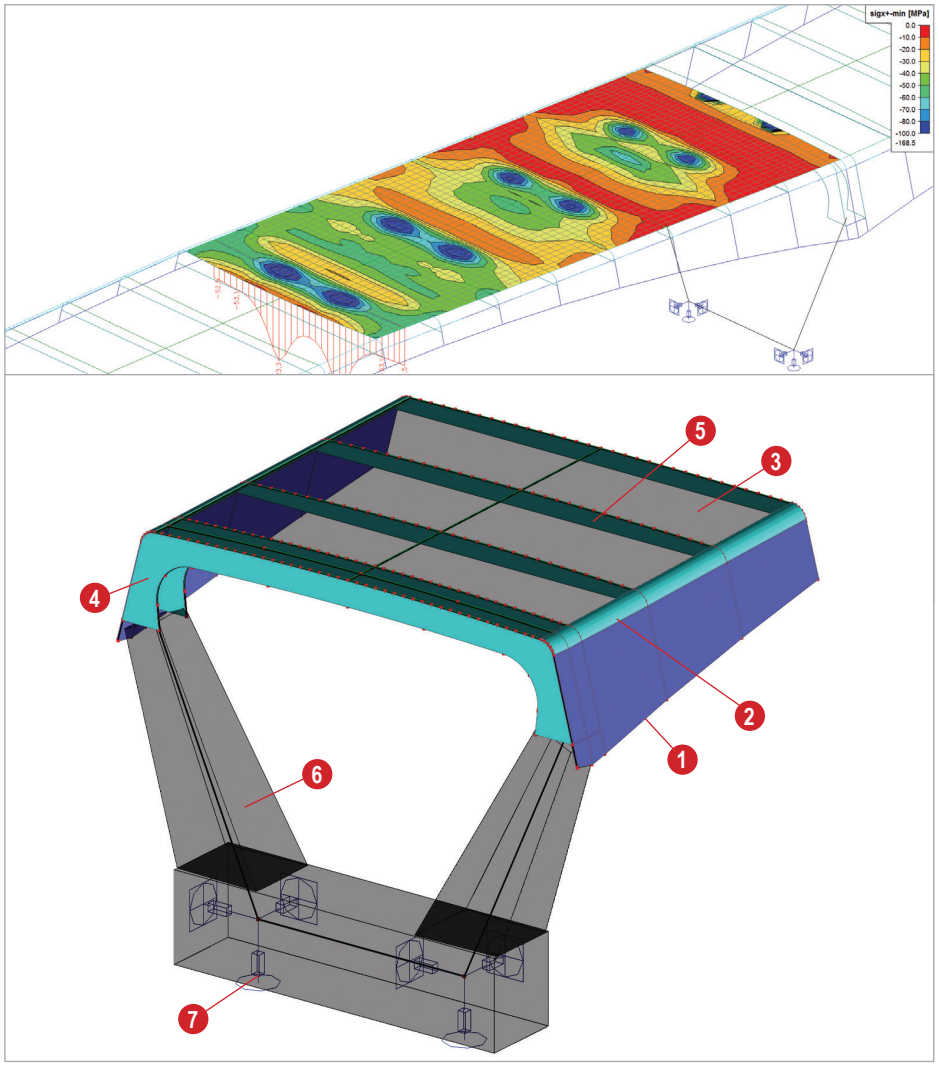
“Vluchthaven” Footbridge - Amsterdam, The Netherlands

Winner Category 2: Civil Structures

Quote of the Jury: *“The jury nominated this project because of the combination of its original design and its functionality. The moveable part of the bridge is totally integrated in the deck and is barely visible in the closed state. The bridge fits well in its surroundings. The structural system consists of a single curved plate merging several functions together, and of concrete foundation piles without extra supports.”*



Software: Scia Engineer

Programme
Architectural and stability study

Concept
The design for the Vluchthaven footbridge provides for an object that stands out for its graciousness and oneness. In a departure from classical engineering, our concept was to limit the hierarchy of the elements by merging several functions together into one whole. The Vluchthaven bridge is an example of integral design: the deck, cross members, main beam and the finishing are one. The bridge is conceived as a single curved and cutout plate.

Inspired by the elegant movement of a heron’s wing during flight, the plate is slightly torsed around its axis, representing the backbone of the bridge. As a result, the form of the bridge evolves: the cross-section at mid-span is concave while the opposite happens above the supports, with the cross-section convex. This way the necessary constructive height is achieved on supports. It gives the Vluchthaven bridge its wave shape, admittedly modest, but sufficient to provide a visual experience and rhythm.

The bridge’s light wave shape, referring to the light waves on the IJ lake, is structurally optimally used, and is continued in the design of the railing. This consists of a series of vertical elements following the wave. The absence of horizontal lines in the railing, additionally accentuates the shape of the bridge deck. This gives the entire bridge a calm and moderate rhythm. LED lights are embedded into the railing.

The mobile part of the bridge has been designed integrally with the bridge. While closed it is hardly visible.

Structural analysis
Scia Engineer has been used to create an analytical model of the entire bridge out of 3D plates. There are mainly seven different types of elements that can be distinguished in the model:
1. The side, as 3D plates
2. The curved corner plates, as 3D plates
3. The light curved plates for the deck, as 3D plates
4. The U-shaped stiffeners above the abutments, as 2D plates
5. The flat stiffeners under the deck, as 2D plates
6. The concrete support structures as beams
7. The supports with the stiffnesses of the present foundation piles

Through the use of the ‘import dxf/dwg’ function, the 3D contour lines of the geometry have been uploaded. While tracing the imported lines and nodes, the curved plates were generated in the model.

Making use of a custom XML-tool we modeled the 98 load cases for the traffic loads.

The specific form of the stiffeners above the abutments could be modeled with the use of the ‘cut-out’ function. Also the flat stiffeners follow the geometry determined by the wave of the deck plate above.

Because it is a mobile bridge, along with the closed situation three open versions have also been modeled to calculate the effects of the wind on the structure during the opening and closing.

With the ‘Productivity toolbox’ the entire plate geometry has been exported in table form into the calculation note along with all the results of the linear calculations. The ‘stability analysis’ was used to estimate the buckling behaviour near the support on the complete 3D model.

To investigate the vibratory behaviour of the bridge, the permanent part of the bridge was analysed with the use of the ‘Dynamics analysis’ function, using the full 3D model.

Ney & Partners

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Ney & Partners is a structural engineering consultancy, established in Brussels. Since its creation in 1997, the office has worked with a pro-active view on the art of engineering through the integration of the different civil works disciplines.

This integration and optimisation of structural elements aims to overcome the classic hierarchic assembly of constructive solutions. Innovative bridges, roof structures and works of art developed by our office most clearly express this vision.

The construction project quality lies in the synthesis of specific design constraints. The structural aspect is of primary importance to this synthesis. From the very beginning of the design process, Ney & Partners conducts constant research for advanced engineering integration. In doing so, our position as an engineering consultancy goes beyond the standardised dimensioning of predefined technical solutions. Ney & Partners currently employs more than 45 civil engineers, architects and draughtsmen.

Project information

Owner	Gemeente Amsterdam
Architect	Ney & Partners
General Contractor	Vandermade bv
Engineering Office	Ney & Partners
Location	Amsterdam, The Netherlands
Construction Period	05/2012 to 10/2012

Short description | **“Vluchthaven” Footbridge**

The moveable Vluchthaven footbridge connects the IJdock peninsula with the Westerdoksdijk, over a length of 105 m, while also providing access to the IJDock marina. The concept consists of a thick folded and shaped sheet of steel. The form of the deck is inspired by the elegant movement of a heron’s wings during flight. This also gives the deck, with a width of 4 m, its needed stiffness. The deck shape allows for better water management in regard to a series of openings on both sides of the bridge. Those perforations make a subtle reference to the water present underneath the bridge and enforce the relation between the passer-by and the bridge. The perforations also allow for subtle lighting integrated in the railing of the bridge. At a height of 15 cm, LEDs are embedded in resin at the base of each of the +1,000 posts.