Department of Architecture and Landscape Architecture
NORTH DAKOTA STATE UNIVERSITY
Fargo, North Dakota

Forms of Performance
Explorations in a Digital Design Studio

BY GANAPATHY MAHALINGAM, ASSOCIATE PROFESSOR AND DIRECTOR

In the Fall semester of 2005, one of the sections of the advanced architectural design studio in the Department of Architecture and Landscape Architecture at North Dakota State University was taught as a digital design studio that focused on the creation of forms based on performance criteria. **form·Z** was used as the vehicle for the generation of various kinds of forms based on various performance criteria.

In all these problems, the various form generation tools available in the program were used in innovative ways. The emphasis throughout was on forms that were derived by satisfying particular performance criteria. The studio was held for a period of 12 weeks. Many of the students were introduced to **form·Z** for the first time in this studio and developed advanced skills in using it in a relatively short time period.

The performance-based form generation was explored through a set of design problems. They involved the creation of audioscapes, landscapes, thermalscapes, forms of visual desire, and forms derived from matrices. A brief description of the projects follows:

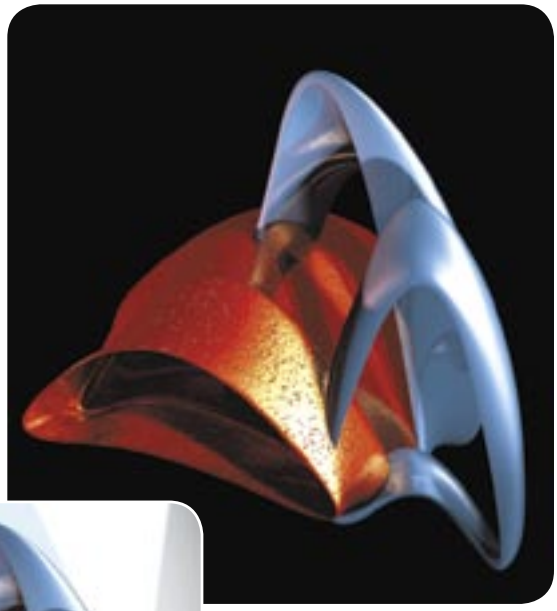
Nestling in the Mother

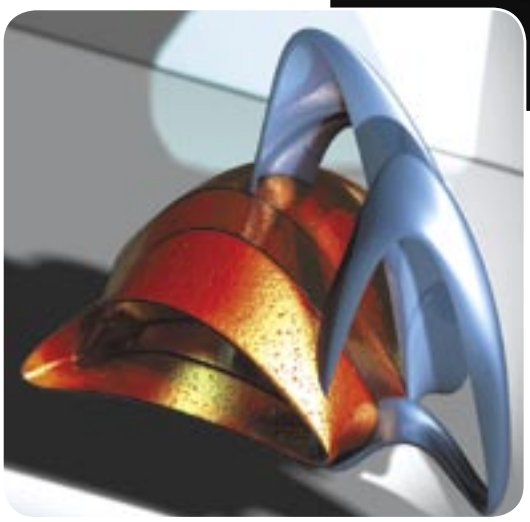
In this design exercise, students were asked to displace a structural matrix and use the spaces created to accommodate various activities.

Given a structural matrix (a three dimensional grid) of a certain volume, students were asked to displace the nodes of the matrix using a number of digital operations. Using the spaces generated by the displacements, the students were asked to accommodate volumes in which various activities could be housed. They were then asked to link these spatial volumes to form a continuous space. Finally they were asked to use the structural matrix to define a structural system that would support this continuous volume within the displaced matrix.

In all these problems the various form generation tools available in **form·Z** were used in innovative ways. The emphasis throughout was on forms that were derived based on satisfying particular performance criteria. The studio was held for a period of 12 weeks. Many of the students were introduced to **form·Z** for the first time in this studio and developed advanced skills in using **form·Z** in a relatively short time period.

JOSH CAROON





NICK BRUHN

On the Verge of Echoes

In this design exercise, students were asked to create an audioscape that was on the verge of creating echo conditions for its inhabitants.

Given a spatial volume, the students were asked to locate 12 sound sources that were distributed three-dimensionally within the spatial volume. They were then asked to trace 3 paths that inhabitants could use to travel through the spatial volume in-between the sound sources. Using locations on the path where an inhabitant could stop, and the various sound sources, the students were asked to create elliptical volumes that represented surfaces that were on the verge of creating echo conditions at the inhabitant's location. Finally the students were asked to merge these elliptical spatial volumes to create a three-dimensional spatial enclosure that was an audioscape.

The main challenge that students faced in creating the audioscapes was in combining the elliptical volumes using the two-way split Boolean operation that had to be carefully implemented.

ROBERT SEHM

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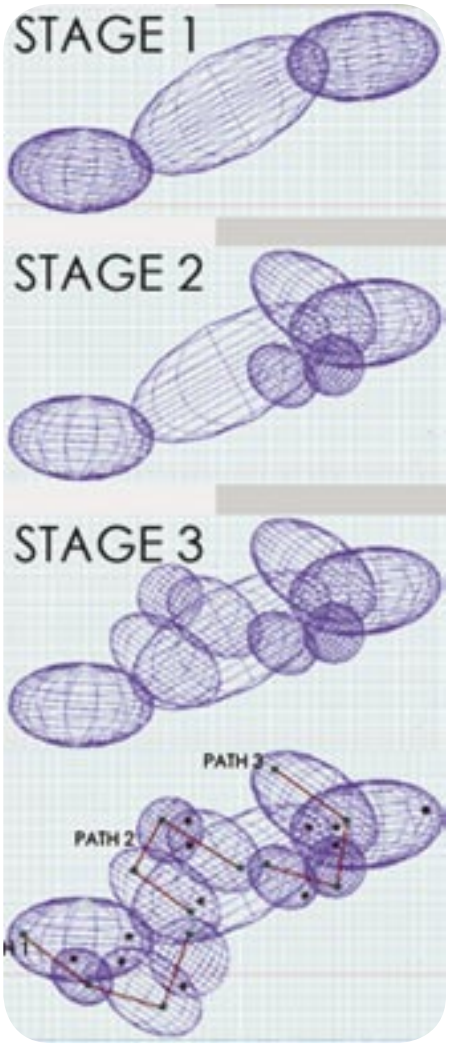
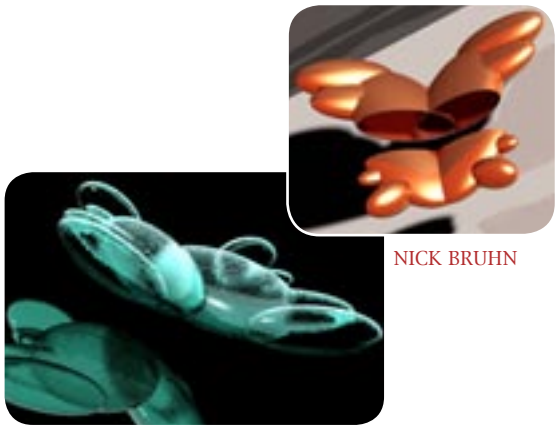
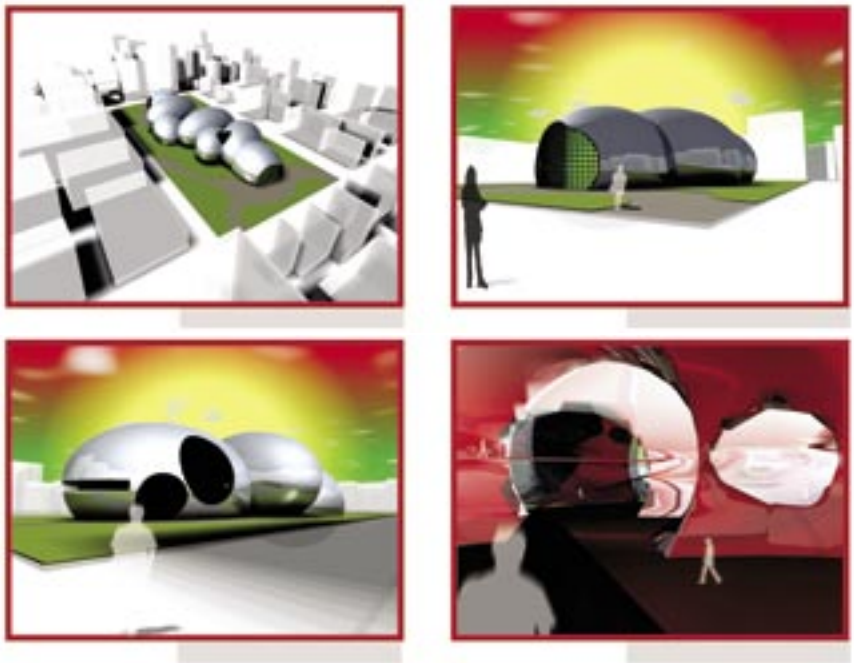




NICK BRUHN

ROBERT SEHM

DEREK KOHLHASE

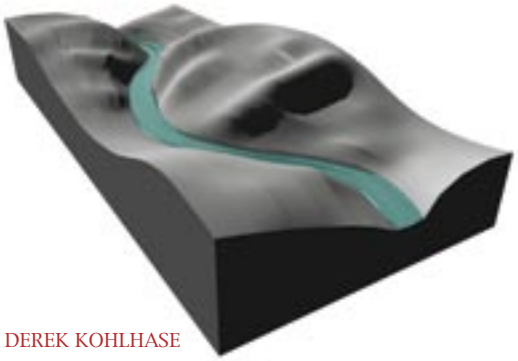


Rivulets of Equal Fathom

In this design exercise, students were asked to create a landscape that resulted in the formation of rivulets of equal depth.

Given an amount of rainfall, and a surface area, students were asked to create land profiles that generated rivulets of an equal depth based on the flow of water generated by the rainfall. They were asked to calculate the flow of water in cusecs (cubic feet per second), define the shape of a channel for this flow for a length of 6 feet, modify this shape to generate new shapes that maintain a fixed depth but the same rate of flow, and use these shapes (land profiles) and flow paths to generate a landscape that created rivulets of equal fathom (depth).

The main challenge that students faced in creating the landscapes was in parameterizing the slope and profile to create the appropriate flow rate of water.



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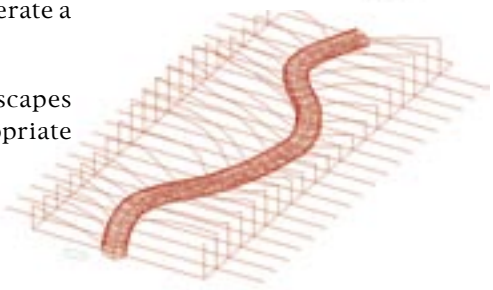

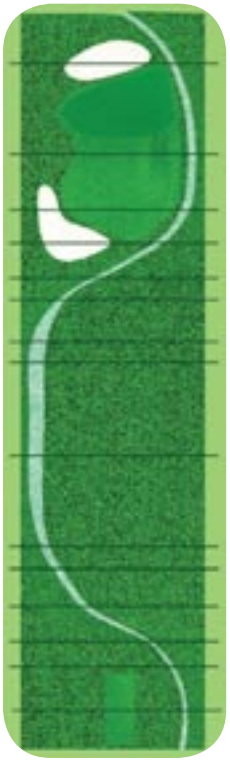

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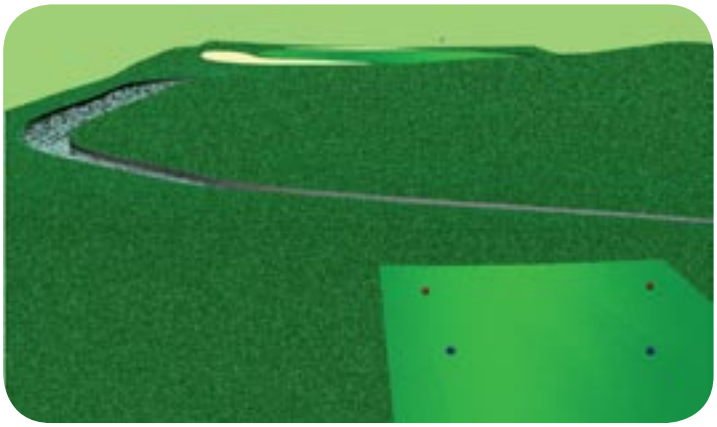
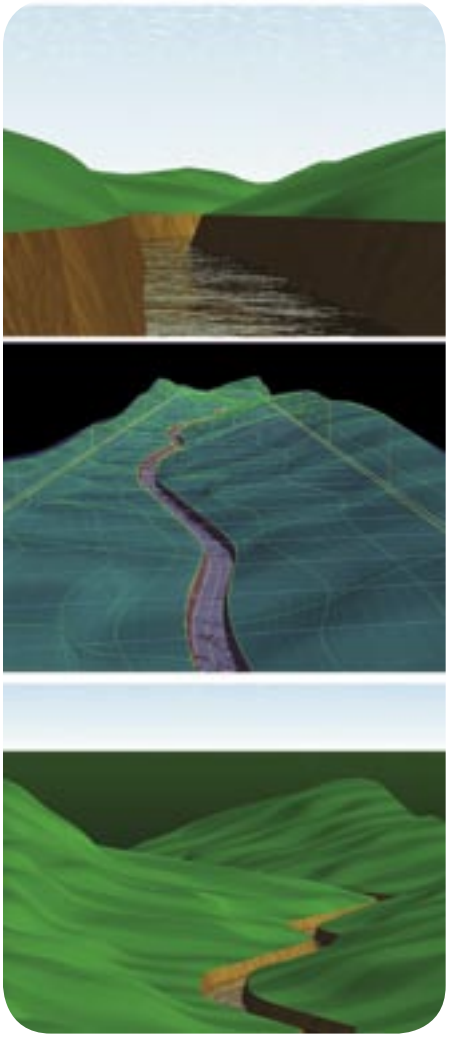
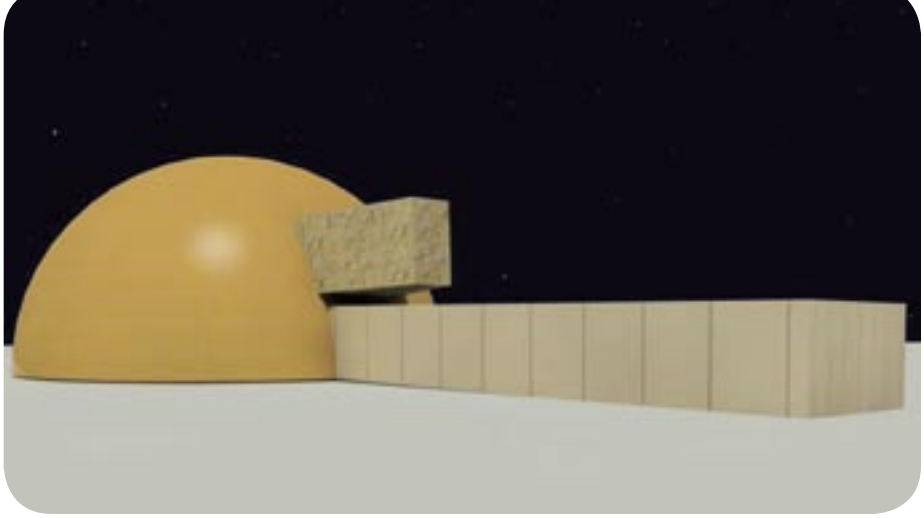




ANDREW DAHLQUIST



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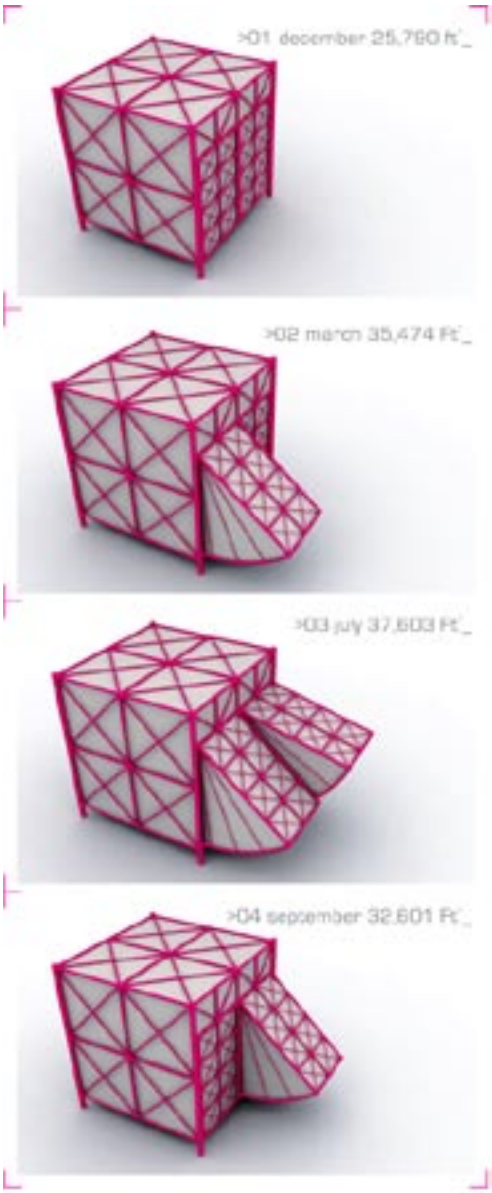
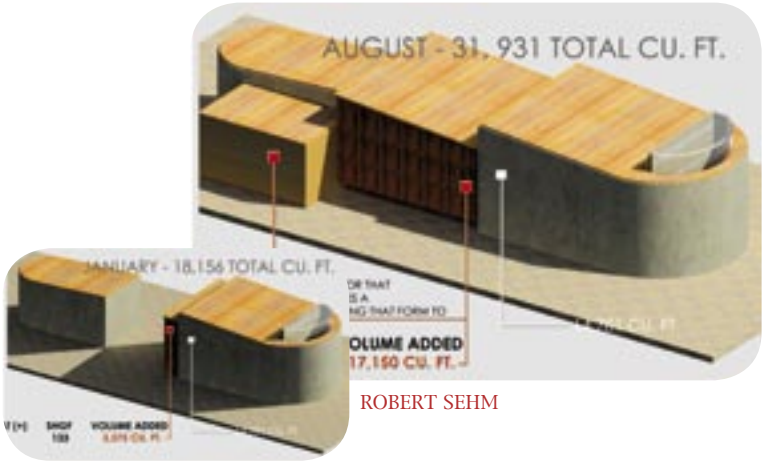


BENJAMIN JOHNSON



ROBERT SEHM

Volumes of Heat

In this design exercise, students were asked to create a series of thermalscapes (spatial enclosures that represented a quantity of heat).

Given a quantity of heat in BTUs (British Thermal Units), students were asked to generate spatial volumes that held that amount of heat at the optimum conditions for human comfort, thereby creating thermalscapes. They were asked to choose a site in the USA to locate these thermalscapes. They were then asked to define openings in the spatial volumes, so that the given quantity of heat could be gained from the sun and maintained in the space during the day. They were also asked to vary the volume of the space to maintain the conditions of human comfort in the space. Finally they were asked to map the ratios of the area of the openings to the volume of the thermalscape for different spatial orientations.

The main challenge that students faced in creating the thermalscapes was calculating the change in volume that was required to maintain the constant conditions of human comfort.

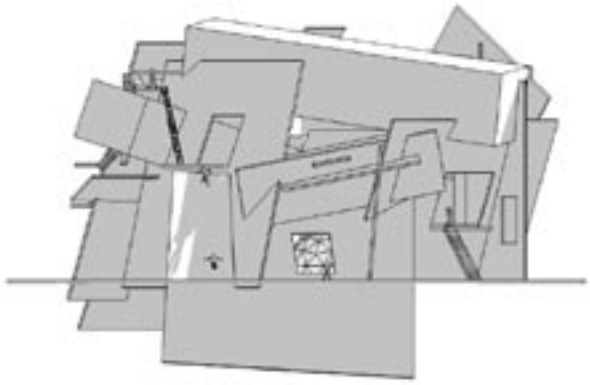
The Space of Visual Desire

In this design exercise, students were asked to use the frustum of a cone of vision to carve a space of visual desire from a spatial volume.

Given a spatial volume, students were asked to define 3 paths that an inhabitant could use to travel through the volume. At fixed locations on the paths, they were asked to orient frustums of cones of vision that looked at objects of interest in different directions. They were then asked to combine these frustums of vision to form a continuous volume. Using this volume, they were asked to carve a space of visual desire from the original spatial volume. Finally they were asked to define a structural system that could be used to support this space of visual desire.

The main challenge that students faced in creating the spaces of visual desire was in defining and orienting the frustums of the cones of vision.

NICK BRUHN



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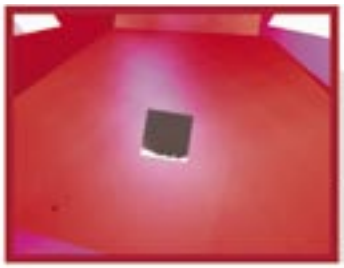

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