COASTAL PROTECTION ON HELGOLAND

Dyke enhancements on Germany's only non-coastal island

The coastal protection measures on the north-east coast of the island of Helgoland are being adapted in accordance with rising sea levels – and specifically, today's design sea level. The flood protection dykes do not meet current requirements in terms of height or construction. The dykes, built between 1952 and 1955, were already damaged by the severe storm surge of 1962 and subsequently repaired. Now they are being adapted in accordance with the design flood level of 4.70 m above mean sea level (+4.70 mNHN).

Inros Lackner was contracted by the responsible state authority (Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein [LKN.SH]) to plan and design the dyke improvements over a length of approximately 1 km. First, wave overtopping calculations were carried out in accordance with the EurOtop manual. This manual contains case studies, example calculations and current techniques for predicting wave overtopping of dykes and other coastal protection structures. The theoretical calculations showed that the height of the dykes would have to be increased disproportionately in order to limit wave overtopping to the usual acceptable rate of 0.5 l/(s m). In consultation with the client, an alternative solution was developed which would meet the flood protection requirements while avoiding unnecessary impacts on the public and on local tourism during the implementation phase.

Evaluation of alternative options

In order to minimise the increase in the dyke's height and thus also the associated widening of its footprint, proposals were developed that deviate from the typical design of a standard earth dyke. For this purpose, physical model tests were carried out by the Coastal Research Center (FZK) at the applicable university institutions in Hanover and Braunschweig. The effectiveness of the different coastal protection proposals was evaluated on the basis of wave overtopping measurements. Force measurements were used to determine the required input values for the structural design calculations. The Inros Lackner team monitored the testing process closely, enabling design options to be refined as appropriate. Through the step-by-step optimisation of the geometry in coordination with both LKN.SH and FZK, it was possible to reduce the wave overtopping rate as required while keeping the height as low as possible.

Detailed design of the selected option

The next step involves the structural design of the walls and surge elements, with the reinforced concrete structures generally shaped and aligned for wave deflection. The focus is on achieving the design requirements as economically as possible. Special logistical challenges arise due to the island location, and the bombing of the island during World War II means that the construction work may be hindered by the discovery of explosive ordnances or widespread construction rubble.

The special challenge is to harmonise the various technical aspects in optimising a solution that takes into account the results of the physical model tests and the demands of constructing in a protected area of a non-coastal island where the needs of the tourism industry must be considered.

Info

Client:

Schleswig-Holstein's state agency for coastal protection, national parks and marine conservation (LKN.SH)

General Planner services:

- Project design and structural design
- Technical supervision of physical model testing
- Tendering and technical supervision of subsoil investigations
- Preparation of the site investigation report
- Geotechnical calculations
- Surveying services
- Assistance with explosive ordnance disposal (optional)
- Local site supervision (optional)

Creative solutions are needed!

Tim Brunert
Project Manager in the field of hydraulic and coastal engineering

The mix of innovative technical solutions, environmental planning requirements and logistical demands can only be mastered with the commitment and the willingness to compromise of everyone involved. For me, this means above all remaining flexible in my approach to my work and curious about new topics, enabling me to develop optimal solutions with the required technical expertise.