Tverrfjellhytta

DESIGN AND MANUFACTURING PROCESS - DIGITAL - ANALOGUE

Detailing in architecture is a necessary tool to ensure precise manufacturing of our architectural intentions. Snøhetta strives for Eco-effective and beautiful design solutions. We therefore like to push the design assignment further, with the ambition to achieve “good growth”, i.e. spaces that are experienced restorative and attractive. To achieve high quality architecture we are constantly re-evaluating our acquired knowledge. Through our ongoing investigations we strive to make use of advances in technology and the forefront of research in our search for cost effective solutions.

By extensive use of hi-tech tools in our workshop, we are able to do research and innovation in close collaboration with the manufacturing industry. Digital modeling allows complex geometries to remain precise and accurate all the way to the finished building. We see this process as a series of shifts from analogue to digital modeling into digital processing and again analogue work on site.

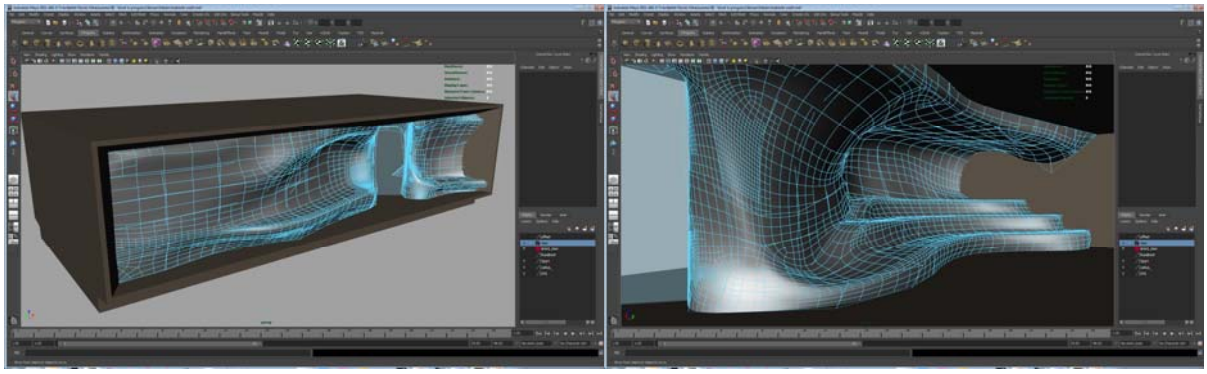
Snøhetta believe in the dialog as the means to reach good solutions and integration of information into a synthetic whole. Our main focus in the design process is to create room for exchange of ideas and active collaboration among all team members – clients, users and the industry included. It is our experience that through clear and continuous communication and rigorous attention to detail the best results are achieved. In the design process Snøhetta focus on physical products as well as digital or 2-dimensional methods of exploring our ideas. We place a high emphasis of working with physical models as well as drawings, and this includes both digital and analog methods of exploration in model making. We think with our bodies as well as with our brains.

In this specific project, the need for detailed drawings in a traditional way has been eliminated by a direct use of digital files following the entire design and manufacturing process. During the design process we made a series of 3d-printed test models. Finally we milled a 1:50 scale model in solid oak using our in house 7 axis KUKA robot controlled router. The same digital 3d-surface model was utilized for the 1:1 milling process by Djupvaag shipbuilders.

The wood construction was transported by a semi-truck from the factory to the site in 3 pieces and placed into the steel and glass frame. The wood is assembled in a traditional way using only wood pegs as fasteners. Finally, the surface is polished by hand machines, and all edges processed with traditional hand tools. The south facing exterior wall is treated with pine tar while the interior wood has been oiled.

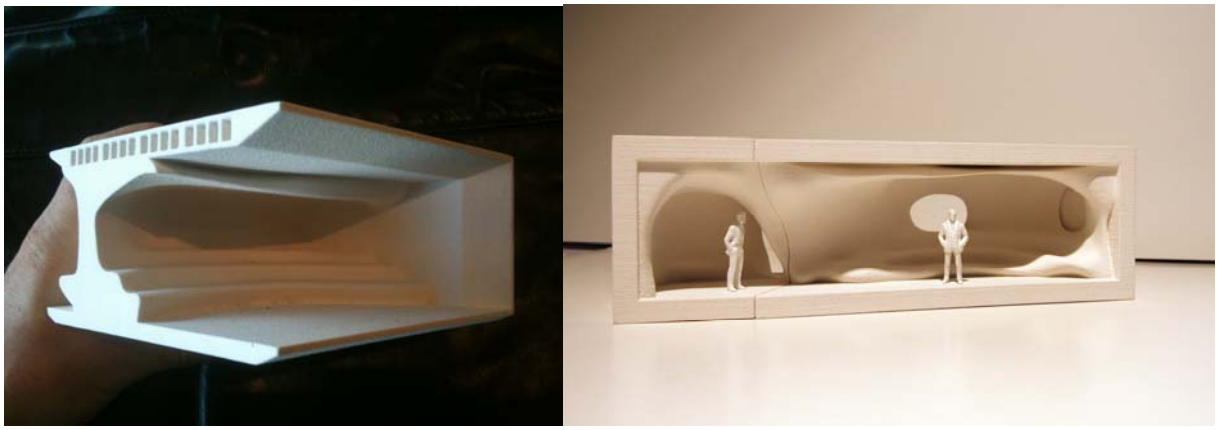
DESIGN AND PROTOTYPING

3D-modeling:
Maya, Rhino



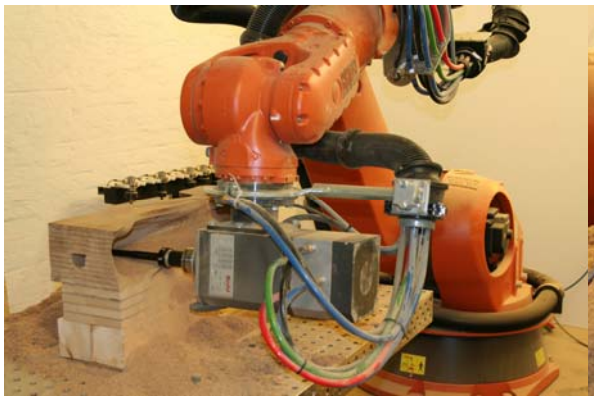
3D-printed-models:

The model was sent to the workshop in the form of a stl-file. Here it was converted to a zbd file. In the 3D-printer software the 3d-model is automatically reduced or converted into a set of layers/cuts to prepare it for print.
The model was printed in a gypsum composite powder called z-130, with a layer thickness of 0.08 mm. The 3D-printer takes powder from a build chamber and spreads a 0,08mm layer in the feed chamber, binder is sprayed onto the areas that is supposed to be solid, floors, walls, roofs. Then a new 0.08 mm layer of powder is added. In this way the model, is slowly building up in the z-axes. When the print is finished loose powder is removed, and the model is excavated, and hardened.
Our printer is a ZPrinter 310 Plus.



Wooden model 1:50

The workshop got the model as a Rhino file.
We imported it into MASTERCAM X4. In MasterCam we make the strategy for the tools to use and the paths to run them.
A program called RobotMaster calculates the robot movements and crash test our strategy. From RobotMaster we generate NC-codes that eventually run the mill.
The robot is a Kuka HA 100, running a 12kW router from Omlat, with a maximum speed of 24 000rpm. The model was milled in solid oak.



MANUFACTURING, Djupvaag ship builders:


A digital 3D surface model is used as a basis for the milling process. The surface model is divided into sections of 10 inch log pine timber layers. Milling paths are generated using AlphaCam, who read 3D-files directly. All milling paths are designed as a combination of 2D paths, where only 3 axes of the machine are used for the rough cuts, and 5 axes for fully interpolated movements to finished surface cuts. Typical cuts for the router is 25-70 mm depth and 40-60mm side offset for each track for 3-axis roughing, and 10 to 40mm cutting depth and 15mm side offset with a full 5-axis interpolated motion for finishing. Feeding rate varies from 6m/min to 20m/min.
NC codes are generated and transferred to NC-control for milling.

Milling:
The mill is a Uniteam Mirror, 5 axis gantry mill with an area of XYZ = 14x4, 5x2, 5m, two polar axes of 440 degrees and 190 degrees of movement, OSAI data management, spindle motor of 17kW and a maximum of 18,000 rpm. Milling is performed one layer of timber at a time. The next layer of timber is then placed on a pre-leveled surface. For each layer we first flattened the surface towards the next layer with a 80mm face mill, then contour-milling the appropriate layers with a 225mm long spiral end mill, roughing the surface with a 150mm ball mill, eventually finishing with a 150mm ball mill. In this way we built the whole structure up to the smallest cross-section. Then this part was taken out of the machine, and the upper part of the structure is built in the same manner, upside down. All milling is continuously monitored and speeds manually controlled.


The whole structure was transported by semi-truck from the factory to site in 3 large pieces and placed into the steel and glass frame. The wood is assembled in a traditional way using only wood pegs as fasteners. Finally, the surface is polished by hand machines, and all edges are processed with traditional hand tools. The south facing exterior wall is treated with pine tar while the interior wood has been oiled.