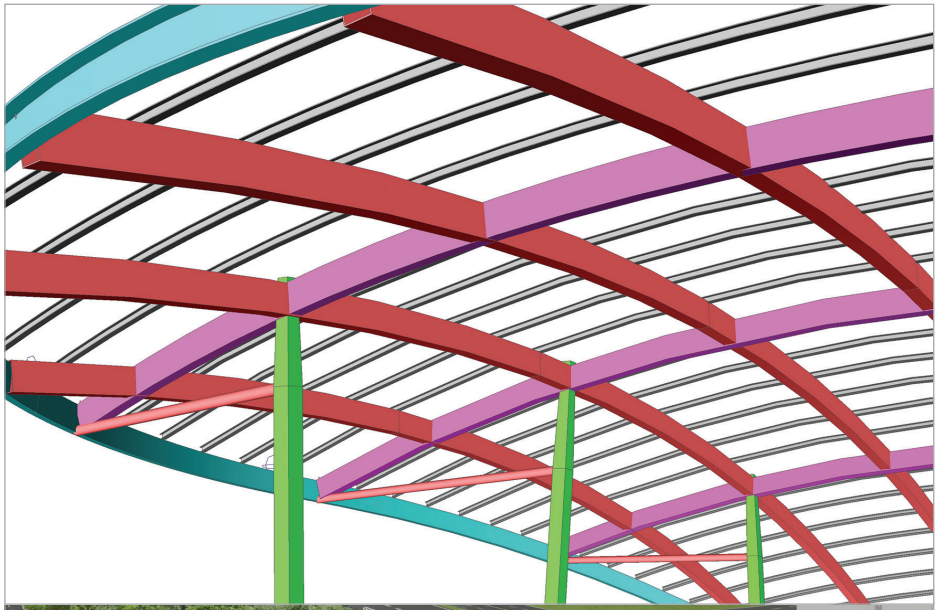
Roof Structure Noorderpark Subway Station - Amsterdam, The Netherlands



Software: Scia Engineer

Introduction

In the city of Amsterdam a new subway line is being created that connects the Northern part of Amsterdam with the Southern part. The line runs underneath the city centre, the central railway station and the waterway known as 'het IJ'.
One of the newly built stations is Noorderpark, located north of 'het IJ', where the subway emerges from underground. The station will be fitted with a glass roof structure supported by steel beams and girders.

Architectural Design

The design is provided by Benthem Crouwel Architects and consists of a transparent smooth roof surface of cold-bent glass. The bend line of the roof edge is characteristic. The vertical and horizontal curvatures follow the spatial structure of the station.

Stuctural Lay-out

The structural lay-out consists of main beams in the transversal direction, supported by slanted columns. The slanted columns provide the stability of the roof structure. The purlins supporting the glass, of which the spacing is adjusted to the size of the bent glass panels, are supported by long curved beams in the longitudinal direction.

Challenges

The complexity of the project mainly lies in the geometry. The roof is constructed by assembling different spherical shapes and intersection surfaces to create a completely smoothly curved surface in all directions. All this is done by an analytical approach to parameterise the design in such a way that the constraints given by the maximum size and repetition of the glass panels are always satisfied.

Another complicating factor was the substructure of the platforms and entrance plateau, already built and designed for the totally different former design of the roof structure.
Finally, considering the bended geometry in all directions, it was a tedious job to determine and input all the different windloads on the structure. Wind suction as well as wind pressure had to be taken into account for different wind directions and different parts of the structure.

Modelling approach

The shape of the roof was modelled with the modelling tools available in Scia Engineer to create spherical bodies. The final shape was then intersected by surfaces. In the intersections the steel beams and girders were modelled.
Finally, since many different combinations of forces at the supports were generated, a governing part of the already built substructure was modelled to check if any reinforcements were needed.

Optimisation

Since the structural design was parameterised from the offset and modelled in Scia Engineer, different variants for the geometrical shape as well as the used steel profiles could be analysed and compared quickly. Thus an optimal design in terms of shape, steel usage and ease of erection is reached, all tailor-made to the cost-effective usage of cold-bent glass.

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Our innovative structural engineering professionals strive to overcome the physical limitations of sites while also meeting the requirements of each project. The teams work with our in-house architects, as well as with clients directly, to develop solutions to the full range of structural needs, in many cases paving the way for the creation of new opportunities for the architect and project owner.

Project information

Owner	Municipality Amsterdam
Architect	Benthem Crouwel Architects
General Contractor	VolkerWessels Visser en Smit Bouw bv
Engineering Office	ARCADIS Nederland BV
Location	Amsterdam, The Netherlands
Construction Period	09/2013 to 12/2013

Short description | **Roof Structure Noorderpark Subway Station**

This project concerns the roof structure covering the newly built 'Noorderpark' subway station in the city of Amsterdam.
The main complexity of the project lies in the geometry, with the roof being constructed by assembling different spherical shapes and intersection surfaces to create a smooth curved surface in all directions. The modelling tools of Scia Engineer were used to create the sperical bodies, intersect them with surfaces and to model the steel beams in the intersections.
A parameterised design of the roof structure made it possible to create an optimal cost-effective structure suited to the usage of bent glass, yet with a very attractive, transparent doubly curved smooth appearance.