

Normative Positions in Architectural Design

Deriving and Applying Design Methods

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This paper presents a recently finished course of eight weeks where CAAD skills, design methodology, and architectural theory are combined to discuss possible perspectives on the use of the computer in design, and its influence on architecture. In the course, three contemporary architects were studied; Peter Eisenman, Ben van Berkel, and Greg Lynn. Each was discussed on aspects of ontology (which are the elements of discourse), design method (design process and organization of the process), and the use of the computer (techniques and approaches). These were linked with design theory, architectural theory, and CAD-theory.

The reflection on the work of the architects resulted in a number of design methods for each architect. The design methods were adapted to the available technologies in the university as well as to the scope of the exercise, since the period of eight weeks for an exercise cannot compete with design processes in practice that take many participants and much time. The students then applied the design methods to a design task: student housing and an exhibition pavilion on the campus area of the university. The task was so devised, that students could focus on either architectural or urban design level with one of the design methods. Also, the choice of architects and accompanying design methods was made in such a way that students with low, medium, and advanced computer skills could take part in the course and exercise.

In a workshop held at the Czech Technical University (CVUT) in Prague, the same procedure was used in a one-week period for a different design task, but in an otherwise almost identical setting with respect to the CAAD software used. The methods and material were easily transferred to the other setting. The students were able to cope with the task and produced surprising results in the short time span available.

The paper will provide an overview of the course, discuss the pedagogical implications of the work, and discuss how this particular work can be generalized to incorporate other architects and approaches.

Keywords: CAAD: design methods; pedagogy.

Introduction

In the architectural curriculum, much effort is spent on studio work. The Design studio is in many cases the main pedagogical approach to have students understand the nature of design. In the CAAD curriculum, a great deal of attention goes to acquiring basic computer skills, on the level of operating the software in an instrumental way. Learning architectural design and learning Computer Aided Architectural Design is more often than not taught separately without strong explicit interactions between the two. The student is mostly considered to bring coherence in the two fields by him- or herself.

The computer offers an opportunity to architectural design, not only as a very convenient tool for all kinds of purposes, but also as a new means of inquiry into the nature of architectural design. Computer models of all kinds can change the way we perceive critical issues in architectural theory such as space, production, evaluation, and the position of the architect in the building process. Within an architectural curriculum, however, it is often difficult to find time on top of the teaching of basic skills to deal with these broader issues.

Although learning a set of CAAD skills has its advantages in its own right, it is useful for students to be prompted into more refined ways of working with the computer in the design process. Broadly speaking, students can learn these skills in the following ways:

- a. Make exercises – focus on small tasks with specific purpose. Use limited set of specific tools (e.g. AVOCAAD exercises, Verbeke et al. 1999, 2000).
- b. Write theoretical essay – explore the relationship by reading publications in the field and formulate own position. The use of tools is not necessarily required, and they serve more of an illustrative point of view.
- c. Work in design studio – make a design in a design studio/computer lab setting. Use wide array of tools; usually intensive mentoring by teacher.

Boundaries between these examples are not strict. It is quite possible to use a mix of these approaches

(see for example The Grunsfeld Variations by Habraken at MIT).

An in-depth study of the relationship between CAAD and architectural design, requires a well-defined theoretical basis that serves as reference. This basis can be an architectural theory or a design method, accompanied by computational theory.

- i. Architectural theory: architectural theory comprises any written system of architecture, whether comprehensive or partial, that is based on aesthetic categories (after Krufft 1994).
- ii. Design methodology: the study of the principles, practices and procedures of design in a rather broad and general sense. Its central concern is how designing both is and might be conducted (after Cross 1984).
- iii. CAAD theory: the computational and working principles underlying CAAD systems, such as information handling, programming, and modeling techniques.

Each of these disciplines in their own right shed a light on architectural design from their own perspective. The combination of any two of these can lead to focused attention to for example design of Palladian villas (i and ii), shape grammars for Palladian villas (i and iii), or the use of shape grammars in design (ii and iii). The combination of all three covers all aspects of using the computer in architectural design.

In this paper, the approach and results of a new course and brief workshop are presented in which computer skills, design method, and architectural theory are combined.

The course and workshop

The course is titled Architectural and Urban Design with CAD, and is an advanced CAD and design course. It runs for eight weeks and consists of lectures combined with an exercise. The goal of the course is to give a sophisticated understanding of the relationship between the use of computers, working methods in design, and the products of this process. In the lectures, three architects are discussed with respect to their use of CAAD in design: Peter

Eisenman, Ben van Berkel, and Greg Lynn. The author has gathered the information on these architects beforehand. By studying and emulating the methods of these architects, students must be able to define their own insights and attitudes towards the use of CAAD.

The architects are discussed in the light of the general theoretical focus areas mentioned above. In the course, these become more specified in the following aspects:

1. Ontology: which elements/concepts does the architect distinguish in his theoretical position?
2. Method: how does the architect organize his process; where and how does he use CAAD?
3. Result: how do ontology and method influence the result of the design process?

These aspects serve as a framework when the information on the architects needs to be ordered for presentation to the students.

In the exercise part, students have to make either a building design for an art pavilion, or an urban design for student housing. Both assignments are located on the EUT campus. All material for the course is available on the Internet: <http://www.ds.arch.tue.nl/Education/Courses/7m690/>.

The choice for Eisenman, van Berkel, and Lynn has been made on three main grounds:

- Varying level of CAAD literacy required to study a particular approach: The sequence Eisenman, van Berkel, Lynn requires an increasing amount of computer skills.
- Methods applicable on architectural and/or urban level: Eisenman's working methods is very much related to the urban scale level, Lynn's method to the building scale level, and van Berkel on both levels.
- Theoretical stance published by the authors: The reflections by the architects need to be made clear. On all three architects material can be found on their architecture, and way of working.

The course has also been condensed into a five-day workshop which was held in Prague at CVUT. The theoretical background was presented in a

starting session, after which the students had to work on an extension to the old Townhall in Staromestske Namesti in Prague.

In both the case of the regular course and the workshop, the distinction in level of CAAD competence and level of scale seemed fruitful and instrumental. The students competence ranged from beginner to advanced. They readily chose the technique and approach they felt most comfortable with.

In both settings, the students first explored the site of the design task, and used methods derived from one of the architects to represent this information. After that a process started in which the design was developed in the context of one of the chosen methods. This phase generated much discussion on the relationship between CAAD and architecture, in particular the question of randomness versus structure. In the end, the process and product had to be presented. In the workshop context, this was done by means of posters. In the course context this was done by (electronic) essay.

Method of analysis

The theoretical positions of the architects were identified in a study of publications written by the architects themselves or others about these architects. By separating the available information on the aspects of ontology, design method, and result, the material could be structured in a relatively short time. Also, the aspects served as a filter to leave out unrelated issues.

In the first pass, this resulted per aspect in a number of text fragments and a collection of images. The texts were chosen when they made a statement on either aspect mentioned above. The images were chosen when they had an illustrative value with respect to the statements. In particular images that showed something of the process, or images that had a schematic quality, were selected.

For the aspect of ontology, this approach has led to a list of informative concepts for understanding the architect. These concepts were then related in a concise framework in which the position of the architect was summarized.

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For the aspect of design method, the concepts were first put in a preliminary chronological order, showing which general tasks precede others. This order, and the design questions that arise by working in this order, was then further described.

For the aspect of design result, the images found in the first pass were correlated to the design method, using the terminology of the concept identified before. In this way it was possible to point out how the theoretical work was related to final outcomes. This also helped to discuss the great amount of other design issues that need to be dealt with before a finalized design is realized.

Each of the architects discussed use particular software in their design office. In the course it is not necessary to have precisely these packages available for students, if there is software that has similar functionality. In all cases, it will be necessary to make a translation step towards the tools available for the students.

Example: three architects, three methods

Peter Eisenman's working method, as described in Galofaro (1999), relies on a simultaneous production of drawings, scale models, and computer models. The technique of superposition is used to combine historical readings of the site into material that forms the basis of a design (this is very well documented in Bédard 1994). In this way, Eisenman is looking for complexity in material related to the history of the site. In a later phase, this already complex superposition gets an additional layer by means of a diagrammatic model: an image that is associated with the project (e.g. the image of the structure of a liquid crystal display as related to the design task of the headquarters of a software firm). This image is used to distort the current design by making the design follow lines and directions present in the diagrammatic model. This is done either in two dimensions, on the plan level, or in three dimensions, in a computer model.

The superposition method works with almost any graphics or CAD package that supports layering. The technique of the diagrammatic model can also be simulated in such a way, although more sophisticated tools are available and required when applying this technique to 3D computer models.

A broad outline of Eisenman's method, as was used in the course, is as follows:

- 1) Collect historical map material of the site.
- 2) Superimpose the maps on each other. Use distortion techniques such as scale and rotation. Try to find significant formal elements in this analysis and relate them to the brief.
- 3) Use the elements of the analysis to make the design.
- 4) Find a (literal) diagrammatic model that is related to the design task.
- 5) Use the diagrammatic model to distort the design.

At any point, this method can be more elaborated in detail by adding more detailed steps and design- or CAAD techniques.

UN Studio, or Ben van Berkel and Caroline Bos, after applying rather traditional analytical techniques on a design task, try to find a diagram that informs their design process (van Berkel and Bos 1999). The diagram is an image of an organizational structure that is related to the core issue in the design task. It forms a metaphor for thinking about the design, and in which direction it should progress (e.g. for the Moebius House, the diagram of two intersecting curvilinear lines is used to characterize the two intersecting sequences of space that form the basis of the house). In their work, the development of the building design and how it relates to the diagram, is an important aspect. The diagram provides a handle on complexity as it hints to directions in which the solution can be developed.

In the work of UN Studio, thinking in diagrams, and the results of the analysis of the brief, is usually translated immediately in 3D forms. Intensities of traffic, use patterns in a site, pedestrian movement, etc. are visualized as volumes, and form a basis for shaping the new design. The continuous surface forms

Figure 1. Example of student work by method of van Berkel. Study of connection movement paths on campus connected with major spaces of the art pavilion. In the elaboration phase, the diagram is a grotto, reflecting the interrelations between space and movement (work by Neeltje Tops).

an important issue in van Berkel's work to connect these volumes, as well as public and private space.

A broad outline of van Berkel's method, as was used in the course, is as follows:

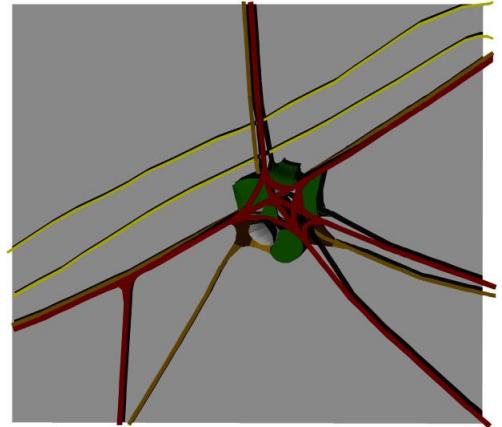
- 1) Analyse the brief and identify major elements.
- 2) Locate these elements in the site.
- 3) Identify a (associated) diagram that has the same abstract qualities as the design task.
- 4) Use the diagram as a metaphor in the design process.
- 5) Combine public- and private space through continuous surfaces.

Gregg Lynn investigates the consequence of computing space, and how architecture as a reactive element in space can be generated by means of animation (Lynn 1999). His main concern lies in understanding the consequence of making every element of architecture computational. Lynn defines the relations between objects in a brief, their interrelationships, and constraints, and also models the characteristics of space and its influence on the objects. Then, by using the technique of keyframing, Lynn introduces time and animation to the system and analyses what happens when the whole is set in motion. In this way, Lynn can handle an increased notion of complexity through the processing power of the computer.

Lynn's work points to the direction where all pieces of architectural design can be coded in a computational form, and thus proceed through architectural design in a reflective, studied, manner that reacts on emerging events rather than a completely controlled process in which the drive behind changes in the design comes from the architect alone. CAD techniques concern mainly animation software to define relationships, movement, and freezing states of the design.

A broad outline of Lynn's method, as was used in the course, is as follows:

- 1) Define major elements in the brief.
- 2) Define relationships between elements.
- 3) Define forces of site and brief on elements.
- 4) Animate the objects.



- 5) Freeze at a point in time where the configuration looks promising and further develop the design (fig 1).

Discussion

The work presented here shows a particular approach to teach CAAD in the context of architectural theory and design methodology. The aspects of ontology, method, and product provide a structure to derive teaching material from literature on architects. The analysis can be extended to other architects provided they have some body of theoretical work. Ready 'candidates' are Spuybroek, Oosterhuis, and McDonald and Kolatan. The goal of the course is to make students aware of the varied ways to use computers in design, to understand the reciprocal relationship between CAAD and theory, and to formulate their own position in this respect.

A theoretical basis in terms of architectural theory and design method seems to be in contrast with the perceived freedom of design. As Christopher Alexander stated: "If you call it, 'It's a Good Idea To Do', I like it very much; if you call it a 'Method', I like it but I'm beginning to get turned off; if you call it a 'methodology', I just don't want to talk about it." (taken from Cross, 1984). Design methods however, capture 'good ideas' and aim at a higher level of abstraction so that they can be more generally applicable. CAAD software now enables us to move freely through a

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number of design methods, and use them as a vehicle to question the design process, the design task, the design outcome, and the position of the architect.

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