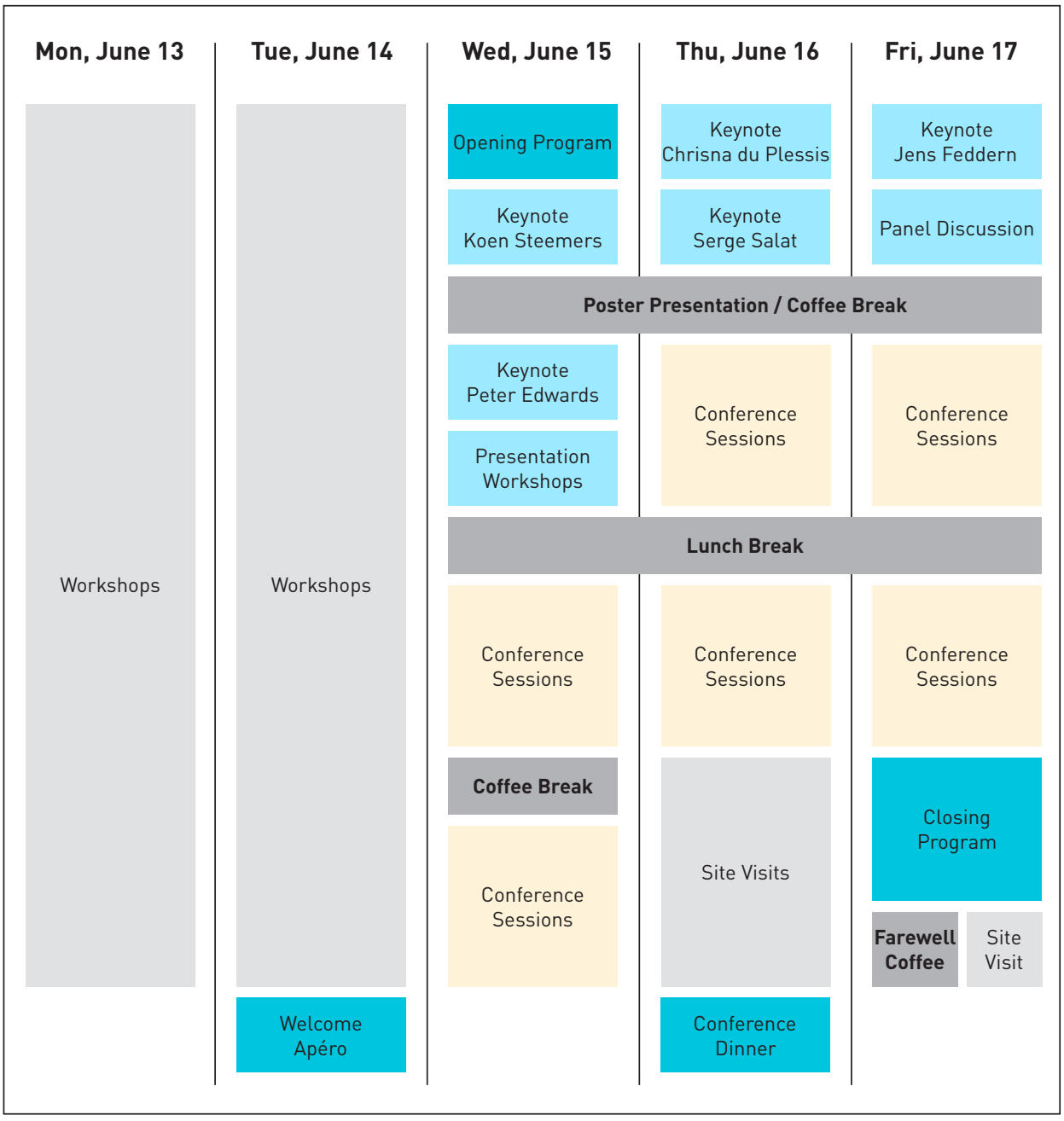
below:
Overview of the SBE16 Zurich conference schedule, June 13 – 17, 2016.



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SBE16 Zurich Poster and Session Schedule

Poster Presentations
Posters were displayed in the conference foyer for the entire duration of the conference. We invited all poster authors to give a short presentation of 1 minute according to the schedule below. For the purpose of this book, poster presenters were asked to provide full papers. These have been allocated to the four conference topics and are included in chapter *05 – Conference Papers*.

Poster Session 1
June 15 / 10:30–10:45

Annette Hafner – Ruhr-University Bochum
Paolo Civiero – Sapienza University of Rome
Karina Krause – Ruhr-University Bochum
Nazanin Eisazadeh – KU Leuven
Alexandra Saur – Lucerne University of Applied Sciences and Arts
Lavinia Chiara Tagliabue – Politecnico di Milano
Daia Zwicky – HEIA Fribourg
Aoife Anne-marie Houlihan Wiberg – The Research Centre on Zero Emission Buildings, Trondheim
Sergi Aguacil – EPF Lausanne
Mehmet Aksözen – ETH Zurich

Poster Session 2
June 16 / 10:30–10:45

Lisa Wastiels – Belgian Building Research Institute
Catherine De Wolf – Massachusetts Institute of Technology
Herbert Claus Leindecker – University of Applied Sciences Upper Austria
Christian Steininger – Vasko + Partner Ingenieure, Vienna
Ferdinand Oswald – Graz University of Technology
Junjing Yang – National University of Singapore
Azza Kamal – The University of Texas at San Antonio
Eric Teitelbaum – Princeton University
Florian Gschösser – University of Innsbruck
Viola John – ETH Zurich
Cappai Francesco – École de technologie supèrieure, Montreal

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Conference Sessions

Conference Sessions were divided into four main topics and additional subtopics as defined below. Presenters gave a 15 minute presentation, followed by 5 minutes of discussion. All papers have been listed in chapter *05 – Conference Papers*.

1 Distributed Energy Systems and Infrastructure
1.1 Urban scale energy systems (and tools)
1.2 Smart living labs and campuses
1.3 Building performance and human interaction

2 Life-Cycle Oriented Approaches
2.1 Building stock (life-cycle) analysis
2.2 Building and infrastructure renovation and retrofitting
2.3 Life-cycle assessment of materials and processes

3 Integrated Approaches and Tools for Decision-Making
3.1 Engaging stakeholders and local communities
3.2 Indices and scoring systems
3.3 Design support

4 Innovative Materials and Components

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June 15 / 13:45 – 15:30

1.1 Urban scale energy systems (and tools)

Chair: Andreas Eckmans – BFE

Stephan Maier – Graz University of Technology
"Optimal Energy Technology Networks in Spatial Energy Planning in Austrian City Quarters"
Anja Willmann – ETH Zurich
"Energy and the City: Investigating Spatial and Architectural Consequences of a Shift in Energy Systems on District Level in a Summer School"
Raphael Wu – ETH Zurich
"Optimal Energy System Transformation of a Neighbourhood"
Thomas Schluck – Lucerne University of Applied Sciences and Arts
"Matching Renewable Energy Production and Consumption by Market Regulated Demand Site Management (DSM)"
Christoph Waibel – Empa
"Holistic Optimization of Urban Morphology and District Energy Systems"

2.2 Building and infrastructure renovation and retrofitting

Chair: Mehmet Aksözen – ETH Zurich

Eero Nippala – Tampere University of Applied Sciences
"Deep Renovations within Smart Asset Management"
Karen Allacker – KU Leuven
"A Multi-Criteria Approach for the Assessment of Housing Renovation Strategies"
Angela Greco – TU Delft
"Business Case Study for the Zero Energy Refurbishment of Commercial Buildings"
Alexander Passer – Graz University of Technology
"Impact of Building Refurbishment Strategies on the Energetic Payback"
Sébastien Lasvaux – University of Applied Sciences of Western Switzerland
"Economic and Environmental Assessment of Building Renovation: Application to Residential Buildings Heated with Electricity in Switzerland"

3.1 Engaging stakeholders and local communities

Chair: Guillaume Habert – ETH Zurich

Aoife Brophy Haney – ETH Zurich
"What a MES(S)!: A Bibliometric Analysis of the Evolution of Research on Multi-Energy Systems"
Giulia Barbano – iiSBE Italia
"Engaging Stakeholders through Local Project Committees"
Helmuth Kreiner – Graz University of Technology
"Management of User and Stakeholder Interests in Multi-Criteria Assessments"
Emanuele Facchinetti – Lucerne University of Applied Sciences and Arts
"Business Model Innovation for Local Energy Management: A Systematic Methodology"
Sébastien Cajot – EIFER and **Nils Schüler** – EPFL
"Establishing Links for the Planning of Sustainable Districts"

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1.1 Urban scale energy systems (and tools)

Chair: Forest Meggers – Princeton University

David Grosspietsch – ETH Zurich
"Matching Renewable Energy Production and Local Consumption: A Review of Decentralized Energy Systems"
Surabhi Mehrotra – IIT Bombay
"Built from Determinants of Urban Land Surface Temperature: A Case of Mumbai"
Jérôme Kämpf – EPFL
"Integration of Outdoor Human Comfort in a Building Energy Simulation Database Using CityGML Energy ADE"
Jérôme Kämpf – EPFL
"Multi-Scale Modelling to Assess Human Comfort in Urban Canyons"
Jimeno Fonseca – ETH Zurich
"Assessing the Performance and Resilience of Future Energy Systems at Neighborhood Scale"

2.3 Life-cycle assessment of materials and processes

Chair: Karen Allacker – KU Leuven

Florian Gschösser – University of Innsbruck
"Environmental Effects of an Alpine Summit Tunnel"
José Silvestre – University of Lisbon
"Selection of Environmental Datasets as Generic Data: Application to Insulation Materials within a National Context"
Laetitia Delem – BBRI
"€coffice-LCC and LCA as Part of the Integrated Design Approach for a High Performance-Low Cost Office Building"
Meta Lehmann – econcept AG
"Sustainable Stepwise Building Renovation"
Viola John – ETH Zurich
"Environment and Economy - An Alliance of Mutual Benefits in Residential Building"

3.3 Design support

Chair: Daniel Kellenberger – Intep

Claudiane Ouellet-Plamondon – ETS
"Ecological Footprint Analysis of Canadian Household Consumption by Building Type and Mode of Occupation"
Charlotte Roux – Mines ParisTech
"Life Cycle Assessment as a Design Aid Tool for Urban Projects"
Ayu Miyamoto – KU Leuven
"From a Simple Tool for Energy Efficient Design in the Early Design Phase to Dynamic Simulations in a Later Design Stage"
Elke Meex – Hasselt University
"Analysis of the Material-Related Design Decision Process in Flemish Architectural Practice"
Dimitra Ioannidou – ETH Zurich
"Economic Flow Analysis of Construction Projects to Support Sustainable Decision-Making"

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June 16 / 11:00 – 12:40

1.1 Urban scale energy systems (and tools)

Chair: Jérôme Kämpf – EPFL

Flora Szkordilisz – Hungarian Urban Knowledge Centre
"Facilitating Climate Adaptive Urban Design – Developing a System of Planning Criteria in Hungary"
Paul Michael Falk – Darmstadt University of Technology
"Comparison of District Heating Systems and Distributed Geothermal Network for Optimal Exergetic Performance"
Eric Teitelbaum and **Forrest Meggers** – Princeton University
"Campus as a Lab: Building- and System-Level Air Movement Investigations"
Georgios Mavromatidis – ETH Zurich
"Uncertainty and Sensitivity Analysis for the Optimal Design of Distributed Urban Energy Systems"
Dan Assouline – EPFL
"Does Roof Shape Matter? Solar PV Integration on Roofs"

2.3 Life-cycle assessment of materials and processes

Chair: Peter Richner – Empa

Ardavan Yazdanbakhsh – City College of New York
"A Framework for Life Cycle Assessment of Concretes with Recycled Aggregates in Large Metropolitan Areas"
Snezana Marinkovic – University of Belgrade
"Life Cycle Analysis of Recycled Aggregate Concrete with Fly Ash as Partial Cement Replacement"
Jiangbo Wu – Chongqing University
"Eco-Efficiency of Construction and Demolition Waste Recycling in Chongqing, China"
Amnon Katz – Technion-Israel Institute of Technology
"Efficiency of Using Recycled Fine Aggregate for a New Concrete"
Philip Van den Heede – Ghent University
"The Cost and Environmental Impact of Service Life Extending Self-Healing Engineered Materials for Sustainable Steel Reinforced Concrete"

3.3 Design support

Chair: Annick Lalive d'Epinay – City of Zurich

Emilie Nault – EPFL
"Urban Planning and Solar Potential: Assessing Users' Interaction with a Novel Decision-Support Workflow for Early-Stage Design"
Carsten K. Druhmann – ZHAW
"Increase the Efficiency in Sustainable Construction Using BIM"
Daren Thomas – ETH Zurich
"The City Energy Analyst Toolbox V0.1"
Alexander Hollberg – Bauhaus-University Weimar
"A Method for Evaluating the Environmental Life Cycle Potential of Building Geometry"
Angela Greco – TU Delft
"Economic Factors for Successful Net Zero Energy Refurbishment of Dutch Terraced Houses"

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1.2 Smart living labs and campuses

Chair: Christian Schaffner – ETH Zurich

Arianna Brambilla – EPFL
"LCA as Key Factor for Implementation of Inertia in a Low Carbon Performance Driven Design: The Case of the Smart Living Building in Fribourg, Switzerland"
Lavinia Chiara Tagliabue – Politecnico di Milano
"Tuning Energy Performance Simulation on Behavioural Variability with Inverse Modelling: The Case of Smart Campus Building"
Sameer Abu-Eisheh – An-Najah National Unviersity
"Strategic Planning for the Transformation of a University Campus Towards Smart, Eco and Green Sustainable Built Environment: A Case Study from Palestine"
Endrit Hoxha – EPFL
"Introduction of a Dynamic Interpretation of Building LCA Results: The Case of the Smart Living Building in Fribourg, Switzerland"
Peter Richner – Empa
"NEST – Exploring the Future of Buildings"

2.3 Life-cycle assessment of materials and processes

Chair: Amnon Katz –Technion University

Alessandro P. Fantilli – Politecnico di Torino
"Eco-Mechanical Performances of UHP-FRCC: Material vs. Structural Scale Analysis"
Sofia Sanchez – Universidad Central de las Villas
"Low Carbon Cement: A Sustainable Way to Meet Growing Demand in Cuba"
Lara Jaillon – City University of Hong Kong
"Life Cycle Assessment of Precast and Cast-In-Situ Construction"
Ravindra Gettu – IIT Madras
"Process Mapping and Preliminary Assessment of LIfe Cycle Impact in Indian Cement Plants"
Alessandro Arrigoni – Politecnico di Milano
"The Environmental Relevance of the Construction and End-Of-Life Phases of a Building: A Temporary Structure LCA Case Study"

4 Innovative materials and components

Chair: Alexander Passer –TU Graz

Daniel Friedrich – Lucerne University of Applied Sciences and Arts
"Bio-Based Plastics-Composites for Sustainable Building Skins: Life Expectancy of Cladding Derived from Wind Suction Tests"
Marvin King – Lucerne University of Applied Sciences and Arts
"Holistic Observations on the Sustainability of High-Rise Building Facades"
Giuliana Iannaccone – Politecnico di Milano
"Integrated Approaches for Large Scale Energy Retrofitting of Existing Residential Building through Innovative External Insulation Prefabricated Panels"
Aurelie Favier – EPFL
"Limestone Calcined Clay Cement for a Sustainable Development"
Matthias Pätzold – Technical University of Munich
"Design-Engineering-Based and Material-Based Improvement of Precast Concrete-Facade-Elements"

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June 17 / 11:00 – 12:40

1.3 Building performance and human interaction

Chair: Zoltan Nagy – ETH Zurich

Zoltan Nagy – ETH Zurich
"What Should a Building be Controlled for? Ask the Occupants!"
Lavinia Chiara Tagliabue – Politecnico di Milano
"Prediction of Users' Behaviour Patterns Impact on Energy Performance of a Social Housing in Cremona, Italy"
Olivia Guerra-Santin – TU Delft
"Towards Sustainable Occupant Behavior and Organizational Change"
Nadine Haufe – Vienna University of Technology
"Modelling Load Profiles for the Residential Consumption of Electricity Based on a Milieu-Oriented Approach"
Junjing Yang – National University of Singapore
"A Methodology for Energy Audit for Commercial Buildings Using Machine Learning Tools"

2.1 Building stock (life-cycle) analysis

Chair: Suzanne Kytzia – HSR

Adélaïde Mailhac – CSTB
"LCA Enhancement Perspectives to Facilitate Scaling up from Building to Territory"
Adélaïde Mailhac – CSTB
"LCA Applicability at District Scale Demonstrated Throughout a Case Study: Shortcomings and Perspectives for Future Improvements"
Fritz Kleemann – Vienna University of Technology
"Combining GIS Data Sets and Material Intensities to Estimate Vienna's Building Stock"
Alessio Mastrucci – Luxembourg Institute of Science and Technology
"A GIS-Based Approach for the Energy Analysis and Life Cycle Assessment of Urban Housing Stocks"
Stefan Schneider – University of Geneva
"Geo-Dependent Heat Demand Model of the Swiss Building Stock"

4 Innovative materials and components

Chair: Claudiane Ouellet-Plamondon – ETS

Ken Zumstein and **Laurent Cattarinussi** – ETH Zurich
"Life Cycle Assessment of a Post-Tensioned Timber Frame in Comparison to a Reinforced Concrete Frame for Tall Buildings"
Gnanli Landrou – ETH Zurich
"A New Route for Self-Compacting Clay Concrete"
Alessandro Arrigoni – Politecnico di Milano
"Improving Rammed Earth Walls' Sustainability through Life Cycle Assessment (LCA)"
Andrea Klinge, Eike Roswag-Klinge – Ziegert | Roswag | Seiler Architekten Ingenieure
"Naturally Ventilated Earth Timber Constructions"
Sharon Zingg – ETH Zurich
"Environmental Assessment of Radical Innovation in Concrete Structures"

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1.3 Building performance and human interaction

Chair: Arno Schlueter – ETH Zurich

António José de Figueiredo – University of Aveiro
"Overheating Reduction of a Cold Formed Steel-Framed Building Using a Hybrid Evolutionary Algorithm to Optimize Different PCM Solutions"
Hongshan Guo – Princeton University
"Model Predictive Control for Geothermal Borehole Depth Determination"
Coosje Hammink – Hogeschool van Arnhem en Nijmegen
"Integrating Persuasive Technology in Prototypes of Interior Walls to Stimulate Behavioural Change"
Ali Motamed – EPFL
"Toward an Integrated Platform for Energy Efficient Lighting Control of Non-Residential Buildings"
Luca Baldini – Empa
"Dynamic Energy Weighting Factors to Promote the Integration of Renewables into Buildings"

2.1 Building stock (life-cycle) analysis

Chair: Sébastien Lasvaux – HES-SO

Yudiesky Cancio Diaz – Universidad Central de las Villas
"Economic and Ecological Assessment of Cuban Housing Solutions Using Alternative Cement"
Ahmed Mokhtar – American University of Sharjah
"A Sustainable Development Approach for Affordable Housing in Egypt"
Isolda Agustí-Juan – ETH Zurich
"Environmental Implications and Opportunities of Digital Fabrication"
Vanessa Gomes – University of Campinas
"A Novel Perspective on the Avoided Burden Approach Applied to Steel-Cement Making Joint System"
Jovan Pantelic – ETH Zurich
"Air Dehumidification with Novel Liquid Desiccant System"

3.2 Indices and scoring systems

Chair: José Silvestre – University of Lisbon

Karen Allacker – KU Leuven
"Which Additional Impact Categories Are Ready for Uptake in the CEN Standards EN 15804 and EN 15978? Evaluation Framework and Intermediate Results"
Daniela Pasini – Politecnico di Milano
"Integrated Process for the Evaluation and Optimization of Buildings Performance"
Damien Trigaux – KU Leuven
"Critical Analysis of Sustainability Scoring Tools for Neighbourhoods, Based on a Life Cycle Approach"
Olivia Guerra-Santin – TU Delft
"Building Occupancy Certification: Development on an Approach to Assess Building Occupancy"
Manuela Prieler – FH Salzburg
"Renovation in Austria – Analysis of the Energy Performance Certificates between the Years 2006 and 2015 of the County Salzburg"

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