DHI CASE STORY

SAFE EMBRACE: HOW INNOVATIVE HARBOUR DESIGN SUPPORTS LOCAL FISHERIES

Our harbour design allows a safe passage at all times and for everybody

Hvide Sande is a picturesque fishing village on Denmark's exposed North Sea coast with little more than 3000 inhabitants and approximately 60 fishing vessels. Fishery is a major source of income, for the fishermen themselves and the associated processing industry as well as a major attractor for the tourism sector.

However, Hvide Sande Harbour faces some problems. The natural depth of the sand bars bypassing the harbour is only 2.5 m, not sufficient to accommodate today's fishing vessels that require a minimum depth of 6.0 m. Moreover, heavy sedimentation in the harbour's access channel, especially following storm events, hampers the safe passage of vessels and ships. Therefore, the authorities wished to increase the navigation depth in front of the harbour from the present 4.5-6.0 m while at the same time reducing sedimentation in the access channel.

Aerial view of Hvide Sande Harbour, located at a tidal inlet on a sandy barrier, in the current harbour design

THE LONELY BREAKWATER

Where do these problems come from? For the last five decades, Hvide Sande Harbour has been protected by one breakwater at the northern side of the harbour entrance. This barrier has blocked the natural drift of sediment along the coast (littoral drift), resulting in sediment deposition in the harbour entrance. Updrift – north of the harbour – the shoreline has advanced at a rate of about 3 m per year. At present, maintenance dredging in the order of 170,000 m^3 per year is necessary to ensure a safe navigation depth of about 4.5 m.

TWO BREAKWATERS FOR A SAFE EMBRACE

In an innovative approach, DHI managed to solve all these problems in one go – through a combination of streamlined breakwaters and capital dredging

SUMMARY

CLIENT

Hvide Sande Harbour, Denmark

CHALLENGE

Facing the need to accommodate larger fishing vessels, the harbour wished to increase the navigation depth in front of the harbour entrance while at the same time reducing the sedimentation in the access channel.

SOLUTION

Promoting sediment bypass past the harbour entrance without increasing downdrift erosion

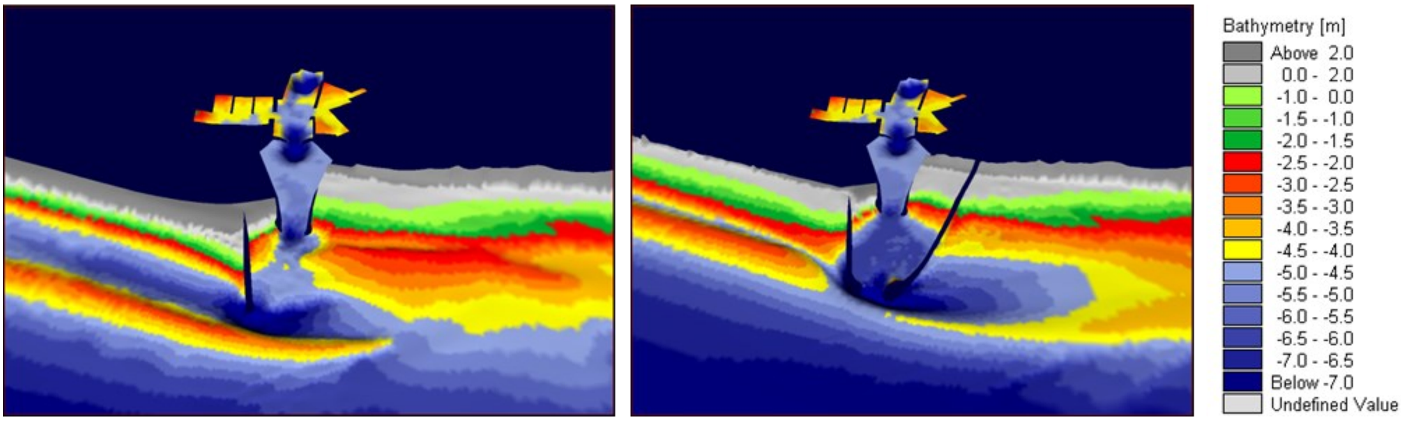
VALUE

- Safe navigation depth at all times
- Reduced need for maintenance dredging
- Sustainment of the local fishing community

LOCATION / COUNTRY

Hvide Sande, Denmark

DHI



3D view of the formation of sand bars with the current (left) and the new (right) harbour design. The proposed scheme results in an increased equilibrium depth of the bypass bar in front of the harbour without increasing the downdrift erosion, and an improved natural bypass of the littoral drift

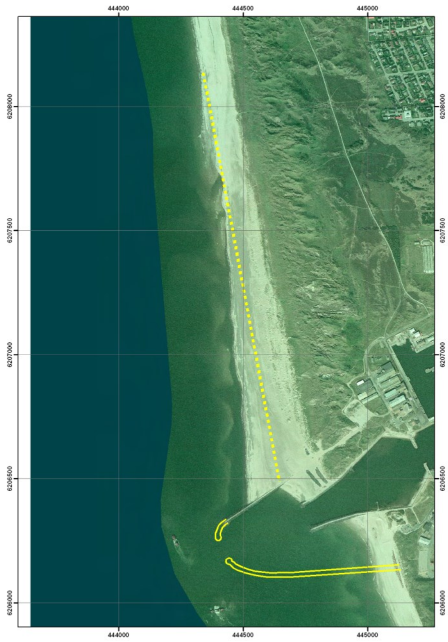
of the shoreline north of the harbour, where the deposited sediment usually originates. The new set of breakwaters, keeping the entrance channel in safe embrace, results in an increased flow velocity past the harbour mouth, thereby reducing sediment deposition in that area. Dredging of the coastline in the updrift area further helps to maintain the required water depth; the dredged material will nourish the downdrift coast. Maintenance dredging will be unnecessary after completion of the new harbour design, should 4.5 m of navigation depth be sufficient. To maintain an increased navigation depth of 6 m, the dredging requirement is in a similar range as today.

THE MODELS

Our approach builds on a combination of its advanced morphological modelling tools, including a comprehensive analysis of wave conditions, overall sediment budget, coastal impact as well as details of the morphological development around the harbour. The study made use of the wave model MIKE FM SW, the littoral drift model in LITPACK and the dynamically coupled modelling of nearshore wave transformation, hydrodynamic flow, sediment transport and bed update. Moreover, our study went far beyond pure modelling as it is heavily supported by field data: hourly wave, wind and water level measurements, as well as weekly soundings of the harbour access channel, allowed for a thorough calibration and validation of the models.

BENEFITTING THE COMMUNITY

As a result, Hvide Sande Harbour is spared double trouble. our solution significantly reduces dredging requirements as well as downtime due to inaccessibility of the harbour. The effect is far-ranging: In the new harbour, fish can be landed during all weather-conditions, guaranteeing the supply of local fresh fish. Fishermen do not need to find another harbour to land their fish, saving them precious time and money. All in all, the new harbour, under construction as of June 2011 and scheduled to be completed by fall 2012, will help to maintain a small fishing community in a rural environment, receiving the local fishermen in its safe embrace.



Future layout of Hvide Sande harbour breakwaters (curved yellow lines). The shoreline location after the capital dredging north of the harbour is illustrated by a straight yellow line which also indicates the extent of the required dredging

CLIENT TESTIMONIAL

> “*Activities provided by DHI were on a very good professional and organisational level and we recommend this company as a credible partner.”*
> *Erik Clausen—Port Director—Hvide Sande Harbour*

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