Movares

Contact Ybele Jelsma
Address Postbus 2855
3500GW Utrecht, Netherlands

Phone +31 302655555
Email ybele.jelsma@movares.nl
Website www.movares.nl

From concept to completion

Movares is an engineering consultancy company, analyzing issues and providing solutions in the fields of planning, mobility, infrastructure and transportation. Usability, future value and sustainability play a major role in the designs we produce and the advice we give. Increasingly, we are turning our attention to related markets, such as water and energy. We contribute to accessibility through our unique combination of expertise. Movares operates throughout Europe and has offices in the Netherlands, Germany and Poland.

An engineering consultancy based on engineers

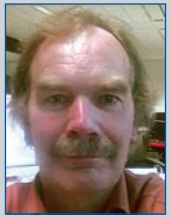
Movares has some 1400 professional staff. In all they do, they are 'professional, enterprising and human' – reflecting our three core values. Our engineering consultancy is engineer-based. That means we focus on developing our people. The result: ideas and solutions that contribute to sustainable development. Development maintaining a healthy balance between social relevance, quality of life, sustainability and economic growth. To us, socially responsible business is not just something you do. It's what you are. And our customers notice the difference.

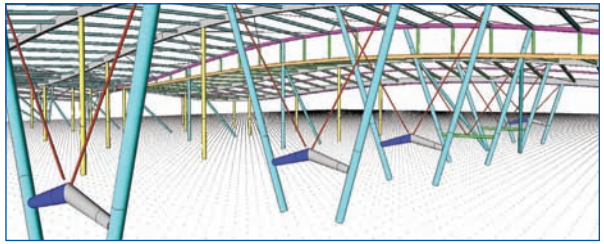
Giving shape to mobility

Infrastructure is the backbone of development, both for society and for the economy: from initial studies and the earliest planning phases, to the design and execution of projects and further on to management and maintenance. Movares plays an active role throughout the entire consulting and engineering process. Our combination of knowledge, expertise and innovativeness is summed up in our motto: 'Giving shape to mobility'.

Projects

Movares is involved in a wide range of projects. Those of which we are mostly proud include the dedicated freight line from the Netherlands into Germany (the Betuweroute), the high-speed line into Belgium (known as the HSL-Zuid), doubling the number of tracks between Amsterdam and Utrecht (the busiest line in the Netherlands), several projects in the port of Rotterdam, a high-voltage switching station and a new public transport terminal in Utrecht.





Short Description

Public Transport Terminal, Central Station, Utrecht

The project regards a state of the art building to integrate all public transport facilities and shops within one location. The works will be carried out in phases, as the station needs to remain fully operational during construction. The integral station building will be able to handle up to 100 million travellers per year. The implementation will take place from 2010 till 2015.
Scia Engineer has been used to get the steel structure determined.
The main construction of the roof is made out of steel and consists of seven lines of curved beams supported by columns. Across these beams are mounted girders, which are curved in one direction. The roof plating is mounted on the girders. The pedestrian and shopping areas are made out of concrete floor.

Project Information

Owner: ProRail
Architect: Benthem Crouwel Architects
General Contractor: n/a
Engineering Office: Movares Nederland B.V.

Construction Start: 2010
Construction End: 2015
Location: Utrecht, Netherlands

Introduction

The present buildings for the Utrecht Central Station have a capacity of 35 million passengers per year. Nowadays the station is already used by 55 million travellers annually. In the next twenty years the number of travellers will raise to about 100 million. The existing building cannot accommodate these numbers of passengers. The plans provide in a state of the art building to integrate all public transport facilities and shops within one location.

The new public transport terminal (called OV-Terminal) will be the largest station in the Netherlands in size as well as in transit values. The realization of the OV-Terminal is planned in the period 2010-2015. As the station needs to remain fully operational during construction, works will be executed in phases.

Design OV-Terminal

The OV-Terminal will consist of a concrete floor structure and a steel roof structure. The concrete traverse is a structure of repeated concrete columns supporting tie beams and PI-beams which connect the tie beams such that they act as portal structures. Spanning the tracks is realised by the use of TT-girders.
The main dimensions of the roof structure are approximately: length 250m, width 90m and maximum height 17m.

Traverse Roof structure

The roof structure of the traverse consists of a main structure with seven rows of steel main girders, supported by steel columns at the existing patterns. In order to reduce the deadweight of the structures and the possibility to utilize large spans, steel as main material was chosen instead of concrete.

For the benefit of the double sided curved roof surface, the main girders are singularly bent. On top of these girders the curved purlins are mounted. During assembly the purlins need to be slightly twisted. In fact all purlins are shaped differently.

On top of the purlins steel roof plating in trapezium shapes, as in the present situation, will be attached. Due to the enormous dimensions of the roof and the temperature changes, the roof has two expansion joints in the longitudinal direction dividing the structure in three parts. The stability in transverse direction is realized by the application of steel tension-compression shores. In longitudinal direction per pattern and per separated part, a steel stabilizing element is applied. The elements consist of two columns connected by buckled elliptically shaped and tapered beams and at the top the columns are connected by wires as wind framing.
Near the roof cut, also called "the eye", for architectural reasons it is decided to apply "Vierendeelliggers" between the higher and lower roof

Used software: Scia Engineer

Public Transport Terminal, Central Station, Utrecht

structure. At this point the main roof girder is split into two separate tubes serving as upper and lower edge of the “Vierendeelliggers”.
The fire resistance of the main steel superstructure itself is established at 30 minutes. The application of Sprinkler systems prolongs the fire resistance by 30 minutes and due to a low fire load another 30 minutes can be added, totalizing to a fire resisting period of 90 minutes.
Because of the fact that the traverse is surrounded by high-rise buildings wind tunnel tests were carried out. Results from the tests are integrated in the design parameters and measures as local increase in wind loading are applied into the design. In relation to wind loadings an analysis of the frequencies of the total roof superstructures was executed.

The use of Scia Engineer software

For the analyses of the steel structures the Scia Engineer software is used because the double bent roof definitely needs 3-dimensional analyses. Originally the main model was shaped with the 3D AutoCAD package and the result is read into Scia Engineer. To the basic model all other structural elements and conditions are added.

As the wind- and stabilizing elements can only transfer tensile forces, these elements are introduced as non-linear members. Consequently all structural members are tested on results from non-linear analyses.
Buckling lengths and the verification of the Codes, as well as the analyses of deformations are done by using Scia Engineer.
In relation with the wind tunnel tests determination of the natural frequencies, the dynamic properties, is established in order to compare the test results with the basic assumptions as mentioned in the Codes.

Link: http://www.movares.nl/Projecten/Stations/OV+Terminal+Utrecht+Centraal.htm