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Boskalis

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

WE BUILD WHAT WE DESIGN

A4 MOTORWAY, THE NETHERLANDS
Consultation by two of our engineers on site. The design, construct and maintenance contract included an aqueduct, tunnel and intersection structures for the final section of the A4 motorway, linking the cities of Delft and Schiedam in the Netherlands.

‘INVOLVED IN ALL STAGES OF THE PROJECT LIFE CYCLE’

As the design and engineering department of Boskalis, we provide top-quality, tailor-made, engineering solutions for large-scale hydraulic and civil engineering projects around the world.

With over 100 specialist engineers from a broad range of disciplines, we are involved in all stages of the project life cycle. Our operational colleagues challenge us constantly to be the best in our field. We have a thorough understanding of our clients and their requirements and we work continuously on new developments by:

- implementing design improvements and innovations that reduce the cost price in (pre-)FEED studies and tenders;
- actively supporting the project team on site during execution by developing efficient work methods and construction optimizations.

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

A UNIQUE COMBINATION OF THINKING AND ACTION

‘OUR ENGINEERS CRUNCH NUMBERS IN THE OFFICE AND GET THEIR FEET WET ON THE PROJECTS’

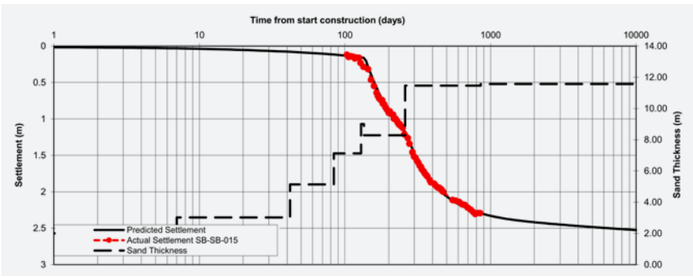
Our specialist engineers combine theoretical knowledge with practical insights and data from previous projects we have executed. They crunch numbers in the office and get their feet wet on the projects to understand the process from start to finish. This combination of analytical thinking and hands-on experience creates the expertise to optimize the feasibility of designs and tailor them for Boskalis’ versatile fleet and equipment. The result is the best possible combination of constructability and cost effectiveness.

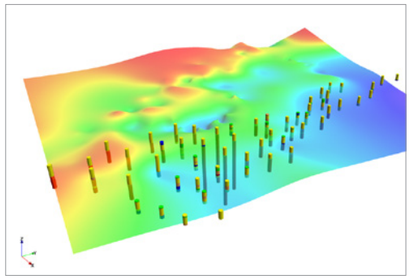
Our team works in disciplinary clusters and we have experts in:

- Structural engineering
- Geotechnical engineering
- Coastal engineering
- Met-ocean data and modelling
- CAD/BIM engineering
- Social and environmental impact management
- Nature-driven design
- Engineering management

Our engineers cover the entire design process from feasibility studies to project completion, fully integrating design with constructability. Many of them have been recognized with highly regarded industry awards for their outstanding engineering performance.

One of our engineers in action and geospatial soil model of the site area. Real-time monitoring of the reclamation settlement during execution and comparison with the predicted settlement.





CREATING NEW HORIZONS TOGETHER

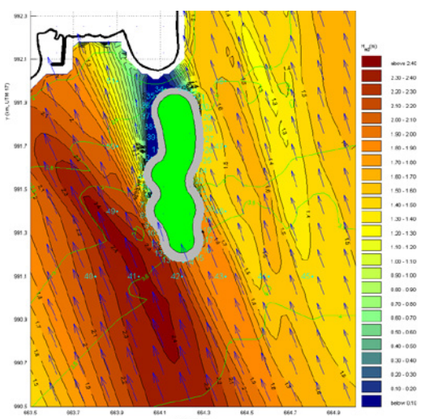
'WE ARE CONTINUOUSLY DEVELOPING OUR SKILLS AND CAPABILITIES'

A key value for us is the continuous development of the skills and capabilities of our team of specialists by collaborating with third parties.

We have an open mind about knowledge sharing and we are always looking for opportunities to collaborate with specialist third parties in our networks to devise the best project solutions.

For decades, our engineers have maintained close contacts with a wide range of consultants, knowledge institutes, specialist research centers and universities. We can draw on those networks for valuable support when we are looking for specific expertise or want to combine research efforts.

By jointly coordinating and controlling our project scope, we can guarantee the Boskalis quality standards and deliver state-of-the-art solutions where required.



PUNTA PACIFICA, PANAMA
Design and construction of the first artificial island in the Americas. The design involved 3D-model testing of the shore protection structures, which also needed to be verified to ensure they met strict seismic requirements. The project was located in a densely populated area and so the management of logistical complexities was essential.

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

EARLY CONTRACTOR INVOLVEMENT

'YOUR PARTNER OF CHOICE IN DEVELOPING A CONSTRUCTABLE DESIGN'

Working with an experienced contractor who has knowledge and expertise in the early stages of a project can generate major benefits.

Given our track record on complex inland and marine infrastructure projects, we are your partner of choice for developing a constructable design and robust working methods, in line with project-specific resources and the available equipment.

We are experienced with partnership procurement routes which enable the contractor's skills and know-how to be introduced early on. For various clients we have been able to reduce the lead time for project development substantially by introducing parallel project processes. Once a conceptual design is available, permit procedures, stakeholder participation and the detailed design can be executed simultaneously. Moreover, our flexibility means we can mobilize our equipment as early as the detailed design phase, ensuring a smooth and rapid transition from design to construction.

PORT OF ROTTERDAM - MAASVLAKTE 2
Our design team was engaged from the early stages in this massive port extension project. Around 1,000 hectares of land was reclaimed for which 240 million cubic meters of sand and 7 million tons of rock was used. This design, construct and maintenance contract provided a lot of flexibility in how to achieve the project requirements.

DRIVEN BY SUCCESSFUL PROJECT DELIVERY

‘WE BALANCE PROJECTS’ RISKS AND OPPORTUNITIES, MAGNIFYING OUR STANDARDS IN SAFETY, OPERATIONS, THE ENVIRONMENT AND SOCIETY IN GENERAL’

The complex world around us needs projects that match that complexity. These projects with broader scopes including dredging, civil structures and soil improvement, in combination with increasing contractual responsibility for engineering, procurement and construction, create a growing demand for wider ranging hydraulic and civil engineering competences.

The successful execution of these projects depends on balancing risks and opportunities by drawing on cross-disciplinary knowledge and engineering management skills. We deliver that balance while strictly maintaining our standards for safety, operations, the environment and society in general.

DUQM LIQUID BULK BERTHS PROJECT, OMAN
The construction of an extensive port area in Duqm, Oman, that will house, among other things, a bulk terminal and a refinery. The engineering, procurement & construct contract included the realization of a large port basin and an entrance channel with a depth of 18 meters, land reclamation and soil improvement, as well as the construction of a kilometer-long quay wall and two 400-meter-long jetties.

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

NO COMPROMISE ON SAFETY

‘SAFETY IS OUR CORE VALUE’

In line with Boskalis’ objective of No Injuries No Accidents (NINA), safety is a key priority to our engineers. The company’s NINA safety program sets clear standards for a safe working environment.

Even though our engineers are constantly looking for engineering optimizations that save costs and add value to our proposition, they never compromise on safety and they always comply with the relevant standards and design requirements.

Our hands-on experience with design implementation (site engineering) puts our engineers in an excellent position to assess the safety of a design during all stages of the construction period.

Our engineering services are ISO 9001 certified, safeguarding uniform quality in line with industry standards and our clients’ requirements.

SAAONE, THE NETHERLANDS
Soil improvement specifically designed for the installation of a 8,400 ton weighing rail road bridge to prevent soil failure and the safety risk that the structure would slide from the installation vehicle.

OUR WORLD

Our engineers are involved in numerous Boskalis projects around the world. The projects selected here highlight their important contribution.

1 KITIMAT

Large-scale LNG export facility in Canada

- Elaborate soil model to facilitate selective dredging and soil treatment
- Management of complex environmental-permit scheme

2 LEKKI PORT

Nature-driven sandbar breakwater in Nigeria

- Ingenious soft structure that shelters the port basin while upgrading the land/water transition
- Morphologically designed to exploit natural deposition processes and become more robust over time

3 TURKSTREAM

Seabed intervention for gas pipeline across the Black Sea

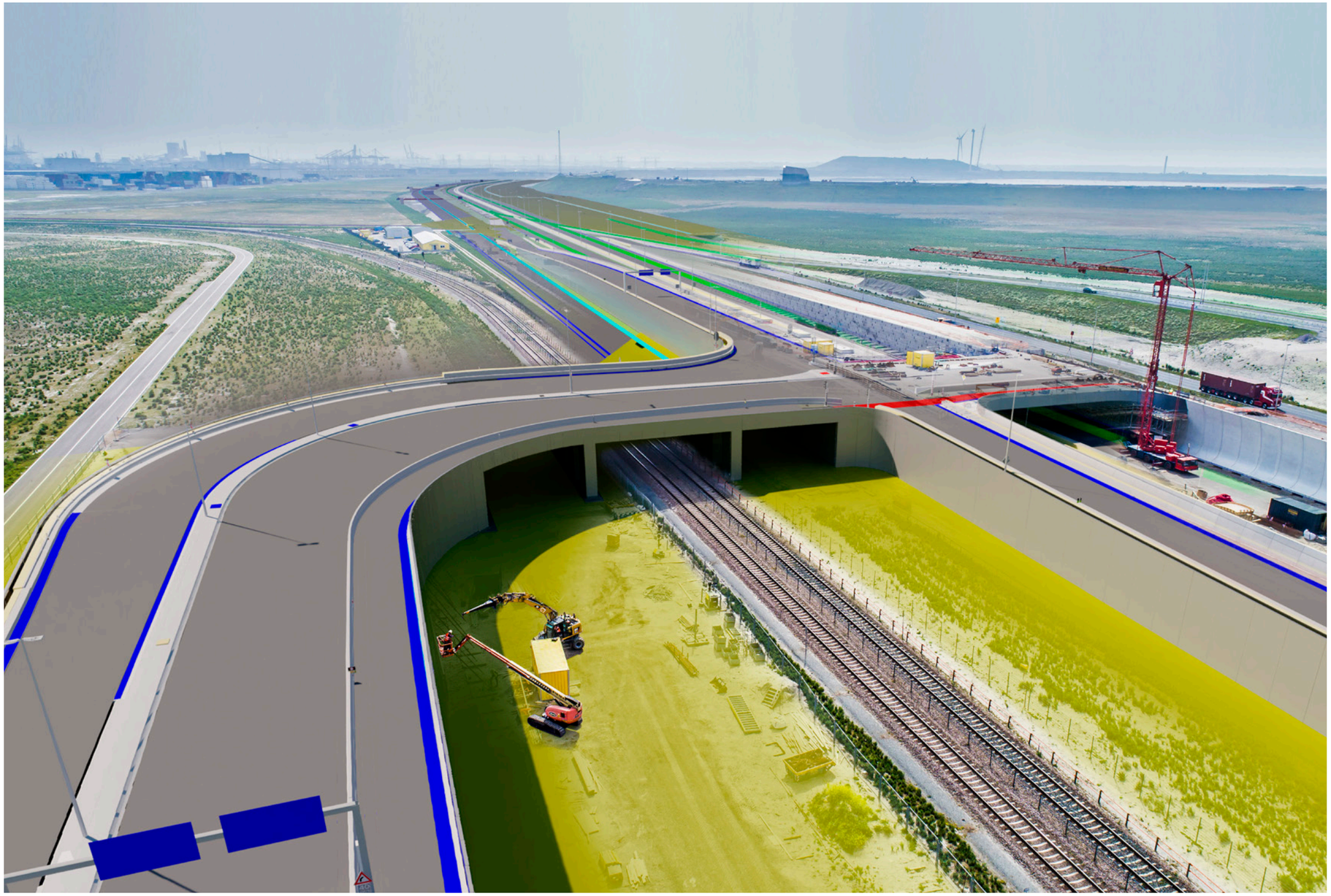
- Successful implementation of local stakeholder management approach in line with the International Finance Corporation's standards on Corporate Social Responsibility
- As the landfall contractor, management of the complex communications and coordination with onshore and offshore pipe-laying contractors

4 PULAU TEKONG

First polder in Singapore

- Design of efficient work methods based on decades of experience in hydraulic engineering works
- Strengthening and closure of a ten-kilometer-long dike surrounding the future polder to allow for the construction and installation of the drainage system

MANAGING COMPLEXITY



PRINCESS AMALIA VIADUCT, THE NETHERLANDS
BIM model combined with a photo of the construction activities for the new overpass for Maasvlakte 2 in the port of Rotterdam. This grade-separated interchange will ensure that the new container terminals remain accessible. This is the first large-scale project to use Beaumix, a new product using a process developed in-house. Beaumix is produced from washed bottom ash from a waste incinerator plant as a replacement for sand.

'CONTINUOUS INNOVATION KEEPS US AT THE FOREFRONT'

For more than a century we have introduced multiple innovations to create new horizons and break new ground for our clients. Our entrepreneurial spirit makes the impossible possible.

To manage project complexity, we make full use of state-of-the-art data management tools to ensure compliance with the client's requirements, planning constraints and cost control. These include:

Systems Engineering, an engineering management discipline that focuses on how to design, integrate and manage complex systems over their life cycles and utilizes systems thinking principles to organize information.

Building Information Modeling (BIM), a digital representation of physical and functional characteristics of the designed objects. It enables instant knowledge sharing and forms a reliable basis for decision-making during the project life cycle.

Parametric Modeling, which enables a model to be automatically updated when one of its attributes has been changed, making the designer's work more efficient.

OUR LICENSE TO OPERATE

‘WE ARE ABLE TO BRIDGE GAPS AND OFFER SUSTAINABLE SOLUTIONS’

Growing awareness of the potential social and environmental impacts of large-scale infrastructure projects demands us to deliver ecosystem integrated designs and engineered construction methods.

The expectations and interests of our stakeholders are a key factor in the design and execution of our projects. Governance institutions, international corporations, credit insurers, financiers and NGOs often evaluate performance on the basis of core elements such as the environmental impact, socio-economic effects and human rights. This requires an in-depth knowledge of the ecosystems and a clear understanding of the socio-economic setting in the vicinity of our projects.

In recent decades, we have strongly developed our capacity and capabilities in these fundamental areas. Our engineers work in a wide range of international contexts and so they are fully acquainted with internationally recognized standards and guidelines such as the IFC Performance Standards and the OECD Guidelines for Multinational Enterprises. We have an adaptive management approach that allows us to align our activities efficiently with the actual on-site conditions and local interests.

Our ability to bridge gaps and offer sustainable solutions with economic and environmental value – even in vulnerable areas around the world – is essential to our business.

KITIMAT, CANADA
Two of our trailing suction hopper dredgers, deepening and widening the Kitimat port area. Stakeholder management was a crucial part of this challenging project. The development of a complex environmental permit scheme required close collaboration with the client, local authorities and local First Nation communities. In addition, full compliance with rigorous requirements was essential to the successful completion of the project.

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

NATURE-BASED SOLUTIONS

‘BOSKALIS IS KNOWN FOR ITS DEDICATION TO THE ENVIRONMENT’

Demand for our services is driven by population growth, expanding world trade, rising energy demand, climate change and the energy transition. To facilitate infrastructure developments in the coming years, we aim to strike a balance between increasing project complexity, sustainable ecosystem functioning and societal demands.

In line with our Building with Nature design philosophy, we develop nature-based solutions that both use and enhance the natural system such that ecological and economic interests reinforce each other. Building with Nature applies the basic principles of the circular economy by replacing materials such as concrete and rock with natural, renewable materials, including sand and mangroves.

We initiated the establishment of the EcoShape foundation to advance this philosophy in partnership with other contractors, the academic world, research institutes, consultancies, NGOs and public authorities. We now draw upon this knowledge and insights delivered by this consortium to make informed decisions pro-actively integrating project developments with the needs of nature and society in order to design viable solutions.

We also share our knowledge and experience with our sector to ensure that know-how is available to the engineers of the future.

MANGROVE RESTORATION, INDONESIA
Construction of permeable dams made from bamboo poles and brushwood to facilitate the large-scale restoration of mangrove forests. The aim of this project in Central Java is to develop a stable, sustainable mangrove coastline that can adapt to rising sea levels while enabling local economic development. These dams dampen the waves and take the energy out of the water, while the sediment can still filter through, accumulate and settle behind them. Mangroves can then grow behind the dams and not be washed away by the waves.

OUR HYDRAULIC & CIVIL ENGINEERING CAPABILITIES

PAVING THE WAY FOR GROUNDBREAKING SOLUTIONS

‘COLLABORATING TO DEVELOP UNIQUE SOLUTIONS THAT ENHANCE NATURE, SOCIETY AND THE ECONOMY’

In close collaboration with the Boskalis Research and Development department, our engineers are frequently involved in the development and implementation of innovative technologies and pioneering research projects.

As an international marine contractor, we have the means and capability to scale-up these innovations from prototypes into full-scale applications in real life projects across the world.

Furthermore, intersectoral and pre-competitive collaboration has been enormously valuable in terms of paving the way for effective, groundbreaking solutions for engineering challenges, and enhancing nature, society and the economy.

Recent examples include:

- **N470 Road, Netherlands:** the Boskalis design includes wind turbines incorporated in noise barriers to generate energy which is stored in a battery and used to operate the road’s traffic lights and lighting system, making this the most sustainable road in the Netherlands.
- **Mud Motor, Netherlands:** beneficial re-use of fine sediment, contributing positively to the safety of existing dikes and local ecology.
- **ReefVival 3D Printed Reefs, Monaco:** installation of 3D-printed reefs made from sand on the basis of a site-specific design to enhance the local habitat.
- **Open FOAM Numerical Wave Flume:** development of a numerical model used for breakwater design. This tool allows the flexible and economic exploration of alternatives in the early stages of design without the need for physical model tests.
- **Workability Estimation Tool:** a tool developed in-house that allows for better assessments of vessel workability in less time by using high-performance cloud computing.
- **Boskalis Data Science Group:** combining mathematics, business and computer science, our team builds models which systematically collect and store data and convert them into practical knowledge and project management information. An example is estimating maintenance volumes in navigation channels using positioning information from dredging vessels.

MARKER WADDEN, THE NETHERLANDS
Aerial view of the Markermeer lake, one of the largest freshwater lakes in Europe. A unique archipelago of five marsh islands was constructed to create a nature reserve and enhance ecological conditions. The islands were reclaimed by re-using fine sediment from the lake’s bed.