



**Engineering makes
the difference**

product

Introduction

Van Oord is a world class marine contractor, working day to day on dredging and marine projects around the world. We have been building tomorrow's infrastructure for over a century now.

We execute projects of any size or complexity anywhere in the world. The combination of expertise, dedication and entrepreneurship perpetually creates new business opportunities. We offer our clients creative and effective solutions from the drawing board all the way to project completion. We are conscious of the environment and anticipate local circumstances.



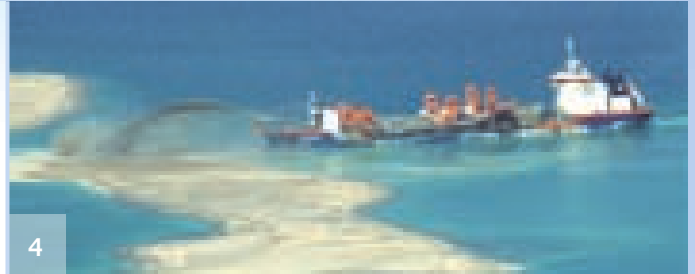
The Engineering department

Continual innovation is essential in order to maintain our leading position. Through desk studies, site reconnaissance and soil investigations, hydraulic and mathematical modelling and testing, Van Oord is often able to present alternative, practical designs.

The Engineering Department focuses on the fields of coastal and marine construction, offshore and pipelines, geotechnical and environmental engineering. Moreover it is engaged in feasibility and design studies, construction sequencing and execution methods. Being part of a large



contractor, the department is able to combine theory and practice in the design work. Although organised into these disciplines, many projects require an integrated approach, in which the expertise of several disciplines is called upon and close communication between these groups is necessary. A good coordination is not only needed between these internal disciplines but also with external consultants and clients on the larger projects on which we work. This approach has proven to be an effective means to reach a successful completion of the work. All of the engineering disciplines make use of modern software packages in the performance of their work.



Research

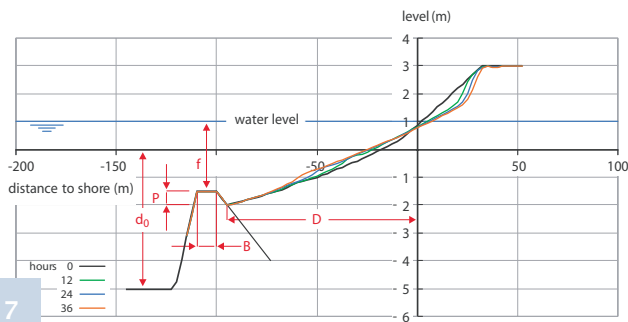
The engineering staff maintains a high standard of technical expertise through direct involvement in the execution of ongoing projects, regular attendance of specialised courses, involvement in research and development activities and by close contacts with research institutes. Strong connections with the Delft University of Technology is sustained through the supervision of graduate research projects and by offering internship positions on many of our projects.



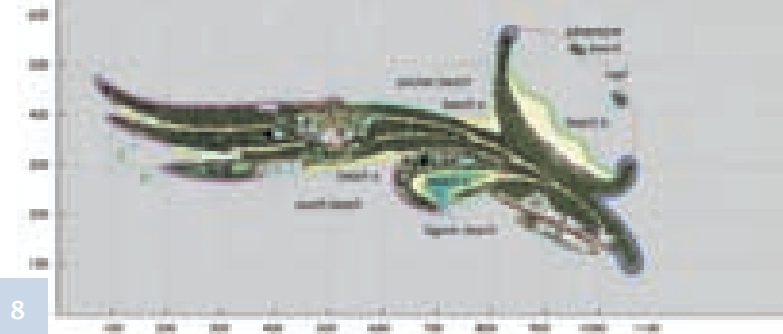
Coastal engineering



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The coastal and marine engineering discipline deals with the design and construction of marine structures such as breakwaters, quay walls, slope and bottom protections, ports and marinas. Morphological processes such as beach erosion and coastal development are evaluated for many projects. Environmental conditions, including wave heights, water levels and currents, are established for both operational conditions and design conditions, using our in-house applications, dedicated software applications and other extensive data-bases.



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Construction supervision

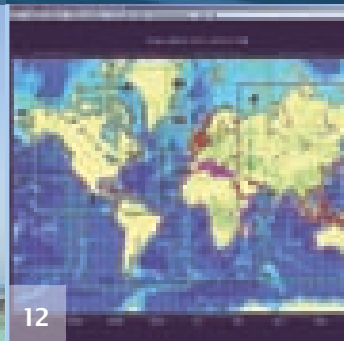
The Engineering Department performs supervision of the construction progress, including QA and QHSE aspects. Activities include controlling source materials, planning and execution of the works to the given specifications. Through involvement in the design and construction phases engineers at Van Oord gain valuable experience and knowledge of all processes of a project.



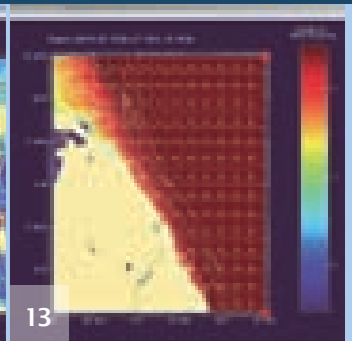
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Design activities

The Engineering Department is continually involved in design activities of many types of coastal structures. Often, novel alternative designs are proposed (and tested) which provide Clients with cost-effective solutions. Aspects including the structural stability, wave overtopping, scour and shoreline evolution are evaluated in conjunction with the constructability of the design.



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Related research

Van Oord has commissioned the development of a model to determine the nearshore wave statistics at about 6000 locations around the world. The model includes bathymetry, coastline data and wave propagation models. Other models have also been developed in house, including an engineering tool to determine sand losses at beaches during storm conditions. We also make frequent use of physical model testing to optimise the stability of coastal structures as well as novel types of pipeline stabilisation structures.

Offshore & pipeline engineering

Van Oord has a strong position in the offshore construction market with its fleet of specialised vessels and equipment. In order to be able to adequately support these activities, the Engineering Department houses an Offshore & Pipeline Engineering discipline.

Our consulting services are available for every phase of many types of projects: for FEED-studies, detailed designs, installation procedures and construction supervision. Our engineers have a long track record of design activities from both the head office as well as involvement in on-site project execution.

Pre- and post-pipelay rock berms

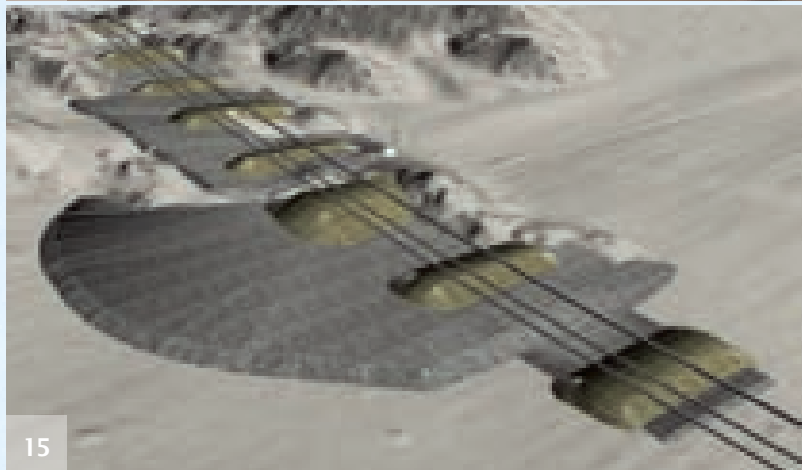
Engineered rockfill is placed under and/or over offshore pipelines and cables in order to prevent freespanning of offshore pipelines or reduce freespanning lengths. Furthermore rock berms can be designed to prevent damage by the impact from falling objects and fishing gear or to provide additional insulation. We are able to offer tailor-made designs which are then implemented by our state-of-the-art flexible fallpipe vessels and side stone dumping vessels.

Pipeline installations

For projects such as the installation of pipelines in coastal areas and landings of gas- and oil pipelines we assist the construction team at every step from project preparation up to commissioning. The same effort is put in projects regarding outfalls of water treatment plants, cooling water inlets and outlets for power plants and desalination plants.



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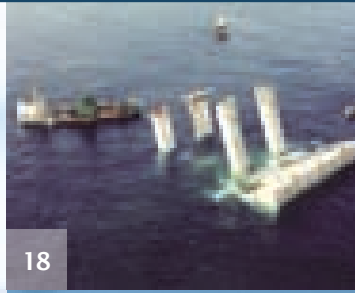
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Seabed foundation structures

Offshore GBS platforms require accurate placement on a level bed in order to prevent distortions in the substructure. For this purpose Van Oord has designed a novel and successful procedure for the installation of the foundation by using a large number of individual rock cones placed by a flexible fall pipe vessel. For example, at a depth of 40 m a GBS of 112 m x 70 m was successfully installed on top of these rock cones, providing an even foundation layer for the substructure.

Related research

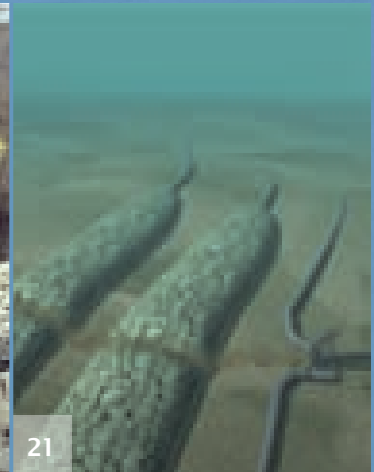
This discipline is also actively involved in applied research work. Over the last years considerable effort has been put into studying a wide range of subjects relevant to our clients such as: the development of a non-metal slip-on coupling for large diameter plastic pipes (patented) which are used for sewerage and cooling water pipelines; the behaviour of a dragging anchor travelling across a rock berm protecting a pipeline or cable; the stability of rock berms under breaking waves in shallow water and around offshore piles, and various aspects related to the optimization of the flexible fall pipe concept for installing coarse material in deep water.

Scour protection

Innovative and economical designs of scour protection structures around offshore installations including windmills and GBS platforms are commonly made using state-of-the-art techniques in combination with physical model studies.



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Geotechnical engineering



Geotechnical Engineering is one of the core activities of the Engineering Department. This expertise is reflected within most of the projects executed by Van Oord world wide.

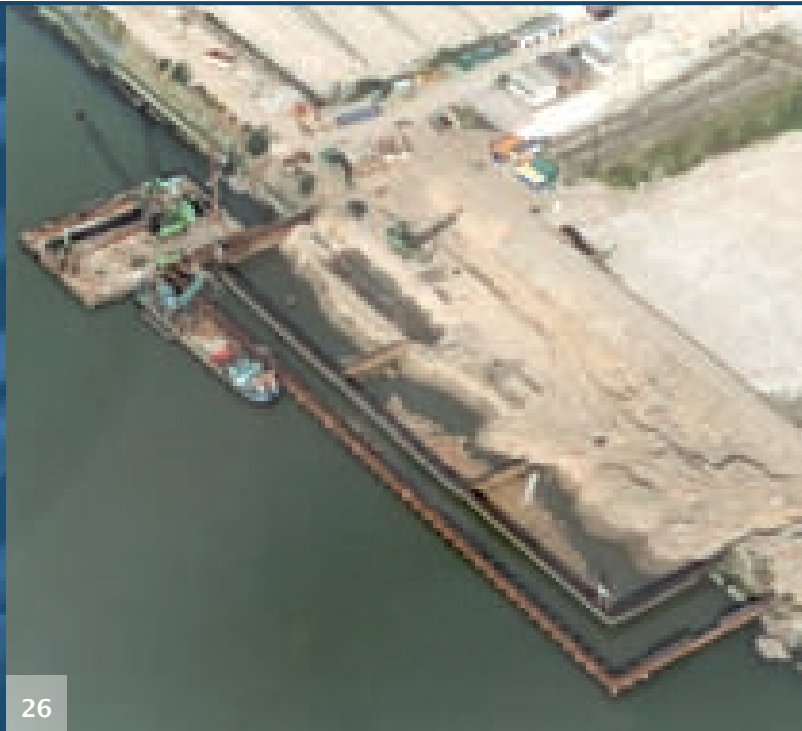
The Engineering Department uses professional up-to-date geotechnical software including finite element models for design and verification purposes. This software is capable to analyse settlements and consolidation, horizontal deformation, geotechnical stability, seepage, foundations and earth retaining structures. Specialised software, which has been developed in-house, is available for the design of specific technical solutions, including our patented PTD accelerated consolidation system. Special attention is given to the design of land reclamations on soft soils, providing reclamation schedules and soil improvement schemes. The focus lies on maintaining overall stability and controlled settlement with minimal residual settlements after construction.

In recent years we have developed various technical and commercial solutions for motorway and railway infrastructural projects as well.



The services and studies carried out

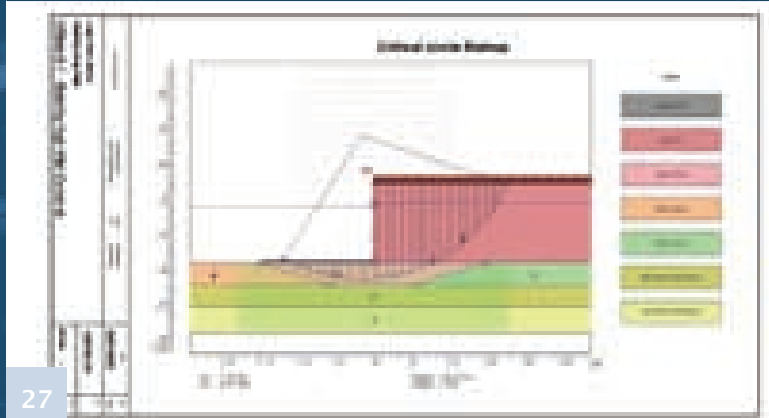
- Supervision of site investigations and the analysis of data
- Project feasibility from a geotechnical point of view
- Detailed design of quay walls, cofferdams, land reclamations, breakwaters, infrastructure, etc.
- Soil-structure interaction problems
- Engineering guidance on site during construction.



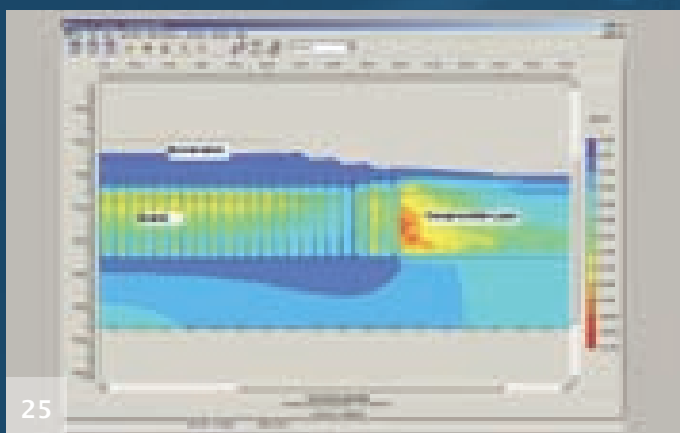
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Quays and retaining walls

For the construction of port terminals, marina's and land reclamation works, retaining walls and quay walls are designed according to international standards. Aspects such as geotechnical stability, impact of earthquakes and constructability are assessed using modern techniques.



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Related research

In order to be able to predict residual settlements with even higher accuracy we perform applied research into the effect of temporary pre-loading soft soils on the residual settlement after construction. Today's stringent settlement requirements call for accurate prediction of settlements after hand-over. Besides a theoretical approach, involving an inventory study on the available knowledge and theories, high precision consolidation tests are carried out in the acclimatised laboratory of GeoDelft. These tests provide valuable information on soil behaviour.

Environmental engineering

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The world of today requires construction activities to be carried out in full compliance with requirements for protection of the environment and sustainable development. Van Oord is very much aware of the requirements of today and takes a proactive position in dealing with environmental issues.

Environmentally friendly construction can be achieved by appropriate phasing of projects and design of morphologically sound marine structures. Also the deployment of purpose-built equipment and beneficial use of dredged materials can be applied. It is possible to compensate adverse effects of the project by, for instance, designing coral relocation, planting sea grass or to design marine structures that attract marine life and stimulate biodiversity.

Considerable experience from executed projects and broad engineering skills enable the Engineering Department to design projects that are not only acceptable in terms of environmental impact but also contribute to sustainable development.

Performance

Examples of Van Oord's outstanding performance in this field of environmental project management include the successful completion of the Øresund project (Denmark), the Penny's Bay project (Hong Kong) and the Caucedo project in the Dominican Republic.

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Projects carried out by Van Oord can rely on the services provided by the Environmental Engineering discipline within the Engineering Department. This discipline is specialised in:

- Quantifying the direct physical effects on the environment resulting from dredging and marine construction activities.
- Development of dredging and marine construction methods, which are environmentally friendly or beneficial to the environment.
- Developing methods and procedures to monitor and report environmental effects in the marine environment.
- Managing the design of schemes for decontamination, isolation or storage of contaminated dredged slurry.

Quantifying effects

For large scale dredging projects the Environmental Engineering section prepares a so-called 'Environmental Project Assessment'. This assessment evaluates the

environmental impact directly related to dredging and or marine construction activities. The impact is then compared with the environmental contractual and legislative requirements. Where necessary, the design and/or construction method is adapted to conform with those requirements.

Monitoring of effects

Monitoring of physical effects is a specialised field of expertise in itself. The Engineering Department develops monitoring procedures that may vary from a basic water sampling protocol to advanced methods for determination of sediment load in dredge plumes by the use of turbidity sensors and Acoustic Doppler Current Profilers.

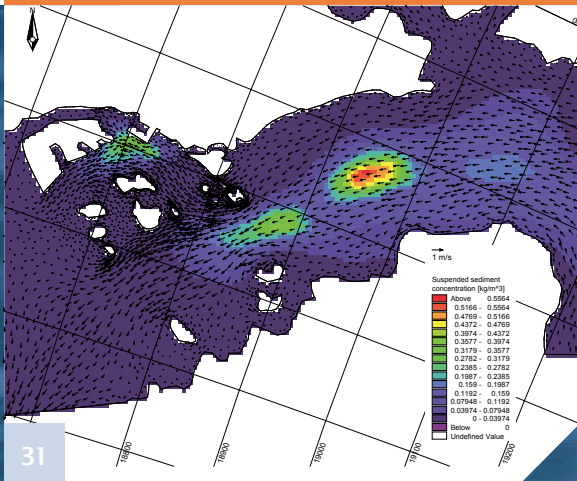
Contaminated dredged material

The problem of dealing with contaminated dredged silt has become an issue in almost all parts of the world. Van Oord can offer solutions for contaminated dredged material. The contaminated silt can be stored and isolated in purpose-built depots which the engineering department is able to design. A good example is the design and construct project 'Silt Depot Hollandsch Diep' carried out by Van Oord in joint venture. Past experience gained during the 'IJsseloo Depot' construction and 'Ketelmeer' decontamination projects has contributed to extremely valuable know how within our company.

Other means of dealing with contaminated dredged material are separation of contaminated and clean fractions and subsequent treatment of the contaminations. The Engineering Department can provide consultancy services and manage design activities of this kind.



Dredge plume analysis



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Related research

To further improve the understanding of the environmental effects of dredging and enhance the accuracy of predictive models, innovative research at various fields is undertaken. An example is the application of satellite imagery to the monitoring of water quality. In this advanced research, we cooperate with renowned research institutes such as WL | Delft Hydraulics, Argoss and NLR (Netherlands Aerospace Institute), to develop a method whereby remote sensing data is used to improve the capabilities of hydrodynamic models in predicting plume dispersion. As part of the SSB (Stichting Speurwerk Baggertechniek) programme research is done in the field of establishing sediment dispersion source terms from dredging activities and sediment losses from reclamation tail water discharge. In cooperation with the Technical University at Delft, we coordinate MSc thesis work on the dispersion of sediment plumes from Trailer Suction Hopper Dredgers. During this study practical experiments are conducted in the laboratories of the TU Delft.

Van Oord is partner in a newly established research consortium that will implement and finance a research programme with a focus on innovative and sustainable construction methods in the marine environment and to enhance the ecological status and minimize adverse environmental effects.

Photo legend

- 1 Palm Jumeirah, Dubai
- 2 Offshore breakwaters, Norfolk, UK
- 3 Estimating & Engineering department
- 4 Rainbowing for land reclamation
- 5 Water injection dredging vessel, India
- 6 Logo Island completed, Dubai
- 7 Perched beach design, Logo Island
- 8 Logo Island layout
- 9 Breakwater design using physical model testing
- 10 Filling of caissons and land reclamation, Gibraltar
- 11 Waterborne rock placement
- 12 World wide wave statistics model
- 13 World wide wave statistics model
- 14 Pipeline river crossing, Burlington, UK
- 15 Design of subsea pipeline foundation berms, Norway
- 16 Construction of foundation for offshore wind farm
- 17 Model testing for scour protection of offshore wind farm
- 18 Placement of offshore Gravity Base Structure (GBS)
- 19 Foundation for offshore GBS
- 20 Testing of offshore pipeline protection against dragging anchors
- 21 Testing of offshore pipeline protection against dragging anchors
- 22 Land reclamation for the 'IJburg' development, Amsterdam
- 23 Road embankment construction
- 24 Land reclamation for the 'IJburg' development, Amsterdam
- 25 Finite element analysis of soil improvement
- 26 Design & construction of quay walls
- 27 Geotechnical stability analysis
- 28 Environmental dredger
- 29 Monitoring buoy
- 30 IJsseloog depot for contaminated silt, The Netherlands
- 31 Dredge plume modelling
- 32 Flexible fall pipe vessel 'Nordnes'
- 33 Model for offshore pipeline foundation, Norway
- 34 Preparation of construction drawings

Graphics design

This group focuses on two main tasks on a day to day basis: technical drawings and graphical presentations.

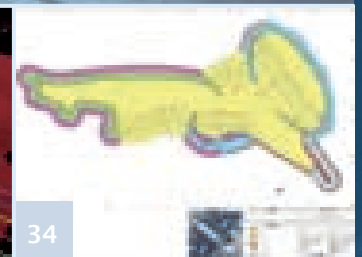
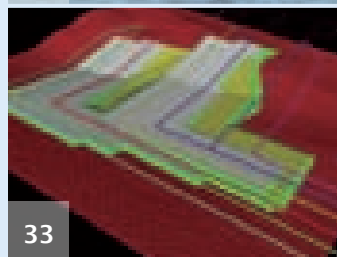
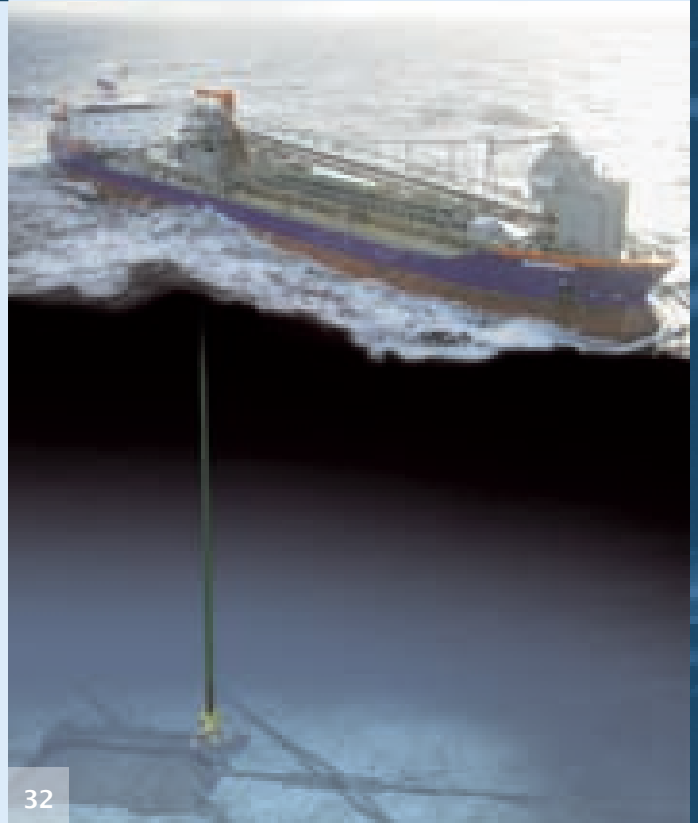
Technical drawings

This involves all drawing activities needed for project execution. Detailed (design) drawings of the structures to be constructed and the execution sequencing, including details of the equipment to be used are produced here. These tasks are required for both tender phases and the execution phases of projects.

Together with the design and construction drawings, detailed volume calculations are performed for all projects to determine the amount of materials required for construction and the amount of material to be dredged. These calculations require great care and precision and are performed using drawing and survey packages with 2D and 3D applications

Graphical work

Graphical design activities are performed to support external communication, related to both general company matters and specific project details. This includes the preparation of presentations, layouts for print work, photographic editing, multi-media products including films and animations. To accomplish this we use various up to date specialist software packages.



Van Oord

PO Box 8574

3009 AN Rotterdam

The Netherlands

T +31 10 4478444

F +31 10 4478100

E info@vanoord.com

I www.vanoord.com