Adaptive facade network – Europe

Andreas Luible
Mauro Overend
Laura Aelenei
Ulrich Knaack
Marco Perino
Frank Wellershoff

cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Adaptive facade network – Europe

Adaptive facade network – Europe

This book is based upon work from COST Action TU 1403 adaptive facade network, supported by COST (European Cooperation in Science and Technology).

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities.

It allows researchers, engineers and scholars to jointly develop their own ideas and take new initiatives across all fields of science and technology, while promoting multi- and interdisciplinary approaches. COST aims at fostering a better integration of less research intensive countries to the knowledge hubs of the European Research Area. The COST Association, an International not-forprofit Association under Belgian Law, integrates all management, governing and administrative functions necessary for the operation of the framework. The COST Association has currently 36 Member Countries.

www.cost.eu

Publisher
TU Delft Open
for the COST Action 1403 adaptive facade network

Editors
Andreas Luible, Mauro Overend, Laura Aelenei, Ulrich Knaack, Marco Perino, Frank Wellershoff

Redaction
Juan Azcarate Aguerre, Marcin Brzezicki, Alejandro Prieto Hoces, Ulrich Knaack

Authors
Laura Aelenei, Marcin Brzezicki, Ulrich Knaack, Andreas Luible, Marco Perino, Frank Wellershoff

ISBN 978-94-6186-581-6

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

COST TU1403 fn/Adaptive facade network

COST is supported by the EU Framework Programme Horizon 2020

Adaptive facade network – Europe

Andreas Luible, Mauro Overend, Laura Aelenei, Ulrich Knaack, Marco Perino, Frank Wellershoff
TU Delft for the COST Action 1403 adaptive facade network

Contents

General introduction 9

Workgroups

WG1 – Adaptive technologies and products 15
WG2 – Component performance and characterization methods 17
WG3 – Whole building integration and whole-life evaluation methods of adaptive facades 19
WG4 – Dissemination and future research 21

Posters

Database of AFN ongoing projects and research activities 25
1 Advance analysis of glued connections for facades systems. Innovative solution for exterior elements connections of adaptive facade 28
2 Industrialized sunspace prototype with solar heat storage. Assessment of post-occupational behaviour in adaptive facades. 29
3 Modelling and simulation of adaptive facades. Opportunities to advance the development of innovative concepts 30
4 Passive and active control systems for adaptive glazing systems and envelopes 31
5 Saxion University of Applied Sciences (NL) Research Centre for Urban & Environmental Development 32
6 Spectrally selective glazing systems / Circadian characteristics 33
7 Sustainable building construction technology for better living conditions 34
8 University of Minho (UMinho) School of Engineering, Department of Civil Engineering 35
9 Research topics at the Institute of Building Construction – TU Graz, UNAB; KAWO 36
10 Improving building sustainability by optimizing facade shape and solar insolation use 37
11 Development of outdoor test facility cells to evaluate the thermal performances of real-scale envelope components in an oceanic climate 38
12 Active Thermoelectric Intelligent Apertures for high efficiency building facades 39
13 Ongoing research on structural glass. Dep. of Civil Engineering University of Coimbra Portugal 40
14 Consideration of the building envelope in terms of energy efficiency and its impact on humans. 41
15 Passive use of solar energy in double skin facades to reduce cooling loads 42
16 Racking testing of the innovative hybrid load-bearing panel composed of laminated glass inserted in CLT frame 43
17 Glass and Façade technology research group University of Cambridge 44
18 Emporium Building Concept Zero-energy buildings with low-exergy storage 45
19 Adaptive Façades Systems: procedures and protocols for performance monitoring & evaluation 46
20 Multiplication of optical phenomena, Façade glare studies, Understanding perception of transparency in architecture. 47
21 Energy performance assessment of adaptive façades through experimental activity - TEBE (Politecnico di Torino) 48
22 Adaptive facades with energy collection and storage systems enabling zero energy operation of buildings, occupants comfort and health. 49
23 The Research Centre on Zero Emission Buildings / Norwegian University of Science and Technology (NTNU) 50
24 Radiant Glass Façade as Energy Efficiency System for building envelopes in the Mediterranean Climate 51
25 Novel façade technologies for the Mediterranean climate. Planning, design, retrofit 52
26 BIPV/T-PCM Automated System 53
27 The Communicational Relationship between Facade and User: Interface Design 54
28 Architectural construction department / University of the Basque Country 55
29 Glass & Transparency Research Group – TU Delft 56

30 Facade research group / Strategy and development of research in the field of the building envelope 57
31 TU DELFT | Façade Research Group / Ongoing PhD Projects 58
32 TU DELFT | Façade Research Group / Completed PhD Projects 59
33 ISM+D – Institute of structural Mechanic + Design 60
34 Attached sunspaces in retrofitting design 61
35 Timber Glass Composites 62
36 Glafo – the Glass Research Institute / Selection of research projects 63
37 Active, Adaptive and Evolving building envelope components 64
38 TECNALIA research & innovation research priorities 65
39 COST Action TU1403 Adaptive Façades / Ongoing research at Ghent University, BE 66
40 Folded Reinforced Glass Connection System 67
41 Smart Envelopes for the Mediterranean Area. The new façade system in the ICT Centre in Lucca 68
42 Bio-materials for the building envelope - expected performance, life cycle costing & controlled degradation 69
43 Smart material systems for high performance building envelopes 70
44 Innovative Façade Concepts Towards NZEB / Façade related activities at EURAC Research 71
45 ISISE-SMCT: thermal behaviour and energy efficiency, R&D Activities Overview 72
46 Pinwheel Origami. Exploring the potentialities of a dynamic shading device by means of Origami geometries 73
47 University of Ljubljana / Faculty of Mechanical Engineering 74
48 Kaunas University of Technology / Laboratory of Building Physics 75
49 Research expertise and topics 76
50 Adaptive insulation: intelligent control of local energy flow across the building skin 77
51 Experimental study, modelling and control of intelligent glazed façade 78
52 User interaction and control of adaptive facades 79
53 Ventilated window and glazed façades 80
54 Energy efficient retrofitting of buildings in Brazil 81
55 Lucerne University of Applied Sciences and Arts, Department of Engineering and Architecture 82
56 Climate-adaptive and solar facade research @ EBD. Energy and Building Design, LTH, Lund University 83
57 Bypass Double Skin Facade 84

Journals

Glass Structures & Engineering 89
JFDE – Journal of Façade Design and Engineering 91

Events

COST Action TU1403 meetings 97

41 Smart Envelopes for the Mediterranean Area. The new façade system in the ICT Centre in Lucca

Marco Sala and Rosa Romano, Department of Architecture, University of Florence

Research information

Abstract

The research project Smart Envelope, developed at ABITA Research Centre, analyses the evolution of smart façade systems in the area of design and industrial production, in order to investigate the technological, functional and qualitative standards of dynamic façades and to evaluate energy performances of the building envelope as a dynamic system that is able to interact with indoor and outdoor space. The study is focused, in particular, on the DOMINO facade, a dynamic envelope developed to improve the energy performances and the indoor comfort in office buildings located in Southern Europe.

Technological features

The DOMINO facade is a modular "dry assembled" system made with an aluminium frame, divided in an opaque and a transparent module. The modules consist of fixed and mobile layers: an aluminium-shading device, a glass panel and a metallic mosquito net that can be moved, with automatic or manual controls, from the opaque module in front of the transparent module.
The modularity of the components allows customizing the facade to fulfil the structural, energy-related and aesthetic requirements. In order to change the image and the energy performance of the façade different types of panels (made with PV, metal, glass, terracotta, etc.) can be integrated in the opaque module.
Furthermore the modularity of the frame and the possibility to move the three dynamic layers located in the opaque module, guarantees to change the energy performance of the façade during the year's seasons:

- In winter, the mobile glass panel is placed in front of the transparent module in order to realize a buffer zone and to increase the transmittance value of transparent and opaque panels.
- In summer: the mobile panel with the shading device is placed in front of the transparent module in order to decrease overheating inside of the building. During the night, the mosquito net is located in front of the operable window to increase air change by night cooling.

Energy simulations

We have simulated the energy performance of the facade system using the thermodynamic software TRNSYS. The energy simulations were done based on placing the façade system in a virtual test room with a size of 5,00 x 5,00 x 3,00 m and analysing the energy requirement of primary energy for heating and cooling in three different climatic zones in Italy (Milan, Florence and Palermo) and for four cardinal directions (East, South, West and North).
The simulations have shown that:
- In winter months the smart facade should be oriented toward the south to improve the solar heat gains and decrease the energy consumption for heating by at least 5%.
- In summer months the smart facade should be oriented south or north to reduce the thermal loads and the solar heat gains and decrease the energy consumption for cooling. During the summer day, the possibility to remove the glass panel from the transparent module allows to reduce the energy consumptions by 70 %, compared to a traditional double skin façade.

Involved persons: Prof. Arch. Marco Sala
Arch. Dr. Rosa Romano
Mr. Giulio Davini

Time span: 2007 - 2012

Contact data: rosa.romano@unifi.it

Associated Publications:

1. ROMANO R., (2011) Smart Skin Envelope. Integrazione architettonica di tecnologie dinamiche e innovative per il risparmio energetico, Florence University Press, Firenze.
2. MARCO SALA, ROSA ROMANO, (2013), Innovative Dynamic Building Component For The Mediterranean Area, in *International Scientific Conference CLEANTECH FOR SUSTAINABLE BUILDINGS FROM NANO TO URBAN SCALE CISBAT 2013,* Lausanne, Switzerland, 4-6 September 2013, pp. 267-272

Fig. 1: The Domino facade was used in the construction of the south and east facades of the New Centre in virtual environments and ICT of Lucca Chamber of Commerce.

Fig. 2: The south façade of the ICT in Lucca. In this case, three PV panels generating an electrical energy production of 0.30 kWP are integrated into the opaque module of the DOMINO façade.

Fig. 3: The smart façade prototype was realized by DAVINI, an Italian Tuscan company. The façade system has a thermal break frame by Schueco and glass panels by Pilkington.

TOC