Making Light Tangible: Simulation of Light Design within Architectural Education

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Abstract

In times where computer-assisted representations dominate the "market" of visual simulation, the major strongholds of simulation in true size in conveying (artificial) light configurations have been observed. Though light cannot be "touched" due to its material absence the human eye reacts extremely sensitively to differing constellations. In matters of seconds differences are perceived and classified. Opening up a rift between the various simulation techniques, however, would not prove wise. The normal procedure still consists of trial positioning of lighting objects on site (i.e.: 1:1 simulation at building site). Regarding the effort this causes attempts as to gaining similar results by means of (partial) computer representations are worth considering. The degree of abstraction, however, might be too significant to make for conclusive decisions. In other words: Can the gap between imagination and translation thereof into reality be bridged? This contribution deals with the experimental implementation of artificial light in the full-scale lab and its possibilities regarding the 1:1 simulation at the Vienna University of Technology, with special attention to the didactic aspects related thereto.

Considerations: virtual-digital and/or physical-analogue?

First a brief glance is dedicated to the work of *James Turrell* issuing remarkable specimens of "handling of light" [1]. Could the experience of viewing his work - and particularly the adaption processes of the human eye - be simulated by means of computer assistance, at all? The answer surely is no. On no account are Turrell`s spatial installations, however, to be deemed "optical illusions". Their impact matches a time-based ascertainable event, thus curiosity dominates upon entry, while the eye adjusts to the situation. The Installation wants to be "discovered". An obviously two-dimensional surface "surprisingly" turns into a somewhat graspable color volume on continuous viewing. The viewer reaches out for the light. A photograph of such a scenario can only act somewhat like a visual memento or an appetizer, also due to the restrictions of photographic material.

What is getting increasingly more difficult is to determine whether an image is “genuine” or has been subjected to composition or manipulation by means of editing procedures. This takes us to a project of the architect Richard Meier for the church “Chiesa dell’Anno 2000” [2]. As a rule comparable projects will not get by without 1:1 model simulations as far as planning of lighting is concerned. Reliable specifications were issued, however, by means of CAD-simulation and according to the project team mock-ups were not necessary. Working in teams doubtlessly benefits from the implementation of computer-assisted (network-) methods - also over major distances (independent of site!). As the project still is in the planning stage the degree of accuracy should be conclusively checked upon constructional realization.

Developments at the Universities of Technology suggest a new orientation. A simulation dome is being developed at the ETH Zürich [3] to be utilized for interdisciplinary visualizing purposes - beyond the narrow limits of specialized branches of studies. Similar approaches are being envisaged presently at the Vienna University of Technology [4] where synergy-effects between the so-called RISG-lab (computer-assisted high-performance visualizing with a SGI Onyx RE2 as main device) and the full-scale lab [5] are being studied at a Research Institute of Space-related Information, Simulation and Design, thus making for focussing particularly at virtual-digital and physical-analogue fields of simulation:

- research in the fields of visual simulation, 1:1 models and rapid prototyping, stereo- and endoscopy, planning databases, simulation supported collaborative work (SSCW); furthermore, main emphasis is put on the interrelations of simulation 1:1 (n) and virtual reality (VR) and the particular consideration of assistance regarding obtaining decisions in space-related matters (generation, moderation and assessment of solution variants and scenarios).

Lighting Equipment and Related Experiments at the TU Vienna

Daylight experiments are practically impossible at the Full-scale Lab of Vienna University of Technology due to the structure of the Main Building. Regarding implementation of artificial light a basic outfit is available. The centerpiece of this equipment is a professional dimmer-box controlling 24 circuits via DMX-signals, thus, if necessary, manual or programmed control of lighting is possible. Power supply thus is to be regarded as substantial and can be provided either via outlets or three-phase busbars. Two high-voltage terminals (380 V/16A or 32A) also exist. Donations from light manufacturers e.g. lamps and lighting devices (spots, fluorescent tubes, incandescent lamp fittings, etc.) complete this “hardware”. Regarding contacts to firms, however, an independent position is being maintained.

What role did the subject lighting design play at the Full-scale Lab of the Vienna University of Technology up to now? The first attempts were like feeling one's way with the lighting devices and means. The first experience was of great significance particularly for students of the lower terms being enabled to test, what can be "produced". For obvious reasons the motto learning by doing was applied for the light experiments performed throughout the lab workshop. Light planning, however, cannot be achieved without a spatial concept, as light merely makes the space visible, the material boundaries naturally result from the structural entity. Furthermore, the experiments have concentrated on the adaptability of architectural structures due to light design. There is a certain danger of creating stopgaps based on the attitude: If you do not know how to continue, then a full array of slide projectors and video-monitors might come in handy. Actionism combined with cheap showmanship might become too dominant in that respect. These outlined didactic ideas are to be considered in connection with three lab exercises performed.

- Example I: Experimental Color Design [6]

As integral component of everyday perception color in architecture is not a mere minor visual addition but an effective means for shaping structure and significance. Impact and meaning off architectural design are substantially determined by the color of appearance. Therefore space-related color is not a simple perceptive unit, but the outcome of complex (inter-) actions of material and surface properties like light and lighting (spectral properties, intensity, distribution, etc.).

Fig. 1 Course Work: Experimental Color Structures.

• Example II: Simulation of Space [7]

Space can appear either vertical or horizontal, single elements suggest one or the other component, a phenomenon already very popular throughout the Renaissance. Neon-lisenes were the structural elements put to use under the project title “horizontal-vertical”. The possibility of a rapid change of vertical and horizontal space, its sequence and its management was the final intention. By turning the light switch the space obtained one or the other design configuration.

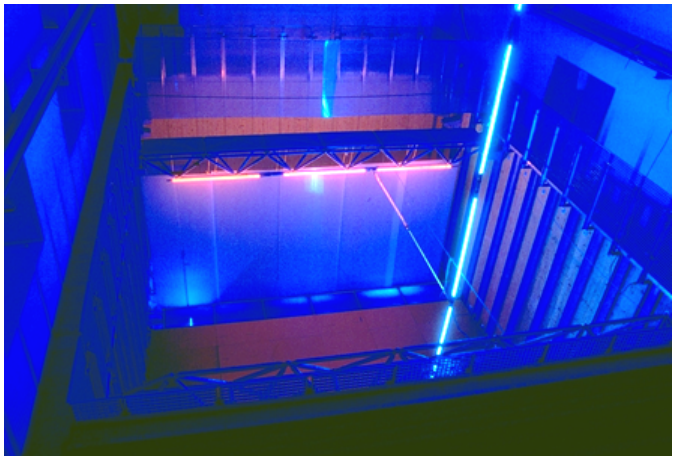

Fig. 2 Course Work: Horizontal - Vertical.

• Example III: Experimental Spatial Structures [8]

The theoretical background of this lab exercise is characterized by the analytic distinction of various kinds of spatial structure not only determining architecture but all expressive human statements within their environment: geometrical-stereometric structures, physical structures: gravity space, experience space: perception and space illusionizing. The main phenomena are elaborated from direct viewing. The space issue is regarded and represented in connection with the human being (his thinking, his body and his activities).

Fig. 3 Course Work: Spatial Structures.

Light Design as a (Postgraduate) Study at the TU-Vienna

Three of a total of five exercises taking place at the Full-scale Lab of Vienna University of Technology have been outlined above. These are incorporated as elective courses in the present curriculum for the study of architecture and offered in parallel due to great demand. The focal subject "Architectural Design" is represents a required course.

Principle considerations as to light and color design are furnished within the obligatory lecture "Spatial Design" (2nd stage of study). As a further area of concentration an elective course on "Planning of Daylight and Artificial Light Plants" is offered. Considerations concerning light naturally have to be made in quantitative and qualitative terms. A profound knowledge of light-technical values will prove wise but surely will not be sufficient in this respect. A difficult question is whether theoretical basics are to be issued prior to practical work or not. Due to the fact that the curriculum for the study arrangement of architecture is to be reformulated ideas as to further development of this subject could be included, such as a lab exercise concerning "Applied Light Design", the contents and training target of which would have to be defined.

Due to the fact that the average duration of study at the Vienna University of Technology amounts to approx. 19 semesters (nominally 10 semester for the study of architecture) *postgraduate education* hardly fits into the whole regime. Provided the attempts as to tightening up the curricula with the resulting reduction of duration of studies work out postgraduate university courses and -programs might become easier to handle, e.g. by establishing cooperations with some light-companies or extra-university institutions, granting an independent position, however. The Full-scale Lab would lend itself well to the end of continuing education in the field of color and light design, also due to the possibility of providing the required appropriate- and visually demanding instruction.

Conclusions and Outlook

So far the Full-scale Lab at the Vienna University of Technology has aimed at integrating as great as possible a variety of individual schools of thought. Thus a team of national and international adjunct faculties was set up consisting of highly qualified persons particularly dedicated to the field of spatial experiments. Light-design matters have been covered by various courses to a certain extent, following the working experience gained a practical lab course surely would be meaningful to be expertly performed by a specialist in this area.

By the way: the theater stage acting as a source of inspiration. Full-scale labs could also be utilized for such purposes as links between stage set and architectural simulation evidently exist, such as when working with (fragmented) stage decorations on stage creating space to be interpreted accordingly. Light design is of great significance in this respect. Attending a live-theater performance can hardly be matched by an (audio-visual) recording thereof. The "actual information input" does not vary too much, but the phenomenon of shrinking away is experienced, i.e. the individual viewer is exposed to the considerably larger stage area in reality. This sensation is ruined e.g. when viewed on TV. Presettings (framing) are used, close-ups (compare opera glasses), however, are possible.

All in all light is linked to the physical presence of built or structural objects. Light can undo single aspects of this structure. In order to gain control over light we avail ourselves of artificial light. Dealing with artificial light has a lot in common with a simulation process, where single aspects to be showed to the viewer are selected. Light in 1:1 simulations is equivalent to a simulation within a simulation. Thus the potential provided by simulation is significantly increased by using artificial light.

References

[1] Exhibition "The Other Horizon" [Museum für Angewandte Kunst in Vienna, 1998].

[2] *ERCO Lichtbericht* No. 59 (1998)12, S. 20-21 (http://www.erco.com).

[3] "VIS DOME", a Visualisation Cave for the ETH Zürich (http://caad.arch.ethz.ch/~patrick/LOCAL/research/visdome)

[4] URL of the RISG-Laboratory: http://risg.tuwien.ac.at/risg/

[5] URL des Full-scale Laboratory: http://info.tuwien.ac.at/raumsim/ Information furnished on the teaching and research scope. A summary of development approached in the 90ies has been published in the "Bauforum" Magazine (no. 2 and 3 of 1998) issued as offprint thereafter.

[6] Study Course 256.018 UE / Lecturer: Leonhard Oberacher (http://info.tuwien.ac.at/raumsim/LVA-Katalog.html#efg)

[7] Study Course 256.014 UE / Lecturers: Bob Martens and Wolf-Michael Tschuppik (http://info.tuwien.ac.at/raumsim/LVA-Katalog.html)

[8] Study Course 256.017 UE / Lecturers: Wolfgang Meisenheimer and Benedikt Stahl (http://info.tuwien.ac.at/raumsim/LVA-Katalog.html#ers)

[9] Lecture Course 262.713 VO / Lecturer: Christian Bartenbach (http://www.lzk.ac.at/lva/tuwien/262.713)