Profile description of the part-time professor in

# Adaptation and life cycle management of complex hydraulic structures



## 1. Appointment size and duration

The position involves a 0.4 fte appointment as professor in "adaptation and life cycle management of complex hydraulic structures". This high-profile appointment will enable the candidate to create substantial impact and to further expand the field of research. The duration of the appointment is envisaged for 5 year with possible extensions and re-appointments, provided the continuation of funding by Rijkswaterstaat.

## 2. Composition selection committee

Given the close cooperation with external parties and importance of the position for society, the selection committee (BAC) includes representatives from the sector (Rijkswaterstaat) and academia. The provisional committee is composed as follows:

| | Name | Role | Position |
|---|---|---|---|
| 1 | Prof.dr.ir. I. van der Poel | Chairperson | DUT, Faculty of Technology Policy and Management |
| 2 | Prof.dr.ir. S. Aarninkhof | Member | Department chair Hydraulic Engineering, CEG, DUT |
| 3 | Ir. R. Jorissen | Member | Rijkswaterstaat / TUD, senior advisor |
| 4 | Prof.dr.ir. S.N. Jonkman | Member | Professor of Hydraulic Structures and Flood Risk, DUT |
| 5 | Prof.dr.mr.ir. N. Doorn | Member | Professor of ethics of water engineering, TPM, DUT |
| 6 | Prof.dr. Nils Goseberg | Member | International member, TU Braunschweig |
| 7 | Ir. Hans Welleman | Member | Director of education (CEG) |
| 8 | PM | Secretariat | Department Hydraulic Engineering, CEG, DUT (currently a vacancy) |
| 9 | Drs. M. Jonker | HR | Manager HR |

## 3. The position

### 3.1 Background and focus

The Netherlands is considered one of the safest deltas in the world and is protected by nearly 3800 km of primary flood defences. These consist of dunes, dikes and major hydraulic structures, such as storm surge barriers and dams.

During the last 10 year Rijkswaterstaat (RWS) has funded a part-time professor position in the field of flood risk (prof. Matthijs Kok, who will retire in the summer 2023). His research focusses mainly on flood risk management for dikes / earthen flood defences. The department Hydraulic Engineering and RWS came to a mutual understanding to continue the collaboration, however to shift the focus towards adaptive & risk-based design, life-cycle management and replacement of storm-surge barriers and large (water-retaining) structures in the primary water system.

Research on performance, adaptation and design of storm surge barriers and hydraulic structures encompasses a number of **challenges** (also see fig. 1). There are complex and unique (one of a kind) structures with very high reliability requirements and financial investments. These systems generally have multiple functions, such as flood protection, navigation and ecological values, which all have to be addressed in design and management. Many of the existing structures are aging and degrading and original design requirements do not always take into account future conditions. There are substantial future uncertainties: sea level rise, subsidence, extreme events and (structural) degradation will all affect future performance. Finally, a multidisciplinary approach is needed to address system adaptation and performance. This includes expertise from civil engineering (hydraulic, structural, geotechnical engineering, risk and reliability) but also expertise in mechanical and ICT systems, and human operations, which all have to be addressed jointly.

**Scope of the new position of "Adaptation and life cycle management of complex hydraulic structures"**

Together with your group you will develop will develop scientific expertise to contribute to design, adaptation and life cycle management strategies for storm surge barriers and major hydraulic structures in the Netherlands and around the world. Core research lines associated with this field include:

- Quantitative assessment of structure performance and reliability, based on sound understanding of structural integrity and forcing conditions throughout its technical and functional life span. This research line also includes the use of novel techniques (e.g. digital twins) and the integration of information from innovative data and monitoring systems, with the ultimate goal to sustain or improve the life span and reliability.
- Development of scientific knowledge for improving future adaptation, operation and maintenance – so called (asset) life cycle management, as a basis for innovative solutions for barrier adaptation and maintenance. This has to be done taking into account the high requirements for flood protection, but also the requirements for other functions such as navigation and ecology.
- Development of risk- and reliability based methods to design infrastructure adaptation for uncertain future conditions associated with sea level rise, land subsidence and extreme events.

The research will have a high scientific level and impact and will lead to journal publications, dissertations and new scientific grants. At the same time, it also important that a substantial part of the research is "translational", i.e. focussed on valorization of the results in partnership with RWS and other parties – leading to uptake in practice.

A schematic visual of the scope of the position is presented in figure 1 below.

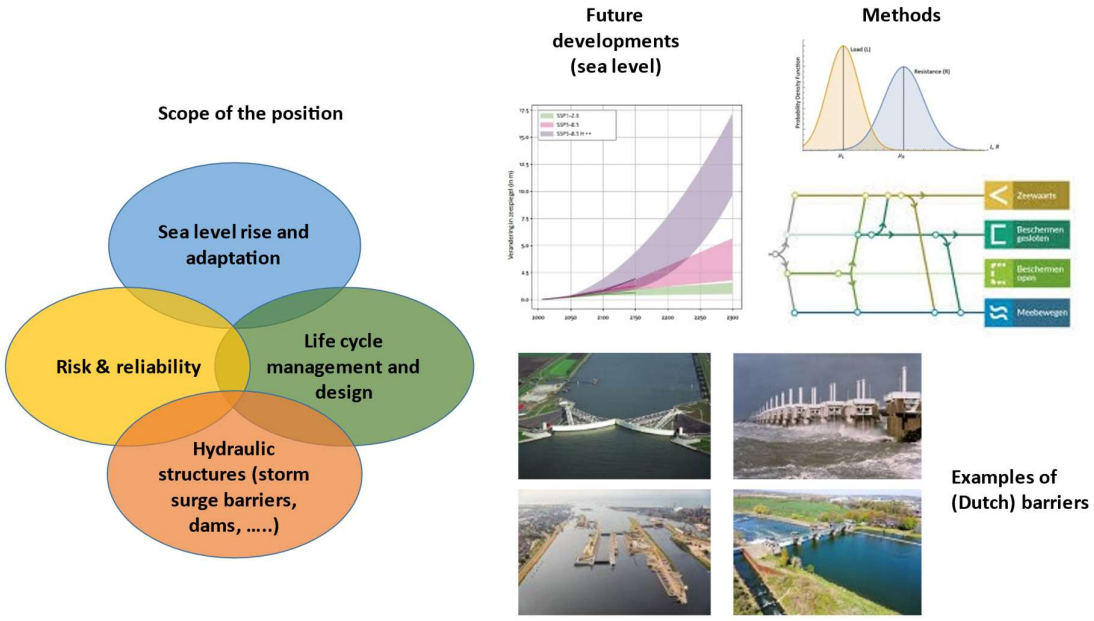


*Figure 1: Scope and focal areas for the new position (left) and visualization of important drivers and methods (top right; sea level rise (KNMI), reliability analysis, adaptive pathways (Deltares)) and some examples of barriers in the Netherlands (lower right).*

The theme addressed by the new part-time professor is crucial for the Netherlands. Sea level rise and climate change impact trigger a timely and fundamental review of the reliability and adaptability of critical hydraulic structures, also in view of their envisaged lifetime and functionality. This also applies to other areas around the world (e.g. UK, USA, Singapore, Vietnam) that are dealing with existing hydraulic infrastructure, or are considering novel “delta works”, such as Texas coastal protection program or storm surge barriers in New York and Singapore. Academic groups as well as practitioners are involved in R&D in this field and the new professor is envisaged to expand both national and international collaborations.

### 3.2 Position within the Department of Hydraulic Engineering

The department of Hydraulic Engineering aims to educate world leading hydraulic engineers, train academic scientists and carry out world-class research in the key areas of sustainable infrastructure and nature-based solutions, renewable energy in the marine environment, dynamics of marine and inland water systems, climate and flood risk management. The Hydraulic Engineering programme enables sound assessment of hydraulic processes and thorough engineering of man-made interventions in support of safe and sustainable development of urbanised deltas, rivers, shorelines and coastal systems worldwide.

The department of Hydraulic Engineering (HE) is composed of five research groups:

1. Hydraulic Structures and Flood Risk (HSFR),
2. Environmental Fluid Mechanics (EFM),
3. Coastal Engineering (CE),
4. Offshore Engineering (OE),
5. Rivers, Ports, Waterways and Dredging Engineering (RPWDE).

The permanent staff of the department of Hydraulic Engineering comprises around 65 persons representing 50 FTE. Within various collaboration networks with the hydraulic engineering sector

about 100 practitioners/researchers are actively involved in research and educational activities. About 100 PhD-students and postdocs do their research projects in the department, often with involvement and contributions from sector parties.

The Hydraulic Structures and Flood Risk (HSFR) group is part of the Department of HE that generates and disseminates academic knowledge in an internationally highly respected Dutch tradition. HSFR focuses on research and education related to hydraulic engineering systems, such as flood defences, storm surge barriers, tunnels, water power and locks. The group also develops methods for probabilistic design and flood risk management. The group is particularly well known for its expertise in flood risk, (design of) flood defence systems and probabilistic methods. Part-time staff is of added value and needed to provide expertise in some specialist areas (e.g. water power, quay walls, geotechnical reliability) and engineering and design. Novel developments concern an increasing focus on adaptation to sea level rise, eco-design, asset management, sustainable energy generation and life cycle aspects in hydraulic engineering. Also, new research lines develop in the field of fluid structure-interaction and risk reduction through nature based solutions. These topics are covered by collaboration with other departments within TU Delft (e.g. Structural Engineering, Geosciences Engineering etc.).

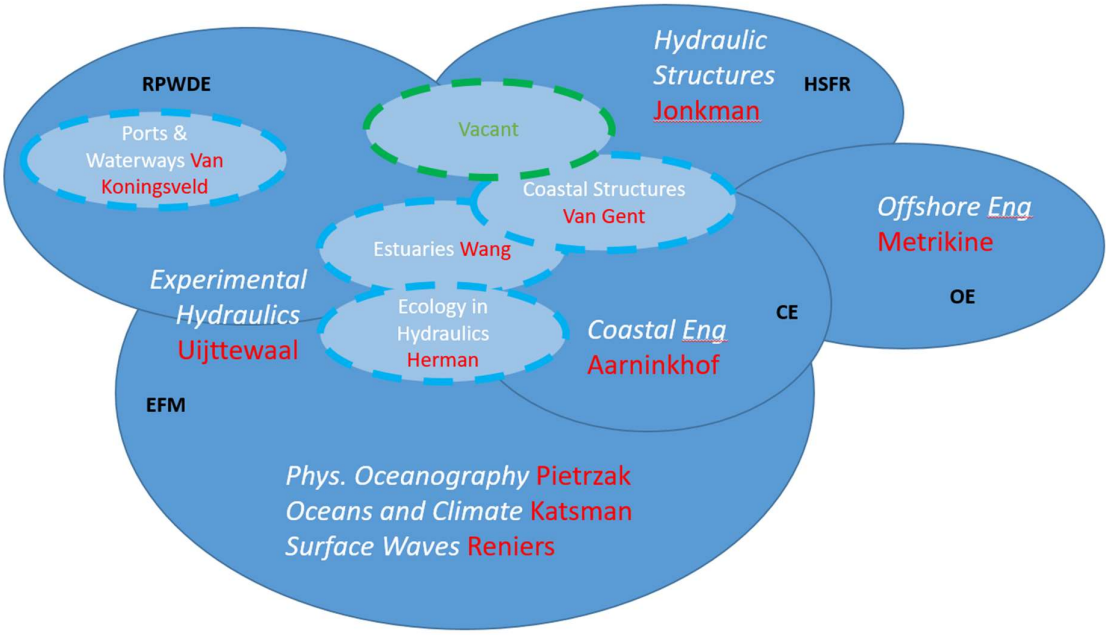


***Figure 1**: Professors (topics in white with names in red) within the department of Hydraulic Engineering at TUDelft: full-time positions (dark blue) and part-time positions (light blue). Research groups and their relative position, indicated by ovals: Rivers, Ports, Waterways and Dredging Engineering (RPWDE), Hydraulic Structures and Flood Risk (HSFR), Coastal Engineering(CE), Offshore Engineering (OE) and Environmental Fluid Mechanics.*

### 3.3 Position within Delft University

The new professor and his / her team will potentially collaborate with several groups within TU Delft, such as:

- At the CEG faculty: structural engineering, water management, geo-engineering, construction management and engineering, geoscience and remote sensing
- At the architecture faculty: delta urbanism, building technology
- At the technology policy and management (TPM) faculty: climate resilience, decision support modelling, safety and security science

- The faculties of Mathematics and Computer Science (EWI) on data, reliability and computing, and with mechanical engineering (3ME) on barrier operation systems
- Also, collaboration is foreseen with overarching TU Delft programs and networks on infrastructure (DIMI), safety and security (DSYS) and climate action.
- Finally, collaboration is foreseen with the Water Engineering group at IHE in Delft. Professors and PhD candidates in the field of Coastal and Urban Risk & Resilience at IHE focus on global flood risk challenges and generally have dual appointment at DUT and IHE.

### 3.4 Positioning in the broader field

The HSFR group has active collaborations in this field with other leading academic groups and research centres in e.g. Texas, Singapore, UK, Belgium and in Germany. Examples of successful collaborations focus on the themes of adaptation to sea level rise, coastal flood risk reduction and barrier design (Texas, Singapore) and solutions for adaptation to climate change.

The HSFR group has active collaboration with governmental organisations, engineering and consultancy firms, knowledge institutes and the Dutch dredging and construction sector. This is collaboration at different levels (Msc students, PhD research, staff exchange, involvement in research projects). Examples of partners include – but are not limited to - HKV, Royal HaskoningDHV, Arcadis, IV-Infra, Deltares, TNO, BAM, van Oord and Boskalis in the private sector and the research institutes Deltares and TNO. Of particular importance in this field is the partnership with Rijkswaterstaat (RWS), the asset manager and owner of the larger barriers in the Netherlands. Over the last years, RWS has funded three PhD positions at TUD CEG in the field of storm surge barriers. A thematic NWO NWA call[1] which focuses on storm surge barrier asset management is expected at the end of 2023.

The collaboration is also expected to expand to other international governments such as the US Army Corps of Engineers (USA) and the Environment Agency (UK). Important networks in this field are I-Storm (international network for storm surge barriers) PIANC at the international level, and ENW (Expertise network on flood protection) in the Netherlands.

## 4. Key characteristics of the position

### 4.1 Appointment and responsibilities

This is a part-time position (0.4 fte) as a full professor in the HSFR section and the hydraulic engineering department at the faculty of civil engineering and geosciences at TU Delft. It is expected that you will establish a strong link with government and the engineering practice and should therefore hold another related part-time position in the field, either in the private sector, government or in a knowledge institute. Rijkswaterstaat has expressed an interest to explore a part-time affiliation with their organization for the remaining part of the work week.

The key characteristics and responsibilities include education, research, valorisation and management & organization – and are further elaborated below. Depending on the other activities of the new professor outside the university, the focus of various activities within TU Delft can be further refined.

*Education*

You are responsible for a successful and innovative (both in terms of content and educational methods) contribution within the 2-year Master track in civil engineering. The HSFR section is actively involved in the development and improvement of her education portfolio that includes the Civil Engineering track 'Hydraulic and Offshore Structures' (HOS). An active contribution to this new HOS

[1] https://www.nwo.nl/en/news/pre-announcement-storm-surge-barriers-in-a-liveable-delta

master track is foreseen as storm surge barriers require insight in geotechnical, hydraulic, structural / dynamic as well as reliability aspects. Besides, you could take part actively in the teaching activities in various courses on civil and hydraulic engineering at the master and bachelor level. Teaching activities also include the management and supervision of students in individual exercises, group projects, Master theses and PhD theses. In the development of learning methodology and materials specific attention needs to be given to e-learning, life-long learning and internationalisation.

*Research*
You are expected to initiate, perform and lead high-level scientific research in your own field of specialization. A key theme is the adaptive, risk-based design and replacement of storm-surge barriers and (water-retaining) structures in the main water system (see section 3.1 for more specifics on the research area). This requires a combination of several disciplines in civil engineering such as reliability, hydraulic, structural and geo engineering. Also, novel approaches in the field of data, monitoring and visualization can be included. The new professor will bring his / her own in-depth expertise, and will also act as an integrator of such various disciplines.

You are expected to initiate multidisciplinary research within CEG and TU Delft in general (see section 3.4 for possible collaborations). You have a good publication record in peer-reviewed journals, experience with obtaining externally funded research projects and a good knowledge of and connection with new developments in the sector.

*Valorisation*
Because of the large impact of hydraulic engineering on society it is expected that you will play an important role in the cooperation of the university with the sector in the Netherlands and worldwide. New developments in the field of hydraulic engineering often originate in actual projects, such as the design of the Dutch delta works, the renovation and adaptation of hydraulic structures in the Netherlands, and the design of new coastal defense systems in worldwide (Texas, New York, Singapore) . Therefore active collaboration with the partners from industry, government and research institutes (see section 3.4) is expected. The research is anticipated to be connected these initiatives, and to have impact on projects and designs in practice.

You will maintain and expand the relationships with other research groups worldwide, and in particular with financing agencies and industries (public and private). The professor is expected to be involved in and provide expert advice in innovative developments in projects in the Netherlands and abroad through positions in boards and (review) committees or through direct interaction with government, contractors and engineering firms. Also representation in relevant networks such as ENW, I-Storm and PIANC is considered to be highly relevant.

*Management & organization*
You will have the task to manage his own team, and may play a role in the management of the section of hydraulic structures and flood risk, but is not (yet) expected to participate in the management of the HE department. The candidate has experience in supervising and guiding groups of engineers or researchers in his or her field. He/she may be asked to participate in work groups at the level of the faculty or university.

**4.2 Profile of the candidate**

You have a leading position in scientific research related to storm surge barriers and hydraulic structures, as evidenced by a PhD thesis, scientific publications, and leadership experience in research. Projects and publications demonstrate scientific quality as well as practical relevance and impact. You have experience with obtaining external funding and a clear vision on future research developments in the field.

You also have:

- MSc and PhD degrees in civil engineering or a strongly related field, and you are a leading expert in one or more relevant specializations in civil engineering such as hydraulic, structural or reliability engineering.
- Demonstrated capabilities to integrate knowledge and expertise from fields beyond your expertise in research and projects. This is needed given the multidisciplinary approach needed to address barrier performance and adaptation.
- Demonstrated ability to innovate through research, leading to impact in practice. Your research has been used in and linked to projects in the field of hydraulic structures and storm surge barriers. Besides, you have a clear vision on how future research can contribute to solving challenges in practice. You have an established national and international network in the sector, spanning industry, government, and academia.
- Excellent teaching capabilities, with a passion and interest in educating the next generation of hydraulic and civil engineers. You have experience in education, knowledge transfer and disseminating information, demonstrating commitment to effective teaching. You have a clear vision on future development in education in the field of the position and have an affinity for educational innovation.
- Strong leadership skills, focused on supporting and supervising academic professionals, leading research teams and projects. You are capable to connect and collaborate with others effectively and is recognized as a team player. You are able to communicate effectively in English, and preferably also in Dutch**.**