

Kommen M. Zizic

+381(0)659332233

kommen.zizic@gmail.com

University of Belgrade

Faculty of Architecture

Department of AT

Short Term Scientific Mission (STSM) Report

Bulevar kralja Aleksandra 73/II

11000 Belgrade, the Serbia

www.arh.bg.ac.rs

To whom it may concern,

I submit the Scientific Report of Short Term Scientific Mission entitled *Digital tools for performance assessment of an adaptive façade in the early phase of design*. In COST Action TU1403 Adaptive Façade Network I participated as PhD student.

At TU Delft - Faculty of Architecture and the Built Environment I was hosted by dr.ing. Ulrich Knaack and dr.ing. Tillmann Klein, Professors of Design of Construction.

In duration of 12 days, I realised my STSM from 9th November to 20th November, 2015. Visit was planned from 10th to 21th October.

The initial objective of the STSM was to further develop methods and techniques for modelling adaptive facade with expert assistance from TU Delft. There I collected information about digital tool-based evaluation and assessment of adaptive façade in the early phase of the design. The idea was to make contribution tasks of WG2 and WG3. The research results will be presented in next international conferences.

In this report I attached a copy of the abstract for International conference Places and Technologies. The research paper is in a developing phase and I hope to finish it in the next couple of weeks. The paper content would be a contribution to current adaptive facade techniques.

My STSM at TU Delft was successful because I: a) defined framework and conceptual model of research paper and so made a base for next steps in studying; b) networked with experts for building envelope, digital modelling and simulation; c) better understood aims and tasks of WG2 and WG3 within COST Action TU1403; d) got feedback about the future research direction; e) began preparing for Training School and next round of STSM in 2016.

1.0 Outline of the Short Term Scientific Mission

Object of the STSM is part of PhD research project *How to make more decision informed in the early phase of architectural design*.

1.1 Objectives

Defining framework, questions, conceptual model and criteria for review of digital tools for an adaptive envelope performance assessment in the early design phase (with focus on methods, techniques and strategies of application).

1.2 Activities

During the visit, I refined my research proposal regarding the design of adaptive envelope in the early phase of design:

- a) in discussions, conversations and meetings with experts: Prof.dr.ing. Ulrich Knaack, Ass. dr.ing. Paul de Reuter, Ass.Prof. dr.ing. Michela Turrin, Prof.dr.ing. Tillmann Klein, Ass.Prof. dr.ing. Martin Tenpierik , Res.dr.ing. Mohammad Taleghani .
- b) reviewing articles, research papers, PhD thesis and books(in electronic and paper form).

1.3 Outcomes

STSM Period of 12 days was enough to make a research outline regarding performance assessment and prediction of adaptive facade based on digital tools. Also, main goal to network with experts in this area was achieved.

- a) Within the area Computer-Aided Architectural Design (CAAD) initial concepts: performance, early phase of design, digital tools and adaptive envelope were defined.
- b) Data on modelling and simulation techniques for prediction and performance evaluation of adaptive facade based on digital tools were collected and classified.
- c) Future research directions were recognized:

Use Multi objective optimization of the adaptive envelope in the early phase design to make efficient decisions.

To investigate relations between BIM and parametric model in the early phase of design.

User interaction with adaptive facade predicted by simulation.

The outcomes of research will be sent for publication in peer review international conferences:

Places and Technologies conference, Belgrade SRB, 14th-15th April 2016;

eCAADe 2016 conference | Oulu School of Architecture, Oulu FIN, 22.-26. August 2016.

In the table below I present what I have done:

Prospected outcome	Outcomes after STSM done
Contribution to task 2.2 of WG2: Evaluate current simulation tools for adaptive facades performance assessment.	Framework and conceptual model were defined during the visit at TU Delft. The research was focused on component level and on integration adaptive system with the building. The scope of research narrowed to outer shading systems that can adapt to changeable circumstances.
D 2.1. Report on current adaptive facades modelling techniques.	The paper is now in preparation phase. Information on current modelling techniques of adaptive facade will be present in next months.
D 2.4. Report on the validation of developed simulation tools and models.	
D.2.6. Contribution to Annual Training School for dissemination of expertise to Early Stage Researchers (Month 18, 30,42). This will include topics on theoretical modelling, numerical simulation, experimental characterization and building integration of adaptive and multifunctional facades.	This STSM helps me to start preparing for Annual Training School in order to actively participate in it and sharing research results (of this STSM) with other trainees during training school.
Research results will be published in international conferences.	The research results will be published in next ones: Places and Technologies conference, Belgrade SRB, 14th-15th April 2016. eCAADe 2016 conference Oulu School of Architecture, Oulu FIN, 22.-26. August 2016.

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In Novi Pazar, 10th December, 2015.

Kommen M. Zizic

DIGITALTOOLS-BASED PERFORMANCE EVALUATION OF ADAPTIVE ENVELOP IN THE EARLY PHASE OF DESIGN

Kommen M. Zizic

PhD student, Faculty of Architecture, University of Belgrade, Bulevar kralja Aleksandra 73 / II,
kommen.zizic@gmail.com

ABSTRACT

Amelioration indoor comfort for the building occupants, reduction in energy consumption and carbon dioxide emissions can be achieved with application the adaptive envelopes in new and old buildings.

Nowadays there is lack of methods for assessing and evaluation the performance of the adaptive envelop at component and whole building scale. Also there is little guidance how to model the adaptive envelope system and how to simulate one on suitable way.

The aim of the paper is review of methods, techniques and strategies for the adaptive envelope performance assessment in the early phase of the design (in scope Computer-Aided Architectural Design (CAAD)).

Author is currently carrying out classification, critical and comparative analysis of existing simulation and modelling approaches of the adaptive façade with focus on the design of outer shading systems. After the aforementioned analysis he will conduct numerical simulation on concrete case study and after that he will compare results found.

One case study will be discussed to show how the method proposed and based on digital tools can be implemented. Numerical simulation will be conducted to evaluate and assess performance and possible energy reduction application the adaptive outer shading system. In this case geometry and material characteristics of shade systems will be investigated in relation to daylight and light performance of indoor space. Optimisation and evaluation will be done between several concepts of the shading system at the component and whole-building scale in order to choose optimal one.

Keywords: adaptive envelope, digitaltools, early phase of design, performance assessment,

Topics: Architectural and building technologies, Architectural technologies or Adaptive reuse