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.

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 personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation."
Back to command
Edited by Mihály Szoboszlay
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
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Members of our local organizing team have supported this event with their special contribution – namely, their hard work in preparing and managing this conference.

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Loveridge, Russell - Switzerland
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Parlac, Vera - Canada
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Verbeke, Johan - Belgium
Vermillion, Joshua - United States
Watanabe, Shun - Japan
Wojtowicz, Jerzy - Poland
Wurzer, Gabriel - Austria
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Contents

14  Keynote speakers

15  Keynote
15  Backcasting and a New Way of Command in Computational Design
    Reinhard Koenig, Gerhard Schmitt
27  Half Cadence: Towards Integrative Design
    Branko Kolarevic

33  Call from the industry leaders
33  Kajima’s BIM Theory & Methods
    Kazumi Yajima

41  Section A1 - Shape grammar
41  Minka, Machiya, and Gassho-Zukuri
    Procedural Generation of Japanese Traditional Houses
    Shun Watanabe
49  3D Shape Grammar of Polyhedral Spires
    László Strommer

55  Section A2 - Smart cities
55  Enhancing Housing Flexibility Through Collaboration
    Sabine Ritter De Paris, Carlos Nuno Lacerda Lopes
61  Connecting Online-Configurators (Including 3D Representations) with CAD-Systems
    Small Scale Solutions for SMEs in the Design-Product and Building Sector
    Matthias Kulcke
67  BIM to GIS and GIS to BIM
    Szabolcs Kari, László Lellei, Attila Gyulai, András Sik, Miklós Márton Riedel
Section A3 - Modeling with scripting

Parametric Details of Membrane Constructions
Bálint Péter Füzes, Dezső Hegyi

De-Script-ion: Individuality / Uniformity
Helen Lam Wai-yin, Vito Bertin

Section B1 - BIM

Forecasting Time between Problems of Building Components by Using BIM
Michio Matsubayashi, Shun Watanabe

Integration of Facility Management System and Building Information Modeling
Lei Xu

BIM as a Transformer of Processes
Ingolf Sundfør, Harald Selvær

Section B2 - Smooth transition

Changing Tangent and Curvature Data of B-splines via Knot Manipulation
Szilvia B.-S. Béla, Márta Szilvási-Nagy

A General Theory for Finding the Lightest Manmade Structures Using Voronoi and Delaunay
Mohammed Mustafa Ezzat

Section B3 - Media supported teaching

Developing New Computational Methodologies for Data Integrated Design for Landscape Architecture
Pia Fricker

The Importance of Connectivism in Architectural Design Learning: Developing Creative Thinking
Verónica Paola Rossado Espinoza

 Ambient PET(b)ar
Kateřina Nováková

Geometric Modelling and Reconstruction of Surfaces
Lidija Pletenac
Section C1 - Collaborative design + Simulation

Horizontal Load Resistance of Ruined Walls Case Study of a Hungarian Castle with the Aid of Laser Scanning Technology
Tamás Ther, István Sajtos

2D-Hygrothermal Simulation of Historical Solid Walls
Michela Pascucci, Elena Lucchi

Responsive Interaction in Dynamic Envelopes with Mesh Tessellation
Sambit Datta, Smolik Andrei, Tengwen Chang

Identification of Required Processes and Data for Facilitating the Assessment of Resources Management Efficiency During Buildings Life Cycle
Moamen M. Seddik, Rabee M. Reffat, Shawkat L. Elkady

Section C2 - Generative Design -1

Stereotomic Models In Architecture A Generative Design Method to Integrate Spatial and Structural Parameters Through the Application of Subtractive Operations
Juan José Castellón González, Pierluigi D’Acunto

Visual Structuring for Generative Design Search Spaces
Günsu Merin Abbas, İpek Gürsel Dino

Section D2 - Generative Design - 2

Solar Envelope Optimization Method for Complex Urban Environments
Francesco De Luca

Time-based Matter: Suggesting New Formal Variables for Space Design
Delia Dumitrescu

Performance-oriented Design Assisted by a Parametric Toolkit - Case study
Bálint Botzheim, Kitti Gidófalvy, Patricia Emy Kikunaga, András Szollár, András Reith

Classification of Parametric Design Techniques
Types of Surface Patterns
Réka Sárközi, Péter Iványi, Attila Béla Széll
227  Section D1 - Visualization and communication

227  Issues of Control and Command in Digital Design and Architectural Computation
Andre Chaszar

235  Integrating Point Clouds to Support Architectural Visualization and Communication
Dóra Surina, Gábor Bődő, Konsztantinosz Hadzijanisz, Réka Lovas, Beatrix Szabó, Barnabás Vári, András Fehér

243  Towards the Measurement of Perceived Architectural Qualities
Benjamin Heinrich, Gabriel Wurzer

249  Complexity across scales in the work of Le Corbusier
Using box-counting as a method for analysing facades
Wolfgang E. Lorenz

256  Author’s index
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

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BIM to GIS and GIS to BIM

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Abstract: Designing of a building and urban planning are two different professions. Apart from the professional knowledge the data, the scale, the applied software are all different. However, these two areas depend on each other. In our opinion, planning does not end at the building level, since a building pertains to a street, and a street is a part of a settlement. The process of building designing has to be a part of the larger scale process of urban planning. Architects would need information the beginning of the designing, which is actually available at the urban level: localization of the parcel, the density of built environment, local architectural regulation, etc. It would be useful to give the opportunity for automated control after completing the design. Furthermore, the work of the urban planner could be highly supported by the 3D architectural models of buildings. Our work is focused on the practical applicability of the issue in Hungary rather than researching new theoretical methods. Our pilot project showed convincing results. With further improvements the implementation can begin.

Keywords: BIM, GIS, urban planning, 3D modelling

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BUILDING INFORMATION MODELING – BIM

BIM has become one of the most popular acronym in the field of architecture over the last few years. BIM comes from the English expression Building Information Modeling. This can be defined as an intelligent, model-based process spanning through the complete life-cycle of the building, which was created to support the more economical, faster and more environmental friendly implementation of construction projects. It generates cooperation between the participants even from different fields, and provides numerous advantages to designers, construction professionals and owners throughout the entire period of the project [1]. BIM is a system to store and manage all the data related to the building, which represents a three-dimensional model-based database. This implies that primarily BIM is a spatial model and secondly it is a database. This is important because the built-up components (elements) in the model space are identified, and later attributes are linked to them depending on their application: statical characteristics by the supporting structures, prices by the budget and thermal characteristics by the energetics.
An independent, standardized file format has been developed in order to help the model- and data-based communication between the various disciplines, which is suitable for the structured description of the BIM objects used in architecture. This file format is IFC (Industry Foundation Classes), and it is recognized by all of the architectural, structural and mechanical design software packages. The collaborators of different disciplines export their models into an IFC file, which contains all the field-specific information. Then the architect imports these files into his own software, and integrates it with the architectural plans.

GEOGRAPHIC INFORMATION SYSTEM – GIS

The Government Decree No. 314/2012. (XI. 8.) contains regulations about the urban development concept, the integrated strategy for urban development, the tools of the settlement planning and its specific legal institutions. The regulations define that the settlements develop the infrastructure network, control the land use and the local building policy within their own competence, while preserving the natural, landscape and architectural values of the environment and ensures consistency with the higher-level regulations. Its tools are [3]:

- **the urban development concept**, which is based on the decision of the local government’s representative body;
- **the urban structure plan**, which is based on the local government’s decision of the urban development concept and developed by the local government’s representative body;
- **the local building code and the regulation plan**, which is based on the settlement structure plan and determined by the regulation of the local government’s representative body.
The local building code contains the construction rules that apply to a particular site. Construction Monitoring System is a web application operated by the Lechner Knowledge Center, and it supports the local building collaborators by displaying 2D informations on basemap about the local building codes. The problem is that the current regulation plan is not directly comparable with the plans of a building permit arriving in 2D format (PDF) to the construction authorities; therefore they can’t be automatically checked and verified. Moreover, some of the rules not only depend on the spatial arrangement of the site, but also on the construction itself. Unfortunately, in the current situation even a simple verification cannot be implemented automatically (e.g. keeping distance from the plot border), since the necessary data is not available or it is not in the appropriate format.

THE CONNECTION BETWEEN COMMUNITY PLANNING AND ARCHITECTURAL DESIGN – GIS TO BIM

In the architectural design, taking certain criteria into consideration from the beginning of the design is essential. The regulations concerning the local single settlement areas can be found for each settlement in different websites and in different structures. The table of contents regularly cannot be found or does not even exist so finding the planning site in the documents and the regulation which is connected to the site can take up much time from the architect.

After the identification of the parcel the actual work begins with the analysis of the written documents and the map appendixes. The cognition of the site and taking into consideration the rules, the designing of the building shall begin. Currently in the course of the settlement planning and architectural planning, in which certain processes are built on each other there is no recent IT data connection.

The architects would need information at the time of the start of the planning which are already available on the settlement level. For example the spatial position of the site, the inbuilt of the neighborhood, the local architectural regulations, etc. The 3D models are arising as the final result of the planning can be automatically compared with the local building codes, and the LOD2-level generalized building models 3D representation could support the settlement planning.

The creation of submission formats and BIM technical guidelines would be worthy to take into account, moreover developing plugins or add-ons for the most popular planning software packages (for example: ArchiCAD, AutoCAD, Revit). It could help the architect’s workflow and would facilitate the automatic check of the files by sending them into the national building registry.

If the architects would not only be able to use the regulations processed by the settlement planners in a text and static map form, but they could get access to its dynamic database, the designing phase and quality control can be accelerated and would be refined. This presupposes the storing of the full regulation in a database to which the architects have to be able to connect by a web-based data connection.

It would be necessary to modernize the processes of the two specialties in such a way that each other’s data and its information should be able to support their own work. These connections should be established with already existing standard technologies to support the building permit procedure at the authority.

From designing a building – BIM model and IFC standard – it is necessary to reach the stage of city model’s geospatial information technology (GIS), than from there back to the building model again. To achieve this goal it is mandatory to be able to handle the 3D building models on their own and in a generalized form for the city-scale as well.

Five different levels of city-scale visualization can be distinguished by LOD (Level of Detail). Floor-plan (LOD0), floorplan with height (LOD1), roofs (LOD2), overhangings, windows and doors (LOD3) and the complete interior design (LOD4) (Figure 2). These levels in the architectural planning appear differently because of the scale. The overall building mass (LOD100), specific geometry (LOD200), specific and accurate assemblies (LOD300), detailed specification and real life solution (LOD400) (Figure 3).

The substance of the levels of the two disciplines can be associated with each other. They show similarity, however the content has some differ-
ences. Using web-browser technologies for the city-scale display, speed is the bottleneck so it is essential to minimize the data quantity sent to the users. In web-browsers using LOD2 the building mass can be seen and the data content and quantity are moderated so that is why this method in visual representation is the mostly accepted. One of the methods to collect large quantities of LOD2 data is based on laser scanning technology, as it results point clouds come into existence. During the process of making point clouds the objects should be recognized automatically (for example: building, ground, etc.). To be able to apply this process different separation workflows are obligatory, based on spectral (color) or geometry (segmentation) separations.

**THE RELATIONSHIP BETWEEN BUILDING DESIGN AND URBAN PLANNING – BIM TO GIS**

Currently, during the building authorization procedure the architect prepares the plans and uploads the 2D blueprints to the Electronic Documentation System Supporting the Building Authorization Procedures (ÉTDR). During the architectural design, it is becoming less common to work in 2D. Building a 3D model is becoming an integral part of the planning process. This model is used by the architect to accelerate and specify his own work, and to create architectural visualizations as well. Once the designing process has finished and the building has been
erected there is no further need for the architectural files. On the other hand in some cases after the realization of the building the 3D model and plans are needed, for example for Facility Management reasons, renovations, and etc. Storing architectural plans and 3D models in native file formats during the process is common. This is the most effective and easiest way to handle the data fast and keep everything updated.

Finished project files remain saved in local computers and after a few years it is really hard to find and open them. Since the original files were made in older versions of architectural softwares, opening and updating them can only be managed with great efforts. Sometimes migrating old libraries, finding unique elements and custom objects are impossible and the project cannot be opened fully as it was. Keeping every project updated during years takes a lot of effort which is not usual especially in small architectural studios. If the already completed 3D BIM models could be imported and stored in a database, it could greatly accelerate the work of the designers and the authorities.

Storing 3D data in a platform neutral, open file format can prevent data loss during time. As for 2D documents PDF format is perfect for conservation, now for 3D data the IFC format is the most suitable. Old IFC files can be opened in present-day softwares without any trouble and further modifications can also be managed. Since IFC is not only able to store 3D data but attribute data too it is the perfect solution to link properties to 3D elements or connect it with other databases. IFC scheme set-ups can define different processes during the life-cycle of a building including new processes like the building authorization procedure.

For the authorization procedure the building plans must be provided in PDF/A format, whether it is a plan, a photo or a text document. If an opportunity arises to submit and use 3D models during the authorization procedure, the authorization eligibility could be verified from a more accurate and detailed model. Using automatic and semi-automatic rules, the objective parameters could be filtered more quickly and efficiently, compared to the manual verification used today.

Nowadays the project documentation can be processed only by the use of human resources. After a plan takes legal effect and is realized, many important building- and city-scale data get lost in the text documents.

After the realization of the building, if the architect could upload a BIM model (IFC file) which contains all the important 3D and attribute data, it would facilitate and accelerate the collaboration between the two spatial levels.

Figure 4: Levels of visualization
PILOT PROJECT, WEB-BASED 3D VISUALIZATION

Aerial data are collected from a sample area, which was resulted in LOD2 and CityGML files, and was stored in PostgresSQL database. Some of the buildings had plans which had been created in Graphisoft ArchiCAD and IFC files were provided as well. The 3D building models were converted to LOD2 models by the FME 2016 software and these were uploaded into a database. The 3D visualization can be divided into two scales: city-scale from LOD2 data and building-scale from the detailed BIM (IFC) files (Figure 4-5). The city models generated from the LOD2 data would provide a complete overview for the general public and authorities, and they could support impact assessments, arrangement models and verifications in 3D. The city-scale visualization was tested by a pilot project. Solutions for the building-scale visualization already exist, which allow walking through and rotation in the model as well. This process successfully demonstrated a system supporting the architectural authorization procedure, where BIM models designed by architects and models from aerial data collection can be integrated. These data could become public during a subsequent design process, and could greatly accelerate the work related to the authorization procedure including the designers and the administrators. Furthermore, important data are stored in databases that can be used for quantifiable statistics and reports on city-scale too. Finally, the pilot project was completed by the combination of Cesium and OpenLayers 3 technologies (Figure 6). The demo integrates the LOD2 models generated from remote sensing and the architectural IFC models. These can be used for simplified web-based queries.

REFERENCES

### Author's Index

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbas, Günsu Merin</td>
<td>185</td>
</tr>
<tr>
<td>Balla-S. Béla, Szilvia</td>
<td>105</td>
</tr>
<tr>
<td>Bertin, Vito</td>
<td>79</td>
</tr>
<tr>
<td>Botzheim, Bálint</td>
<td>213</td>
</tr>
<tr>
<td>Bödő, Gábor</td>
<td>235</td>
</tr>
<tr>
<td>Castellon Gonzalez, Juan José</td>
<td>177</td>
</tr>
<tr>
<td>Chang, Tengwen</td>
<td>163</td>
</tr>
<tr>
<td>Chaszar, Andre</td>
<td>227</td>
</tr>
<tr>
<td>D’Acunto, Pierluigi</td>
<td>177</td>
</tr>
<tr>
<td>Datta, Sambit</td>
<td>163</td>
</tr>
<tr>
<td>De Luca, Francesco</td>
<td>195</td>
</tr>
<tr>
<td>De Paris, Sabine</td>
<td>55</td>
</tr>
<tr>
<td>Dino, Ipek Gürsel</td>
<td>185</td>
</tr>
<tr>
<td>Dumitrescu, Delia</td>
<td>203</td>
</tr>
<tr>
<td>Elkady, Shawkat L.</td>
<td>169</td>
</tr>
<tr>
<td>Ezzat, Mohammed</td>
<td>111</td>
</tr>
<tr>
<td>Fehér, András</td>
<td>235</td>
</tr>
<tr>
<td>Fricker, Pia</td>
<td>119</td>
</tr>
<tr>
<td>Füzes, Bálint Péter</td>
<td>73</td>
</tr>
<tr>
<td>Gidófalvy, Kitti</td>
<td>213</td>
</tr>
<tr>
<td>Gyulai, Attila</td>
<td>67</td>
</tr>
<tr>
<td>Hadzijianisz, Konsztantinosz</td>
<td>235</td>
</tr>
<tr>
<td>Hegyi, Dezső</td>
<td>73</td>
</tr>
<tr>
<td>Heinrich, Benjamin</td>
<td>243</td>
</tr>
<tr>
<td>Iványi, Péter</td>
<td>221</td>
</tr>
<tr>
<td>Kari, Szabolcs</td>
<td>67</td>
</tr>
<tr>
<td>Kikunaga, Patricia Emy</td>
<td>213</td>
</tr>
<tr>
<td>Koenig, Reinhard</td>
<td>15</td>
</tr>
<tr>
<td>Kolarevic, Branko</td>
<td>27</td>
</tr>
<tr>
<td>Kulcke, Matthias</td>
<td>61</td>
</tr>
<tr>
<td>Lam, Wai Yin</td>
<td>79</td>
</tr>
<tr>
<td>Lellei, László</td>
<td>67</td>
</tr>
<tr>
<td>Lorenz, Wolfgang E.</td>
<td>249</td>
</tr>
<tr>
<td>Lovas, Réka</td>
<td>235</td>
</tr>
<tr>
<td>Lucchi, Elena</td>
<td>155</td>
</tr>
<tr>
<td>Matsubayashi, Michio</td>
<td>87</td>
</tr>
<tr>
<td>Nováková, Kateřina</td>
<td>133</td>
</tr>
<tr>
<td>Nuno Lacerda Lopes, Carlos</td>
<td>55</td>
</tr>
<tr>
<td>Pascucci, Michela</td>
<td>155</td>
</tr>
<tr>
<td>Pletenac, Lidija</td>
<td>141</td>
</tr>
<tr>
<td>Reffat M., Rabee</td>
<td>169</td>
</tr>
<tr>
<td>Reith, András</td>
<td>213</td>
</tr>
<tr>
<td>Riedel, Miklós Márton</td>
<td>67</td>
</tr>
<tr>
<td>Rossado Espinoza, Verónica Paola</td>
<td>127</td>
</tr>
<tr>
<td>Sajtos, István</td>
<td>149</td>
</tr>
<tr>
<td>Sárközi, Réka</td>
<td>221</td>
</tr>
<tr>
<td>Schmitt, Gerhard</td>
<td>15</td>
</tr>
<tr>
<td>Seddik, Moamen M.</td>
<td>169</td>
</tr>
<tr>
<td>Selvä, Harald</td>
<td>99</td>
</tr>
<tr>
<td>Sik, András</td>
<td>67</td>
</tr>
<tr>
<td>Smolik, Andrei</td>
<td>163</td>
</tr>
<tr>
<td>Strommer, László</td>
<td>49</td>
</tr>
<tr>
<td>Sundfør, Ingolf</td>
<td>99</td>
</tr>
<tr>
<td>Surina, Dóra</td>
<td>235</td>
</tr>
<tr>
<td>Szabó, Beatrix</td>
<td>235</td>
</tr>
<tr>
<td>Széll, Attila Béla</td>
<td>221</td>
</tr>
<tr>
<td>Szilvás-Nagy, Márta</td>
<td>105</td>
</tr>
<tr>
<td>Szollár, András</td>
<td>213</td>
</tr>
<tr>
<td>Ther, Tamás</td>
<td>149</td>
</tr>
<tr>
<td>Vári, Barnabás</td>
<td>235</td>
</tr>
<tr>
<td>Watanabe, Shun</td>
<td>41, 87</td>
</tr>
<tr>
<td>Wurzer, Gabriel</td>
<td>243</td>
</tr>
<tr>
<td>Xu, Lei</td>
<td>93</td>
</tr>
<tr>
<td>Yajima, Kazumi</td>
<td>33</td>
</tr>
</tbody>
</table>
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."