



The OV-Terminal and the K5 Office Building are the final pieces of the complete masterplan of the reconstruction of the station area in Arnhem, the so-called Phase 2 of the project. The buildings are located next to each other and due to the organic forms they smoothly fit into each other. Both buildings are built on top of the car parking area, on top of and against the bicycle parking area (the so-called substructure) and against the K4 and K2 Office Buildings. These structures were already built in Phase 1 of the project and have a large structural interaction with each other.

### Structure of OV-Terminal

The structure of the OV-Terminal consists of the structure of the roof and the structure of the balcony and road bridge. The roof structure is designed in steel and is basically a ship structure inside out. This structure is engineered and built by CSC (a ship builder) and modelled with the FEM-package Ansys. The balcony and the road bridge are reinforced, in situ concrete structures with spans of 25 m. The structure of the balcony is characterised by large beams (1.4 x 1.8 m<sup>2</sup>), a concrete deck (0.2 m thickness) and a high number of kinks and inclinations. The road bridge is a concrete plate structure with weight-reducing elements in between.

The structure of the balcony and the road bridge is supported by a limited number of walls, of which some are inclined. Elements like the flip, the V-walls, the fronttwist and the backtwist are examples of inclined supports. This results in large horizontal forces which transfer through both the structure of Phase 1 (already built) and Phase 2 (current project) to satisfy equilibrium.

### Structure of the K5 Office Building

The K5 Office Building has a steel structure composed of high truss structures with steel-concrete floor structures in between. These truss structures are necessary to support the total building on just six supports. The truss structures follow the organic form of the roof and a number of them are twisted, inclined or both. This also results in horizontal forces which

should make equilibrium within the structure itself. One support, the so-called 'trumpet wall', which supports one of the trusses, is also inclined and introduces a large horizontal force of 2.5 MN in the structure of both K5 and the OV-Terminal.

Noteworthy is the fact that the stability of the K5 office building is provided by the OV-Terminal in one direction and the K5 wall structure in the other.

### Use of Scia Engineer

Scia Engineer is used to model the concrete structure of the balcony and the road bridge and the steel structure of K5. The complex forms, kinks and curves of the structure, the inclinations of the supports and the complex interaction with the structure of Phase 1 and the roof made it necessary to model both structures (the balcony and road bridge of the OV-Terminal, and the K5 Office Building) in Scia Engineer.

For the balcony and road bridge structure, Scia Engineer is used to determine the horizontal and vertical load transfer. For the calculation of the reinforcement of the beams, integration strips are successfully applied.

Scia Engineer is used to calculate the load transfer and to check the steel elements with steel codes.

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BAM Advies & Engineering is the consultancy and engineering office of BAM Utiliteitsbouw. It provides consulting, management, design and engineering expertise. This enables its customers to develop, build and maintain themselves in an optimum way. BAM Advies & Engineering has approximately 110 enthusiastic and motivated staff members.

BAM Advies & Engineering is engaged in all parts of the construction process. Its services include: Design expertise, engineering and consultancy in the field of engineering, construction, installation, construction methodologies and maintenance.

## Project information

Owner	Prorail
Architect	UN Studio
General Contractor	Ballast Nedam speciale projecten en BAM Utiliteitsbouw regio Arnhem
Engineering Office	BAM Advies en Engineering
Location	Arnhem, The Netherlands
Construction Period	12/2012 to 2014

## Short description | OV-Terminal and K5 Office Building

The OV-Terminal and the K5 Office Building are the final pieces of the complete masterplan of the reconstruction of the station area in Arnhem, the so-called Phase 2 of the project. The buildings are located next to each other and due to the organic forms they smoothly fit into each other. The roof structure of the OV-Terminal is a steel ship structure inside out. The balcony and road bridge, which supports the roof, is a complex concrete structure with spans of 25 m.

The K5 Office Building is built next to the OV-Terminal and is an integral part of the project. The structure consists of steel trusses with steel-concrete floors. Noteworthy features of the project are the complex forms, the limited number of supports and the structural interaction between K5, the balcony and road bridge, the roof structure and the existing structure of Phase 1.

