2016 CAADence in architecture

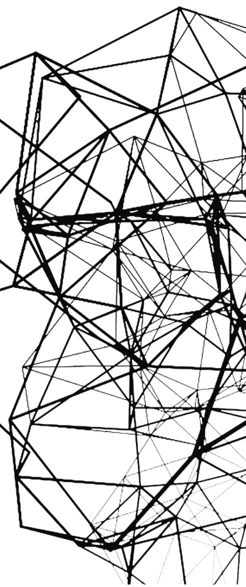
Back to command

Edited by Mihály Szoboszlai

2016 CAADence in architecture

Back to command

Edited by Mihály Szoboszlai



Editor

Mihály Szoboszlai
Faculty of Architecture
Budapest University of Technology and Economics

2nd edition, July 2016

CAADence in Architecture – Proceedings of the International Conference on Computer Aided Architectural Design, Budapest, Hungary, 16th-17th June 2016. Edited by Mihály Szoboszlai, Department of Architectural Representation, Faculty of Architecture, Budapest University of Technology and Economics

Cover page: Faraway Design Kft.

Layout, typography: based on proceedings series of eCAADe conferences

DTP: Tamás Rumi

ISBN: 978-963-313-225-8
ISBN: 978-963-313-237-1 (online version)

CAADence in Architecture. Back to command
Budapesti Műszaki és Gazdaságtudományi Egyetem

Publisher: Faculty of Architecture, Budapest University of Technology and Economics

CAADence in Architecture

Back to command

Proceedings of the International Conference on
Computer Aided Architectural Design

16-17 June 2016
Budapest, Hungary
Faculty of Architecture
Budapest University of Technology and Economics

Edited by
Mihály Szoboszlai

Theme

CAADence in Architecture
Back to command

The aim of these workshops and conference is to help transfer and spread newly appearing design technologies, educational methods and digital modelling supported by information technology in architecture. By organizing a workshop with a conference, we would like to close the distance between practice and theory.
Architects who keep up with the new design demanded by the building industry will remain at the forefront of the design process in our IT-based world. Being familiar with the tools available for simulations and early phase models will enable architects to lead the process. We can get "back to command".
Our slogan "Back to Command" contains another message. In the expanding world of IT applications, one must be able to change preliminary models readily by using different parameters and scripts. These approaches bring back the feeling of command-oriented systems, although with much greater effectiveness.

Why CAADence in architecture?
"The cadence is perhaps one of the most unusual elements of classical music, an indispensable addition to an orchestra-accompanied concerto that, though ubiquitous, can take a wide variety of forms. By definition, a cadence is a solo that precedes a closing formula, in which the soloist plays a series of personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation."
Nowadays sophisticated CAAD (Computer Aided Architectural Design) applications might operate in the hand of architects like instruments in the hand of musicians. We have used the word association cadence/caadence as a sort of word play to make this event even more memorable.

Mihály Szoboszlai
Chair of the Organizing Committee

Sponsors

GRAPHISOFT.
ARCHICAD

AUTODESK.

STUDIOIN-EX
ARCHITECTS&ENGINEERS

MŰEGYETEM 1782

Építészeti Ábrázolás Tanszék
Department of Architectural Representation

Acknowledgement

We would like to express our sincere thanks to all of the authors, reviewers, session chairs, and plenary speakers. We also wish say thank you to the workshop organizers, who brought practice to theory closer together.
This conference was supported by our sponsors: GRAPHISOFT, AUTODESK, and STUDIO IN-EX. Additionally, the Faculty of Architecture at Budapest University of Technology and Economics provided support through its “Future Fund” (Jövő Alap), helping to bring internationally recognized speakers to this conference.
Members of our local organizing team have supported this event with their special contribution – namely, their hard work in preparing and managing this conference.

Mihály Szoboszlai
Chair of the Organizing Committee

Local conference staff
Ádám Tamás Kovács, Bodó Bánáti, Imre Batta, Bálint Csabay, Benedek Gászpor, Alexandra Göőz, Péter Kaknics, András Zsolt Kovács, Erzsébet Kőnigné Tóth, Bence Krajnyák, Levente Lajtos, Pál Ledneczki, Mark Searle, Béla Marsal, Albert Máté, Boldizsár Medvey, Johanna Pék, Gábor Rátonyi, László Strommer, Zsanett Takács, Péter Zsigmond

Workshop tutors

Algorithmic Design through BIM

Erik Havadi

Laura Baróthy

Working with BIM Analyses

Balázs Molnár

Máté Csócsics

Zsolt Oláh

OPEN BIM

Ákos Rechtorisz

Tamás Erős

GDL in Daily Work

Gergely Fehér

Dominika Bobály

Gergely Hári

James Badcock

List of Reviewers

Abdelmohsen, Sherif - Egypt
Achten, Henri - Czech Republic
Agkathidis, Asterios - United Kingdom
Asanowicz, Aleksander - Poland
Bhatt, Anand - India
Braumann, Johannes - Austria
Celani, Gabriela - Brazil
Cerovsek, Tomo - Slovenia
Chaszar, Andre - Netherlands
Chronis, Angelos - Spain
Dokonal, Wolfgang - Austria
Estévez, Alberto T. - Spain
Fricker, Pia - Switzerland
Herr, Christiane M. - China
Hoffmann, Miklós - Hungary
Juhász, Imre - Hungary
Jutraz, Anja - Slovenia
Kieferle, Joachim B. - Germany
Klinc, Robert - Slovenia
Koch, Volker - Germany
Kolarevic, Branko - Canada
König, Reinhard - Switzerland
Krakhofer, Stefan - Hong Kong
van Leeuwen, Jos - Netherlands
Lomker, Thorsten - United Arab Emirates
Lorenz, Wolfgang - Austria
Loveridge, Russell - Switzerland
Mark, Earl - United States
Molnár, Emil - Hungary
Mueller, Volker - United States
Németh, László - Hungary
Nourian, Pirouz - Netherlands
Oxman, Rivka - Israel
Parlac, Vera - Canada
Quintus, Alex - United Arab Emirates
Searle, Mark - Hungary
Szoboszlai, Mihály - Hungary
Tuncer, Bige - Singapore
Verbeke, Johan - Belgium
Vermillion, Joshua - United States
Watanabe, Shun - Japan
Wojtowicz, Jerzy - Poland
Wurzer, Gabriel - Austria
Yamu, Claudia - Netherlands

Contents

Keynote speakers

REINHARD KÖNIG

Reinhard König studied architecture and urban planning. He completed his PhD thesis in 2009 at the University of Karlsruhe. Dr. König has worked as a research assistant and appointed Interim Professor of the Chair for Computer Science in Architecture at Bauhaus-University Weimar. He heads research projects on the complexity of urban systems and societies, the understanding of cities by means of agent based models and cellular automata as well as the development of evolutionary design methods. From 2013 Reinhard König works at the Chair of Information Architecture, ETH Zurich. In 2014 Dr. König was guest professor at the Technical University Munich. His current research interests are applicability of multi-criteria optimisation techniques for design problems and the development of computational analysis methods for spatial configurations. Results from these research activities are transferred into planning software of the company DecodingSpaces. From 2015 Dr. König heads the Junior-Professorship for Computational Architecture at Bauhaus-University Weimar, and acts as Co-PI at the Future Cities Lab in Singapore, where he focus on Cognitive Design Computing.
Main research project: Planning Synthesis & Computational Planning Group see also the project description: Computational Planning Synthesis and his external research web site: Computational Planning Science

BRANKO KOLAREVIC

Branko Kolarevic is a Professor of Architecture at the University of Calgary Faculty of Environmental Design, where he also holds the Chair in Integrated Design and co-directs the Laboratory for Integrative Design (LID). He has taught architecture at several universities in North America and Asia and has lectured worldwide on the use of digital technologies in design and production. He has authored, edited or co-edited several books, including “Building Dynamics: Exploring Architecture of Change” (with Vera Parlac), “Manufacturing Material Effects” (with Kevin Klinger), “Performative Architecture” (with Ali Malkawi) and “Architecture in the Digital Age.” He is a past president of the Association for Computer Aided Design in Architecture (ACADIA), past president of the Canadian Architectural Certification Board (CACB), and was recently elected future president of the Association of Collegiate Schools of Architecture (ACSA). He is a recipient of the ACADIA Award for Innovative Research in 2007 and ACADIA Society Award of Excellence in 2015. He holds doctoral and master’s degrees in design from Harvard University and a diploma engineer in architecture degree from the University of Belgrade.

Towards the Measurement of Perceived Architectural Qualities

Benjamin Heinrich[1], Gabriel Wurzer[2]

[1,2]Digital Architecture and Planning, TU Wien , Austria

e-mail: [1]bmh@benjaminheinrich.at, [2]gabriel.wurzer@tuwien.ac.at

Abstract: *"Architectural quality" is a property of the built environment that, even though often quoted, is hard to define in rigorous terms. In our work, we take a step into that direction, based on recent results in cognitive sciences: We have conducted a survey in which our participants were asked to mark the occurrence of five qualities (monumental; progressive; structured; conservative; puristic) in photographs showing buildings (taken consecutively in an urban area). Combining the marked occurrences of multiple participants gives a density distribution on facades for every term. We may then correlate and compare the so-found qualities on the facade, in an effort to characterize and contrast them.*

Keywords: *Architectural Quality, Measurement, Occurrence Maps*

DOI: *10.3311/CAADence.1684*

INTRODUCTION

There is no clear notion of architectural quality. Some researchers define it as an impression of space, as experienced by an outstanding observer, others say that it is measurable – and have done so using algorithmic methods. However the quality of these statements is yet unclear; there has been little work on architectural space as experienced by real people, leading to a definition in rigorous terms that can define what "quality" really is. This paper seeks to bridge this gap by conducting a graphical survey along these lines, across a wide range of features available in a mixed use urban complex (both in Vienna and Shanghai), which is unprecedented to the best of the authors' knowledge. If architectural quality can be defined by "evidence based methods" instead of speculation or "common sense knowledge", we might be able to approach the subject in a more fact-based way, leading to a broader discussion.

Our work (also see [1]) is based on "Bodily maps of emotions" [2], a paper given by neurobiologists to survey the respective locations where emotions are felt in the human body (see Background and Related Work). From this, we deducted a method for architecture, in which we survey observed "qualities" (see Method). In the actual survey, participants of the study entered their respective perceptions according to the five terms "monumental", "progressive", "structured", "conservative" and "puristic" in a graphical manner, by drawing over photographs (see Survey). The choice of the qualities was arbitrary, and we made no effort to establish a "complete" or otherwise "meaningful" listing of these. What we wanted was to showcase how any choice of qualities can be compared and contrasted during a future study, in order to get to a such a "complete" catalogue (see Analysis).

We contribute an objectified view of architectural qualities by real people (not necessarily architects) which can be applied e.g. during the preparation or evaluation of competitions and for the verification of the hypothesized role of architectural features in buildings.

BACKGROUND AND RELATED WORK

The general idea for introducing a measurement method for subjectively experienced emotions was inspired by a study of neurobiologists of the Department of Neuroscience and Biomedical Engineering School of Science at Aalto University, Finland. In their paper 'Bodily maps of emotions' they conducted a study using a graphical approach, in which participants marked where they feel certain emotions (e.g. anger, fear, happiness, sadness) on a map of the human body [2]. The aggregation of all "bodily maps" then gives an overall impression on where each terminus is felt. The authors furthermore do a hierarchical clustering of emotions, leading to the discovery of which emotions are contained in one another, and which are closely related. The method we are proposing substitutes "emotions" with "qualities" and "bodily maps" with photographs of buildings taken sequentially in a common urban context.

Other rigorous investigations of architectural quality are mostly based upon spatial analysis within the digital floor-plan. For example, Franz et al. [3] predict different spatial qualities (spaciousness, openness, complexity and order) using isovist analysis. Key et al. [4] use a grid-based analysis approach in which they sample "enclosure", "viewfield" and "continuity" as by their own definition.

Subjective investigation of spatial qualities has for example been conducted by Franz [3], who looks e.g. into emotional response concerning color and space, in categories of "pleasingness", "beauty", "excitement", "interestingness" and so forth. The author concludes that color saturation and openness were the main determinants for emotional response. The question of whether participants with a professional background give a different assessment than non-professional ones has been researched by Llinares et al. [5] in the context of urban qualities. The authors conclude that there is no difference, which is also reflected by our own results (see Analysis). We also include a discussion of our results, which furthermore points to future work (see Discussion) before summarizing (see Conclusion).

METHOD

Our method proceeds in the following steps (also refer to Figure 1):

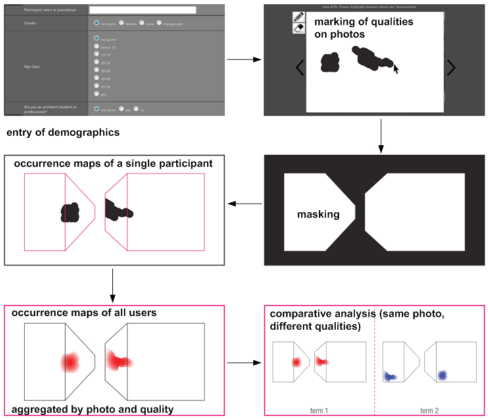


Figure 1: Overview of all data entry and processing steps involved

(1.) We let users mark qualities on photos, using a web-based surveying tool provided by the authors. In more detail, users are taken through a series of photos and asked to highlight features that they think belongs to a specific quality. Each quality is asked for separately, i.e. the same photo is presented multiple times before moving on to the next one. More technically, we use an overlay bitmap to capture the marks drawn over the original picture as transparent bitmap (fully black where the user has marked, transparent otherwise). In order to exclude non-architectonical features, we also apply a manually produced mask (made beforehand for each picture.

(2.) The captured bitmaps are called "occurrence map"; as said, we have exactly one for every quality in every photo in the case of a single survey participant. Aggregating all the occurrence maps of the same quality and photo for all participants gives a density distribution, which can tell us where a high number of participants agree that they see the quality in question on the photo.

(3.) For each photo, we may now compare the qualities based on some difference measure. In our case, we took the absolute sum of pixel differences among the two aggregated bitmaps. In that way, we could technically determine a "dissimilarity" between the two qualities for a single

Figure 2:
(rows 1-2) Viertel Zwei in Vienna
(rows 3-4) KIC Jiangwan in Shanghai

photo. We were also able to get to a global dissimilarity measure by taking the average dissimilarity of all photos.

SURVEY

The actual survey was conducted both in Austria and in China, using newly developed mixed use urban complexes ('Viertel Zwei', Vienna; 'KIC Jiangwan', Shanghai; see Figure 2) as a context. In Vienna, we had 16 and in Shanghai 13 participants. Thus, our results are necessarily explorative, i.e. not significant but rather hint at possible outcomes of a full-blown study to be conducted in the future.

Participants. Our participants were almost equally distributed in gender, yet the age class was mainly young people (Vienna: between20 - 40 years ~84%; Shanghai: between 20 - 29 years ~72%). Most did not have any relation to architecture or urban design (Vienna: 79%; Shanghai: 79%). Generally there was a low percentage of 'not provided' information and most people did complete the survey fully.

Captured qualities. We captured five qualities, namely "monumental", "progressive", "structured", "conservative" and "puristic". Most participants were able to associate these terms with the facades of the buildings shown, even though we had just asked them to highlight where they see a certain quality on a photo (i.e. not especially mentioning buildings at all).

Comparability Vienna to Shanghai. It is questionable at first whether we can actually compare the Shanghai case to the Vienna one. First, both are successful urban development areas. Second, we have conducted an additional on-site survey with 30 participant (18 in Vienna and 12 in Shanghai) which captured "atmospheric data" concerning the emotional, architectural and urban perception, with quite similar results. Both areas were seen as 'calm', 'inspiring', 'open', 'orderly' and 'simple'.

ANALYSIS

For every photo, we did a comparative analysis that shows the difference between the perceived qualities (Figure 3 gives an example for the case of Vienna).

In the Viennese case, the choices of marked areas (intensity) were more diverse, yet the areas which were marked, have been very specific (density) - assumption: a lot of quality distributed in the area, sure where it is;

In the Shanghai case, the choices of marked areas (intensity) were less and very specific, yet the areas which were marked have been more diverse (density) - assumption: less quality in the area, not sure where it is.

We also aggregated all results (all qualities in all photos) and got an overall outcome along the following lines: **(1.)** The quality 'conservative': is the most controversial term since it was marked very specifically, yet the contestants distributed their marking very diversely - disagree about the location. **(2.)** The quality 'structured': is distributed all around the areas and marked very diversely, in the meaning of everything in the area can be structured.

For now, the conclusion which we would draw from conducting these surveys is that the quali-

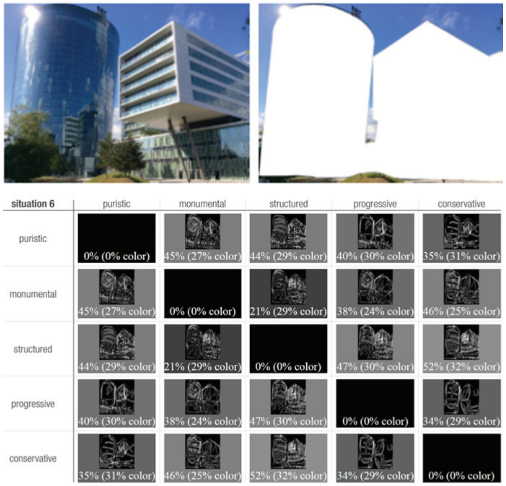
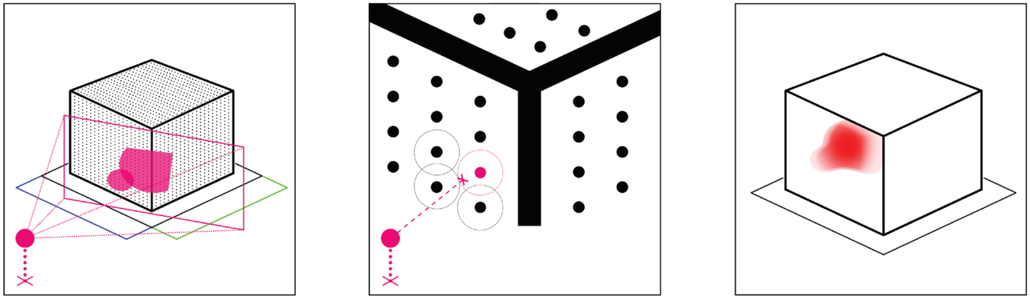


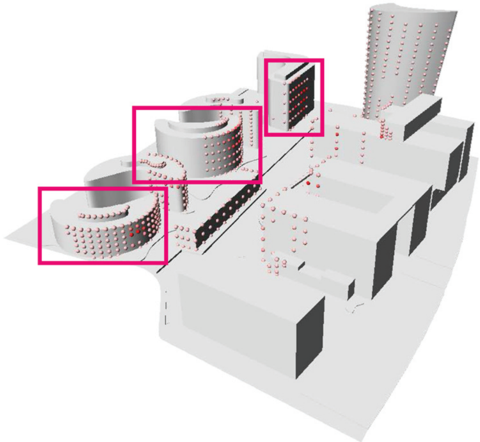
Figure 3:
Example of comparative analysis between the five captured qualities for the Vienna case.

Figure 4:
Example of markings of architectural qualities conducted by our users

Figure 5:
(upper part) Process of reverse projection
(lower part) outcome for the term "progressive" in the Vienna case



ties sought for are distinguishable in most cases, and the place on the facade where people see a certain quality is non-arbitrary.



DISCUSSION

The method for marking occurrences of qualities in images is certainly improvable (also refer to Figure 4): Some people would encircle parts of the image rather than marking in a hatched way, which we had assumed. As a result, more work needs to be done on interpreting the results, which is what we need to do in future work.
Furthermore, we thought it beneficial to integrate all occurrence maps into a 3D model, by reverse-projecting the pixel images of all participants onto an urban model. In more detail (refer to Figure 5), the process (1.) needs to project each pixel image from the original viewpoint the camera had onto the facade, which (2.) is subdivided into a regular grid of which we take, for every ray intersection, the nearest point and add one to its color intensity. Since we do this for every bitmap and every vantage point, intensities accumulate, leading (3.) to a intensity distribution as is also shown in the lower part of Figure 5.

CONCLUSION

We have presented an approach that measures architectural qualities by use of a survey method deemed as 'occurrence maps': Users mark features which they perceive as belonging to a certain architectural quality in photographs, allowing us to study areas within the facade where such qualities occur. By contrasting different perceived qualities using the same photographs, we can furthermore get an impression about correlations or differences between the architectural terms used. Our studies were performed both in Vienna and in Shanghai, accounting for different perceptions and/or urban contexts. In effect, our method can be used for objectively quantifying urban space, e.g. for competitions, evaluation of the built environment and, in further work, also for the establishment of a catalogue of architectural terminology that is based on evidence rather than 'common-sense knowledge'.

ACKNOWLEDGEMENTS

We would like to acknowledge the valuable input of Lauri Nummenmaa, Enrico Glereana, Riitta Hari, and Jari K. Hietanend, who sent us the following statement: "Your approach surely seems novel and it will be interesting to see how people rate buildings in this type of task. [...] People often pay attention to the features they find interesting etc., thus this would give you a natural and unobtrusive way to see how people evaluate architectural features."

REFERENCES

[1] Heinrich, B., *perceptibility - towards understanding of perceived spatial qualities*, Master Thesis, TU Wien, 2015.

[2] Nummenmaa, L., Glerean, E., Hari, R. and Hietanen, J.K. Bodily maps of emotions, *Proceedings of the National Academy of Sciences of the United States of America*, vol. 111 issue 2, 2013, p. 646–651.

[3] Franz, G., von der Heyde, M. and Bülthoff, H., Predicting experiential qualities of architecture by its spatial properties, Proceedings of the 18th International Association for People-Environment Studies Conference, 2005, p. 04:1-04:10

[4] Key, S., Gross, M.D. and Do, E.Y.-L., Computing Spatial Qualities For Architecture, *Proceedings of ACADIA 2008*, 2008, p. 472-477.

[5] Llinares, C., Montañana, A. and Navarro, E., Differences in Architects and Nonarchitects' Perception of Urban Design: An Application of Kansei Engineering Techniques, *Urban Studies Research 2011*, 2011, p. 736307:1-736307:13.

Author’s index

The aim of these workshops and conference is to help transfer and spread newly appearing design technologies, educational methods and digital modelling supported by information technology in architecture. By organizing a workshop with a conference, we would like to close the distance between practice and theory.

Architects who keep up with the new designs demanded by the building industry will remain at the forefront of the design process in our information-technology based world. Being familiar with the tools available for simulations and early phase models will enable architects to lead the process.
We can get “back to command”.
The other message of our slogan is <Back to command>.
In the expanding world of IT applications there is a need for the ready change of preliminary models by using parameters and scripts. These approaches retrieve the feeling of command-oriented systems, although, with much greater effectiveness.

Why CAADence in architecture?

"The cadence is perhaps one of the most unusual elements of classical music, an indispensable addition to an orchestra-accompanied concerto that, though ubiquitous, can take a wide variety of forms. By definition, a cadence is a solo that precedes a closing formula, in which the soloist plays a series of personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation."

CAADence in Architecture
Back to command
International workshop and conference
16-17 June 2016
Budapest University of Technology and Economics
www.caadence.bme.hu

ISBN 978-963-313-225-8
9 789633 132258