School of Built Environment

Department of Civil Engineering

Hydraulic Engineering Minor

Hydraulics (Dutch "*Waterbouw*") (*From:* http://www.geonet.nl/upload/images/Dossiers/2waterbouw1.jpg)

This brochure gives a short overview of the Hydraulic Engineering Minor programme as well as brief descriptions and visual impressions of the individual courses.

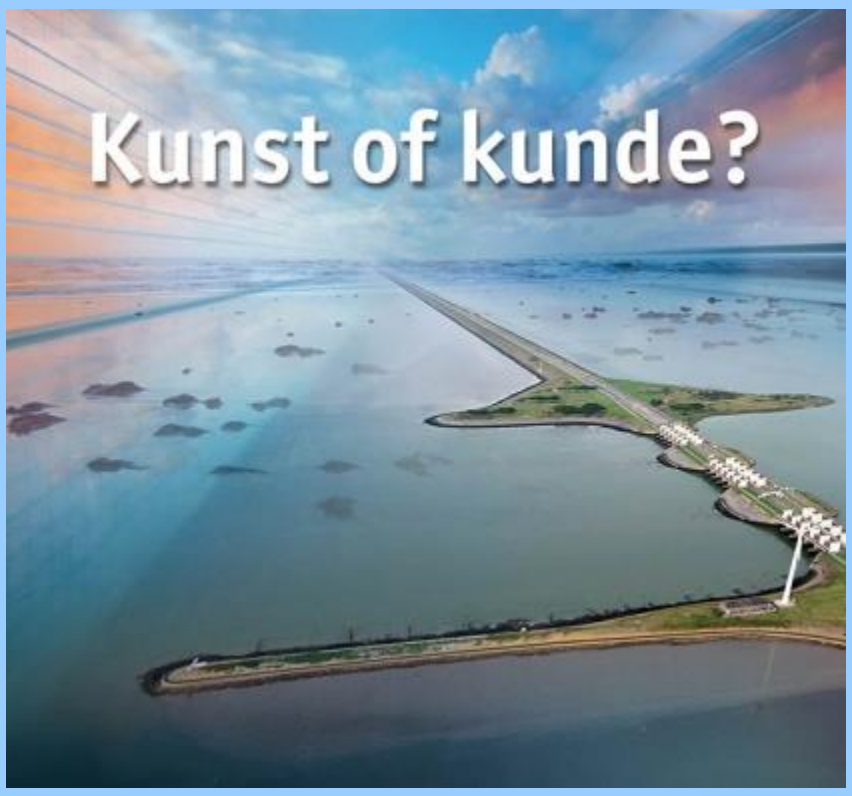

Figure: **Afsluitdijk, Ijselmeer, between the provinces of North Holland and Frisland (*Closure Dam*)**

(From: http://www.waterbouw.nl/nieuws/detail/waterbouwdag-2015-kunst-of-kunde)

This picture above with the Dutch slogan "Kunst of Kunde", freely translated as "Art or Ability", was used for the annual event, the Day of Hydraulic Engineering, which took place in Rotterdam, in November 2015. Use the following link http://waterbouwtv.nl/?p=156 to view the opening film of the event as it will provide you with a breathtaking impression of what this branch of Civil Engineering is capable of achieving.

Contents

1. Hydraulic Engineering Minor: Programme Overview

As a minor, Hydraulic Engineering is offered during the Autumn semester, starting in September and ending in January. It contains both theoretical and practical courses and is accessible to third and fourth-year bachelor degree students of Civil Engineering, Water Management and Mechanical Engineering. The programme is also accessible to fourth-year Dutch students of Rotterdam University of Applied Sciences who wish to engage in a career abroad studying jointly with students from abroad and improving their intercultural and English language skills.

The programme consists of both theoretically and practically oriented modules.

Theoretically oriented modules (15 ECs):

- Morphology
- Hydraulic Energy Engineering
- Dredging and Land Reclamation
- Hydraulic Engineering Innovations
- Hydraulic Structures
- Water Monitoring and Water Control Systems
- Flood Risk Management

Practically oriented modules (15 ECs):

- Offshore Engineering Project
- Hydraulic Engineering Project
- Delta Development Project

These modules are taught in two blocks of the Autumn semester.

Block 1

Course title	Course code	ECs[1]	Lesson time x 50 mins	Test
Offshore Engineering Project	igoOFF01p	-	18	group assignment
Hydraulic Engineering Project	igoHYE01p	4	36	written test; assignment
Morphology	igoMOR01c	3	32	written test; assignment
Flood Risk Management	igoFRM01c	2	18	written test; assignment
Dredging and Land Reclamation	igoDLR01c	2	18	assignment

Total number ECs Block 1	11 ECs

[1] According to the European Credit Transfer and Accumulation System (ECTS), one EC (European credit point) equals 28 working hours in the Netherlands.

Block 2

Course title	Course code	ECs	Lesson time x 50 mins	Test
Offshore Engineering Project	igoOFF01p	7	18	group assignment
Delta Development Project	igoPDD01p	4		group assignment
Hydraulic Engineering Innovations	igoIHE01c	2		assignment
Hydraulic Structures	igoHYS01c	3		written test; assignment
Water Monitoring and Water Control Systems	igoWMC01c	3		written test; assignment

Total number ECs Block 2	19 ECs

2. Brief Course Descriptions with Visual Impressions

2.1 **Offshore Engineering Project** (taught in blocks 1 and 2)

Course Code	igoOFF01p
Course title	Offshore Engineering Project
Credit points	7 ecs
Entry Level	Accessible to students of the Hydraulic Engineering minor
Learning Objectives	After the course, which includes a project, students are capable of: ♦ making an analysis of a project area: soil configuration, hydro-meteo conditions, water-depths, traffic-lanes etc. ♦ making a description of structures and other facilities for offshore-activities in oil and gas industry as well as for wind and tidal energy; ♦ developing procedures for the installation of the construction; ♦ evaluating safety during transport by making stability calculations; ♦ writing design reports of the installation equipment; ♦ writing research reports on (impact of) legislation and international cooperation
Content	The most northern part of the Dutch North Sea may contain large numbers of undiscovered oil and gas reservoirs. Recent analyses executed by new techniques indicate that the structures of the underground resemble structures on the British and Norwegian continental shelf. The Dutch state company EBN (*Staatsbedrijf Energie Beheer Nederland*), responsible for the oil and gas exploration in the Netherlands, is speaking of a promising area with high potential. Some companies are in dialogue with the EBN about test-drilling operations. In cooperation with Offshore contractor Heerema Engineering the student has to design an installation procedure for an exploration platform.
Teaching methods	Combined lectures with group-assignments
Assessment	Assignments and a presentation
Reference material	*Installation procedures and requirements,* from: Noble Denton, Det Norske Veritas, ABS, Lloyds etc. Additional relevant reference material is still be announced.
Remarks	The course is part of the Hydraulic Engineering minor.
Course coordinator	Ir. L.A. van Gelder (contact person: Edwin Schaap; E.A.Schaap@hr.nl)

2.2 **Hydraulic Engineering Project** (taught in block 1)

Course Code	igoHYE1p
Course title	Hydraulic Engineering Project
Credit points	4 ecs
Entry Level	Accessible to students of the Hydraulic Engineering minor
Learning Objectives	After a successful completion of the course, students of Civil Engineering will be capable of: ♦ solving problems related to water flows using the software tools MicroFEM and SOBEK. students of fields other than Civil Engineering will be capable of: ♦ making calculations on settlements using the Terzaghi method; ♦ making design calculations on sheet pile using the software package D-sheet; ♦ performing calculations on and producing drawings of concrete armouring for a relief floor.
Content	Topics for students of Civil Engineering: ♦ Making analytical calculations for groundwater flow, to be evaluated using EEM-computations in micro-FEM. ♦ A system of surface waters within a specific geographical area will be modelled and evaluated computationally using SOBEK. Solutions are submitted for possible sticking points in the hydraulic system. Topics for students of fields other than Civil Engineering: ♦ Soil behavior of clay, peat and sand subject to loading and unloading. ♦ Soil investigation on site and in the laboratory ♦ Vertical and horizontal total soil and grain stresses, water pressures and effective grain and shear stresses; ♦ Lowering of groundwater level in construction trenches and control of neighbouring groundwater effects; ♦ Various computational groundwater models
Teaching methods	Class Lectures with assignments
Assessment	Individual and group assignments
Reference material	The relevant reference material is still to be announced
Remarks	Part of the Hydraulic Engineering Minor
Course coordinator	Harry Dommershuijzen (contact person: Edwin Schaap; E.A.Schaap@hr.nl)

Visual course impression

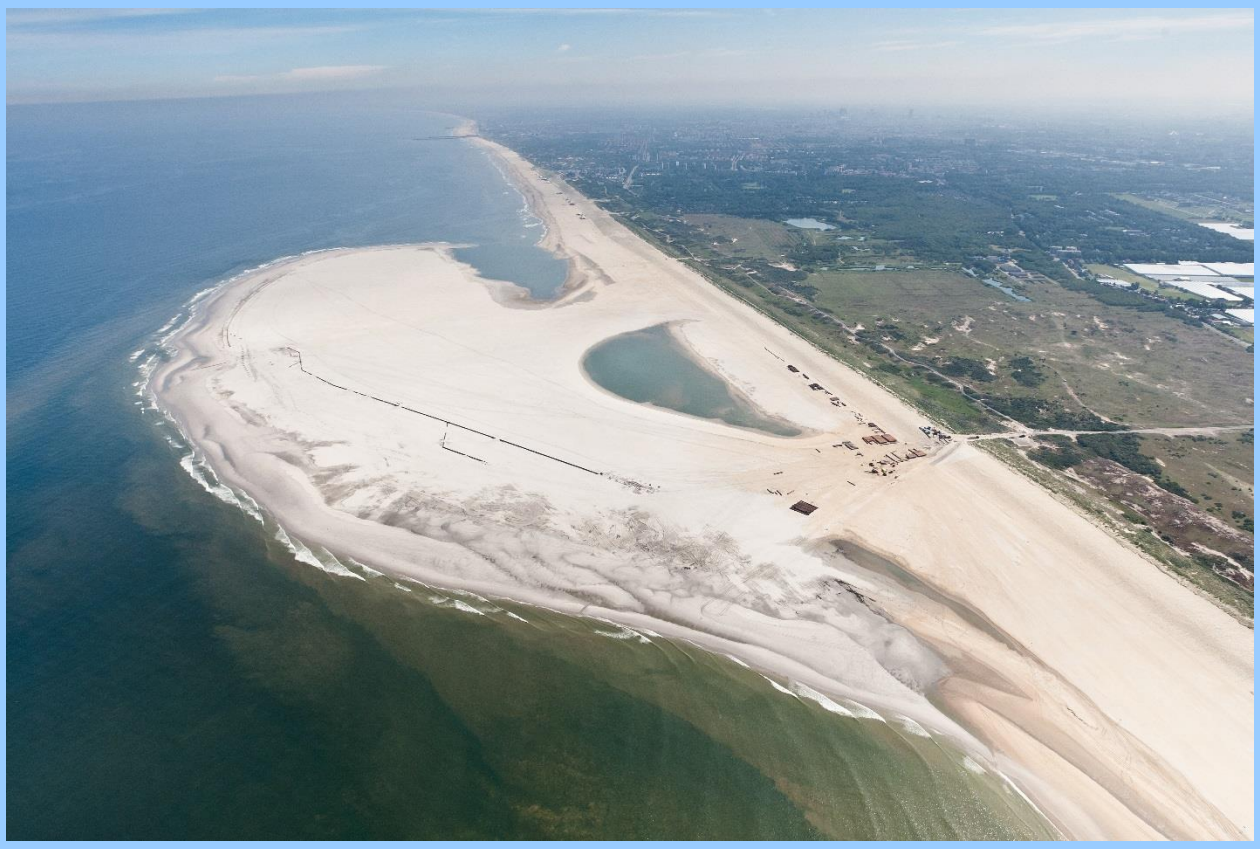

***Figure: Sand Engine** (From: https://beeldbank.rws.nl, Rijkswaterstaat/Joop van Houdt)*

2.3 **Morphology** (taught in block 1)

Course code	igoMOR01c
Course title	Morphology
Credit points	3 ecs
Entry level	Accessible to students of the Hydraulic Engineering minor
Learning objectives	After a successful course completion students will be capable of: • Describing and quantifying stationary uniform currents in water flows; • Describing and calculating sediment transport as a result of currents; • Describing and calculating transverse and longitudinal transport as a result of waves; • Describing the impact of sediment transport on the shape of rivers and coasts; • Describing and calculating the impact of rising sea-levels on the shape of coasts; • Giving examples of morphological intervention in practice, and explaining the qualitative and quantitative effects of these interventions; • Making suggestions for morphological interventions in a practical problem area and explaining the qualitative and quantitative effects of these interventions; • Measuring and describing morphological features, and making comparisons with theory; • Giving examples of morphological interventions in practice and explaining their qualitative and quantitative effects.
Content	Morphology literally means 'the study of shapes'. In hydraulics we are looking at the shapes of rivers, estuaries and coasts on various scales: from large-scale shapes of meanders or coast-lines to small-scale ridges in a sand-bed. Under the influence of currents, waves and rising sea-levels these shapes are continually subject to erosion and sedimentation. Hydraulic engineers use their morphological knowledge to develop and manage coasts and rivers. The "Sand Engine" near Kijkduin utilises natural sand transport flows in order to protect the South-Holland coast. For reinforcing the Hondsbossche Zeewering in North-Holland, the old, 'hard' seawall has been provided with a 'soft' protective layer consisting of sand. Dredging is necessary in some spots in our large rivers in order to keep them navigable because of sedimentation. In other places banks need to be protected against erosion. This course will teach you how currents, waves, rising sea-levels and human intervention influence the morphology of coasts and rivers. We will study the physical processes that determine transport of sediment, erosion and sedimentation along coasts and rivers, of which estimates will be made with the aid of (experimental) calculation rules. You will learn how this knowledge may be applied to making a hydraulic design or a plan for managing a coast or river.
Teaching methods	Lectures combined with group-assignments, practical, presentation.

Assessment	Written test (individually), practical report (group), presentation (group)
Reference material	♦ *Sediment Transport*, Liu (2001), Aalborg Universitet Additional relevant reference material is still to be announced.
Remarks	The course is part of the Hydraulic Engineering minor
Course coordinator	Jeroen Langedijk (j.m.p.a.langedijk@hr.nl)

2.4 **Flood Risk Management** (taught in block 1)

Course code	igoFRM01c
Course title	Flood Risk Management
Credit points	2 ecs
Entry level	Accessible to students of the Hydraulic Engineering minor
Learning objectives	**Learning attainment target:** at the end of the course the student is able to perform or supervise a design or safety assessment of a flood defense. **Specific learning objectives** At the end of the course the student is able to: 1. Explain the system, legislation, rules and regulations of flood defense management in the Netherlands and use this knowledge for the design and safety assessment of flood defenses. 2. Explain the failure modes of flood defenses and use this knowledge for the design and safety assessment of flood defenses. 3. Explain the difference between design and safety assessment of flood defenses and use this knowledge accordingly in daily practice. 4. Explain the difference between the semi probabilistic analysis (probability of exceeding a design criterion) and the probabilistic analysis (probability of flooding) and know where, when and how to use these analyses. 5. Integrate all necessary knowledge and experience to design or assess the safety of a flood defense. 6. Reflect on the design or safety assessment in order to determine if the design or safety assessment meets the requirements of legislation, rules and regulations and of the client.
Content	The lectures outline flood risk management in the Netherlands. The following subjects are addressed: • History, system, organization, legislation, rules and regulations concerning flood defense management in the Netherlands; • Modelling of flood defenses for design and safety assessment; • Failure modes of flood defenses; • Safety approaches concerning flood defense; • Methods for designing and assessing flood defenses.
Teaching methods	Lectures, tutorials and homework assignments (groups of 4-5 students).
Assessment	Homework assignments and a written test.
Reference material	The following publications are used: • Publications of the research program National Flood Risk Analysis for the Netherlands (VNK), the Delta Program, the Statutory Safety Assessment Instruments (WBI2017) and the Design Instruments (OI2014 & OI2018); • Publications produced under the supervision of the Expertise Network on Flood Protection (ENW), formerly the Technical Advisory Committee on Flood Defense (TAW);

	• Publications on the periodic safety assessment of flood defense All reference material will be made available for downloading from n@tschool (intranet working environment for students). Additional relevant reference material will be announced during the lectures and tutorials.
Remarks	This course is part of the Hydraulic Engineering minor
Course coordinator	Peter Blommaart (p.j.l.blommaart@hr.nl)

Visual Course Impression

Figure*: Waal left bank, high water at Beuningen* *(From: https://beeldbank.rws.nl, Rijkswaterstaat / Bart van Eyck)*

2.5 Dredging and Land Reclamation (taught in block 1)

Course Code	igoDLR01t
Course title	Dredging and Land Reclamation
Credit points	1 ec
Entry Level	Accessible to students of the Hydraulic Engineering Minor
Learning Objectives	After completing the course, students of Civil Engineering can: ♦ Relate soil characteristics to production characteristics of trailing suction hopper dredgers (TSHD) and cutter suction dredgers (CSD); ♦ Select and adjust dredging equipment to cope with actual maritime and geological conditions; ♦ Adapt production processes and characteristics to varying properties of soil to be dredged and transported; Students in fields other than Civil Engineering can: ♦ Account for a proper selection of dredging equipment most suitable for a specific project.
Content	This course provides an optimal match between the knowledge of dredging techniques, acquired in previous courses, and practical work. After a number of summary lectures on the principles of trailing and cutter dredgers, students are offered the possibility of using dredging simulators, located at the office of Koninklijke Boskalis Westminster in Papendrecht. Instructors at Boskalis will confront students with varying conditions (geo-/ hydro-/meteo-environment, dredging equipment) that may have to be dealt with when working at the simulator. The possible situations and subsequent actions to be taken, process responses (cockpit displays etc.), experiences and conclusions should result in a report. Students in other fields of Engineering take part in a guided tour and lecture at the National Dredging Museum in Sliedrecht. Facts, experiences and conclusions obtained at the museum are to result in a report. This should reflect sufficient understanding of possibilities and methods of large-scale (hydraulic) transport of soil.
Teaching methods	Class lecture, given as a refresher course and preparation for training with the Boskalis dredging simulator
Assessment	Written report; group assignments
Reference material	Reference material is presented during the lectures. As a result of the policy of restricted public accessibility of the material, the sources cannot be provided as hand-outs (no permission being granted by the Union of Dutch Contractors in Hydraulic Engineering).
Remarks	Part of the Hydraulic Engineering Minor
Course coordinator	Wim Leeuwestein (w.leeuwestein@hr.nl)

Visual Course impression

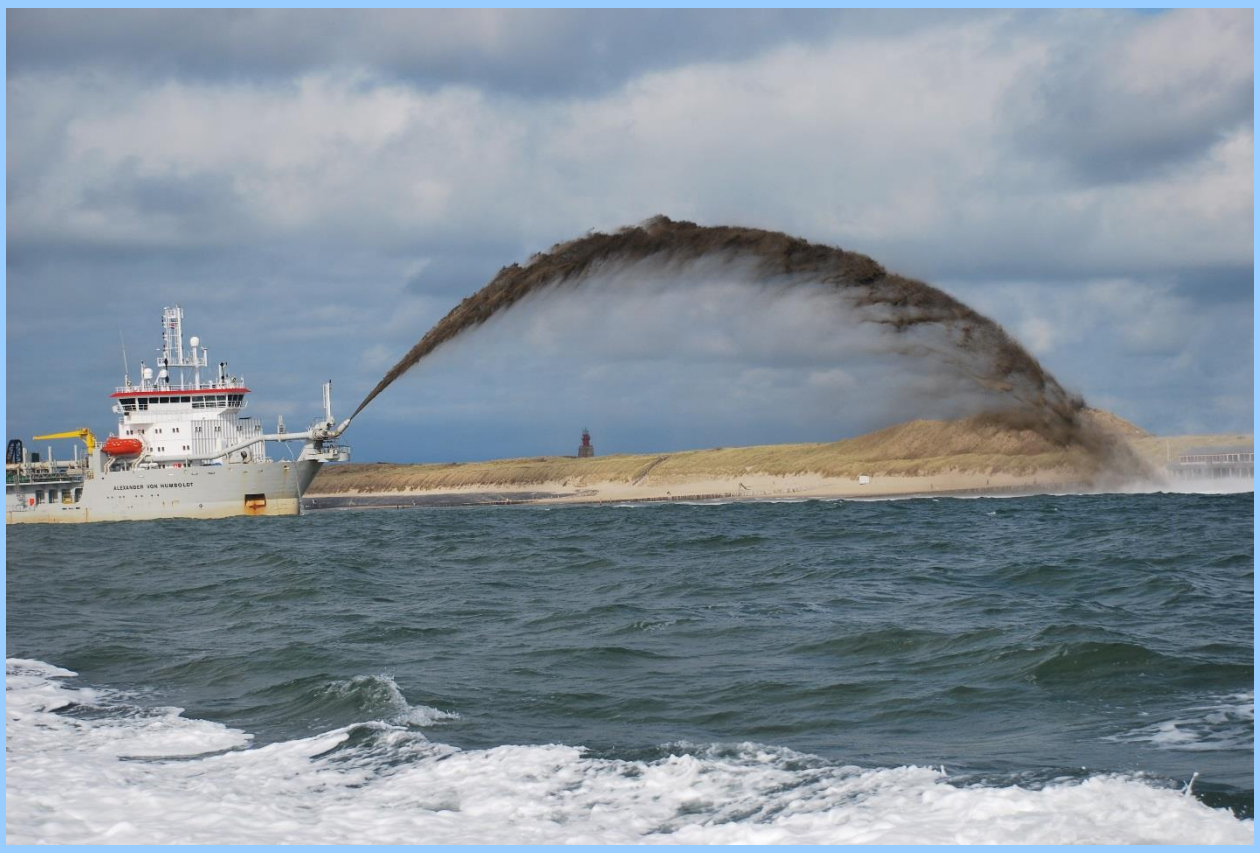

Figure: Trailing Suction Hopper Dredger Alexander

(From: https://beeldbank.rws.nl/MediaObject/Details/406282)

2.6 **Delta Development Project** (taught in block 2)

Course code	igoPDD01p
Course title	Delta Development Project
Credit points	4 ecs
Entry level	Accessible to students of the Hydraulic Engineering minor
Learning objectives	1. Analysing a hydraulic engineering problem 2. Developing and translating models
Content	Towns in delta areas are severely threatened by rising sea-levels and increased rain intensity. This is aggravated if ground levels are falling, either through settlement or a lowering tectonic plate. Jakarta is a case in point, where on average soil levels are falling by over 4 cms per year. The central issue in this project is the protection against water: how can a delta city be best safeguarded against floods?
Teaching methods	Project
Assessment	Well-founded Plan of Action (A), poster presentation of final product (B) and final report (C).
Reference material	♦ Brinkman, J., Hartman, M. (2008). *Jakarta Flood Hazard Mapping Framework*. Delft, Nederland Deltares (pdf). Additional relevant reference material is still to be announced
Remarks	Part of the Hydraulic Engineering minor
Course coordinator	William Kuppen (contact person: Edwin Schaap; E.A.Schaap@hr.nl)

Visual course impression

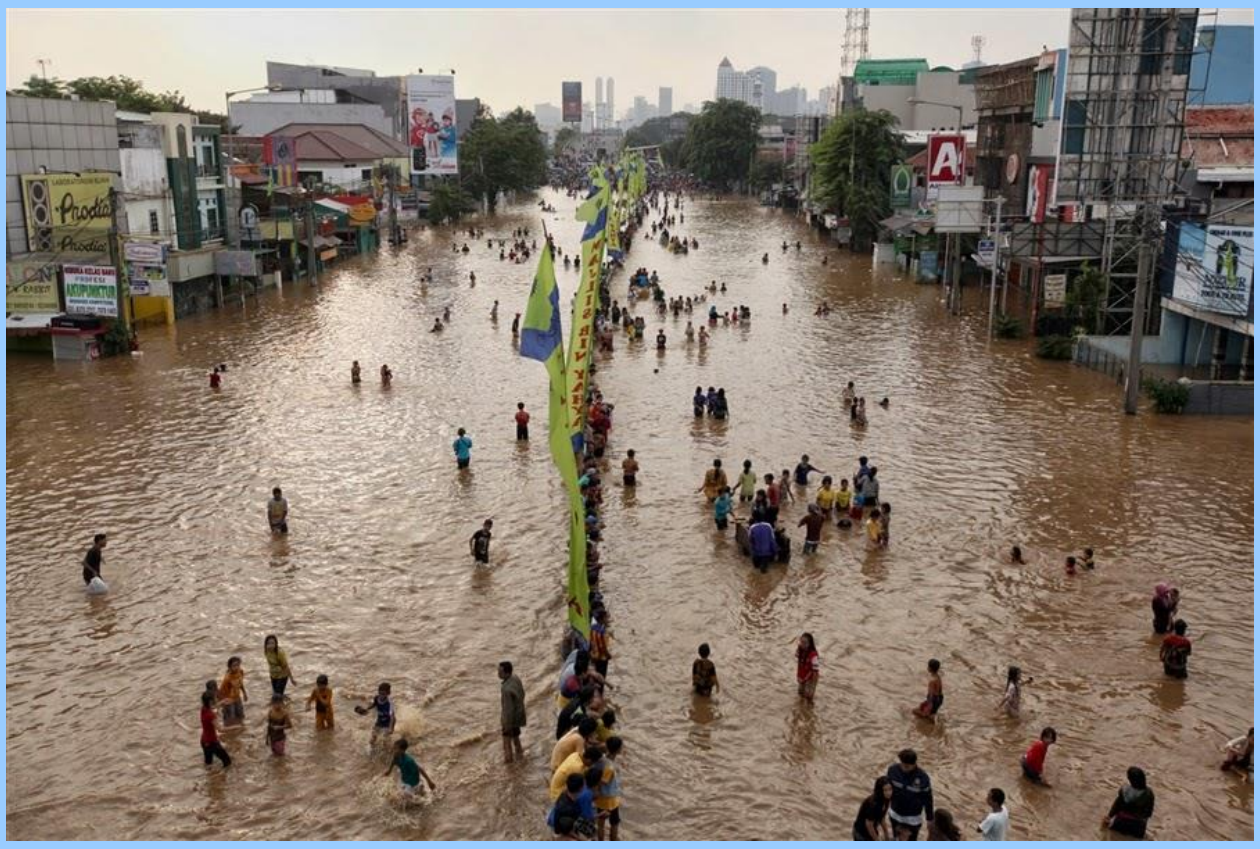

Figure: **Saving Jakarta from Sinking**

(From: https://cdn4.dogonews.com/images/3126a789-c8a6-4fd4-826d-6c4e65ba0bb8/flood-jakarta.jpg***)***

2.7 **Hydraulic Engineering Innovations** (taught in block 2)

Course Code	igoIHE01c
Course title	Hydraulic Engineering Innovations
Credit points	2 ecs
Entry Level	Accessible to students of the Hydraulic Engineering Minor
Learning Objectives	During the course, students become familiar with the current state of the art and with various innovative developments in the professional practice of national and international hydraulic engineering. Through applied assignments students develop an insight in processing and applying the knowledge concerned.
Content	The field of Hydraulic Engineering is subject to various developments, both in the Netherlands and internationally. The objective of this course is to keep up with these developments. Since the course is intended to present the latest developments, improvisational changes may be applied to the programme as initially presented. Assignments may therefore not be announced until late, in consultation with various experts involved. Recent developments in water management of inland water in the province of South-Holland are related to recreational navigation. In order to keep up with the current state of affairs, there will be active participation in a symposium.
Teaching methods	Class Lectures with assignments
Assessment	Individual and group assignments
Reference material	Relevant reference material is still to be announced.
Remarks	Part of the Hydraulic Engineering Minor
Course coordinator	Ir. L.A. van Gelder (contact person: Edwin Schaap; E.A.Schaap@hr.nl)

Visual Course Impression

Figure: New floodgate barriers for the Italian city of Venice

(***From***: http://www.yachtingmagazine.com/venice-sinks-mtu-stands-guard)

2.8 Hydraulic Constructions (taught in block 2)

Course Code	igoHYS01c
Course title	Hydraulic Structures
Credit points	3 ecs
Entry Level	Accessible to students of the Hydraulic Engineering Minor
Learning Objectives	After having completed this course successfully, students will be able to: ♦ Make calculations (strength, deformations, foundation depth) for piles exposed to hydraulic (currents, waves), geotechnical and other external loadings; ♦ Perform stability analysis and computational evaluation of inclination of floating construction equipment with simply shaped underwater bodies. ♦ Make economic analysis of basic structures eg. water defences, outlet structures and caissons.
Content	♦ Foundation of mooring constructions; ♦ Computation of strength (1st and 2nd order) for offshore windmills; ♦ Hydraulic loadings (wind, currents, waves) on slender cylindrical structures; ♦ Local scour around cylindrical structures and calculation of bed protection; ♦ Stability and inclination of floating bodies; ♦ Economic analyses.
Teaching methods	Combination of weekly lectures and skills training
Assessment	Written test
Reference material	Obligatory (provided through N@tschool): ♦ Baars, S. van, H.K.T. Kuijper et.al., *Manual for Structural Hydraulic Engineering* (available in PDF). Additional relevant reference material is still to be announced.
Remarks	Part of the Hydraulic Engineering Minor
Course coordinator	William Kuppen (contact person: Edwin Schaap; E.A.Schaap@hr.nl)

2.9 Water Monitoring and Water Control Systems (taught in block 2)

Course code	igoWMC01c
Course title	Water Monitoring and Water Control Systems
Credit points	3 ecs
Entry level	Accessible to students of the Hydraulic Engineering Minor
Learning objectives	After having completed the course, students will have attained the following knowledge-oriented and skills-oriented learning targets: ♦ an insight in functional design of spillways, bottom outlets and culverts; ♦ an insight in functional design of measuring artefacts, drainage artefacts and level controls; ♦ analysis of backwater curves; ♦ application of Donnan's and Hooghoudt's equations; ♦ application of Bélanger's and Bresse' s equations to determine the place where backwaters split; ♦ determining the need of water in an area consisting of irrigation, reservoirs and polders; ♦ setting up a computer model to quantify water levels and flow rates within an area.
Content	Water Monitoring and Water Control System deals with *monitoring, predicting* and *controlling* water levels and drains in order to secure the *functions* in an area.
Teaching methods	Lectures and workshops, computer practical (SOBEK) waterlab practical
Assessment	Written exam, assignment, practical and practical report. Individual written test; assignment and practical report in groups (3 to 4 students).
Reference material	Obligatory (available from n@tschool): ♦ Ankum, P. (1996). *Polders, Drainage and Flood Control, Delft,* Nederland: TU-Delft dictaat. Recommended (available from University library): ♦ Henderson, F.M. (1966). *Open Channel Flow*. Christchurch, New Zealand: Macmillan Series in Civil Engineering. Additional reference material is still to be announced
Remarks	Part of the Hydraulic Engineering Minor
Course coordinator	William Kuppen (contact person: Edwin Schaap; E.A.Schaap@hr.nl)