Iv-Consult

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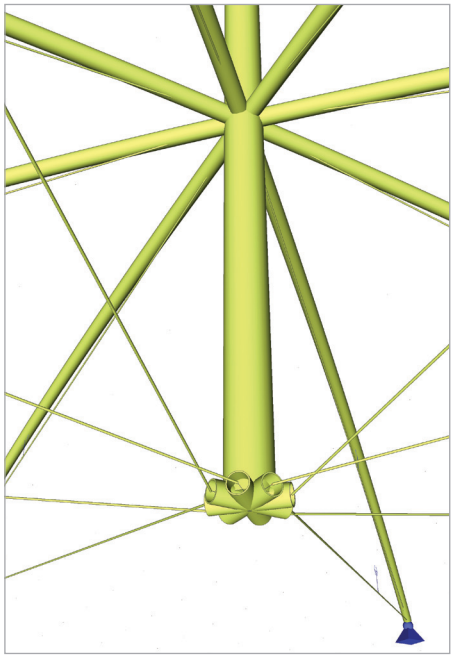
Iv-Consult is a division of Iv-Groep, a group of professional engineering companies with approximately 800 employees. Iv-Groep was founded in 1949 as a design and drawing office for steel structures. Through the years the company has developed itself into a sparring partner for clients who need independent advice or a constructive solution.

Services are provided from preliminary design up to detail design. Iv-Consult is a market leader especially in detail design of steel structures. Besides the main office in Papendrecht, the Netherlands, Iv-Consult also has offices in Almere, the Netherlands and Kuala Lumpur, Malaysia.

As an engineering company Iv-Consult focuses on the challenging design and engineering of complex structural and mechanical projects. The company has the know-how and experience to also realise larger scale projects like power plants and harbours. For clients varying from end-users to developers, architects to contractors, we provide engineering services with a creative mind setting and a high focus on cost effective design. Quality is our selling point.



Software: Scia Engineer

Park your Bike in an Apple - Alphen aan den Rijn, The Netherlands

As the bicycle is a popular means of transport in the Netherlands, it is not uncommon to encounter literally hundreds of bikes at or near major train stations. A unique bicycle parking facility in the shape of an apple, large enough for 1.000 bicycles, aptly named the 'FietsAppel' now takes centre stage at the new station boulevard.

Description of the structure

Two parallel upward spiralling curves constitute the basic geometry of the structure. The spirals ascend from the ground to a height of 16 m, moving gradually outwards. The two spiral beams, which are approximately 6 m apart, support a lightweight steel floor which has sufficient space to accommodate two rows of bicycle racks and a walkway in between. The outer spiral beam is supported by the 'apple peel', a triangulated space frame shell constructed of CHS struts and ties, while the inner spiral beam is carried by 9 CHS columns, inclined outwards at 15 degrees. At the tops of the columns there is a horizontal ring which ties the column tops together visually. This is the 'core'. Near the top, the outer spiral beam moves back towards the inside, until the spiral blends into the top ring. In this way, a complete structural load bearing system is formed. Just above the centre of the top ring, a leaf shaped wind vane is positioned which has both a functional and aesthetic purpose. It consists of an aluminium leaf, a bearing mounted stalk and a cable staying suspension system. The cables are pre-stressed and are connected to the stalk housing in staggered fashion similar to the spokes in a bicycle wheel. This provides both translational and rotational stiffness.

Analysis approach

Apart from the complicated spatial geometry, figuring out how this unique structure behaves under the various loading conditions was also a challenge for the structural engineer. Horizontal stability under wind loading is not provided by the central core as would be the case in other conventional structural arrangements. This is due mainly to the architectural requirement that no bracing should be added to achieve stability. The stability is inherent in the framework thereby achieving the desired 'transparent' look. The central core which is formed by the columns and top ring does not contribute at all to the structural stability. The structure receives its stability entirely from the triangulated outer peel which functions as a dome and can resist wind loads from any direction. Another interesting phenomenon is the effects of temperature change. Due to variations in the temperature of the steel members in direct sunlight and those in shaded areas, expansion and contraction of particular elements are not synchronized which results in the creation of additional internal member forces.

Use of Scia Engineer

Modelling a geometrically complex structure like the FietsAppel would be a challenge for any structural analysis program available today. The XML coding component of Scia Engineer makes this process not only possible but also surprisingly simple. The entire geometry of the apple was based on the two spiral curves, which were described mathematically and controlled by variables. MS Excel was used to calculate the spatial coordinates of the key nodes on the spiral beams and to generate the corresponding XML scripts for Scia Engineer. Thereafter a very simple parabolic arc beam was created in Scia and copied repeatedly until all of the previously defined key nodes were duplicated. In the tools category of Scia Engineer, an XML file consisting of the nodal data was generated. Then by simply updating the scripts in the XML file with those in the spreadsheet, the complete inner and outer spiral beams were generated automatically and precisely. In this way it was relatively easy to connect all the key nodes diagonally with the tubular members completing the model in a very short time.
As with all projects of this nature, the geometry often requires some adjustment after the initial generation. Being able to modify the parameters in the mathematical formula and repeating the above process instead of redoing the entire model saved valuable time. A robust design has been achieved by eliminating certain members and analyzing the structural integrity for the remaining parts, for instance there is a possibility that a vehicle could collide into the structure and cause local failure or total collapse. In addition, a separate model for the 'wind vaan' was made in Scia Engineer to verify the correct behaviour of the pre-stressed cable-staying top structure.

Park your Bike in an Apple

Alphen aan den Rijn, The Netherlands

Project information

Owner	Municipality of Alphen aan den Rijn
Architect	KuipersCompagnons
General Contractor	Jos van den Bersselaar Constructie
Engineering Office	Iv-Consult
Construction Period	From April 2010 to October 2010
Location	Alphen aan den Rijn, The Netherlands

Short project description

A unique bicycle parking facility in the shape of an apple, large enough for 1.000 bicycles, aptly named the 'FietsAppel' now takes centre stage at the new station boulevard in Alphen aan den Rijn, the Netherlands. Two parallel upward spiralling curves constitute the basic geometry of the structure. The structure consists of a triangulated space frame shell ('apple peel'), 9 CHS columns with spiral beams ('apple core') and bearing mounted stalk with a cable staying suspension system ('apple stalk' and 'apple leaf'). By implementing XML scripts coding in Scia Engineer, a parametric model is achieved which saves lots of modelling time.