The New Storstrøm Bridge – Pier Design

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Abstract

The New Storstrøm Bridge in Denmark has 40 concrete piers ranging from 18 to 35m high. The piers comprise multi-faceted stems and pier heads. To simplify offshore construction a precast segmental solution was used, with a prestressed insitu pier head. The design was optimised through parametric analysis including non-linear modelling and automated calculation reporting. A modular approach maximised repetition of segments between different pier heights to enable precast construction in a factory environment prior to assembly offshore. Non-linear dynamic modelling was used to validate resistance to ship impact. Detailed analysis of the insitu joints between segments was undertaken, using headed bars to provide the required anchorages. The pier head was designed using finite element models to confirm the strut and tie behaviour and a prestress layout that minimised external pockets.

Keywords: Piers; precast; modular; parametric design; prestress

1 Introduction

The New Storstrøm Bridge has 40 concrete piers ranging from 18 to 35m high over the 3.8km length of the structure. The layout of the bridge is shown in Figure 1. This paper discusses the pier design, while details of the prestressed box girder design and the pylon and stay cable design are available in [2] and [3] respectively.

The piers are of similar visual form comprising multi-faceted stems and pier heads. To realise this architectural vision while allowing for the practicalities of offshore construction a precast segmental solution was implemented comprising regularly spaced insitu joints topped by a prestressed insitu pier head.

The design of each pier stem segment was optimised through parametric analysis techniques. A modular approach was used to maximise repetition of segments between different pier heights and to enable precast construction in a factory environment prior to assembly offshore.

Non-linear dynamic modelling was used to validate resistance to ship impact, including advanced analysis to determine second order effects.

Headed bars were used in the insitu joints between segments to achieve full structural connection while minimising reinforcement congestion.

The pier head has a central void to allow for safe inspection and maintenance, including a large bearing inspection platform recessed into the top. This necessitated local finite element modelling to confirm the strut and tie behaviour and to determine a prestress layout that minimised the detrimental aesthetic effects of visible external pockets.