From the editor ...

Welcome to the first new letter of 2020. We start this year with a general edition, which reminds me of the broad church for the application of science in architecture and the many countries in the world where architectural science is prospering. As I suggest in this edition, increasingly we live in a world where the process of science and its outcomes are being ignored or denied. So this edition brings to our attention some useful theories and practices, which may serve us well into the future.

The newsletter features the coming publication of the Special Edition on socio-technical factors in architectural science. I would like to congratulate Professors Ning Gu and Veronica Soebarto, the scientific committee and authors for bringing this to fruition.

This is a large edition and is particularly topical since research and discussion is increasingly concerned with at the interface between humans and technology. The complex problems for example of changing climates, increasing urbanisation provide architectural science with an increasing role in providing input into that debate.

I have selected the book on Passive House in Different Climates by Mary James and James Bill, which adds to this debate. The Passive House approach developed for cold climates is claimed to be an ultra low energy approach to buildings. There is increasing transfer of the approach world wide and we are now seeing houses being built in Australia. The book provides useful background and the research reported in the Special Editions broadens the discussion of social and technical implications of low energy buildings.

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SPECIAL EDITION

ASR 63.3 Guest editors

Professor Ning Gu and Professor Veronica Soebarto

Socio-technological approaches to understanding and measuring building performance

The theme of the forthcoming Special Edition concerns the developing and applying of integrated socio-technological approaches to understanding and measuring building performance, in order to better improve our overall living experience in the urban and built environment. The focus subject areas are as follows:

- Building performance in terms of environmental, design, and related social and cultural aspects;
- Performative, social, design and other integrated indicators for more liveable, sustainable, or age-friendly environments;
- Smart buildings and cities;
- Building and urban informatics, and opportunities with big data;

New technologies and methods for advancing the above subject areas. In this Special Edition, we will assemble a range of papers by leading authors and research teams on a wide range of topics that are intimately related to the theme above.

The background and rationale for the theme is based on the following two emerging opportunities in the field. Firstly, the emergence of new technologies and innovative methods have provided alternative ways of conceptualising and conducting building performance research. Secondly, the increasing levels of interdisciplinary collaboration have enabled the broader research communities to work closely together to address grand challenges and to develop much more integrated and comprehensive understandings about building performance and environmental research.

To address and improve our overall living experience in the urban and built environment will require systematic, socio-technological approaches to consider and optimize the performance of the environment from a wide range of perspectives, including from the environmental, design, and related social and cultural areas.

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*ASR and Journal Metrics

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Taylor & Francis ASR website (http://www.tandfonline.com/tasr) also gives the number of reads and citations for each paper, as well as information on ‘most read’ and ‘most cited papers’. For more information about Architectural Science Review please visit: http://www.tandfonline.com/tasr;

Subscriptions email: salesportland-services.comInformation for authors: Authors at http://journalauthors.tandf.co.uk We invite readers to suggest topics, submit book reviews or other material which may be of interest to our readers. We will consider advertising material. Please contact us at sue.macleod8888@gmail.com
A number of featured papers have been included from the first Edition this year. Ayşegül Tereci paper is called ‘Biophilic wisdom of the thirteenth and fourteenth century Seljukians Mosque architecture in Beyşehir, Anatolia’ and it analyses how these remarkable buildings draw from the wisdom of nature.

Hossein Omrany provided a review research on daylighting in atria. This is a difficult issue because the design of atria is climate specific as we move to the tropics courtyards are easier to use to avoid the heat whilst in the high latitudes the atria is favoured as it conserves heat.

Finally, Ruth Tamas, Mohamed M. Ouf & William O’Brien examine the issue of building automation and the controversy around replacing manual controls of their thermal comfort with automated systems. I tend to favour manual controls, coming from a warm climate like Brisbane I want to open the windows if it’s too hot, feel the breeze, if it’s too cold I need a heat source. It is either a one or two sheep dog night in the winters here, depending how far west you go.

The second edition is a Special Edition on design computing brought to us by Dr Benjamin Speathe from the Welsh School, which we highlighted in the last Newsletter.

Finally, I would like to thank the Editorial Board including the Associate Editors for their assistance in 2019. We welcome four new Associate Editors in 2020. Professor Justin B. Hollander Cognitive Architecture and Urban Design, Tufts University, USA who is putting together a Special Edition in this area. Dr David Behar from the Technion-Israel Institute of Technology, Israel joins the team on daylighting. We are receiving more papers in this area. David has acted as referee for many years and so is a welcome addition to ASR. We’d also like to welcome two academics from the University of Moratuwa, Sri Lanka. Professor Indrika Rajapaksha looking after the Healthy Buildings, Dr Upendra Rajapaksha who specializes in low energy architecture. This strengthens our reach into the Indian subcontinent.

I wish you all the best; it will be a challenging year. Stay safe.

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ASR 63.3 Guest editors

Ning Gu is Professor in Architecture at the University of South Australia. He is Deputy Director of Australian Research Centre for Interactive and Virtual Environments (IVE). He has researched in the broad areas of Architectural Computing and Design Cognition, including topics such as Computational Design Analysis; Computer-supported Collaborative Design; Interactive and Virtual Environments; Building Information Modelling (BIM); Generative and Parametric Design Systems; Intercultural Design and Communication; and Protocol Studies on designers’ behaviour and cognition.

Professor Ning Gu’s scholarly outputs have been documented in over 180 peer-reviewed publications. His research has been supported by competitive grants from prestigious funding schemes including Australian Research Council (ARC) Discovery Project, and Linkage Infrastructure, Equipment and Facilities (LIEF) Grants; Office for Learning and Teaching (OLT) Innovation and Development Grant; and Cooperative Research Centre for Construction Innovation (CRC-CI) Grant.

Veronica Soebarto is Professor of Architectural Science, Leader of the Environment and Building Research Unit, and Research Director of the School of Architecture and Built Environment, The University of Adelaide. Her research spans span from age-friendly built environment, environmental performance assessments of buildings, building performance simulation, building monitoring, human thermal comfort, to the social dimension of sustainable design.

Professor Soebarto currently leads an Australian Research Council funded research project on improving the thermal environment of housing of older South Australians as well as co-lead a citizen science based pilot project, funded by SA Health, for communities to reflect on how they utilize green space and the value of green space to them. She held the position of Vice President of the Architectural Science Association (ASA) for a number of years as well as the President in 2015-2016. In 2018 she was awarded the title of Fellow from ASA. Professor Soebarto is also an Associate Editor of Architectural Science Review as well as Editorial Board member of Energy and Buildings and Journal of Building Performance Simulation.
Biophilic wisdom of the thirteenth and fourteenth century Seljukians’ Mosque architecture in Beyşehir, Anatolia
Ayşegül Tereci

Figure 1. Plan drawings (Çayci 2008), external and internal views of Esrefoglu Suleyman Bey Mosque, Bayındır Mosque and Köşk Mosque (top to bottom).

Introduction

Modern life is becoming disconnected from nature. Yet many scientific studies suggest that people feel better at places where they can engage with nature, or in places designed with nature in mind. This study is about Biophilia, one of the new design trends that connects the built environment to nature. The studies conducted in this field show that the existing historical buildings are fascinating thanks to their biophilic characterization.

The basic idea of this research suggests that this effect is high in the thirteenth and fourteenth-century’s buildings in Anatolia which are influenced from admiration of nature in the Sufism belief in Seljuks. Within this scope, the conformity with the biophilic criteria was determined to examine by the Esrefoglu Mosque, Bayındır Mosque and Köşk Mosque. Esrefoglu Mosque, in particular, was found to be a reference building in terms of biophilic design and the reason behind that is its harmony with nature.

Ayşegül Tereci is a building scientist, Assistant Professor, and Head of the Architecture Department at KTO Karatay University. Tereci's research focuses on building and urban energy modelling, sustainable and ecological design. She got the MSc degree from the Department of Construction Technology and Control of Physical Environment at ITU and holds a PhD in Building Science from the METU. She worked as a researcher in the EU Marie Curie project, Citynet, at the Stuttgart University of Applied Science. She worked also as a branch manager at The Ministry of Environment and Urban Planning and actively participated in harmonization studies on the Energy Performance of Buildings Directive. She has articles in Energy and Buildings, HVAC&R Research, Architectural Science Review, etc. and has been a referee in many journals. Ayşegül Tereci is a board member of the International Building Performance Simulation Association-Turkey (IBPSA, Turkey) and editorial board member of Mimaran Journal - Konya Chamber of Architects. She is also head of the Organizing Committee of Konya, Sustainable Living Film Festival.
Is atrium an ideal form for daylight in buildings?
Hossein Omrany, Amirhosein Ghaffarianhoseini, Umberto Berardi, Ali Ghaffarianhoseini & Danny H.W. Li

Introduction
This paper aims to review the achievements of previous studies addressing the capability of atriums for providing adequate levels of daylight and visual comfort. This study also performs several simulations using Radiance IES-VE software predominantly with the target to support the literature review results. The analysis discusses ways of daylight transmission through different atrium structures. Findings underline the promising potentials of atriums in reinforcing social life, supporting the psychological well-being of individuals, and enhancing the sense of place among people living in a particular area. Furthermore, it is found out well-designed atriums can reduce buildings' energy usage in both cold and warm climates through supplying daylight and natural ventilation to interiors. Nevertheless, the results show the improper design of atriums may lead to increasing energy consumption or occurring visual and thermal discomfort. This paper suggests certain measures to effectively improve the daylighting performance of atriums in different climates.

Hossein Omrany is currently doing his Ph.D. at School of Architecture and Built Environment, the University of Adelaide, Australia where he focuses on investigating pathway towards realization of Net Zero Life Cycle Energy in the Australian residential buildings. Hossein completed his bachelor degree in Architecture Engineering in Azad University of Shiraz, Iran in 2010. He also holds a master's degree from University of Technology, Malaysia in Construction Management. Hossein has a solid background in practice, acted as a professional architectural engineer/designer in several construction projects in Iran.

As a researcher, Hossein has been actively collaborating with multiple interdisciplinary research groups such as Responsive + Green Urban Built Environment Lab, NZ (www.rgube.com) over the past years. He has authored and co-authored several scholarly articles in top-ranked journals, and spoke in various international conferences. His current research interests primarily lie with the enhancement of sustainability in the built environment via minimizing total life cycle energy use of buildings. Hossein is also interested in indoor daylight analysis, passive housing design, integrated application of Building Information Modelling (BIM), and building automation systems.

Links to other authors to come:
Amirhosein Ghaffarianhoseini: https://www.aut.ac.nz/academic-staff/amirhosein-ghaffarianhoseini
Ali Ghaffarianhoseini: https://www.aut.ac.nz/profiles/?id=alighh&asset=262881
Umberto Berardi: https://sites.google.com/site/umbertoberardihomepage/short-bio-1
Danny HW Li: http://bccw.cityu.edu.hk/main/wp_staff_view.asp?people_number=1183
A field study on the effect of building automation on perceived comfort and control in institutional buildings
Ruth Tamas, Mohamed M. Ouf & William O’Brien

Introduction

Increasing building automation aims to replace manual controls with programmed systems to improve energy efficiency. However, limiting manual control may compromise occupant comfort. To this end, this paper presents a field study that explores the relationships between occupants' perceived control and comfort, and their preferences for building automation. In-office semi-structured interviews were conducted with 170 occupants in 23 institutional buildings at a Canadian university campus. All interviews entailed verbally administering a survey while photographs were systematically captured to document each occupants’ workspace and the context of their interactions with their buildings. Occupants were generally dissatisfied with building automation and preferred more manual controls. Their perception of comfort was moderately correlated to their perception of control over their indoor environment. The findings of this research contribute to a broader debate within the research community about the appropriate level of building automation and the relationship between occupant comfort and control.
**Books**

**PASSIVE HOUSE IN DIFFERENT CLIMATES**

**The Path to Net Zero**

**Authors:** Mary James, James Bill, 2016, ZED Architects Co., Ltd

In the introduction the book makes the case for using the PH approach in a worldwide context. This is based on a study carried out in 2012 and reported 2015. This emphasized that ‘Passive Houses are buildings, which provide comfortable indoor conditions at an extremely low heating and cooling load. The peak daily average heating and cooling loads are typically below 10W/m2 and annual useful energy demands are below 15kWh/(m2a).’ Through a simulation study, cost effective strategies where developed for ‘relevant climate zones, represented here by Yekaterinburg, Tokyo, Shanghai, Las Vegas, Abu Dhabi, and Singapore.’ The research looked at the influence of key passive characteristics such as the window quality, insulation levels, and mechanical services all depend on the climate as well as on the building’s shape and orientation. Changes were made to the PH approach. ‘In climates which are hot and humid all year long, the total useful energy demand for sensible and latent cooling may exceed 70kWh/(m2a) even in a Passive House.’ Finally they argue this approach will not ‘compromise architectural quality’ In essence PH call this climate responsive building, where they look more closely at the biophysical conditions and the technical fit.

The first chapter explains the seven principles of Passive House design for cold climate. These are first the passive system-a super insulated building envelope, with high-performance windows and doors and airtight with no thermal bridges (Figure 2). Second, active systems; mechanical ventilation with heat or energy recovery, depending on the local climate is required, systems to minimize energy losses and manage energy gains. Third, preconstruction validation can be achieved through the PH energy modeling software. In cold climate it is recommended that the entire envelope is super insulated, however as we move to milder climates these are some adaptions, no insulation under the slab and the recommendation is to use the level of insulation normally used in conventional building (Figure 3). No specific type of insulation is recommended however consideration of the embodied energy of the envelope as well as the operational energy is needed. A down side of the higher efficiency of envelope is the total embodied energy may increase and can exceed the savings in operational energy over the building life. However PH metrics don’t recognize this issue.

Design strategies and construction practices to seal and control moisture are also impacted by the climate and location (Figure 4). In cold climate thermal bridges create condensation, lack of airtightness causes draft and infiltration and exfiltration of air. However even in milder climates this may be less problematic however PA mandates fixed environmental requirements; high levels of airtightness and indoor air quality to benefit thermal comfort. **Indoor Air Quality** is determined by the absolute indoor air humidity levels, which should not exceed 12 g/kg for more than 20% of the occupied time. Dehumidification allowance if no cooling plant is proposed. **Airtightness** is set at = 0.6 ach (+/- 50 Pascals). Alternatively, air permeability is set at = 0.6m3/hr/m2 (+/- 50 Pascals) for larger buildings. **Occupant thermal comfort** is required that indoor air temperature must not exceed 23°C for less than 10% of the occupied time to ensure that comfortable temperatures are achieved during the hot summer months.

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**Figure 1.** Iksan House, South Korea 2014. (Source ZED Architects Co., Ltd). North polar facing elevation. Compact two storey bedroom kitchen dining area and single storey lounge.

**Figure 2.** Iksan House, South Korea 2014. (Source ZED Architects Co., Ltd). North south section showing the super-insulated envelope.
The passive systems control the heat, moisture and pressure flux and help manage thermal loads on the active systems. Heat and enthalpy recovery systems are available to do this and provide fresh air for human metabolic needs and air quality. Natural ventilation normally provides for these needs however in this system the HRV or ERV needs to work 24/7. This is one of the downsides, PH argue that this is trade off against the energy saving from heat losses achieved by the passive systems. Relating this issue to the climate design strategies (Figure 4) Iksan located in a Koppen Warm humid continental climate, which is characterized by extremes of temperature and humidity; High August temperatures are found of 30 degrees C. Rainfall highs are in the summer. Lows of -4 degree are found in winter with 50 per cent cloud cover. High humidity is a characteristic of this climate, particularly at night it settles to about 66% RH during the day and near 80% RH at night. We notice that for approximately two thirds of the year the building is in heating mode.

**Heating mode:**
- 20% passive heating though internal heat gains
- 20% passive solar gain with thermal mass
- 36% active space heating

**Comfort mode**
- 7.3% no active or passive heating

**Cooling mode**
- 18% active dehumidification
- 10% active cooling and dehumidification
- 8% passive shading

From this analysis we can infer that potentially the passive systems are useful control strategies for accommodating nearly 40% heating demand remaining 36% is from space heating. For the cooling demand 28%; cooling and dehumidification; 8% passive shading. An important principle of PA is that of minimizing heat losses and managing energy gains. How this principle plays out in to the case study building in Figure 5.

For heating the window size is relative to orientation, i.e. larger windows to the equator for solar gains. The kitchen is in a central location in the main pavilion for a heat source. For overheating, the main pavilion has large operable windows to the equator for ventilation to vent internal gains, which are useful in winter but not in summer. The smaller pavilion has similar management flexibility in the envelope to allow for natural ventilation and would make an ideal summer space. The south windows have shading systems for summer passive cooling. The authors report ‘As natural ventilation is a cultural preference in Korea, ZED made sure to design in cross-ventilation strategies. On cool nights in the warmer seasons, when the outside temperatures are comfortable, strategically placed windows can be tilted open to help reduce the home’s cooling needs.’

In summer months winds at 21-27 degrees C from the south provide potential cooling up to 6 m per second on average for 10% of the time activating this strategy (Climate Consultant). Westerly winds however bring higher temperatures and should be shielded.

Active systems selected for this building include,
- **High-performance HRV.**
- **Hydronic subfloor heating** in winter and the domestic hot water in summer is provided by a geothermal heat pump system
- **Air conditioning,** electric heat pump system with a COP 3
Figure 4. Design Strategies for Kwangju, South Korea the reference climate for Iksan. PMV model of comfort is used given the tight comfort bands required by PH. (Source Climate Consultant)

PH has four performance metrics based on treated floor area, for Iksan House: 189 m².
1. Annual space heating demand. PA Target: 15kWh/m².a. Iksan House: 12 kWh/m²/a.
2. Annual space cooling. PA Target: 15kWh/m².a. Iksan House: 14 kWh/m²/a.
3. Total source energy. PA Target: 120kWh/m².yr. Iksan House: 79 kWh/m²/a.
4. Air leakage. PA Target: 0.6 ach (+/- 50 Pascals) Iksan House: 0.4 ACH50.

The second chapter and the case studies provide information on the application of PA approach across maritime, cold and very cold, mixed dry and hot dry climates. I have focused on the Iksan House because to fully understand the application of PH more detailed climate analysis is needed to reflect the ambitions of the proponents, make the standard more climate responsive.

The third chapter examines the evolution of PH standards, with several new classifications. More importantly a new metric that evaluates the renewable energy generation potential of the building has been developed. This evolution of new class and metric recognizes ‘single PH standard for all climate types does not work.’ To be effective PH standards would need to be in step with local environmental conditions and standards. For example, in Australia the National House Energy Rating Scheme has developed 54 climate zones across Australia with energy specific targets for each zone and 10 star rating is used. Whilst standards such as NatHERS push the building industry to minimum energy targets, voluntary standards such as PH have the capability to pull energy conservation to higher levels of performance and have a cumulative effect of redirecting design practice to mitigate and adapt to climate change.

The book by Mary James, James Bill, was published in 2016. Called Passive House in Different Climates The Path to Net Zero. Since then advances in socio technical thinking means we are further down the track and there is another chapter to be written.

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Figure 5. Iksan House, South Korea 2014. (Source ZED Architects Co., Ltd). Ground floor plan

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