



## The Hindenburg project

*The most famous zeppelin in the world recreated in LEGO®*

*By Jeroen Ottens*

### The inspiration

It was a sunny day in August 2011 when I saw my first flying zeppelin. I was on holiday with my family and we had decided to camp near the Bodensee. We drove through the city of Friedrichshafen when I spotted a white oval shape in the sky above me. I still remember the surprise and excitement that sight gave me. For all I knew the zeppelin was extinct. It had died in the flames of the Hindenburg crash before the war. My excitement grew even more when I found out that Friedrichshafen was home to the official zeppelin museum. I dragged my family with me to visit it. During that visit I began to truly appreciate the engineering achievement of the German engineers during the interwar. Within half an hour I had decided that I wanted to make a replica from LEGO so I spent the rest of the visit photographing details and soaking up as much information as I could. In the museum shop I was able to buy a book full of photos and data of the Hindenburg. That gave me enough information to start designing my LEGO® replica.

### Sketching the outlines

The most important thing to decide upon was the scale. One of the first things you see when you enter the zeppelin museum is a curved ceiling above you. It took some time before I realized that that ceiling was actually a 'small' part of the Hindenburg on a 1:1 scale.

The Hindenburg was big with a capital B. It's total length: 245 m. At his widest point: 40 m. For a comparison, the A380, the world's largest passenger aircraft, measures only 73 m. The Hindenburg was three times longer than the biggest aircraft today! And made without any of the materials that modern engineers can use to construct light and stiff structures.

But let's get back to the question of scale. At first I wanted to build it at minifig scale. That is roughly 1:50. It would mean I would get a model of 5 m long and 80 cm wide. I am not afraid to make big models, but this would be too much. It wouldn't even fit in my attic. So I decided to build it on a 1:100 scale. That would still lead to a 2.5 m long model, but at least it would fit in my attic :).

#### Facts & figures:

Length: 291 studs  
Width: 53 studs  
Pieces: ~7000  
Weight: ~4.8 kg  
(of which 460 g is of the passenger decks)  
True building time: A few weeks  
Build duration: 1½ year

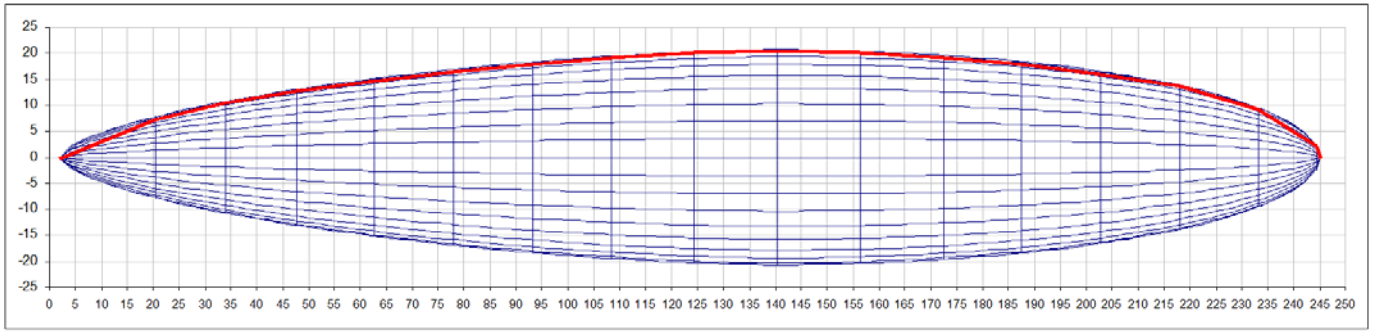


Figure 1: The Hindenburg outline (blue) and the LEGO version (red)

With that decision taken I could work on the next big question. How to create the shape? This turned out to be the most difficult puzzle to solve. The Hindenburg was built as a series of exterior rings that were connected with horizontal girders in between them. Every third ring was strengthened with steel cables that were connected to the central axis of the zeppelin, much like the spokes in a bicycle wheel. In between the main rings the large hydrogen filled balloons were placed. In total there were 15 main rings. Unfortunately each ring had a different diameter. And to complicate matters more some ancient Greek guy had invented the ratio between a ring's circumference and it's diameter. Since I wanted to replace the steel cables with LEGO® axles I needed both an integer length

for the radius and an integer length for the circumference. An impossible task so it seemed. But fortunately the rings weren't round. They are 18 sided polygons. That means that the center of a polygon edge is ever so slightly closer to the center than the endpoint of the polygon edge. So I could choose to end my spokes at the center of an edge or at the endpoint. That gave enough freedom to minimize the error within acceptable tolerances. After a lot of Excel wizardry I came up with a nice set of measures. In figure 1 the real outline and the LEGO version are drawn. (Or at least so I thought at the time. It turned out that the real shape tapers less quickly than I thought. In hindsight I should have searched the web a bit more thorough before I started the project.)

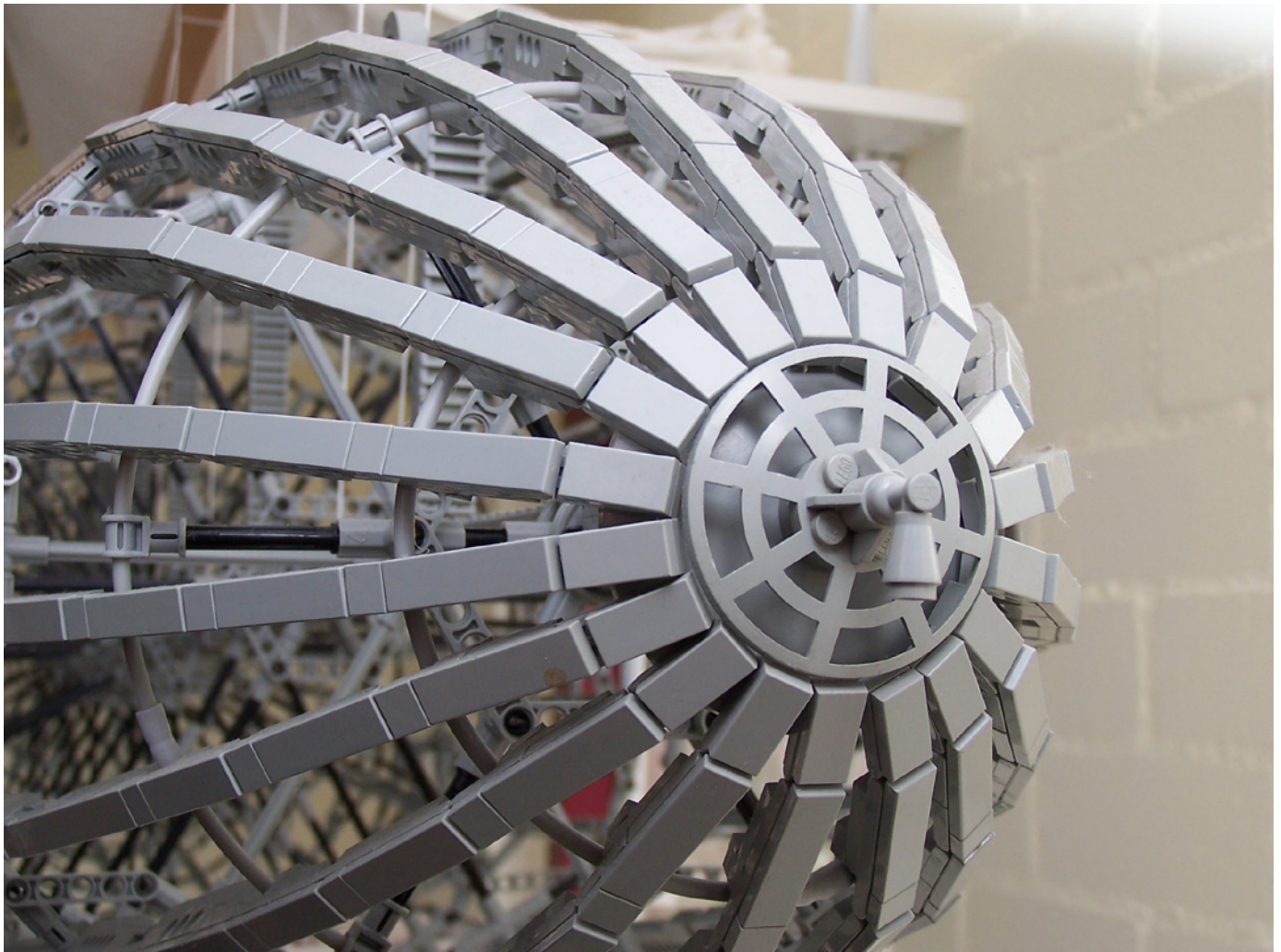


Figure 2: A close up of the front of the zeppelin, including the nose hook for the mooring mast



## Working out the construction

And now finally the build could begin. I started with the front. Since the curvature was so big between the first rings I had to use a different technique than simply placing beams between the rings like I did at the rest of the model. Instead I used the old hinge plates. Also the rings couldn't be made as polygons (the edges were smaller than 3 studs), so I used flextubes instead. In order to minimize the stress on the structure I pre-shaped them and then used a little piece of pneumatic hose to connect the ends. I used tiles as outer layer to suggest the smooth look of the fabric covering.

For the rings I could use only 6 spokes to connect the 18 sided polygons to the central shaft. I had to invent a way to keep the other corners at the right distance as well. For that I reverted to a technique that was also used by the original builders. I added shallow triangles to the spokes to connect at least 3 points to one spoke. To my surprise this arrangement was much stiffer than I had anticipated. The rings were so stiff that they could bear the weight of the structure when lying on a table. In figure 6 you can see the zeppelin resting on its rings somewhere midway through the build.

In figure 9 a dark gray flexcable end is just visible. All the beams on the top lengthwise rib are connected to each other with flexcables. Once the zeppelin is hanging this top rib will have the tendency to be pulled apart, the flexcables are holding it together.

### How to pre-shape flextubes

- 1) Make a holding structure to fix your flextube in the desired shape
- 2) Heat the flextube using a hairdryer for a few minutes
- 3) Cool the tube down in running cold water
- 4) Remove the structure and you will see that the flextube is now keeping its shape by itself.
- 5) If the tube is bending back once it is released you can repeat the procedure, but heat it a little longer, or over stressing the shape a little bit to accommodate for the relaxation afterward

## It's all about the details

When building such a big model as the Hindenburg it is easy to lose its attractiveness due to the inherent repetition. By incorporating as many details as possible the attention of the viewer is kept alive when he or she looks at the model. Fortunately the Hindenburg was filled with interesting details. First of all the outer objects; the steering gondola, the four



Figure 3: The nose seen from the inside. The ring with the gray spokes is the last segmented ring. The ones after that are made from pre-shaped flextubes.





Figure 4 A view from the inside, looking towards the rear. You can see several different techniques used to make the triangles at the end of the spokes. The first 3 rings in this picture are the biggest rings and are the only ones to have 12 spokes instead of 6.

motor gondolas and the four tail fins. But inside the zeppelin a whole zoo of objects was present:

A two story passenger area, with on the upper floor:

- The passenger cabins
- The lounge area (with the yellow piano made from titanium)
- The dining room

And on the lower floor:

- The smoking (!) room
- A Michelin star kitchen
- A bathroom with bubble bath
- The officer's mess

At the bottom of the hull a one foot wide passage ran from the nose to the rear. Alongside of it countless drums for water

and other fluids were hung. There was a radio chamber and a post office aboard the ship as well. At every second main ring a ladder was mounted that went all the way from the bottom to the top of the ship. At the top of these ladders venting holes were located that were used to vent excess hydrogen when needed. Next to the motor gondolas drums were present that contained diesel, oil and water to operate the motors. In the next figures some of these details can be seen.

A view of the upper passenger deck. The passenger cabins were located at the center of the ship. In the lower left the lounge area with the yellow piano is visible

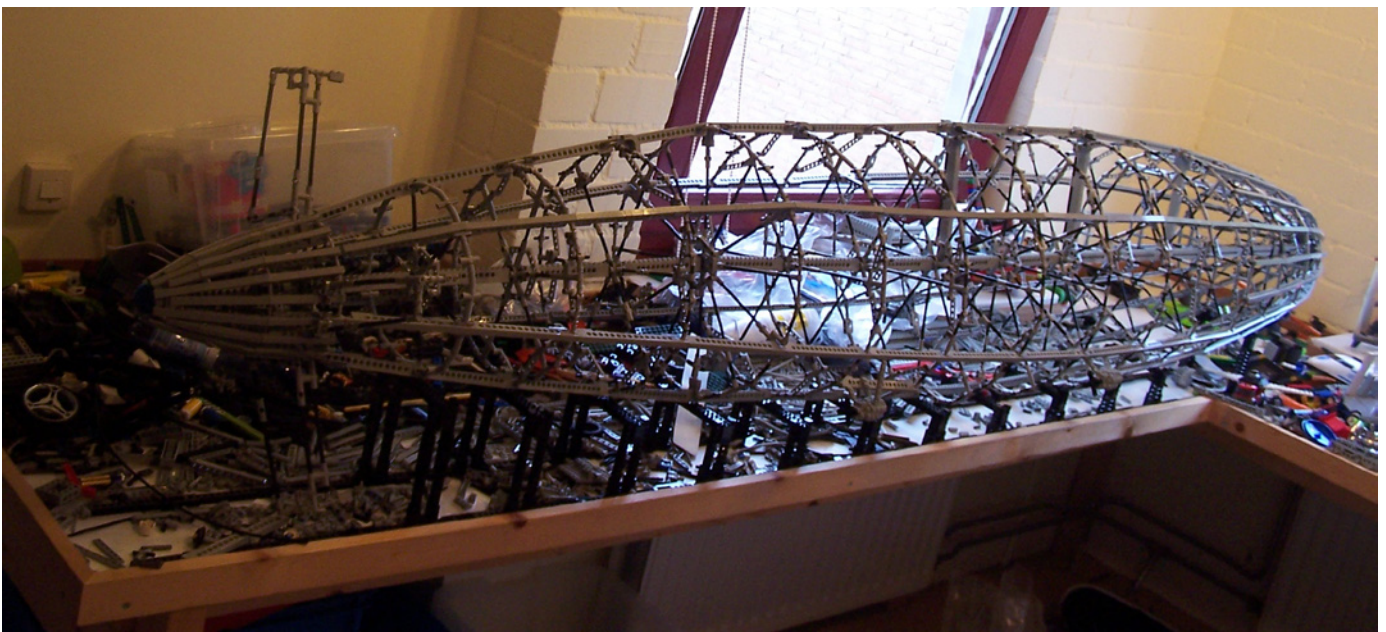
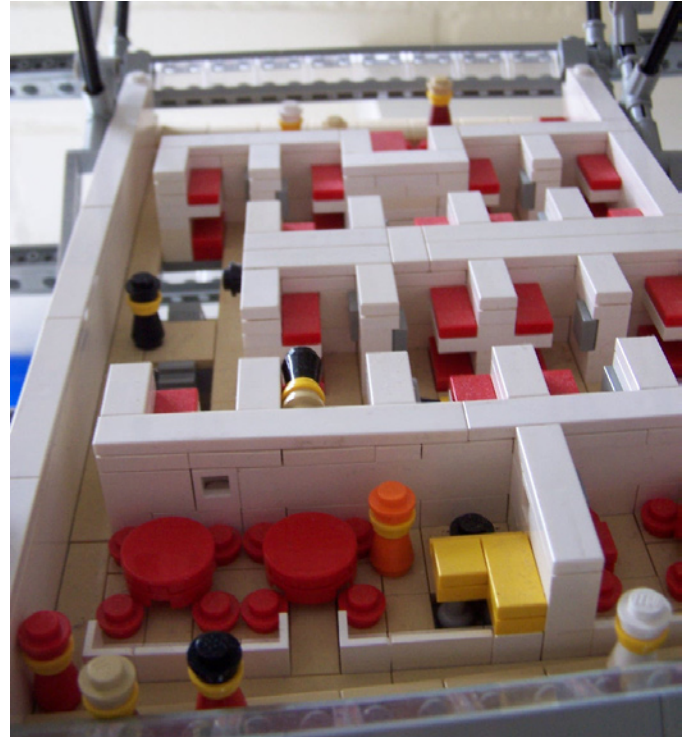
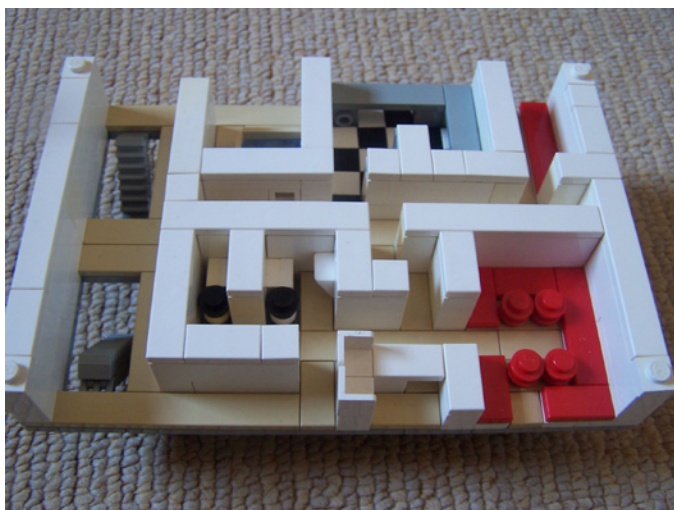


Figure 5: The outline is done, the model is resting with its belly on the black supporting structure. The stiffening triangles are visible at the edges of the rings (especially in front of the window).



The lower deck, with clockwise starting upper left: the bathroom, the kitchen, the officer's mess, the smoking room with bar and the toilets. The boarding stairs are extended to the ground.



One of the venting outlets at the top of the hull. The ladder is visible as well.



## The finishing touch

The last detail that needed to be added was the black limousine that also stood in the entrance hall of the zeppelin museum. It was the first car ever to be flown over the Atlantic Ocean and embodied the luxurious, almost decadent, image of the zeppelins.

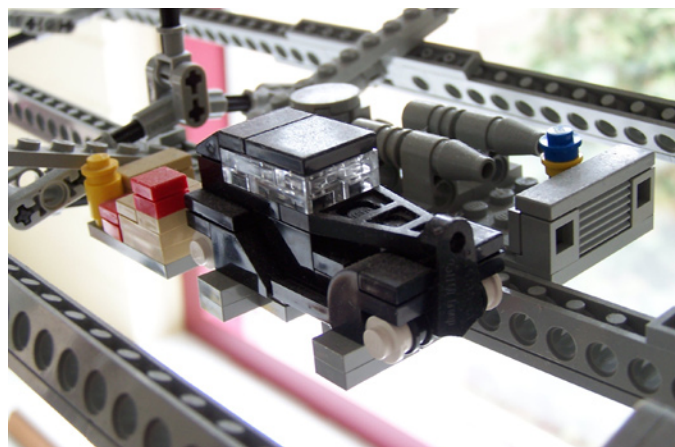


Figure 9: The Opel "Olympia" cabriolet

During the build of the zeppelin the LEGO® CUUSOO site went public. So once I had the model in decent enough state I published it there as well. If you want LEGO to consider producing this replica you can vote for it here. I am quite curious what the official LEGO comments will be, so I'll be very happy to reach the 1000 vote barrier :).

That leaves me with the hope that you enjoyed this article as much as I did building the Hindenburg. If you liked this zeppelin, you might also want to take a look around my Flickr page for other (big) flying machines. In figure 11 you can see the finished model in all its glory as it is hanging in my attic. Sailing above my head like the white zeppelin I saw on my holiday two summers ago.

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