

Closing the Gap

THE E4D DESIGN SERIES AND THE MEDIATION OF
DIGITAL DESIGN SKILLS

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The e4d design series is looking for an innovative use of digital technology in architectural education to overcome the gap between design development and the acquisition of digital skills. Digital design approaches include multimedia technology, the crossover of analogue and digital techniques, rapid-prototyping, visualization, and the presentation in artistic movies. Over the past two years a problem-based design approach was developed, which enabled students to learn digital and architectural skills simultaneously and efficiently. The educational concept consisted generally of four steps, which, though independent of each other, are determined by questions of the ongoing design process. The first step consists of an abstract or subjective research phase; in the second step the findings are transferred into dynamic spatial structures. Later, the detected qualities are used to develop a given building program. Finally, the different traces are connected, when site-specific parameters are blended with the design traces. This paper examines and evaluates textual and visual design approaches, the precise use of different kinds of media for the projects' visualization, and the way architectural projects can be discussed; in addition, a competent monitoring of the process and outcome of innovative and efficient design strategies in architectural and pedagogical aspect is included.

1. INTRODUCTION

The capacity of computational design exceeds digital drawing and programming, as soon as its imaginative capabilities are unleashed. We are suggesting a design process that takes the unforeseen and dynamic aspects into account—giving our design series the distinct name: design in four dimensions (e4d).

In many architectural schools the mediation of architectural design knowledge is separated from the so-called technical skills, forcing students to decide how and if these two traces are combined in design. This is accompanied by the practice of design departments, which neglects the means used, and their enormous influence on the quality of the results. (Barber and Hanna, 1998; Tidafi et al. 2006).

Taking these experiences into account, several questions evolved: What kind of designs would arise from the use of digital techniques within the complete architectural design process? How can digital tools be used besides as a form driving engine (Terzidis and Kostas 2004) or a digital substitution of traditional approaches to design (Knight et al. 2006)? What is the shape of an adequate design method that supports different digital tools as imaginative parts in an innovative design process?

2. CONTEXT AND AIM OF E4D DESIGN SERIES

In order to gain a full digital design, we introduced the use of digital tools in all essential phases of design:

- analysis and abstraction
- development of concept
- elaboration and visualization

Within the series we aimed at crossbreeding traditional design approaches (a given brief, site, building program, urban structure), which usually lead to a design that can be built design with the experimental capacities of the digital realm. We furthermore expected the given brief to be a point of reference, whenever students encounter the inescapable problems within learning a digital design process. Within the design process we expected students to learn the necessary digital skills and to develop an individual way to use digital tools in order to strengthen their design capabilities instead of mimicking a formal design process introduced to them by their teachers.

In order to counter the lack of intuitive design tools in most CAD packages, 3-D animation software was used because it offers higher experimental flexibility. The absence of building elements and architectural gadgetry forced students to improvise and break the chains of their former designs. The advanced modeling and animation features, the ability to use physical simulation, parametric elements etc. provided a broad variety

of tools with which to start the experiment (Mark 2006). We expected the project based learning of digital tools would be very effective, as it would give the students a high degree of motivation (Bridges 1992).

3. STRUCTURE OF E4D DESIGN PROCESS

The e4d series should first of all set free a spirit for innovative designs - including new proceedings, understandings, and ways of presentation. Thus, the design start should not be primary digital but an innovative search for answers to new architectural problems.

We introduce a meta level in our method, giving a consistent structure to handle different digital tools. Thus, we would be furthermore able to give the students and structure to cope with the experimental approach.

The invented series consists of 4 steps. Formal and conceptual ideas are continuously developed within the process; nevertheless every step can be seen as a task of its own. The single tasks are not necessarily dependent on each other. Thus, the steps provide a mental fallback solution for students who could not cope with the previous step, as the next level might be more appropriate for them and give them a chance to re-enter productive work.

STEP 1: BRIEF, RESEARCH, ASSOCIATIVE REFERENCES

This phase aimed to give all students an atmospheric and/or conceptual idea for their project. The phase started with a brief, which did not demand a digital solution (Figure 1).

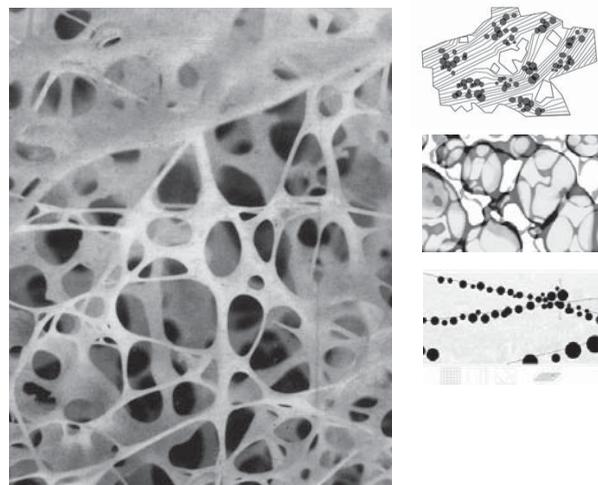


FIGURE 1 Illustration of Step1—Instant Homes Design Project—Winter term 04-05—Structural Game. The access towards the design is done by examining structures according to personal knowledge and motivation. 10 individual chosen spatial structures are analyzed and individually interpreted. Projects by Nana Apel, Florian Holik, Michael Boelling, Stefan Neudecker

STEP 2: TRANSFORMATION, IDEA TO FORM

Due to digital techniques, ideas (e.g. images, dynamic fields and structures of any scale) are directly transformed into form and evaluated afterwards. Instead of running through the traditional order of design (urban context as start, box-like figure as proposal), the students create a problem-specific and detailed 3-D –object (Figure 2).

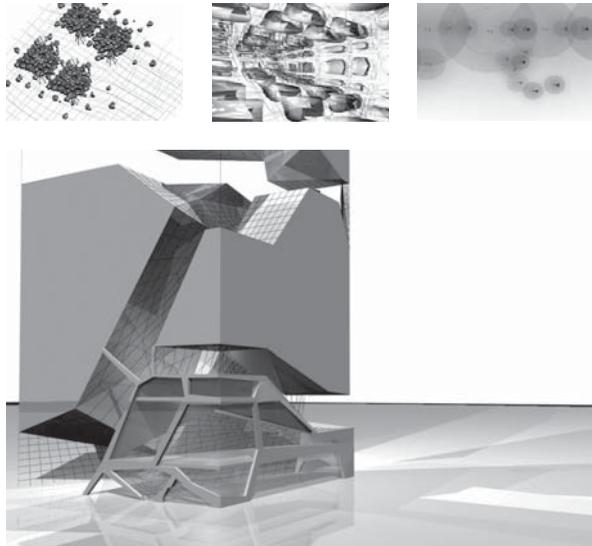


FIGURE 2 Illustration of Step2–Instant Homes Design Project–Winter term 04-05–Transformation The findings are transformed into a three dimensional structure with a high emphasis on spatial questions. Projects by Nana Apel, Florian Holik, Michael Boelling, Stefan Neudecker

STEP 3: FORM TO FUNCTION

The hypothetical atmospheres and structures are used to refine the given building program. In a reversal of usual design approaches this bottom up process provides the chance to test the solutions ability to scale and adapt to other formations (Figure 3).

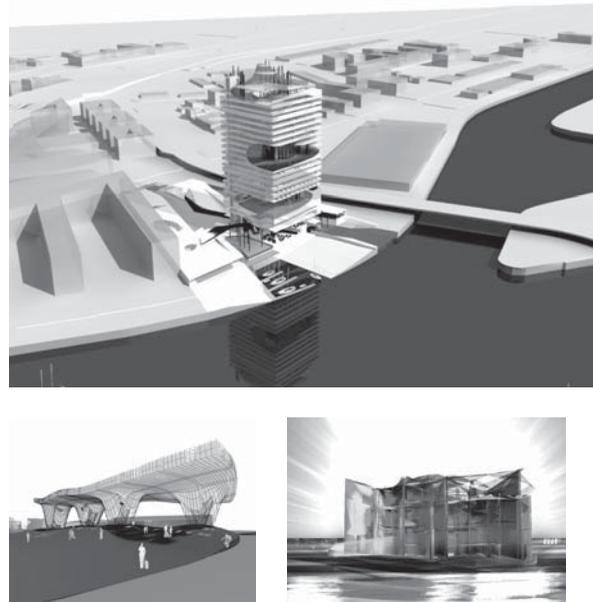


FIGURE 4 Illustration of Step4–Instant Homes Design Project–The developed structures are redesigned to match a specific site. Projects by Nana Apel, Florian Holik, Michael Boelling, Stefan Neudecker

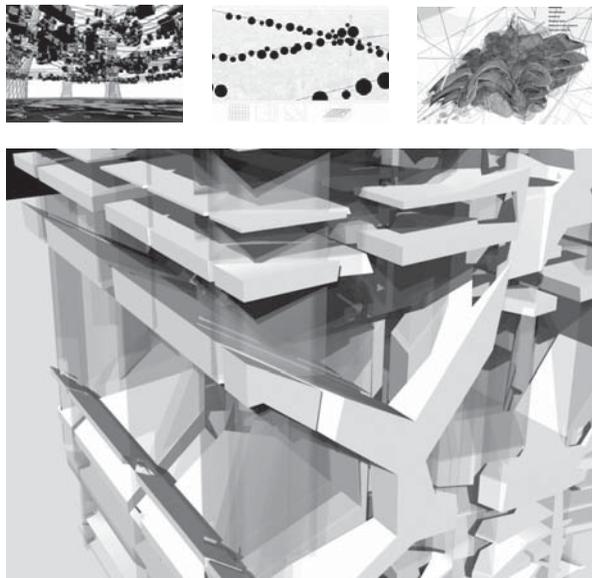


FIGURE 3 Illustration of Step3–Instant Homes Design Project–Winter term 04-05- Programm + X. The detected atmospheric and organisational qualities are used to develop a given building program towards a specific solution. Projects by Nana Apel, Florian Holik, Michael Boelling, Stefan Neudecker

STEP 4: SITE IMPLEMENTATION

The different traces are interconnected. Site-specific parameters are blended with the found design traces and concepts (Figure 4).

In each design project, we focused on a distinct topic, to test the method's ability to cope with different tools. In the beginning we dealt with the software's experimental possibilities, combining innovative features, animation and rendering styles. Later, specific tasks, such as virtual reality and its making; light simulation and the transfer of light into VR; dynamic systems; 3-D video capturing; and augmented reality were examined.

The projects, mainly undertaken by 4th year students, took place within a strict schedule of 13 weeks. The digital knowledge was mainly taught by concentrated tutorials (3-4 x 2 days), which gave an overview of the techniques. Further imagination arose from lectures at the beginning. Student tutors gave supplementary help.

4. EXAMPLES OF E4D DESIGN TASKS

Four different design tasks were created as an experiment

in digital techniques and teaching and were constantly improved by insights made during the process.

SUMMER TERM 2004 | NCCA KALININGRAD/RU

The task and process of this project took place, for the most part in traditional design studios. Our brief asked for an extension to an existing art center, situated in an old fortress tower. A dialog between the massive old structure and the new building had to be designed. Abstract atmospheric images were demanded first, from which the students derived structure and concept. A focus was set on the use of software specific tools (dynamics, metaballs, layering of surfaces). The last 2-3 weeks were used to refine the concepts in form of movies (Figure 5).

WINTER TERM 04/05 | INSTANT HOMES

“Instant homes” was an attempt to develop new, networked living structures and communicative atmos-

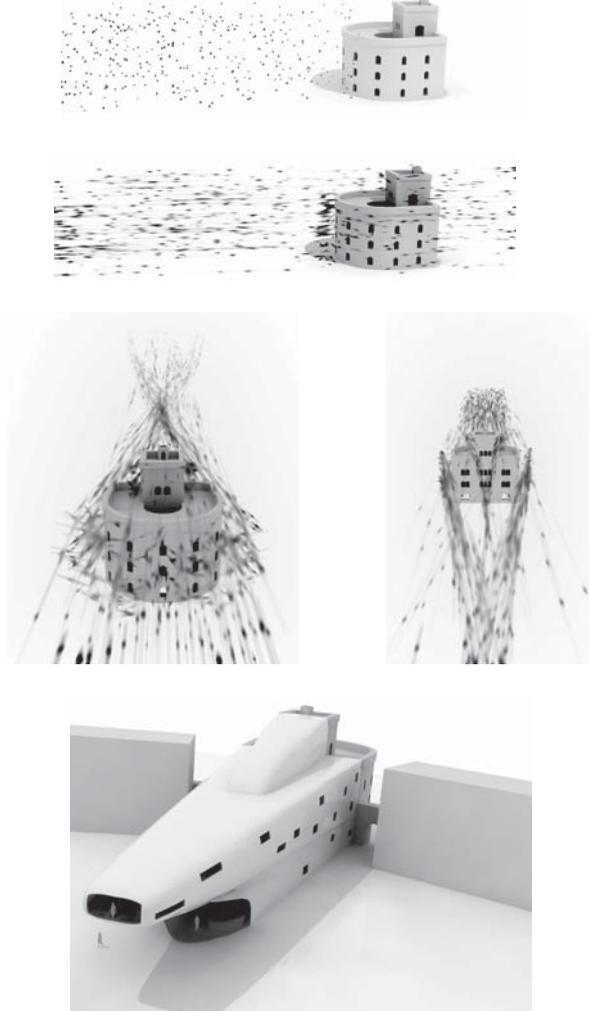


FIGURE 5 NCCA Kaliningrad_RU—design project of Peter Roch using particle systems for form generation

pheres free from the boundaries of site or function, which were introduced later on. This studio had a strong emphasis on interaction, movement, and the creation of atmosphere in design. VR, digital design reviews, and the use of light simulation were used intensively (Tamke 2005). At first the functional aspects of living were abstracted to pure structure—serving as blueprint for the later elaboration. The final presentations were done as interactive multimedia files, following the seminar’s overall theme (Figure 6).

SUMMER TERM 2005 | CHERNIKOV MUSEUM

This design demanded radical ideas for a museum for the

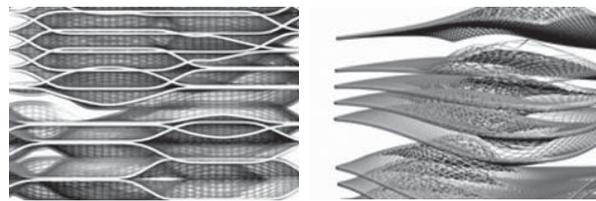
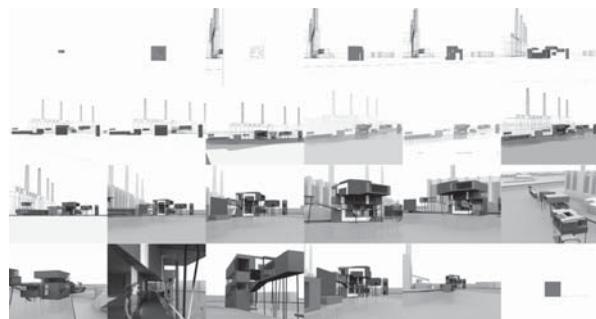
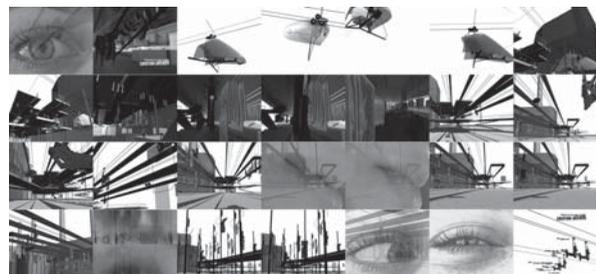
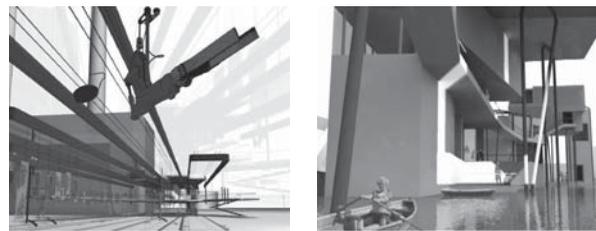


FIGURE 6 Instant Homes—Design Project of Monika Losos, 3d structure to create sponge-like communication spaces



FIGURES 7 AND 8 Chernikov Museum—Design Projects of Julian Busch and Eva Dietrich, Exploration of the dynamic qualities of the Museum—Image sequences from the animations

Russian architect Jakov Chernikov, who is well known for his expressive drawings. Focusing on one single work of Chernikov, the students started individual approaches. After formulating a manifest, the following transformation mimics the traditional way of adopting a 2-D sketch into a 3-D drawing, but underlined the graphic qualities of Chernikov's drawings. Movements within the building were stressed in the later steps. Movies presented the graphic and dynamic qualities of the designs (Figure 7/8).

SUMMER TERM 2006 | CAMPUS SYMBIONT

The shift from mainly synthetic to mixed reality design processes was stressed in the last of the e4d series. The desire to emphasize the site's specificity and to take into account the granularity of reality was done through the use of digital video. 3-D tracking tools helped to overlay digital and video footage with the virtual space. The movie centric approach dealt further on with the crossbreeding of the designs in the physical and virtual realm and was completed by the making of architectural movies—consisting of synthetic as well as video material (Figure 11/12).

5. DISCUSSION OF TEACHING PROCESS

According to questionnaires completed by the student, participants appreciated the general approach and the



FIGURES 9 AND 10 Campus Symbiont—Design Project of Lars Wintjen and Stefanie Wallis, stills from Video to Form and Augmented Reality

skills learned very much. Some would have liked less abstract approaches and support by using analogue tools. Most students asked for more lessons in techniques and more personal tutorials. Generally, the combined teaching of design and digital skills was appreciated. Although students stated that they continue to use their new skills intensively, especially in the specification of a concept and in elaboration and presentation of their projects, they also noted the issue of time constraints. In particular the time-consuming theoretical background (abstraction, transformation) portion of the process has always been a matter of discussion, especially by students with more interest in using known design principles. Still, most students experienced the intense

project as a worthwhile learning situation and a highlight in their curriculum.

The modular system of the series (design tutorials, technical workshops by experts, and guidance by previous e4d students at the end of the program) is flexible so as to adjust to new circumstances and future digital tools. The integration of external professionals in the studio allows for experimentation with different digital media from year to year.

The division of the project into 4 different steps proved to give the students a reliable structure to orient themselves within and a fallback level in case they did not cope well with the abstract level of the first steps or with the project's experimental approach in general. Thus especially weaker students had the chance to take up parameters as site or program to start over with their project in a later phase. Although the direction of the steps in some of the projects proved to be quite heterogeneous, the students' motivation and curiosity was refreshed as soon as they entered a new phase.

6. DISCUSSION OF DESIGN RESULTS

The resulting design projects are of great diversity in terms of concepts. Although all students were confronted with the same architectural problem and course structure, certain individual approaches can be enumerated:

- 1) Students who started with a strong abstract idea as the solution to the architectural problem.
- 2) Students who started with a strong interest in a specific digital tool.
- 3) Students who started with a strong interest in exploring new sculptural forms.
- 4) Students who started with their repertoire of analogue techniques.

The initial subjective abstraction of the architectural problem not only frees the student from traditional expectations, but also enables him or her to find an experimental proposition. The order of the classification above was thought to be a ranking of the resulting design quality. This assumption was proved to be true by the work handed in, however students who constituted their abstract idea at a later stage in the process also developed significantly good results (Figure 13).

The work of Henning Rose is exemplary for the results. Firstly we asked for a collage representing the (subjective) essence of the existing building. Fascinated by the Piranesian like circulation within the tower, different movements were imagined. A 3-D model of the tower and its site was used to examine the context, which could not be visited. To evaluate the internal space of the tower and to simulate the imagined movements, several particle systems were tested (Step 1).

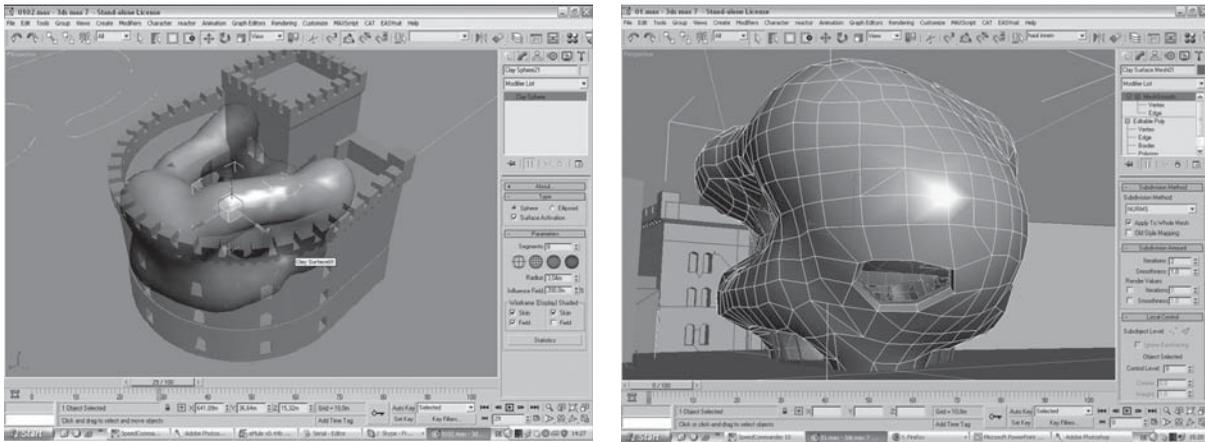


FIGURE 11 A AND B NCCA Kaliningrad_RU—Design Project of Henning Rose, the task specific digital analysis of the existing building developed a twin-like extension to the tower

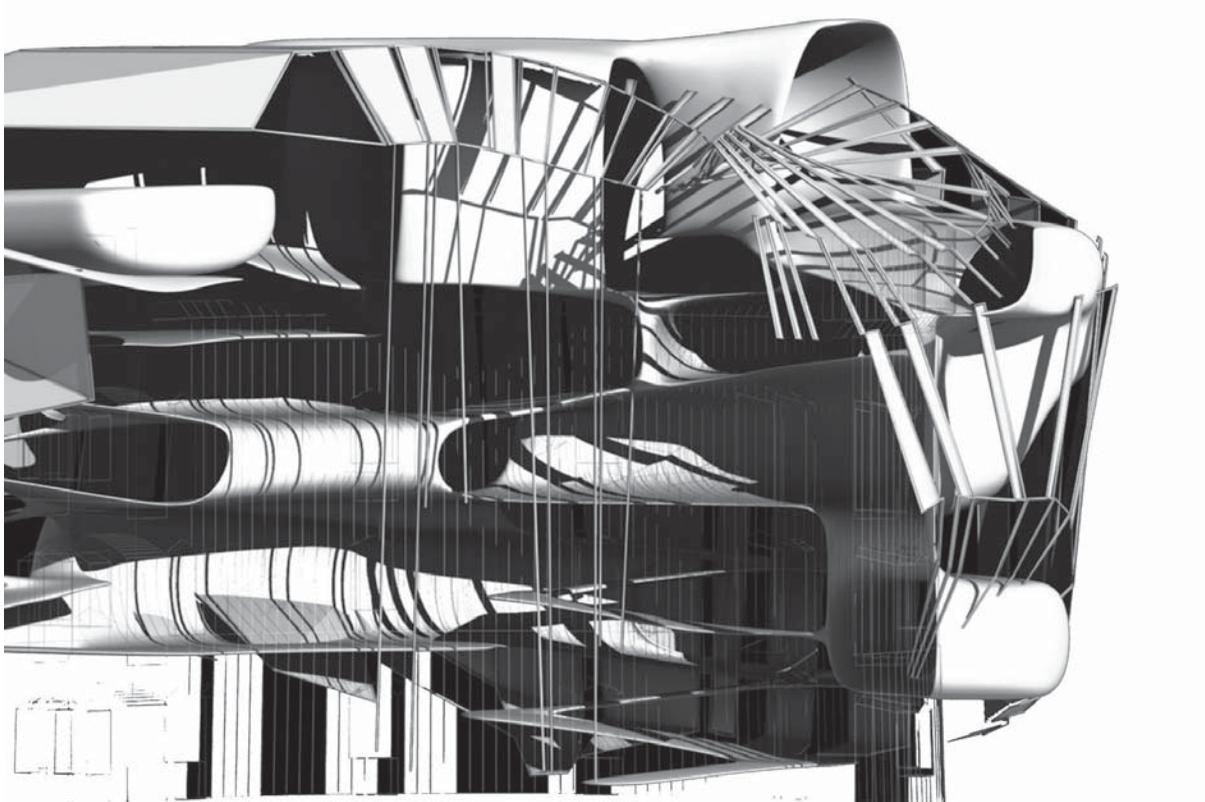


FIGURE 12 NCCA Kaliningrad_RU—Design Project of Natalja Kopycko, elevation of the Kronprinz Tower and the new Art Center parasite

A modifier (meta-balls) on the particle system transformed the inherent qualities of the existing buildings spaces into form. A sculpture was created (Step 2), which was adjusted and detailed. Material properties and illumination qualities were introduced to match the characteristics of an art center as well as to create a dialog with the old building (Step 3). The new object, virtually breaded within the old structure, was finally placed as a twin adjacent to the existing tower (Step 4).

As intended, the abstract idea became the starting point of a digital analysis. The 4-step e4d structure constantly triggered the student's imagination and encouraged the use of experimental techniques on different levels of the process. In dialog with the given task a specific set of tools was chosen and a concept emerged unimaginable without digital means (Figure 14).

7. CONCLUSION AND FUTURE PROSPECTS

The focus on specific digital presentation formats, especially virtual reality and film, distinguishes these projects from other design projects represented in drawings and models. Although this alone is not an indication of quality, the simple difference creates the possibility for wide public reception of the work.

The e4d series explores the inherent qualities of digital production and representation of design. The 4-step e4d structure provokes experimental design concepts, as well as the tutorials give broad insides to digital techniques. As these parts are taught parallel, the students are encouraged to superimpose technique and concept, leading them to a highly subjective design, inseparably connected to both (Figure 15).

The claim to teach digital techniques by means of architectural design and vice versa seems to be fulfilled. In order to achieve a balance between both sides, compromises had to be made, for example the time necessary to learn and carry out experiments within software, alien to most students, reduces the amount of detailing and functional and constructional parameters are often of lower development. The approach chosen, stressed the formal and conceptual quality of the design. Our aim was the discovery of new spatial and conceptual relationships. Some of the work led to new tectonic qualities, which might be worked out in new construction methods. Other participants simply ignored questions of construction and focused on different fields. These fields were highly determined by the proposals given and the digital techniques introduced to the students. Especially the projects dealing with experimental, formal structures in the beginning led to new tectonic inventions.

The building qualities related to concept, form, and movement are generally deeply detailed as a different

focus arose within the projects. As new forms and design concepts are stressed, the four dimensional presentations emphasize the buildings atmospheric and dynamic qualities.

Within the design series a direct link between the student's ability to handle the software and his or her will to use it in an experimental way can be drawn. Those who had used 3-D software before usually performed better. Thus, the use of digital techniques should be emphasized throughout the student's curriculum, enabling him or her to master critical skills between different packages and methods.

Students, who come with a learned set of fixed analogue tools, have to transform this knowledge to the e4d structure - a problem for weaker students. Consequently the concentration on only one digital tool and a less individual approach was regularly discussed by the staff, as the self-positioning of the student in the "experimental" designs would take less time and provide specialization. This master class-like system was never established. The student's responsibility for his or her own decisions and his or her self-conscious positioning in terms of design strategy is not only important to develop a personal agenda, but seems to create extraordinary and unforeseen results in design. While some of the projects results may be seen as situated within the realm of blob- or bionic architecture, the method introduced does not aim at formal qualities, but towards a discussion of design methods in the digital realm, which do not necessarily have to follow well-established rules of site, program and tectonics.

The experimental use of tools from a different discipline (here mainly animation software, as Greg Lynn did in the 1990's) will continue to produce new, innovative results. Still, the interdisciplinary approach needs to incorporate new modules and other packages. However, time-consuming mediations such as scripting are difficult to integrate into the existing time schedule.

In order to foster the theoretical background in digital techniques, we are currently introducing a preliminary research seminar with practical exercises, enabling the students to experiment with digital media. The same students, charged with detailed digital knowledge, will work on the next e4d project in spring 2007.

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REFERENCES

Barber, T and R. Hanna. 1998 Appraisal of Design Studio Methodologies. In *Proceedings of the Third*

- Conference on Computer Aided Architectural Design Research in Asia, Osaka (Japan) 22-24 April 1998*, ed. T. Sasada, S. Yamaguchi, M. Morozumi, A. Kaga, R. Homma, 21-30. Kumamoto, Japan: CAADRIA, Morozumi & Iki Laboratory, Department of Architecture and Civil Engineering, Faculty of Engineering, Kumamoto University.
- Bridges, Alan H. 1992. Computing and Problem Based Learning at Delft University of Technology Faculty of Architecture, CAAD Instructions: The New Teaching of an Architect? In *eCAADe Conference Proceedings, Barcelona (Spain) 12-14 November 1992*, 289-294. Barcelona.
- Knight, Michael, Wolfgang Dokonal, André Brown, and Claire Hannobal. 2005. Contemporary Digital Techniques in the Early Stages of Design, Computer Aided Architectural Futures. In *Proceedings of the 11th International Conference on Computer Aided Architectural Design Futures, Vienna (Austria) 20-22 June 2005*, ed. Bob Martens, André Brown, 165-174. Vienna: Springer.
- Lynn, Greg. 1999. *Animate Form*. New York: Princeton Architectural Press.
- Mark, Earl. 2006 *Animating the Design Studio, Communicating Space(s)*. In *24th eCAADe Conference Proceedings Volos (Greece) 6-9 September 2006*, ed. V. Bourdakis, D. Charitos, 574-581. Brussels: eCAADe.
- Tamke, Martin. 2005. Baking Light: Global Illumination in VR Environments as architectural design tool. In *Proceedings of the 10th International Conference on Computer Aided Architectural Design Research in Asia, New Delhi (India) 28-30 April 2005, vol. 2*, ed. Anand Bhatt, 214-228. New Delhi: TVB School of Habitat Studies.
- Terzidis, Kostas. 2004. Algorithmic Design: A Paradigm Shift in Architecture? Architecture in the Network Society. In *22nd eCAADe Conference Proceedings, Copenhagen (Denmark) 15-18 September 2004*, ed. Bjarne Ruediger, 201-107. Copenhagen: The Royal Academy of Fine Arts, School of Architecture.
- Tidafi, Temy and Ivanka Iordanova. 2006. Experimental Approach in an Architectural Design Studio—How Digital Technologies Could Change a Design Process, Communicating Space(s). In *24th eCAADe Conference Proceedings Volos (Greece) 6-9 September 2006*, ed. V. Bourdakis, D. Charitos, 852-858. Brussels: eCAADe.