# Use of 3D product modeling in cable stayed bridge design and construction

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## Summary

The Crusell Bridge, built in Finland 2010, is the first large scale Bridge in which the modelling has been applied all the way through from engineering design to the construction. This paper collects experiences from a large size bridge project, describes the processes finding benefits and problems of product modelling in practise in the most challenging structures – in large scale bridges.

**Keywords:** Cable Stayed Bridge, product modelling, BIM, steel-concrete-composite

## 1. Introduction

*Fig. 1: The Crusell Bridge (copyright M.Rekilä)*

The new Port of Helsinki, outside the city centre, was inaugurated 2008 relieving central land areas for dwelling and business construction. Crusell bridge was planned to reply to the new traffic requirements and in addition, to create a landmark for the new area.

This Cable stayed Bridge has two asymmetrical spans 92,0m and 52,5m. The Bridge width is 24,8m (including cable areas 2x 1,50m) and the Pylon top is 49,0m above the sea level. The Bridge carries two lanes for trams, two for road traffic and two for pedestrians and cyclists.

The superstructure is cast in place concrete girder and post tensioned in longitudinal direction. The girder is slender and wide, with thickness 1,49m from the elevation line. The Deck is supported by two cable planes. The longitudinal girder width varies due the unbalanced span ratio and has smooth rounded outer edges. In in transverse direction steel cross beams forms a steel-concrete composite structure. The bridge pylon is a steel box with stainless steel cladding.

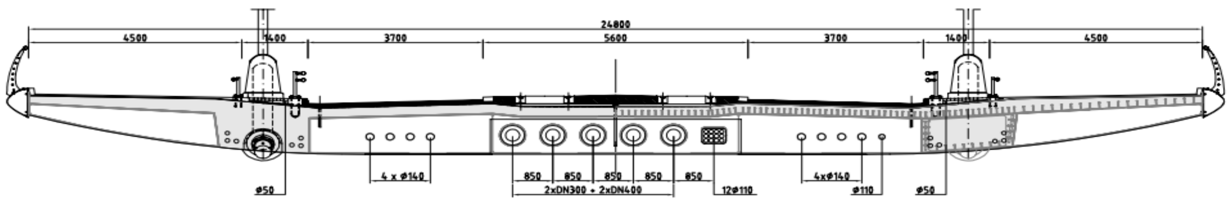


*Fig. 2: Structural cross section of the bridge*

In addition to the traffic, the bridge carries all kind of utility pipelines, accessories and attachments. This all created a multi complex structure which has not been modelled in this extent before.

## 2. The Product model

Most of all components (structural or not) were modelled in 3d. The product model was prepared into the construction coordinate system. Foundations, substructures and superstructures were included with all steel, concrete, prestressing tendons and reinforcement.

https://doi.org/10.2749/222137813808627208

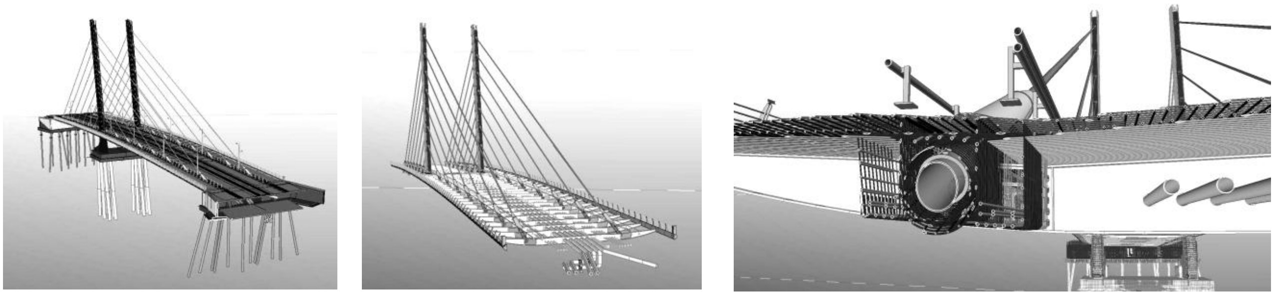

*Fig. 5: General and detailed views of the Bridge product model*

Attachments like base bolts, drainage systems, piping and cabling, inserts, lightning poles were included. Stainless steel cladding for pylon and cable anti-vandalism tubes were also modelled. All modelled objects included part and material information for production.

## 3. Use of the product model

For the design approval and filing traditional construction drawings were needed. Those were prepared by the modelling software. Otherwise, the model was used as much as possible straight for construction.

Steel structures were CNC (computerized numerical control) fabricated from the model database using general DSTV format. At the workshop, the part drawings are used only for quality control. Reinforcement and some formwork structures were also prefabricated with the data exported from the model.

Three dimensional model also provided a great possibility for structure visualization in details. It was powerful tool to study the complicated structure beforehand. It was also linked to the scheduling software with modelled temporary structures for site management and planning.

The product model provided all the bridge geometry information in compatible format for site measurements. It was possible to compare any point measured at the site respectively to the model. Laser scanning was also used at the site.

## 4. Pilot projects are needed

The Crusell Bridge extensive product modeling proved that there is a plenty of benefits and modern applications in bridge construction which can be applied in the practice at the site. On the other hand, construction based only on product model still needs a lot of development. General outcome from this case is that:

- Modelling improves quality in the designs.
- Modern technology support the use of model at site
- Component fabrication can be based of the information extracted automatically from the model database.
- Modelling provide new tools for site managing and material flow control.
- Accuracy in modelling complicated geometries is not sufficient yet.
- To apply model based construction require modern and well equipped contractor
- There is no common practise for modelling yet.