



## The bearable lightness of all glass structures.

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### Summary

This paper is new developments in structural engineering related especially to the use of the material glass. After a philosophical discussion about why glass is the material for the Future, all glass elements and related techniques are presented from which an all glass building can be assembled. To conclude this paper, all glass structures like a glass bridge, glass columns, a glass brick wall and a corrugated glass faced are shown in realised projects.

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### 1. Philosophical discussion.

Glass is a mysterious material, there are also sociological important arguments. And that begins with the gift of transparency that glass gives us, humans. We can look from inside to outside, almost unhindered, but protected, by the glass, from wind, cold and rain. Transparency or Privacy? It is my conviction that if you look at the possibilities that the modern, Internet offers us, our modern computer based society is already almost 100% transparent, like it or not.

### 2. Elements and techniques to make an all glass building/ bridge.

#### 2.1 Elements.

The flat panels of glass can be manipulated with the following techniques:

- cutting in any size or shape you like, preferred is water jet cutting that gives the best results for the smoothness of the edges of the, new, flat, panel.
- adhesive- based assembly, by means of a layer of glue (to be hardened after applying to the glass surface) two individual panels can be fixed to form a strong unit.
- hot forming. If you heat up glass to around 800 degrees Celsius, the glass will become viscous, syrup like if you wish, and it starts to deform due the forces of gravity

### 3. Realised glass structures with the elements and the techniques mentioned.

As an example to show the new opportunities that the glass elements and the techniques mentioned in paragraph 2 present, we will give you four projects in which this was realised. That are: a bridge between two buildings made completely out of glass, an all glass column, a façade made out of glass bricks and facades for modern Architecture buildings made out of hot formed glass panels.

#### 3.1 All glass bridge.

In the Arnhem (NL) zoo there was a need for a connecting bridge to be made between two, existing buildings, one in wood, the other in brickwork, and the architect could not decide what material to use, wood or bricks or even steel?



Fig. 2, A broken but still functioning glass bridge.

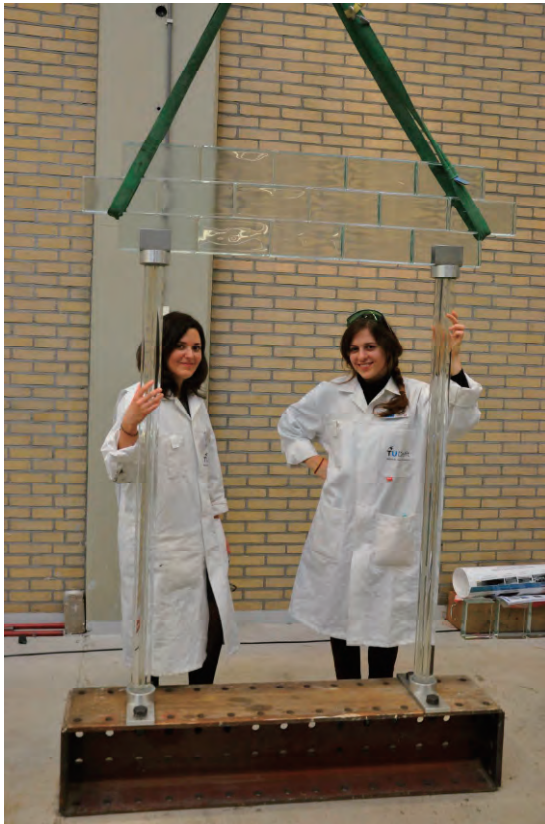


Fig. 2, All glass portal, two bundle columns and a glass brick tapered beam on top, at the TU in Delft (NL).

### 3.2 Bundle of Glass bars: an all glass column and cast glass bricks.

Studies have been made by ABT and the Technical University of Delft into the possibility to create a safe glass column. Glass in compression is very strong and stiff; therefore it would be an ideal material for a column, certainly if we take its natural transparency into account. Columns are never treated with respect: for an architect they block the view and for a client they stand in the way.

Next to this text we see a completely glass portal. Two glass columns each composed of seven massive glass bars, diameter 30 mm, (the bundled type of structural safe column) and, on top of the bundle columns a glass beam made from glued together glass bricks. The glass bricks are made by pouring molten glass in a “brick”-shaped mould and cooled down very carefully to prevent cracking of the massive glass block during cooling down. A structural design that represents new possibilities for architecture. Architecture made out of one of the most sustainable material on earth: Glass. For glass is made out of sand (there is a lot of sand on the world), glass does not corrode or rot and, very important, glass is transparent. Test will be done in the laboratories of the University of Delft to learn more about the structural behaviour of these new structures.