Biggest hybrid lightweight bridge in the world

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Summary

A program has been initiated to utilize the advanced composite materials in structural applications. The goal is to be distinctive with respect to other contractors and to offer better solutions for clients. One of these solutions was a hybrid bridge of 142 m long and 6.5 m wide for heavy transport made of steel trusses and a composite deck. It concerned a project for a client who wanted both low life cycle costs and low weight. Special techniques and materials were used to make the connections. The special techniques and materials used for this project are now used for maintenance, repair and upgrading of structures.

Fig. 1: Bridge on SPMT's

Keywords: composites; hybrid, connection, resin, truss, lightweight, durability, deck, innovation, Heijmans.

1. Introduction

In a rail extension project of the Dutch rail network organization Prorail the railway capacity between Central Station Utrecht and Houten has to be increased. There is a specific location where the railway crosses the Dutch highway A27. This location demanded extra attention because of local circumstances in the underground: there is a concrete viaduct over highway A27 for railway and heavy traffic. This viaduct for heavy traffic has been converted to a railway viaduct and a special new heavy traffic viaduct of 142m has been built nearby.

Fig. 2: Hoisting composite deck

This new heavy traffic viaduct, a hybrid lightweight bridge, has been made of steel trusses and a fibre reinforced plastic deck. The highway is located deeper than the surrounding road. The main reason the client demanded a lightweight construction was that an underground foil construction was needed to keep the groundwater out from coming up. Normally we would have used big concrete piles. These did not fit however, as they would pierce the foil construction and the highway would be flooded with water.

Fibre reinforced plastics or composites are well known these days. Generally the combination of glass fibres and polyesters is used for for example small pedestrian- and bicycle bridges and rebars.

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Composite materials are used because of very specific advantages. These advantages are high specific strength and modulus, high fatigue strength and fatigue damage tolerance, anisotropic, as well as designable or tailored materials for both microstructure and properties, corrosion resistance and durability. Other unique functional properties are damping and a low coefficient of thermal expansion.

Because of this project new possibilities have been discovered for problems we have today. The big advantages of using fibre reinforced plastics for constructions or resins for glued connections are clear. Especially lightweight constructions are sometimes preferable for upgrading constructions. Resin is not only good for composite projects, but also for upgrading them. The special technology which is used to make a glued connection between the steel trusses and composite deck of the hybrid bridge will also be used in maintenance and upgrade of steel bridges with fatigue problems.

Fig. 3: Bridge moving over the highway

2. Conclusion

Composite materials are used for specific advantages, which are deployable for different needs. In this case, composites made it possible to produce one of the largest and lightest bridges in the world, connecting the city of Utrecht to Lunetten. The big challenges in combination with the huge risks sometimes made it hard to successfully complete the project. Although these difficulties were not easy to overcome, this specific project was a success. Therefore, high-tech materials will be used in other projects in the near future.