a collaboration between:

DARCH Digitalwerkstatt

&

caad DARCH
Prof. Dr. Ludger Hovestadt
Computer Aided Architectural Design

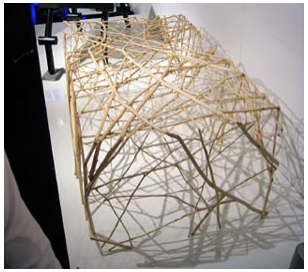
lit·er·a·cy (ltr--s)
The condition or quality of being knowledgeable in a particular subject or field: cultural literacy; biblical literacy.

lit·er·ate (ltr-t)
adj.
Knowledgeable or educated in a particular field or fields.
Well-written; polished: a literate essay.

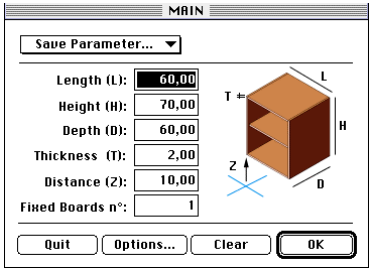
n.
One who can read and write.
A well-informed, educated person.

em·pow·er (m-pour)
To equip or supply with an ability; enable:
“Computers... empower students to become intellectual explorers” (Edward B. Fiske).





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Depth (D): 60,00
Thickness (T): 2,00
Distance (Z): 10,00
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Quit
Options...
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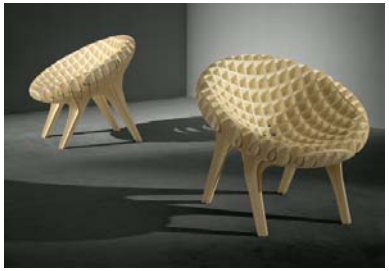
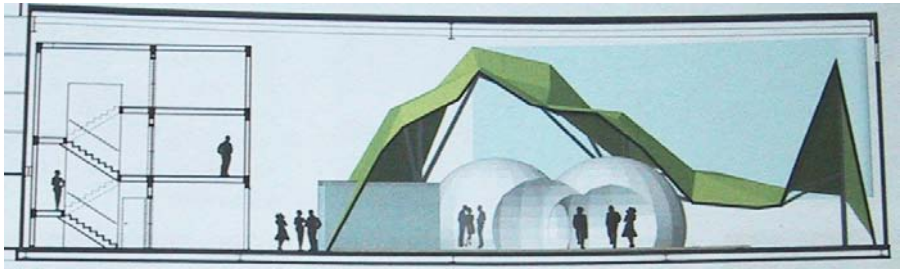











precision
CNC-Machines allow even unskilled users to produce parts of great precision.

speed
Once a design is in the computer, it can be modified and "printed" again and again. Changes in design / construction can be tested fast without having to laboriously re-build geometries by hand.

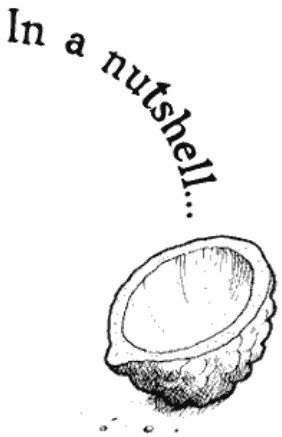
complexity
Due to the universal nature of most CNC-Machines, systems of great complexity, be it varying parts or decoration, can be manufactured.

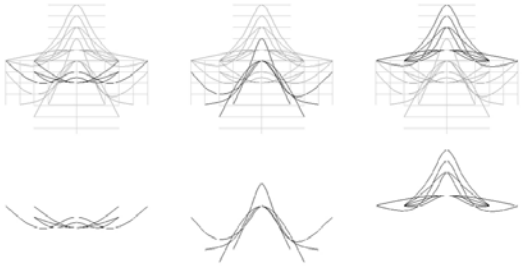
versatility
The 3-Axis Mill used for the course can process almost any material with the exception of glass, stone and metals.

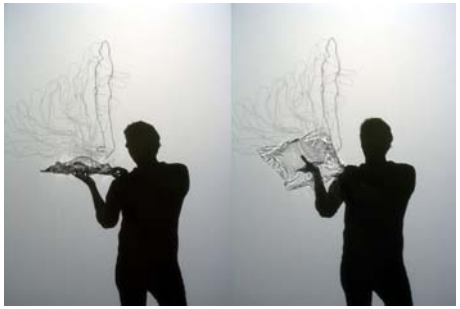
rapid prototyping
fast testing of designs in the real world, adaption, modification -
resulting in a series of prototypes and mock-ups.

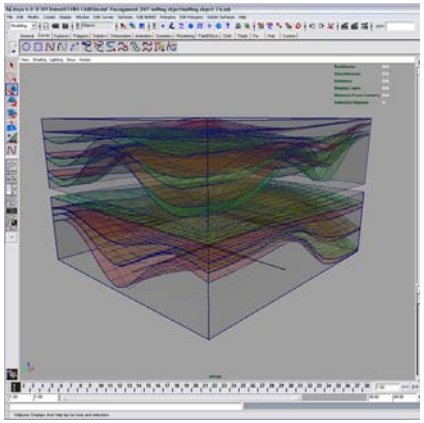
rapid fabrication
the precision and versatility of the CNC-mill used on the course allows for creative use of materials, mixing “new craft” (digital processes) and “old craft” as appropriate.

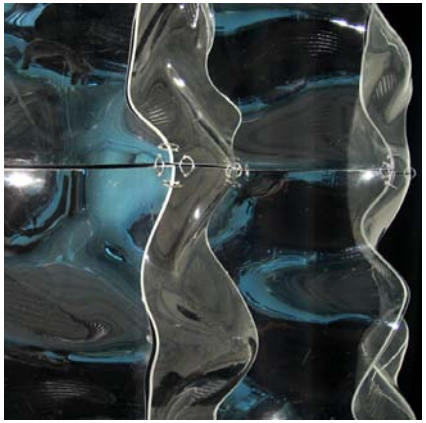
ves·sel (vsl)
n.
A hollow utensil, such as a cup, vase, or pitcher, used as a container, especially for liquids.
A person seen as the agent or embodiment, as of a quality: a vessel of mercy.











```
Script

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select -r nurbsTorus1.cv[0][0:7] ;
move -r 5 0 6;
select -r nurbsTorus1.cv[0:3][0:7] ;
select -tgl nurbsTorus1.cv[0][0:7] nurbsTorus1.cv[1][2] ;
select -tgl nurbsTorus1.cv[1][2] ;
scale -r 1 0.75 1 ;
select -r nurbsTorus1.cv[0][0:7] nurbsTorus1.cv[1][2] ;
select -tgl nurbsTorus1.cv[1][2] ;
scale -r -0.309098 1 1 ;


for ($x1=0; $x1<4; $x1++)
{
        for ($y1=0; $y1<8; $y1++)
        {
                select -r nurbsTorus1.cv[$x1][$y1];
                move -r (rand((-1*$v),$v)) 0 0;
        }
);

select -r nurbsTorus1.cv[0:3][0] nurbsTorus1.cv[0:3][2] nurbsTorus1.cv[0:3][4]
nurbsTorus1.cv[0:3][6];
scale -r 1.5 1.5 1.5 ;
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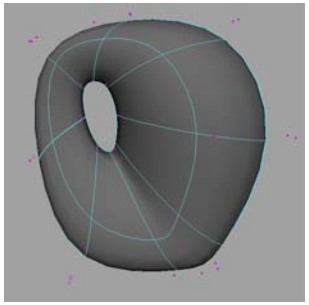
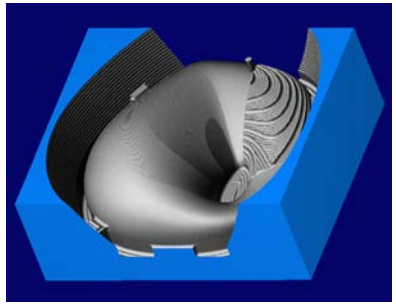
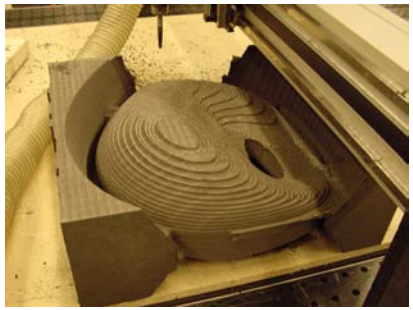
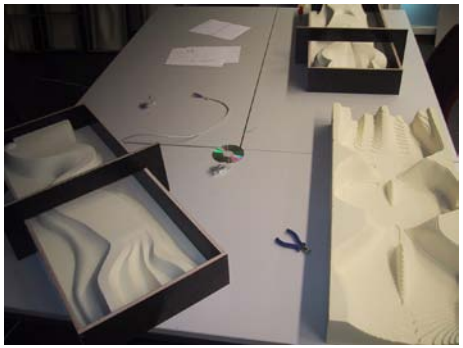
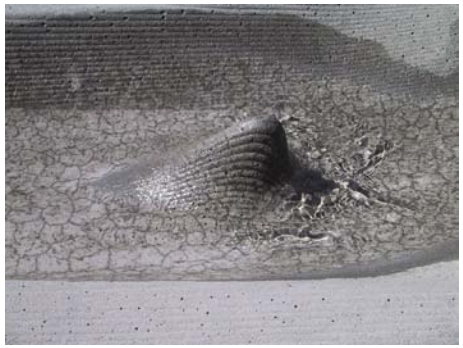
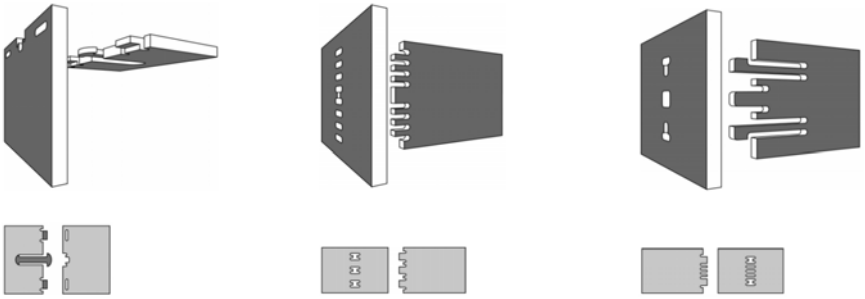


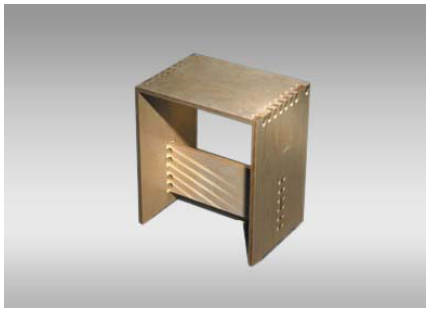


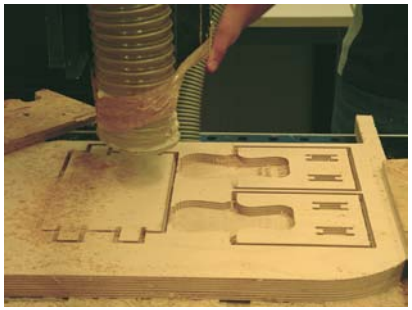


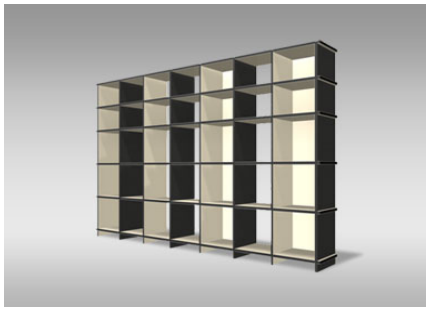


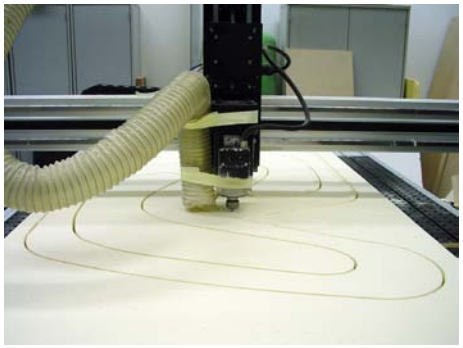


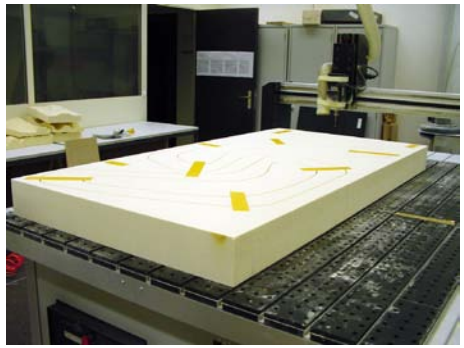


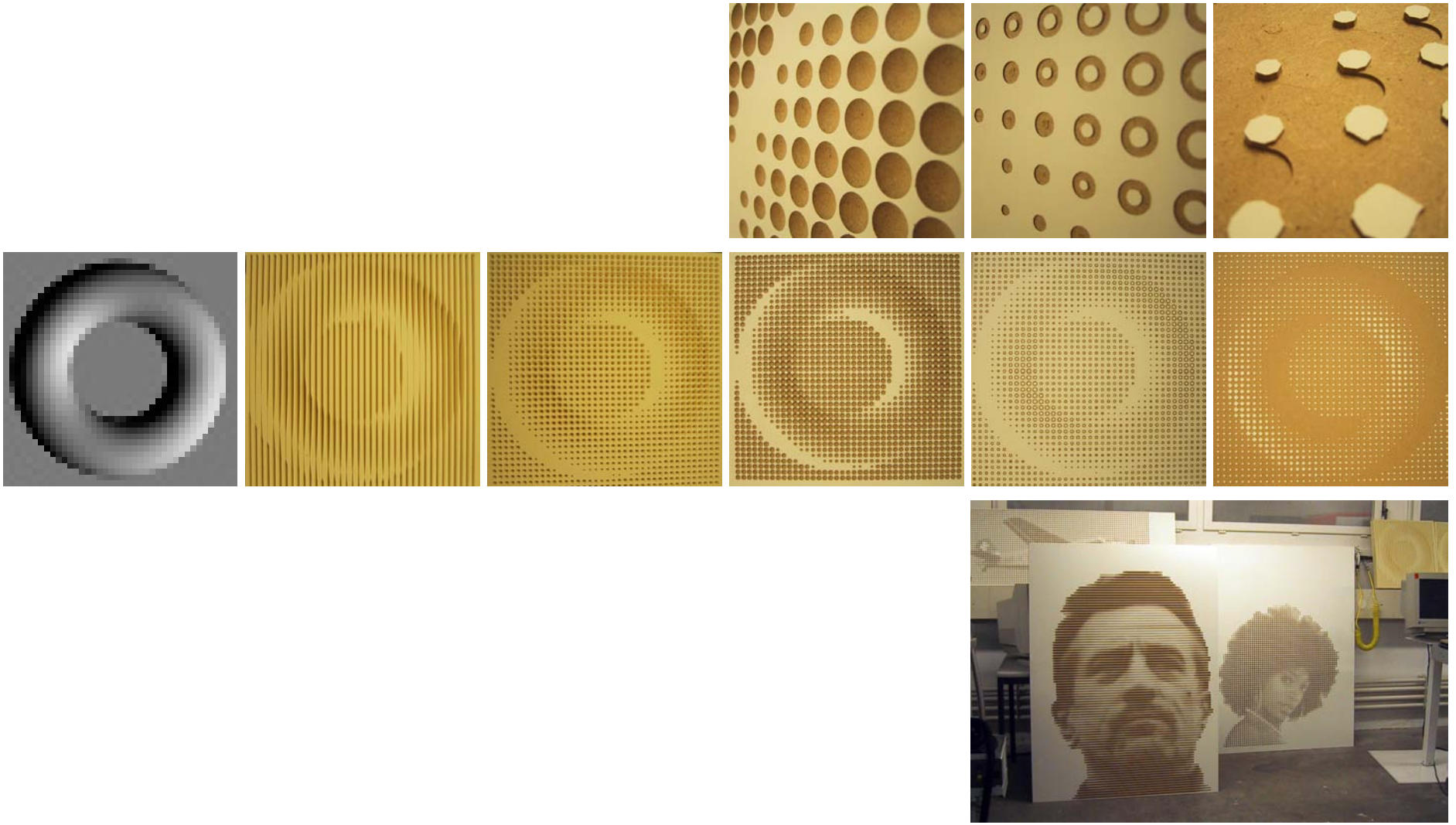


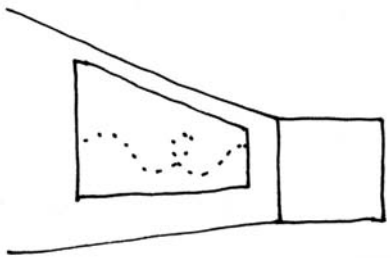




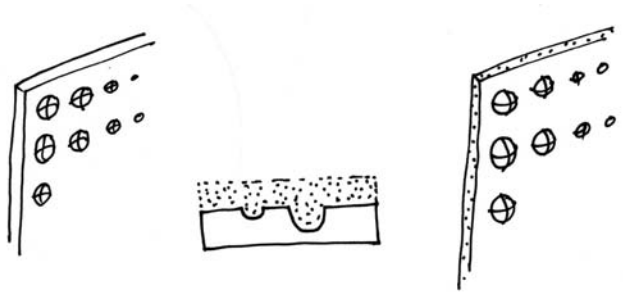




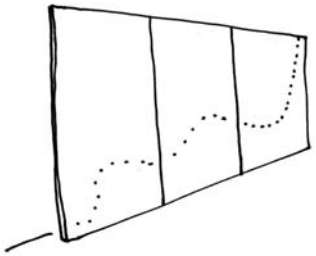


large scale

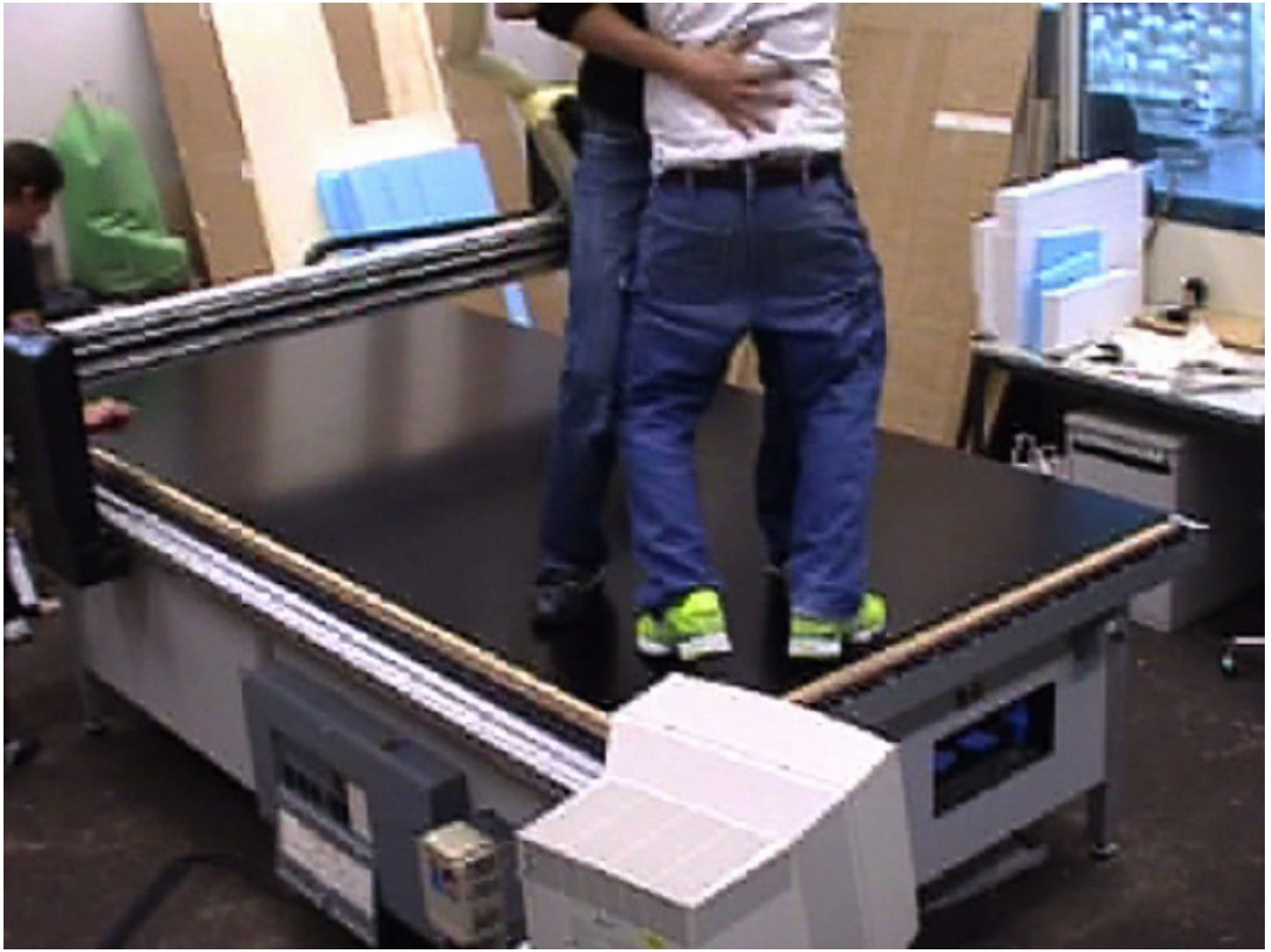


casting

different styles of pixel representation



collaborative (styles-mix)



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Redesign: Laszlo Moholy-Nagys "Von Material und Architektur"

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DARCH HBT

MAS ETH ARCH/CAAD - 2005/06
Master of Advanced Studies in Architecture, Specialization in Computer Aided Architectural Design | 065-0005/6
Supervision: Prof. Dr. Ludger Hovestadt, Philipp Schaerer
Chair of CAAD, ETH Zurich

MODULE 03: RAPID FABRICATION | CNC - MILLING
Supervision: If Ebnöther, Alexandre Kapellos, Steffen Lemmerzahl, Philipp Schaerer

Introduction | Warm-Up | Assignment2 | Ressources |

Introduction:

Over the past fifteen years, computer-aided design has dramatically changed the development and fabrication cycle in most design industries. In the large design based professions outside of architecture, (aerospace, auto, shipbuilding, industrial design…) computer aided manufacturing (CAM) has evolved alongside CAD as the principal method of transferring a design from digital into a physical reality.

Recent changes in affordability and availability of computing power, complex modeling software, and facilities for CAM have made this technology available to architects and the greater design industry. This changes the current typical production cycle, from the distinction between design and fabrication, to a process where the designer is also intrinsically involved in the manufacturing of the components for the assembly of the whole.

There are a number of different forms of automated fabrication based on either 2d cutting of materials, or three dimensional methods of solid or surface form creation. There are two basic processes of 3d fabrication, additive and reductive. Additive processes, sometimes referred to as 'rapid prototyping' construct a model by building-up its geometry based on sectional layering of material, the smaller the layer thickness - the greater the precision of the model. Reductive fabrication is the opposite; it begins with a solid block of material and carves off the excess to reveal the designed form. In this course we will primarily focus on the reductive technology of CNC milling.

This seminar will be an introduction to the design and manufacturing of complex surface forms. The focus of study is the aesthetic, technical, and tectonic potentials of three-dimensional surface topology in architecture, based on the combination of digital modeling, scripting or programming, and computer numerically controlled (CNC) manufacturing. The module will be run as a product development studio, where the methodology and design decisions are as important as the final produced piece. Experimentation and the design cycle are an integral part of the working methodology, and the results of all trials should be documented. The seminar will be conducted as both an experimental design project, and as a skill-building tutorial.

Warm-Up:

Firstly, there will be a basic skill building assignment following the basic milling work progression:

1. generating a surface, or series of surfaces, (MAYA or other CAD)
2. translating them into G-Code, (Surf-CAM)
3. and finally milling the pieces. (Precix)

Each student is required to create a milled surface with dimensions of 500mm x 400mm x 70mm (maximum). The surface is to be created in Maya (or any other CAD program), and broken into several component areas. When using Surf-CAM to create milling paths for the surface, the different areas can be used to differentiate and experiment with parameters for the milling path types, step sizes, and milling bits. By varying the parameters the different areas across the surface should demonstrate differing surface textures and patterns.

The emphasis of this assignment is to familiarize the students with the different software, introduce the students to the machine and give them an overview of its capabilities (and limitations), and give the students an idea about the basic work flow and the time requirements.

Assignment2:

The second part of the module will focus on Rapid Prototyping and Rapid Fabrication. In Rapid Prototyping the aim is to quickly develop, test and adapt concepts and designs using CNC-Machines to output the geometry. In Rapid Fabrication we are experimenting with extended processes based on the physical output of the CNC-Mill (casting, GRP, moulding).

Key aspects of CAM-Manufacturing:

Precision
CNC-Machines allow even unskilled users to produce parts of great accuracy.

Speed
Once a design is in the computer, it can be modified and "printed" again and again. Changes in design / construction can be tested fast without having to laboriously rebuild geometries by hand.

Complexity
Due to the universal nature of most CNC-Machines, systems of great complexity, be it varying parts or decoration, can be manufactured.

Versatility
The 3-Axis Mill used for the course can process almost any material with the exception of glass, stone and metals.

There are two available project tracks to follow:

1. A Vessel

A vessel is generally speaking a container for something, most often a liquid. In the project, students define the thing to be contained (a piece of jewellery, fruit, people, an aeroplane) and develop a housing for it. As important as the end result is the documentation of the process, especially with models and mock-ups.

2. Imaging

The imaging project track is really a further development of some of the skills learnt in Module 02, here the focus is on large-scale "imaging objects" or a texture wall. With enough participants, this could lead to a collaborative design.

Ressources:

Schedule and Deadlines

Check always MAS05-06 Calendar : the page about deadlines, meetings and locations. It's the permanently moderated list and central infobase.

Links

http://www.untothislast.co.uk/ : a shop in London which sells products fresh from the mill
http://www.tisch-mischer.ch/ : design your table, made to order
http://www.gewerbemuseum.ch/ : link to the exhibition "DesignLabor"
http://www.frontdesign.se/ : very innovative Swedish Designeresses
http://www.newcraft.de/ : original developers of cnc wood joints

http://www.wired.com/wired/archive/13.09/fablab.html
http://www.wired.com/wired/archive/12.11/gehry.html

http://millcam.ethz.ch/Jview.htm : the webcam, user: millcam, pwd: miller

Reading

"fab", Neil Gershenfield (MIT), 2005

Downloads

smb://prof-server.ethz.ch/mas0506/all/ (Mac) or
\\prof-server.ethz.ch\mas0506\all (PC) : digital wood-joints by c_labor
http://wiki.arch.ethz.ch/twiki/bin/view/Extern/CaadBooklets : manuals for Maya, Surfcam

Lectures from previous courses (historical and technological development of CAD/CAM):
040112_MAS03-04_MODULE03_MILLING_INTRO_001_LOVERIDGE-R.pdf 040404_CAAD-SS04_MILLING_INTRO_001_LOVERIDGE-R.pdf