

# Teaching experimental design with CAAD

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## Preface:

2-D CAAD Is the standard tool in architectural work and education, whereas 3-dimensional CAAD is still used to present a finished design.

This paper demonstrates that experimental design in 3-D allows students to deal with new methods of design. At North East Lower Saxony Polytechnic, 1995 saw the beginning, of development of didactic methods for teaching, design with the interactive use of common 3-D CAAD tools. Six exercises were devised, the first two being 2-D exercises in urban and layout design. Subsequent steps introduced three styles of architectural designing with 3-D tools. The students selected one of these styles for their three-day exercise in urban planning. Based on the results, three main ways were developed: the "digital tool kit", the "additive design approach" and the "lighting simulation".

## Introduction

During the 7-day course, each student worked at a PC station with autocad-acadGraph (R 12). The students had previous experience of the practical use of 2-D and 3-D autocad tools.

### "Three solids of equal size and eight trees in a square"

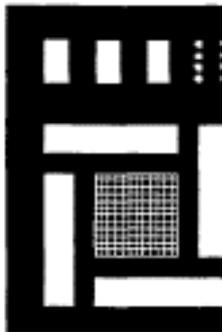


Figure 1.

The students were set the task of designing three compositions with 3 variations and giving each a title. Trees and solids are to be so arranged as to produce a tensional geometric composition. The trees especially may relate to, or form a contrast to, the solids. The purpose and development features must be defined. The choice of title is intended to illuminate the intellectual approach to the solution. The students assemble a variety of forms, such as solitaires, edges, rows, etc., and analyse the particular setting. In this simple task, the complexity of the act of designing is made evident through the use of various forms and compositions. Most students worked successfully on what is an illustration of the subsumption of ideas.

### "Poster design: the Department of Architecture at North East Lower Saxony Polytechnic presents itself to High Schools."

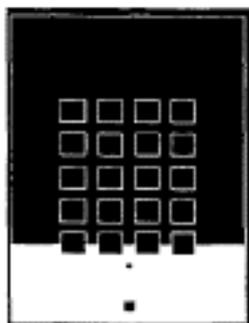


Figure 2.

The students were to design graphics supporting corporate identity. Similar designs by Madrazo from ETH Zürich and Bauhaus posters were shown beforehand. The poster was partially pre-designed, the elements given being a building with a classical roof inscribed "North East Lower Saxony Polytechnic, Department of Architecture". This exercises trains the ability to perform graphic abstractions and has practical use for the acquisition of commissions with a project-related layout.

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## "Going in - going out"

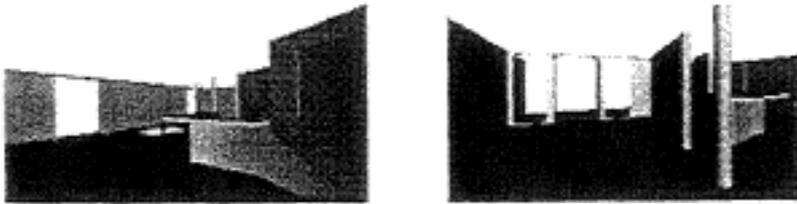


Figure 3. entrance way out

The task is to design a cinema foyer with separate entrances and exits. The design should underline the atmospheric differences. Impressions of going in and going out were discussed on the basis of the "abstract cabinet" of El Lissitzky. The students had to work out the contrast between these rooms; walking into the movies and back out to reality. The foyer, measuring 10m by 12m, had to integrate functional features such as the box office, a small cafe and a preview showcase.

The aim is to train allegorical design and the ability to convey mood, the configuration of the rooms being subordinated to the concept. The idea of going in and out gives rise to pairs of concepts such as light-dark, day-night, chaos-order, etc. In addition, moods such as bustling silence emerge and shape the design. In this exercise, the objects and interior should result from the extrusion of 2-D plans.

Most students demonstrated their command of 3-dimensional modelling; the lack of time available however, had an impact on the design.

## "Variation of types"

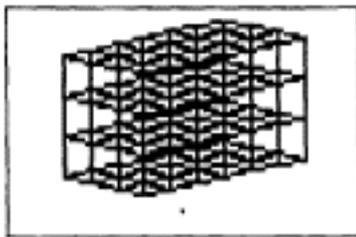


Figure 4.

Three series of buildings, each refined, are to be developed from 54 cubes. The volume is to be varied by subtraction and by arranging the solids into solid and transparent elements. The exercise is derived from O.M. Ungers' entry for the urban planning competition on Roosevelt Island, New York in 1975.

Production starts with 3x60 wire frame cubes. Deleting yields the body, the solid cubes being covered with a net and their lines becoming invisible. The transparent cubes, in contrast, retain their wire frame appearance. This "negative" design method was common in the Baroque, corresponding as it does with modelling in clay. This kind of model is analogous to combining

wire and styrofoam. The arrangement of transparent and solid elements occurs in many modern architectural designs.

The students worked pretty well and produced a wide variety of structures such as trisections, arrangements of nucleus and mantle, etc.

### "Composition with elements from Mies van der Rohe"



Figure 5. prototype



Figure 6. commercial building

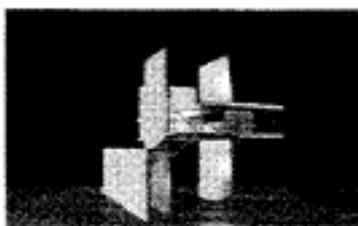
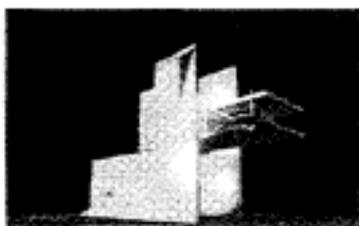


Figure 7. pavilion

The Farnsworth house (the 3-D file had been prepared in advance) is to be taken apart and reassembled (move function) or copied and mirrored. The elements must retain their original dimensions.

This method of design with modules is additive. Building with prefabricated elements is an economical method of construction. Designing with limited shapes produces buildings such as implicit proportions and design parameters. The overall result of this exercise was of such quality; the conception of an exhibition pavilion incorporating the elements, and a commercial building, developed by the addition of a series of Farnsworth houses around a square atrium and linked by a spiral staircase, were the outstanding designs.

### "The end of a legend - the Millerntor Tower in Hamburg"

The building was blown up.

The students had to design a commercial office building in a 3-dimensional environment employing one of the above methods. The result was to be displayed in a series of slides taken from different angles. Ground plans (scale 1:500) were to be established for the ground floor and one upper floor and a system section taken. The facades must be suggested in the 3-D simulation.



Figure 8. townplan

Preparation began with a discussion of the last three exercises. Examples of each method were given, Alvar Aalto's residential high-rise in Bremen-Vahr being representative of the extrusion method. Models from constructivists demonstrated subtractive design. The house by Gerrit Rietveld is a constructivist vision of architecture developed from simple elements.

An urban planning model had been converted from data (ASCII: surface and ground plans provided by the Hamburg authorities (software used: Terrano, manual input of building heights). The students were able to check their designs within this digital environment simulation. In the not too distant future, these data will be available for every project from the start of planning.

Because of the lack of time for this exercise, new aspects were ignored, the common methods such as the extrusion of 2-D plans, being preferred. The interactive use of the digital environment had little impact on the result.

### **Evaluation and conclusions**

Work on the above results yielded modified concepts for a future didactic method. The simulation of light became the main focus of the work on the cinema foyer. In this point, 3-D CAD software (Ray-Trace, Radiosity) can achieve a unique position compared with conventional means. In my own design, the entrance to the cinema was lit up by powerful spotlights and in the dimmed exit area the shadows of incoming visitors created the impression of actors in a movie.

The exercise with variations of types has itself been varied and now has the digital tool kit for a broad range of scales.

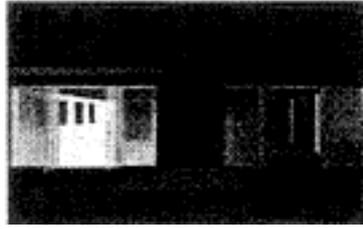
After structuring the solidum, the building blocks are refined by the exchange of blocks; with the use of object-based CAAD programs, the cubes dissolve into plates, pillars and ceilings, which is equivalent to designing a working model from pasteboard and rods. The insertion of window lintel and breastwork elements as well as doors is performed in a similar way. Vertical development is designed into the volume created by amalgamation. In this way, the solid model has developed into a walk-in architectural model from which the 2-D plans can finally be derived although only to a limited extent, since the programs do not quite correspond to the state of the art. In contrast to T-square planning, the opposite route is taken. The various modes of depiction and perspective in CAAD programs simplify analysis of the bodies created. Design with elements is derived from building with prefabricated parts. Specific elements such as the Farnsworth house are available on Internet servers, for example from Lava's Modelshop as 3-D DXF or DWG files.

## Examples

The simulation of light



Figure 9. entrance



facade

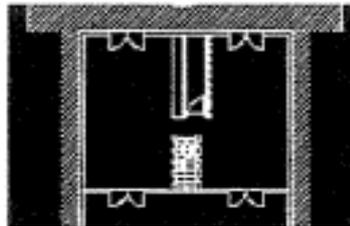


way out

It depicts non-materialised spaces. Visualising a theme, a spatial concept for a cinema foyer shapes the actions of entering and exiting a cinema through mood: spotlights in the entrance foyer create artificial daylight. the exit merely receives light from the entrance area through two perforated walls which contain the functional features. The bright room is given a vibrant, active atmosphere, the dimmed part a contemplative, introverted mood. Passing through the entrance hall, the cinema-goers cast moving silhouettes on the long wall marking the limits of the exit foyer.



Figure 10. view into the way out



groundplan



view into the entrance

The digital construction kit

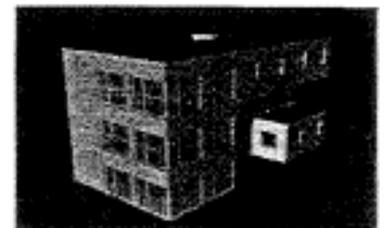
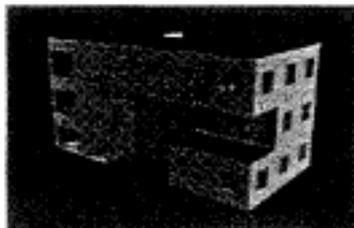


Figure 11.

Refining building blocks by the exchange of blocks; cubes dissolve into plates, pillars and ceilings. The solid model develops into an architectural model.



Figure 12.

The various modes of depiction and perspective within a drawing program simplify analysis of the body created.

## 1. References

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## 2. Figures

Designer of the exhibition works:

Figures 1, 2. Kirschner U.

Figures 3, 4. Zleger R.

Figure 5. Kirschner U.

Figure 6. Prickner S.

Figures 7, 8. Schünemann C.

Figures 9,10,11,12. Kirschner U.

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