

# Weaving with Concrete.

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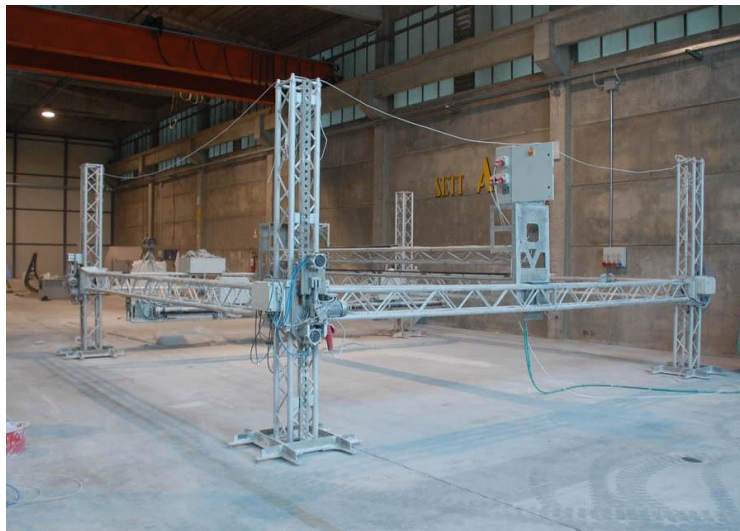
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## Abstract

This article describes the realisation of some of my sculptures with the 3D “stone” printer developed by Dinitech.

## 1. Introduction

**1.1. Dinitech.** In 2009 I met Enrico Dini of the company Dinitech at a conference about innovation in architecture at the University of Eindhoven (WAAS – Workshop Advanced Architectural Structures). After his presentation about the development of a 3D printer “stone” printer (Figure 1 it was immediately clear to me that I had to go to Pisa where the printer was located, for the realisation in stone of some of my Rhino designs.



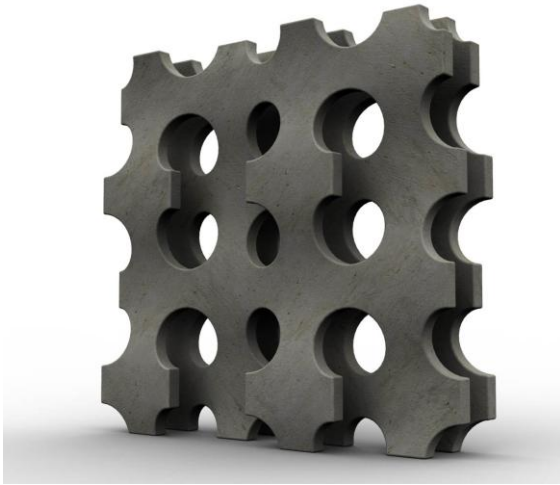
**Figure 1:** *The printer developed by Dinitech in Pisa.*

After our first contact it took about one year before we could start our first project together.

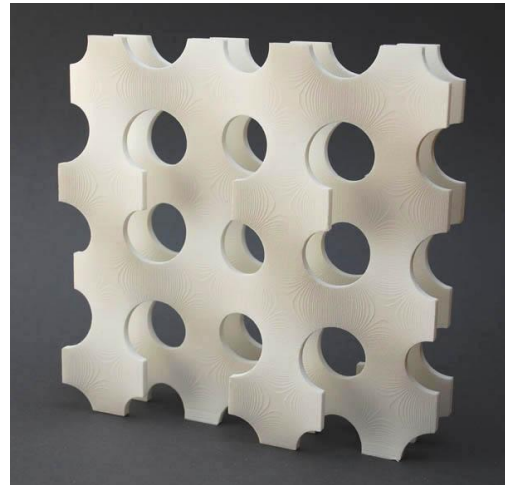
## 2. First Project – Arte Sella.

**2.1. The Design.** In 2010 I was invited by the sculpture park Arte Sella in the North of Italy to make two sculptures for the park. For me this was a unique opportunity to realise one of my designs by the use of the 3D printing technique developed by Dinitech. One of the projects I was working on was the exploration of multilayer surfaces based on the use of helical holes (Figure 2). In the rendering of the computer model,

which was designed in Rhino you can see how it would look like in concrete. I had already small nylon models produced using the technique of SLS-printing (Selective Laser Sintering) (Figure 3).



**Figure 2:** *Computer rendering of the model*



**Figure 3:** *3D print of the model in nylon.*

**2.2. Realisation.** With Enrico Dini we discussed the details of the model and I made some adjustments before we started the printing process. Mainly the thickness of the surface had to be changed. After our first meeting a complete new printer (Figure 4) was built with many improvements based on the experiences with the first printer. The new printer came in use just before the start of this project.



**Figure 4:** *The new printer.*



**Figure 5:** *Printing the sculpture.*

Printing the sculpture took about four days and after that it had to be unpacked and cleaned before it was ready for transport. The height of sculpture is about 2 meters and as you can see the base as well as the “cage” to avoid damage during transportation are printed together with sculpture (Figure 6). After three years now the sculpture is still in the park of Arte Sella and in good shape.



**Figure 6:** *The sculpture with the printed cage.*

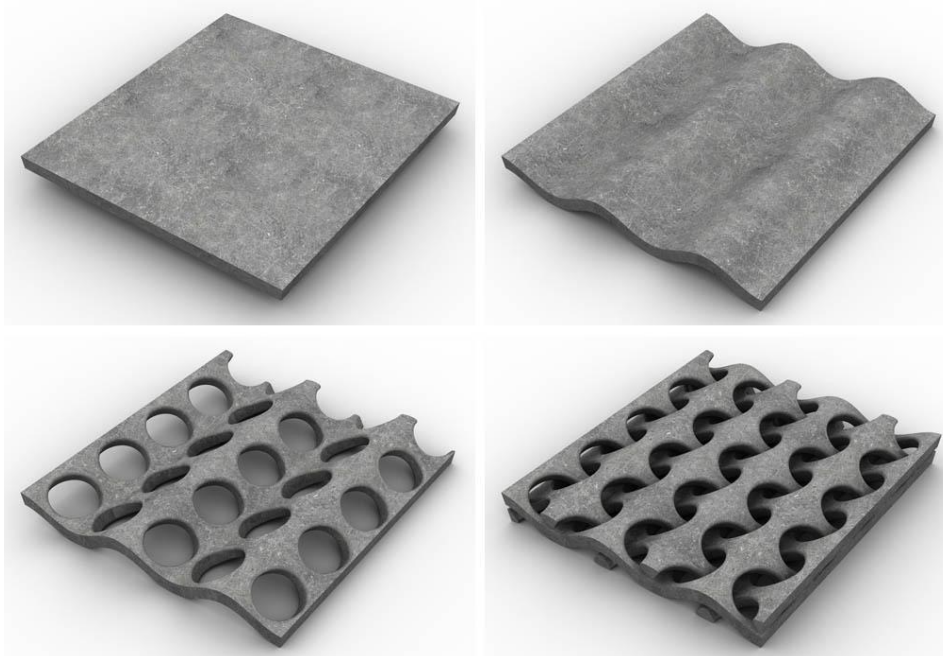


**Figure 7:** *The final sculpture.*

### 3. University Twente.

**3.1. Introduction.** The next project was in 2011. To celebrate their 50<sup>th</sup> birthday the University of Twente had ordered four sculptures to be placed at the campus of the University.

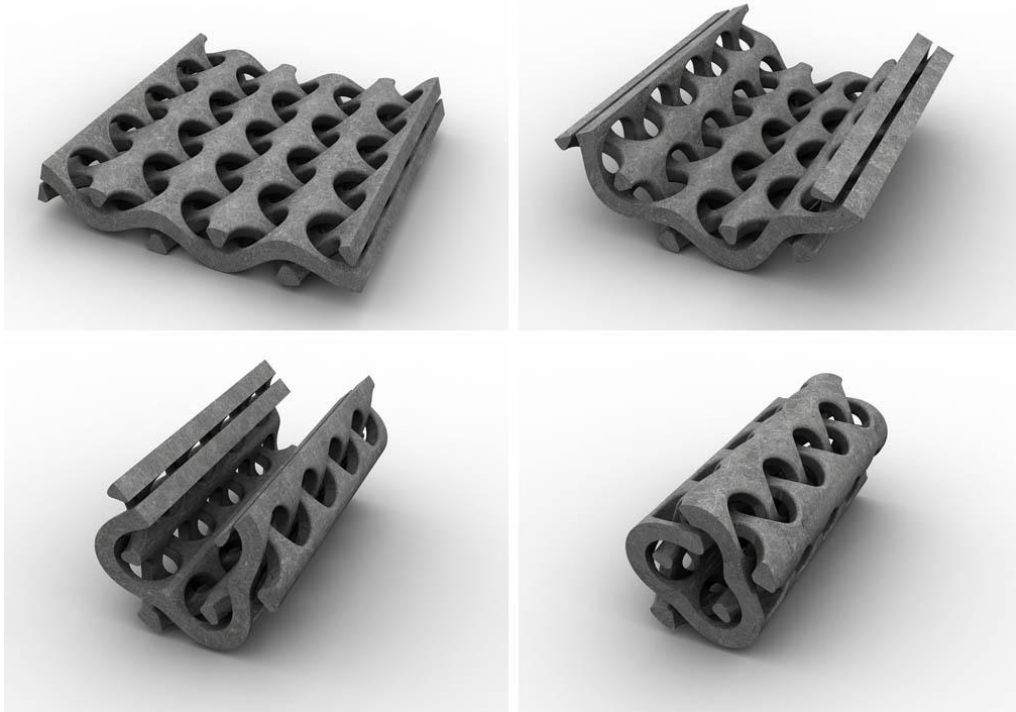
**3.2. Design.** Again the design is made using the computer program Rhinoceros. Starting point of the design of the first two sculptures was a weaving with two surfaces as can be seen in Figure 8d. From this point on the double surface can be rolled up in two different directions and in both cases this can be done in such a way that you end up with just one entwined surface.



**Figure 8 a,b,c,d:** *Weaving two surfaces.*



**3.3. The first sculpture.** The two interwoven surfaces can be rolled up as in Figure 9 a,b,c,d. At the moment the left edges gets connected to the right edges, the first of the two entwined surfaces becomes connected to the second. So now the total structure has become one single surface interwoven with itself.



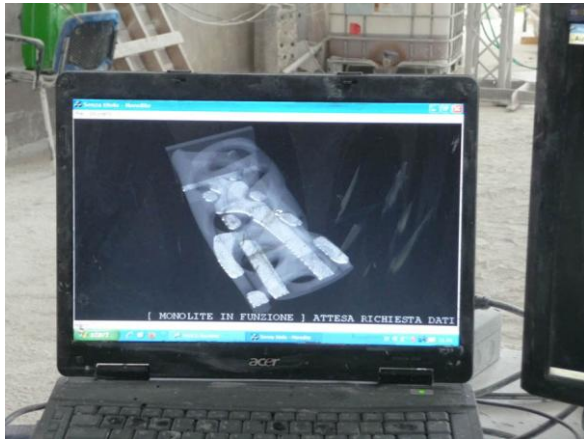
**Figure 9 a,b,c,d:** *From two interwoven surfaces to one surface.*

Before sending it to the printer I decided to make the design more attractive by twisting the total structure a little (Figure 10 b).

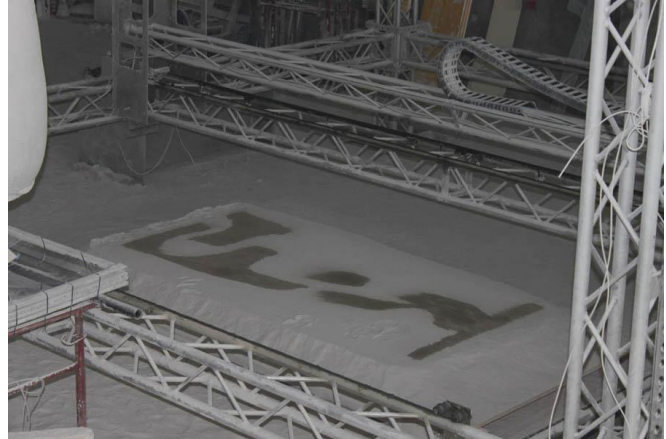


**Figure 10 a,b,c:** *The final transformation.*

**3.4. Printing the Sculpture.** Because of the fact that the sculpture had to be transported from Italy (Pisa), where it was printed, to Holland (Enschede) we decided to print the sculpture with a height of 2.5 meters. Figure 10 shows how the sculpture is printed: layer by layer a cross section is “drawn” by pouring the liquid in a bed of “sand”; when a cross section is made a new layer of sand is placed on top of the others in which the next cross section is drawn. The thickness of each layer is about 5 millimetres.



**Figure 11:** *Cross section on the computer screen.*



**Figure 12:** *The result in printer.*

When the printing process is ready all the dry sand has to be removed before you can see the final sculpture. And after that it is made ready for transport. In the some of the empty spaced foam is injected to give the structure more stability during the transport.



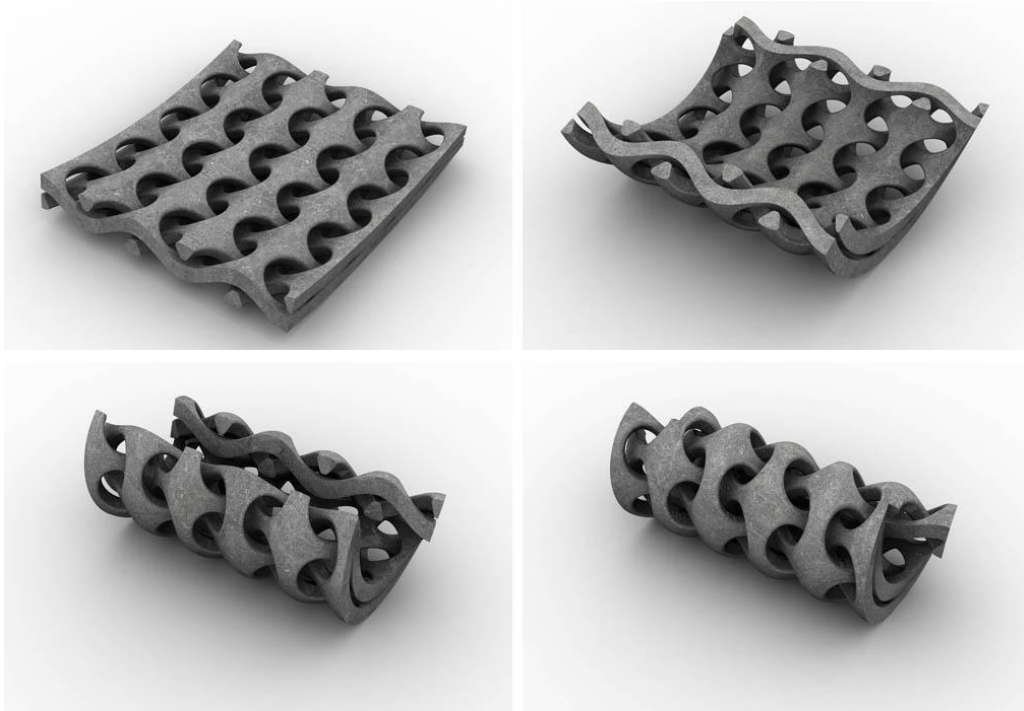
**Figure 13:** *The sculpture after cleaning.*



**Figure 14:** *Ready for transport.*

**3.5. The second sculpture.** Rolling up the two entwined as shown in Figure 8d in the other direction can

also lead to a single surface structure. This is shown in Figure 15 a,b,c,d. Instead of connecting the left edge to right edge now the front edge is connected to the back edge. This is done with a little shift of the edges before connection. It is fascinating to see how different the final result is compared to the sculpture of Figure 10c.



**Figure 15 a,b,c,d:** *From two interwoven surfaces to one surface.*

It might be hard to see in the design that the resulting structure is really just one single surface. I first made a test 3D print in nylon (size about 15 centimetres height) and after that we decided to print this in concrete at the height of 2.5 meters.



**Figure 16:** *The small nylon model.*



**Figure 17:** *The result in concrete.*



## 4. Transport

**4.1. At the Campus .** After the transport from Pisa to Enschede we still had heavy job to do. The sculptures had to put on place and cleaned up. The foam had to be removed and some polishing had to be done.



**Figure 18:** *The truck has arrived.*



**Figure 16:** *Sculpture 1.*



**Figure 17:** *Sculpture 2.*

**4.2. The Result .** The sculptures were placed in August 2011 and the final result can be seen at the Campus

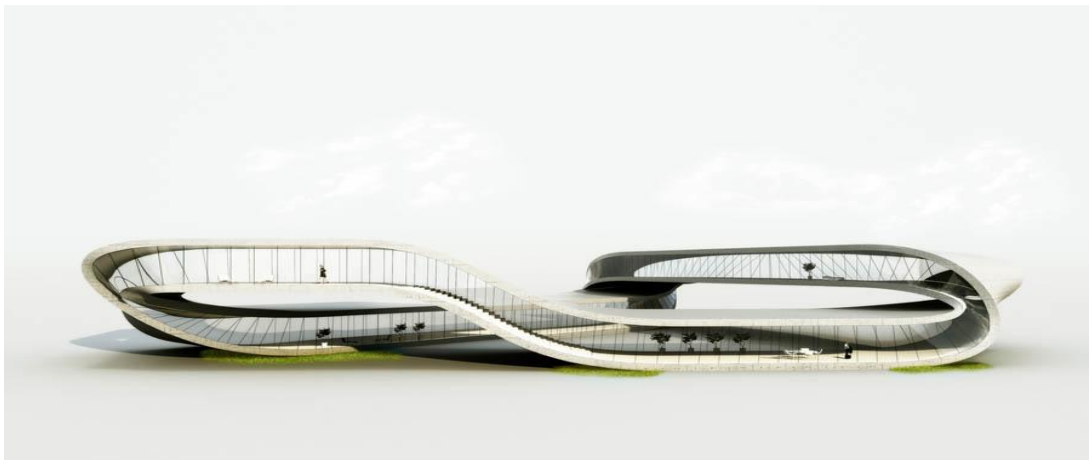
of the University in Enschede.



**Figure 18:** *The sculptures on the Campus of the University Twente in Enschede, Holland.*

#### **4. Future Projects**

**4.1. Landscape House .** One of the future projects is the printing of the “Landscape House”. Together with JanJaap Ruijssenaars we worked out his design of a house based on the Moebius strip. We hope to be able to realize this design together with Enrico Dini and his company Dinitech.



**Figure 19:** *The Landscape House.*