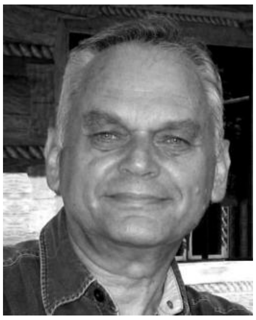
Preliminary Design of Four Optional Long Bridge Solutions for the Western Scheldt Crossing, Netherlands

Ryszard A. DANIEL
Senior Consultant/Specialist by the Ministry of Infrastructure and Environment, Division of Infrastructure,
Utrecht, the Netherlands
richard.daniel@rws.nl



Ryszard Daniel, born in 1949, received MSc. in civil engineering from Silesia Univ. of Techn. and PhD. from Gdansk Univ. of Techn. He is a designer, project leader, consultant, reviewer and author of many publications in civil engineering, particularly in the field of bridges and hydraulic structures.

Summary

Two structural systems dominate the choice of a very long span bridge nowadays – the suspension and cable-stayed bridge, both with one or more main spans and in steel or concrete version. Yet, the combination of these possibilities leaves the designer with quite many options. The question which option represents the best choice has been studied in details as part of the Western Scheldt Crossing project in the Netherlands. This paper presents the conclusions of that study and the comparative conceptual designs of four final bridge options. The results can be indicative for prospective studies on long span bridge crossings in other projects.

Keywords: Long span bridge, suspension bridge, cable-stayed bridge, navigable clearance, pylon, main span, multiple span, suspension cable, anchor block, bridge girder.

1. Introduction

Netherlands is a country with the most compact network of both roads and waterways in Europe. These networks are of vital importance to the Netherlands' economy, the big part of which directly or indirectly serves the freight transport from and into the member states of the European Union. The crossings of roads and waterways are, obviously, of prior concern too – in particular when not only Dutch but also foreign vital interests are involved.

In the 1990's, a project of the Western Scheldt river crossing was carried on. The river provides the main access to the Belgian harbour of Antwerp, one of the biggest harbours in Europe. As the crossing was to be located near the city of Terneuzen, i.e. downstream of Antwerp, the combined bridge-tunnel option was considered. It was meant to provide an unlimited navigation clearance for the largest vessels above the tunnel section – and a limited but still large clearance under the bridge (Fig. 1). This idea was an option to the entire tunnelling that finally won the competition for other than technical reasons. Nonetheless, the performed studies and designs of the bridge delivered many valuable conclusions. Several of them are still valid now and will be presented in this paper.

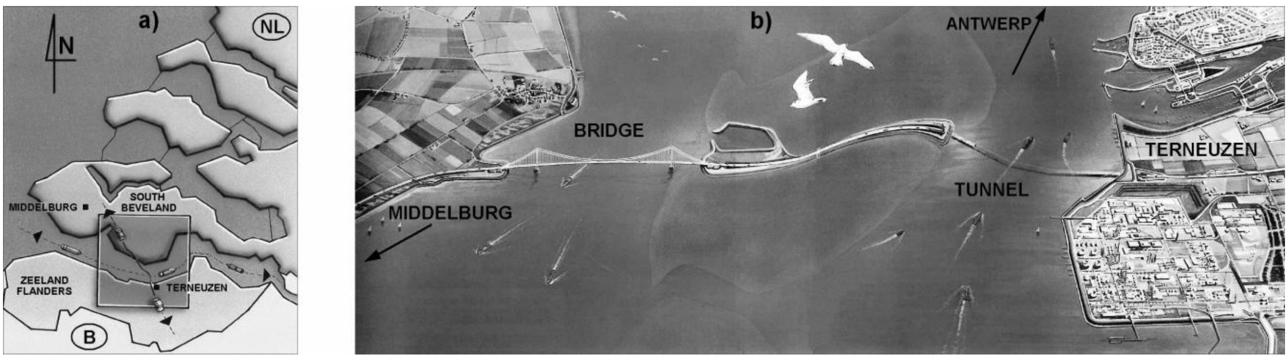


Fig. 1: Situation sketch (a) and a bird view (b) of the intended bridge-tunnel crossing

https://doi.org/10.2749/222137813808626858
Distributed by structurae

2. Four bridge options

As the river width section to be bridged equalled more than 2 km and the navigation requirements did not allow for many pillars in that section, only the long span bridge systems could be taken into account. This included suspension bridges and cable-stayed bridges. Other systems, even if feasible in technological sense, were considered economically not compatible for this project. The study on possible longitudinal profiles of the crossing resulted in four options: two with suspension bridges and two with cable-stayed bridges (Fig. 2):

1. Single main span suspension bridge;
2. Double main span suspension bridge;
3. Steel cable-stayed bridge of three middle spans;
4. Concrete cable-stayed bridge of four middle spans.

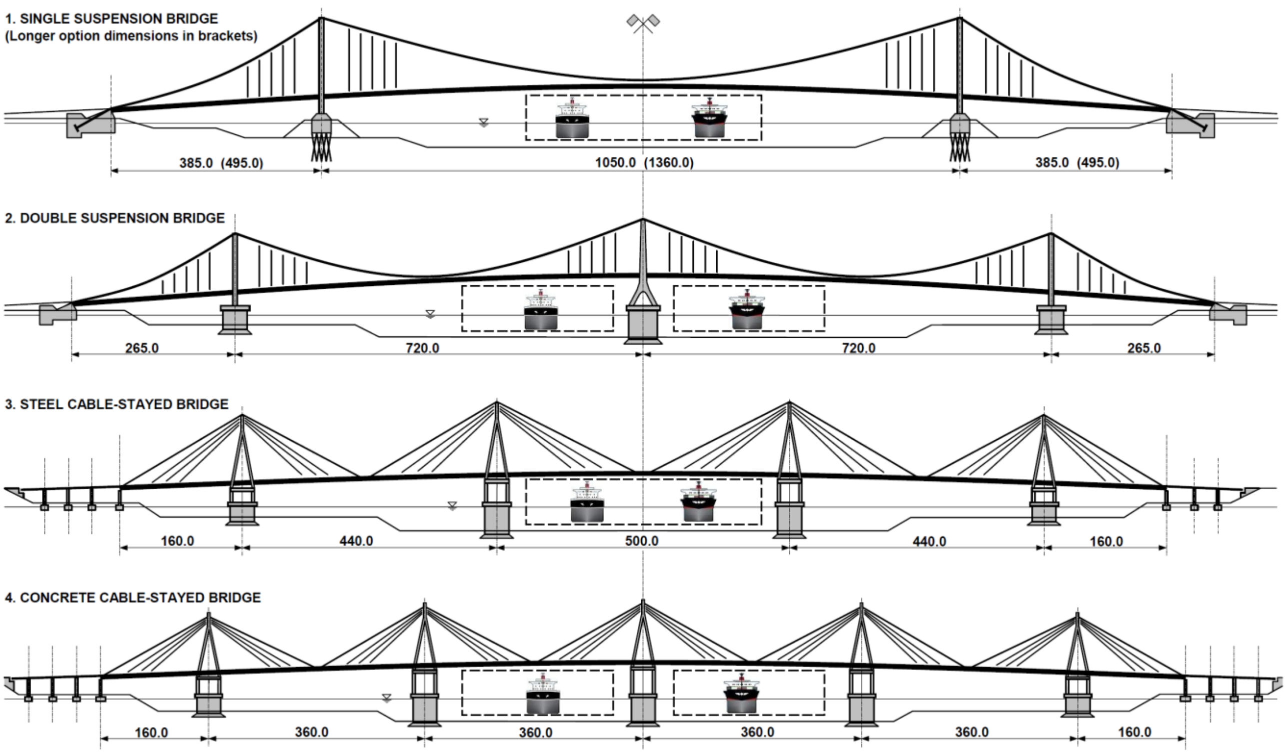


Fig. 2: Four bridge system solutions for the Western Scheldt crossing

All these options satisfied the navigation requirements by providing either one 400 m wide or two 250 m wide ship passages. Though the Western Scheldt is a tidal river in that area, the requirements of proper navigation draught and overhead clearance did not present a major problem too. The inclusion of a double main span suspension bridge option caused, however, some discussion. This system was generally not favoured at that time due to the high horizontal loads on the middle pylon. Despite that it still proved to be feasible and there was no ground to rule it out.

3. Conclusions

The completed designs allowed for pronouncing all the four bridge systems (Fig. 2) feasible and in line with the specifications of the project. However, they also highlighted a number of remarkable differences in optimal shapes, materials, technologies, project execution approaches etc. What was a good choice for one option did not have to be the same good for the other. Despite the general “fit for purpose” label, the considered bridge systems showed also differences in terms of risks and performances – regarding both the project execution and the bridge service life. The differences emerged at the level of entire systems as well as their components. It is impossible to discuss them all in one paper. This presentation focuses on a selected number of issues and details.