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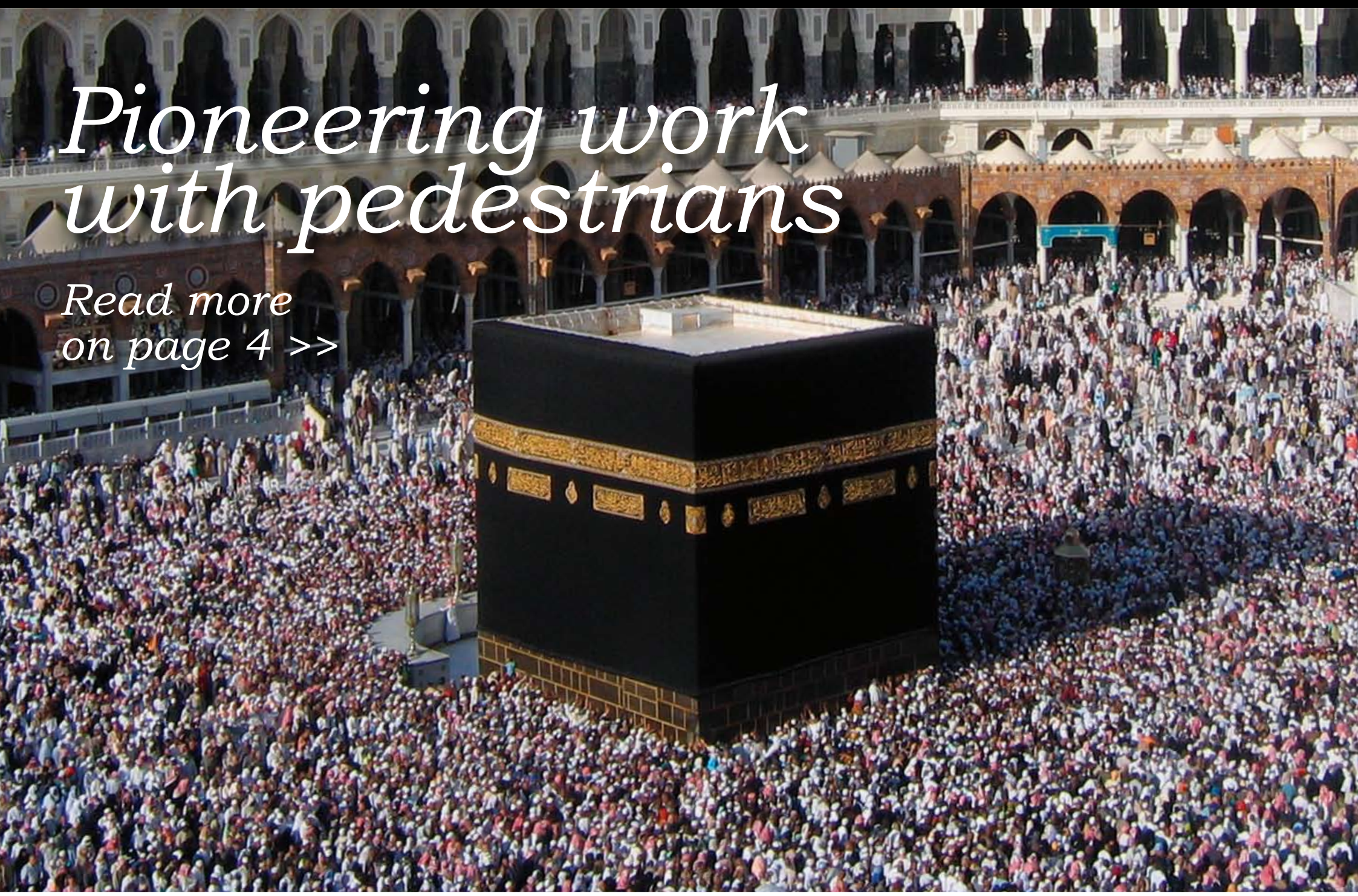


Pioneering work with pedestrians

Read more on page 4 >>

It could be classed as every civil engineer's dream: helping to rebuild a country destroyed by a natural disaster. Alumnus Mathijs van Ledden, Hydraulic Engineer, worked on the reconstruction of New Orleans after Hurricane Katrina's destructive visit for four years. ***Read more on page 2 >>***

Ties Rijcken is more an integral thinker than a hydraulic engineer. He graduated in Industrial Design, worked at the Architecture department, among other things, and is currently working on a realistic 'game' for further shaping scenarios for water-based infrastructure development in the Netherlands. ***Read more on page 3 >>***

For almost 50 years now, the Netherlands has been using natural gas from a number of gas fields. These will be depleted by approx. 2050. In order to prevent the country becoming entirely dependent on imported gas it is important to start using new sources of gas. Researchers at the Geotechnology department have high hopes for unconventional gas. ***Read more on page 6 >>***

Dear reader, *This is the second edition of our magazine Contact which we use to keep you up to date on research, education and cooperation in Civil Engineering and Geosciences.*

We are very proud of how well things are going at the Faculty of Civil Engineering and Geosciences both financially - this year we finally managed to submit a break-even budget again - and as far as research and education are concerned: in early April it was announced that Civil Engineering at TU Delft ranks 13th in the world in the QS Engineering & IT Rankings 2011, the former Times Education Rankings. The faculty's renewal is shaping up: the virtual knowledge centre StuDoc where you too can collect (digital) information on our research opened its doors in April. Julie Pietrzak who specialises in fluid mechanics was appointed as the Antoni van Leeuwenhoek professor and became the first female professor at the faculty. And finally, the cooperation with the private sector is becoming increasingly intensive thanks to various research projects and educational innovations. Think, for example, of our new PDEng Comprehensive Design in Civil Engineering (CDCE) study programme which starts in September 2011.

Over the coming years, we will strive to engineer permanent exchange with our supporters and would therefore welcome feedback on this magazine or the manner in which you wish to continue to be involved with our faculty.

Louis de Quelerij, Dean of the Faculty of Civil Engineering and Geosciences

TU Delft Delft University of Technology

Challenge the future

RECENT PHD AWARDS

Concepts for railway transition maintenance
Dhr B.E. Zuada Coelho

Transition zones in railway tracks are locations of discontinuity in the support, such as at bridges, culverts and tunnels. These zones are of main concern to railway inframanagers, since often substantial additional maintenance is required to preserve line, level and ride quality. This extra maintenance increases the exploitation costs, and often causes delays. Despite the importance of transition zones, the fundamental causes of their poor performance are not fully understood. This thesis aims to give new insight in the behaviour of transition zones. The main observation from the static measurements is that the settlement of the track is composed of two different stages. Initially, after maintenance has been performed, a significant densification of the ballast occurs, followed by a second stage related to ongoing settlement of the embankment and peat layers. This causes a differential settlement of the track across the culvert, which has a stiff foundation.

Wave Dissipation over Vegetation Fields
Dhr T. Suzuki

It has been widely recognized that ongoing climate change, most likely due to human interference with nature, may accelerate sea level rise and increase storm intensity. It is therefore urgent to design countermeasures to alleviate the impact of climate change on coastal regions.
Apart from the view point of coastal protection, it is also very important for coastal engineers to keep an eye on environmental issues in the coastal region.
In this context, vegetation fields such as salt marshes, sea grasses and mangrove forests in coastal regions have started to attract the attention of coastal engineers due to their function as wave attenuator. However, the wave attenuation function of a vegetated field is not well understood yet. To utilize coastal vegetation fields as a part of coastal management in practice, it is crucial to accumulate more knowledge about the physical processes, especially the hydraulic processes, and these need to be modeled in a practical sense. Hence, this thesis is intended as an investigation of the process of wave dissipation over vegetation fields through various approaches, specifically theoretical, physical and numerical studies.

Details of other doctoral dissertations can be found at: http://repository.tudelft.nl

Alumnus Mathijs van Ledden:
"New Orleans clearly shows us hydraulic engineering's importance to society"

It is probably every civil engineer's dream to help a country destroyed by a natural disaster. Alumnus and hydraulic engineer Mathijs van Ledden spent four years helping on the reconstruction of New Orleans after hurricane Katrina.

Top: Mathijs van Ledden
Below: The construction of the IHNC storm surge barrier in Lake Borgne on the eastern edge of New Orleans

- Secondary school: Lambert Franckens College (VWO), Elburg, 1993
- Graduated in: Hydraulic Engineering, 1998
  Graduation thesis on: Sand-silt segregation in the Nieuwe Merwede
- PhD (2003): Sand-mud segregation in estuaries and tidal basins
- Royal Haskoning (2003):

  2003 - 2006 Project manager for various projects (including MER Maasvlakte 2/Kust en Zee, Passende beoordeling Waddenzee [Coastline and Sea, a suitable assessment of the Wadden Sea])
  2006 - 2010 Resident director Royal Haskoning in New Orleans
  2010 Marketing manager Delta Technology - Coastal & Rivers Division, Royal Haskoning
- Marital status: married, two children aged 4 and 1

"After all, it is every boy's dream," he explains enthusiastically at his employer Royal Haskoning's head office in Rotterdam, immediately after returning from the US. "Suddenly you are working on a project where everything you have learned can actually be applied. And you are doing something that is very socially relevant. That's inspiring."

USACE

Van Ledden was 11 when the Oosterscheldekering [Eastern Scheldt storm surge barrier] was opened in 1986. This started a fascination with major hydraulic engineering projects and resulted, among other things, in a PhD under Huib de Vriend. In 2003 he was employed by Royal Haskoning - a company he experienced an immediate personal affinity with. When the request came in to assist the US Army Corps of Engineers (USACE) - the US' Directorate of Public Works and Water Management - in the reconstruction of the city of New Orleans, Van Ledden's profile suited the assignment surprisingly well. "I was subsequently responsible for our work there for four years. Among other things, the programme consisted of reinforcing all the dikes around New Orleans. An enormous project worth some 15 miljard dollars, comparable to the Delta Works in the Netherlands. We provided advice to USACE on strategic choices, a role which carried great responsibility. Very different to carrying out an assignment."

Hierarchy

It was an exceptional job, particularly by American standards. Because the relationship between the principal and the contractor is normally very hierarchic there. Van Ledden: "In the US a consultant is expected to do exactly what the principal demands. In the Netherlands your provision of specialist knowledge is appreciated. Another difference, which partially has to do with the project's urgency, is how fast things could be implemented. We became involved in the design of the storm surge barrier in 2007, determined its height in 2008 and I stood on top of it for the first time in August 2010. Fabulous." Van Ledden not only provided knowledge, but also gained a lot in return. "Only now do I understand what it means to protect people from flooding."

Critical thought

His time at TU Delft primarily taught Van Ledden to think critically. "I learned a great deal from professors such as Battjes, De Vriend, Stive and Vrijling, who often challenged you. Of course learning techniques and models is important, but it is even more important to take it one step further: why do we do things the way we do and could we do them a better? During the first year of my PhD research I really had to set my own course as part of the learning process. At the time, this is frustrating because it would have been much easier if someone had told me what to do. But I learned a great deal from this. I try to apply this to my own students too: I let them go, but intervene if it seems necessary. This is essential in the positions we end up in as we often have to come up with what to do next."

Enthusiasm

In the Netherlands, Van Ledden is going to carry out strategic work and projects for Royal Haskoning's Coastal & Rivers Division. The first request for a quote is already on his desk. "I work immediately under the divisional director and am responsible for the Delta Technology market theme." That is a good position, but to be quite honest I have never had much time for career planning. I am a strong believer in enthusiasm for my field, in doing what you are good at. For me that is putting complex matters simply. I often work in multidisciplinary teams and then it is important to be able to communicate with other experts. I think I have a knack for that and can also make people enthusiastic. Furthermore, among other things thanks to my PhD research, I have a clear profile as far as acumen is concerned. I am interested in technology, but also in the business process. That is why, over the course of the past two years. I also completed an MBA."

Proud

Van Ledden is proud of the worthwhile contributions he and his team were able to make in New Orleans in spite of the demanding setting. "Another culture, intense pressure because it has to be finished and of course all that political and administrative business surrounding it. It was enormously inspiring to take students over there. You can't show them this type of situation enough. Furthermore, their fresh approaches were great to see." Van Ledden has no fixed ideas about what the future might bring. "I try to do what I do well. And to opt for things which inspire me and make me enthusiastic. My passion is to engage in research and education in the field of water and if possible in developing countries. In a few years' time, I hope to be able to do something worthwhile abroad again. Yesterday, I stood on the dike by 't Haringvliet, where I currently live. And that makes me think how beautiful it is to live in a country where everything to do with water has been so eminently arranged."

"I am interested in technology, but also in the business process. That is why, over the course of the past two years. I also completed an MBA"

Deltatechnology

A water system is never finished

Ties Rijcken is more an integral thinker than a hydraulic engineer. He graduated in industrial design, worked for, among others, the Architecture faculty and is currently working on a realistic 'game' for shaping scenarios for water infrastructure development in the Netherlands. Just don't call it a 'game' because people won't take it seriously then.

Interviews, he is used to them. When he was working on floating construction after he graduated in 2003, he was fielding calls for interviews on an almost weekly basis. No wonder because floating homes seemed to provide a good solution for the inhabitants of a country that has controlled water on 95% of its surface area. He has since stopped working on the subject - floating has all sorts of advantages, but doesn't constitute 'an answer to climate change' as people so often put it. Mainly because you would need 10-metre-high mooring poles to stay afloat in the event of flooding. In order to provide a more structural solution to rising sea and river levels, Rijcken ended up in civil engineering: hydraulic engineering and water management.

The Netherlands as a water machine

The solutions are to be found in the field of water-related structures, thinks Rijcken. Initially, he thereby does not look at the structures, but at the system as a whole. "This arose from an advisory report for the Delta Committee which I co-wrote concerning the protection of the so-called Drechtsteden [Drecht towns] and Rotterdam. My study examines how the area can be controlled as a system. This allows you to use various measures at different points in time which all affect the area. A sort of switchboard which allows you to capitalise on the uncertainty of climate change." Rijcken opts for the system approach because he does not believe in 'the best solution of the century'. "Moreover, you don't know which changes will take place over the coming 30 years in the fields of prediction, modelling or other techniques or in society, for that matter. What is also the case is that a disaster or a near disaster is guaranteed to lead to different ideas and more funds becoming available. My system allows new ideas to be added every year. It is flexible. A sort of selection list as it were: if the risk near Dordrecht is considered unacceptable, there are various solutions. The one you opt for affects the rest of the area and when the next problem arises you have other choices."

Communicating with stakeholders

Alongside substantive ideas for improving the Dutch water system, Rijcken is busy with - the equally important - communication between technicians and stakeholders. "In this day and age, a large number of people want to have a say concerning the water system. Engineers are not the most important party. There are many other people involved in water who know nothing about hydraulic engineering technology." These parties are valuable thinks Rijcken, but the lack of technical knowledge often ensures that discussions are conducted at a low level because basic matters sometimes have to be explained. This is a shame because the knowledge of - often expensive - experts is not used in an optimum manner. Rijcken has a solution however. "I am busy creating a 'realistic computer game', an attractive, interactive visualisation which rapidly provides insight into how the system works technically, but also spatially. You can click on possible projects and see what the system would look like after their implementation: how the dikes would be, what the fresh-water distribution would be like and also how the ecosystem functions. Naturally this is based on a conceptual model, it is more than just eye candy. It is a simulation which is to ensure that people understand how the system works so they can discuss matters on the basis of knowledge." Visualisation is the future. Not being able to clearly communicate what you intend to do and what the consequences are is like coming up with an invention and then not marketing it. "It won't be implemented in practice in that case."

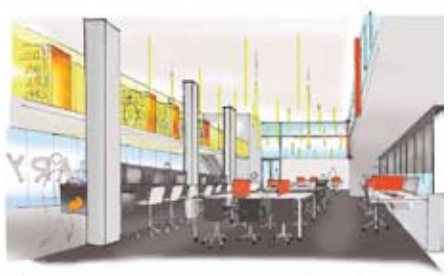
Delta Programme Commissioner

Alongside his own project, Rijcken also works as a researcher for two of the four 'DRIs' (Delft Research Institutes. The DRIs are assigned to link the faculties to one another, the university and the outside world. "Exactly the sort of thing I enjoy; working in an interdisciplinary manner and in practice." On the basis of these DRIs, he set up the initiative 'Deltaprogramma Link Delft' [Delta Programme Link Delft] together with Jos Timmermans of TBM and organised a visit from Delta Programme Commissioner Wim Kuijken who is charged with implementing the Veerman Committee's recommendations (2008) concerning water safety in the Netherlands. "We would like to increase TU Delft's role in the Delta Programme," says Rijcken. "Our influence on the water system has gradually decreased since the completion of the Delta Works." In late January, the Programme Commissioner was provided with an excellent programme of presentations by professors, but also students and young researchers. Students could ask the Delta programme Commissioner and a panel of TU Delft experts questions. "An inspiring day," says Rijcken, "which definitely strengthened ties". Kuijken indicated he would like to view TU Delft as the programme's outboard motor - a sort of independent think tank. Furthermore, bilateral contacts were made and reinforced, for example, between programme directors and professors active in the field of urban planning. Kuijken also asked us to look into multifunctional water barriers which could be combined with, for example, solar panels and wind turbines or infrastructure and homes. This type of research and cooperation increases our visibility and can be used as leverage for research requests."

Visual future

Rijcken predicts that interactive models or 'realistic games' such as the one he is working on will be the future. "You can bring hydraulic, civil engineering and spatial ideas and models together. I think this type of interactive models will replace reports. It is naturally, very frustrating that a large number of reports are written that are never read in any case not by government officials. The summary is read, the rest is almost solely viewed as proof that the author knows what he is talking about. An interactive model provides a better sense of a system or the problem in less time, because it is visual. There is a market there. Engineering firms will have to study this in order to sell their advice better. It constitutes the future for highly-developed, democratic countries: an interface between government officials, stakeholders and technicians (and knowledge). Social media will also be added and using intelligent crowdsourcing the idea can be worked on continuously in an interactive environment."

Rijcken looks enthusiastic. In June he delivered an initial, simple version of the model to the Delta Programme. There may be a bigger project waiting for September to June. "We should then be able to have something pretty advanced. But," he emphasises, "it will never be finished. Your model always has to approximate reality better. And in the water system's reality everything can always be improved: safety, appearance, environmental aspects … A water system is never finished."



StuDoc-CEG Online knowledge centre

On 26 April, the new StuDoc was officially opened on the first floor of the faculty's building. StuDoc offers students a modern, quiet place to study with connections for laptops, a large collection of books, magazines and a limited number of scientific journals, lecture notes and reports. StuDoc is also accessible online via the website **http://studoc.tudelft.nl**.

The website makes online knowledge centres for every field available which provide direct access to reports (MSc and PhD theses and third party reports). It also provides links to conferences and magazines.

New PDEng in Comprehensive Design in Civil Engineering (CDCE)

There is an increasing demand for engineers who have comprehensive insight into and can combine the specialist knowledge from various fields and who, as a lead designer, can be responsible for technical design. This is why, in September, a new, two-year post-MSc design study programme will be started: the Professional Doctorate of Engineering (PDEng) in Comprehensive Design in Civil Engineering (CDCE).
The programme turns engineers into technical civil engineering designers and constitutes a TU Delft led alternative to a design traineeship at a company. For further information please refer to: **www.pdeng-cdce.tudelft.nl.**

Transport

Pioneering with pedestrians: from Mecca to the NS

Pedestrians are complex creatures. They can literally move in any direction and they even shift shape. This makes them tough to study. No wonder that TU Delft was a pioneer when, in 2002, it started its experimental pedestrian research. The university is currently one of the top institutes in the field of pedestrians. Requests for advice come in from around the world.

"Actually, pedestrians constitute just a small part of our research," says Prof. *ir.* Serge Hoogendoorn, head of Traffic Management and Traffic Flow Theory at the department of Transport & Planning. "Three of our 50 staff work in this field. Pedestrians are basically traffic flows and when it comes to traffic management, roughly the same rules apply to all flows." Hoogendoorn set out four main lines or solution directions for traffic management which can be applied when traffic systems become overburdened (see next page). He discussed these in his Diesrede [Foundation Day Lecture], in January 2011, and - to his surprise - saw the audience experience an epiphany. He modestly remarks: "I was actually convinced that people were aware of these main lines and applied them as they are pretty obvious." In brief; traffic management is all about increasing capacity in various ways or making better use of the existing capacity. This applies to both traffic and crowd management. Evolution is slowly taking place and Hoogendoorn's ideas for solutions are being implemented increasingly often to tackle traffic and pedestrian problems.

Pioneering with caps

Pedestrian research is relatively new. "In the 1970s, a lot of psychological research was carried out into pedestrians and pedestrian interaction, but this did not lead to the development of quantitative computational models," explains Hoogendoorn. "There was almost nothing at the start of this century. Perhaps because it is such a complex process, much more complex than road traffic, for example. Pedestrians mingle, walk in various directions and at varying speeds, with prams and arm-in-arm. This makes things difficult because automated video analysis is easier to conduct with fixed-shape objects. In 2002, Winnie Daamen and I were the first to bring a large group of pedestrians together in order to conduct walking experiments with them. In a very pragmatic fashion, we gave everyone a red or a green cap and monitored the caps. This method has since been emulated a lot abroad. Alongside this experimental research, we also carried out measuring activities at railway stations with infrared sensors on the platforms and particularly in tunnels. Our objective was to measure how busy certain areas at the stations were in order to catalogue the stations' quality for travellers. The advantage of these observations is that they were not conducted in a controlled environment and people behaved naturally; the drawback was that conditions were not always what we as researchers wanted.

Simulation model Nomad

Hoogendoorn and his researchers created the Nomad simulation model on the basis of the experiments conducted in 2002 and their insights into pedestrian behaviour. "Naturally it is aimed at making predictions. I am convinced that we have knocked together one of the best simulation models. It is used in many places. The pioneering work was fabulous and in the meantime we can safely say that we have developed into one of the world's top institutes. That is why, for example, a request such as the one concerning Mecca ended up here; we are one of the few institutes conducting research at this level. Although an increasing number of models are being developed including commercial versions. Our model is very good substantively, but the companies can invest a lot more money in theirs and their models look better; we just can't compete in that respect. We do however often receive requests for advice (see next page). For the design of railway stations, but also for the development of guidelines for buildings for the Ministry of Infrastructure and the Environment, Schiphol Plaza and sometimes also from events which attract large crowds."

Crowds in Mecca

The research in Mecca has almost been completed. This is the second question from the Saudi authorities Hoogendoorn has tackled. Last year, he worked as an advisor assessing the comprehensive plan surrounding the holy cities of Mecca, Medina and Meshire. "Between 2020 and 2030, the Saudis expect the number of pilgrims to double from the current 2.5 million to 3 million. And the facilities there are already reaching maximum capacity. The Jamarat bridge was a bottleneck where many injuries occurred every year. This has since been solved by using a new bridge design: a modern, suitably dimensioned facility. But removing a bottleneck often shifts the problem as it does on the road. We are now studying the mosque at which a chain of activities takes place. Four major, international consultants are working on it. My task is to provide advice on the redesign, on pedestrian flows and crowd management. At the moment, two plans are being detailed which have been approved on the basis of the sketched designs."

Turbulence in the crowd

"Solutions to the problems at the mosque basically boil down to building additional infrastructure and limiting cross flow, like you would on a motorway," says Hoogendoorn. "The principles can be applied to every flow. When it is quiet, the cross flows organise themselves. Pedestrians or cars for that matter, barely hamper one another, everything runs very efficiently. It's really fascinating! But when things get busier, the process stagnates. Then you have to separate the flows as much as possible or keep people away at the edges. When the system collapses, people no longer cross over, but end up facing each other. This is what happened during the Love Parade in Duisburg, Germany. There was nowhere for them to go." When things get busy, the system changes into a granular medium. It becomes a body which starts to behave in certain ways due to the pressure from the people along the edges. If things become extremely busy e.g. there are approx. ten pedestrians per square metre, a type of turbulence develops in a large crowd which is very dangerous because the forces people exercise are passed on.

No panic

People often say: "Panic developed", when things go wrong. Is that what actually happens? "That association quickly develops," says Hoogendoorn. "but that needn't necessarily be so. Purely the fact that there are so many people exerting forces on one another can be enough. Naturally, people can panic, but that does not influence the system or what happens to you. Panic has therefore not been incorporated into models for pedestrian flows or crowd management." How can things be improved and how can tragedies such as the one at the Love Parade be prevented? Serge: "Advice or information in advance could possibly help, but it often is not adhered to anyway. People think: 'That won't happen to me'. I have the same thing when I'm at a busy festival. This is why, as a scientist, I am inclined to physically bar people's way at major festivals where it is very busy. For example by using gates. I think that is a stronger tool."

Safe future

Models and automated systems for crowd management such as cameras or infrared sensors which automatically measure how dense a crowd is and in which direction and at which speed it is moving are increasingly used in applied scientific research. Hoogendoorn: "This allows you to predict which direction the crowd will head and allows you to intervene, if need be. The next step is to intervene more intelligently using estimates and predictions: how many people do we have to stop now to ensure that no problems develop later on?" Can this prevent problems with large crowds? "Theoretically," says Hoogendoorn. "Because even if your models and mechanisms are superb, things have to be carried out in practice. If, as was the case in Duisburg, it takes 45 minutes before the person who can prevent the influx is contacted then there isn't a model in the world that can help. We are learning more and I expect this knowledge to trickle down so that problems can be prevented using good designs and crowd management strategies, and by assuming that things will go wrong. You should never base yourself on ideal circumstances."

Winnie Daamen and Serge Hoogendoorn

Four main lines for traffic management

1. ***Counteracting recoil effects***
   Ensuring that a traffic jam does not continue to expand after the off-ramp, by limiting influx from the on-ramp.

2. ***Increasing throughput***
   E.g. by instituting dynamic speeds or temporarily adding capacity using, for instance, rush hour lanes.

3. ***Distributing traffic across the network***
   This can be achieved by, among other things, providing good information: explain where traffic is at a standstill and other road users will automatically avoid that location.

4. ***Limiting influx into an area***
   On the one hand, by improving traffic distribution across the network (see preceding main line) and, on the other, by regulating the influx so that the number of vehicles in the network stays under the critical limit.

Studentproject

Jasper Righolt, Transport & Planning student: "There are a huge variety of applications for pedestrian monitoring."

Not only Mecca, but also TU Delft faces impending capacity problems. Master's student Transport & Planning Jasper Righolt is working on a system for monitoring students in real time using an RFID tag on their campus cards.

"Capacity problems are developing for lecture halls due to the growth in the number of students," explains Jasper. "My client, Henk van der Zanden of SSC-ICT, wanted to gain more insight into where students are at which point in time, how lecture halls are used and what their occupancy levels are like. This occasioned my graduation project. If you monitor everyone's location, you can start to study how to improve lecture hall usage. This is relatively simple and that is why we expanded the project to include the entire campus. We will now also examine the routes walked by and the movements of students, and, on the basis thereof, I will create a prediction algorithm."

For monitoring purposes, Righolt wishes to use RFID tags (the type of chip Albert Heijn uses for self-scanning registers) on the campus card with boosted transmission. This means the card can be read the minute a student, for example, walks through a door. There are many possible applications for the monitoring system, thinks Righolt.

"Once you know where everyone is, it is easy to track people in the event of disaster. The predictions of the routes walked allows you to see where, for example, bottlenecks develop in the event of reconstruction, but also allow you to optimise timetables. I expect that, if it works, you can even deduce interesting marketing information from it at, for example, trade shows or other large events. Particularly in combination with new media or augmented reality."

For the time being, he will focus on TU Delft and capacity management. "I am going to build a small-scale version of the system and test it at a hospital in Amstelveen. Then it can be rolled out at TU Delft. I am planning to graduate this summer. The literature is pretty tough going, but the research itself is really fascinating. It is a subject everyone has an opinion on. Privacy is a hot item and I am curious how people will respond when they find out they are being monitored in real time."

Pedestrian projects: advice from TU Delft

- A simulation model was created in cooperation with Hispeed for the positioning of reservation printing machines on the Hispeed platforms at Amsterdam Central Station, Schiphol Airport and Rotterdam Central Station. The question was where to position the machines in order to hamper travellers on the platforms as little as possible and how many machines would be required if you take malfunctions into account and the fact that people still have to catch their train. (2008)
- Calculating the new design for Schiphol Plaza. Would there be sufficient space for pedestrians if the plaza was busier and if turnstiles were installed at the head of the railway platforms? (2008)
- Experimental research for what was then the Ministry of Housing, Spatial Planning and the Environment occasioned by the difference in opinion concerning the capacity of doors in the building decree. The fire brigade considered the value set unacceptable and Hoogendoorn and his colleague Winnie Daamen conducted experiments with large groups of varied composition. Blindfolds were used, stroboscopes and a conga formation (20% more capacity!). (2009)
- Handigap: research into public transport accessibility for the handicapped. Experimental research involved a mock-up of a railway platform to study the horizontal and vertical distances between platform and train that handicapped people (in particular the wheelchair bound and those that use walking frames or mobility scooters) could traverse. (2006)
- Boarding and disembarking studies to see how long it takes travellers to get on or off a train depending on the horizontal or vertical distances to be traversed, the quantity of luggage involved, but also whether people board and disembark simultaneously or how people stand in the area adjacent to the doors when the train is packed. (2006)

NEW PROFESSORSHIPS

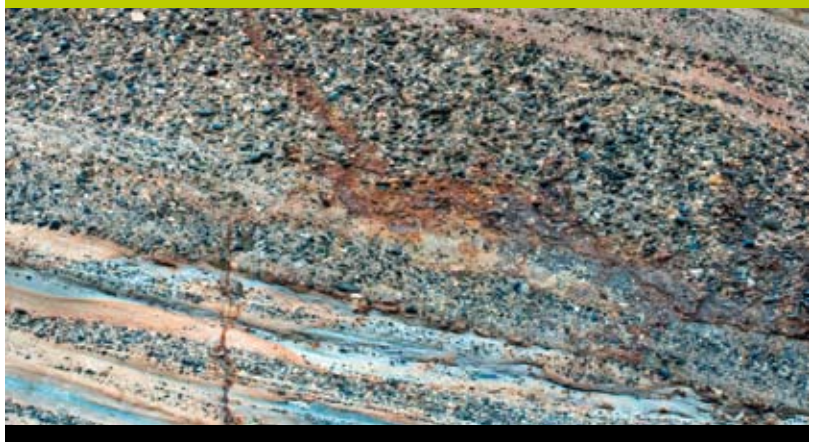
Prof.dr. Rob (R.B.) Polder
Durability Chair (Sustaining Technology), Materials & Environment research group

Concrete is a durable construction material which enables a long lifespan. Actually achieving that long lifespan is not as straightforward as it might seem. The degradation of concrete structures arises from aggressive loading and sometimes from internal causes. This is particularly true for infrastructure, but even applies to buildings to a certain extent. Both the concrete and the reinforcement materials are sensitive to degradation, for example, due to the effects of frost, chemicals or corrosion. Society demands fast, cheap construction and prefers not to engage in maintenance afterwards. The reality is that lifespans are shorter than expected and corrective activities will be required. Lifespan for newly built structures has its own specific problems including design models, regulations, costs, raw materials and environmental effects.

The conservative approach; doing things the way they have always been done is no longer tenable for a variety of reasons. Experienced staff are getting older, other parties are making decisions, insights are decreasing; things have to be faster and cheaper, but also better and more environmentally friendly! Are we ready to face this challenge? Existing concrete structures are starting to become so old that their weaknesses are becoming apparent. Reinforcement steel starts corroding and concrete cracks; over time, safety becomes an issue. Are we ready to monitor, repair and protect it safely, reliably and with as little hindrance as possible? In both cases the answer is negative. The reason being that we are not open to serious questions, to collectively learning from the past and to solutions outside our comfort zone. There are solutions available, but which ones should we opt for? Or should we seek out new solutions? And who is going to design and build these? Research and education at TU Delft can only partially contribute to this. The sector as a whole should be open to the questions that exist and impending innovations!

Prof.dr. Michael A. Hicks
Soil Mechanics Chair, Section Geo-Engineering

In geotechnical design, we need to adopt a strategy that reflects the complex and variable nature of the materials that we are dealing with. We need to take account of uncertainties in characterising material behaviour, in defining material properties and in quantifying possible geo-structural performance. This leads to a probabilistic approach to geotechnical engineering. Therefore, our challenge as researchers and engineers is to investigate ways of reducing uncertainties in design that arise due to problems in measuring, characterising and modelling soil behaviour. This will be achieved through a better fundamental understanding of how the soil in the ground (or used in construction) behaves, when it is subjected to changes in loading and changes in environmental conditions such as temperature, water, pollution and biological activity. Secondly, we need to continue developing innovative ways of identifying what the sub-surface looks like at the metre scale. And finally, we live in the age of the computer; we need to utilise advances in computer technology to carry out realistic modelling of structures that are invariably 3-dimensional.



Further information
www.intreeredes.citg.tudelft.nl

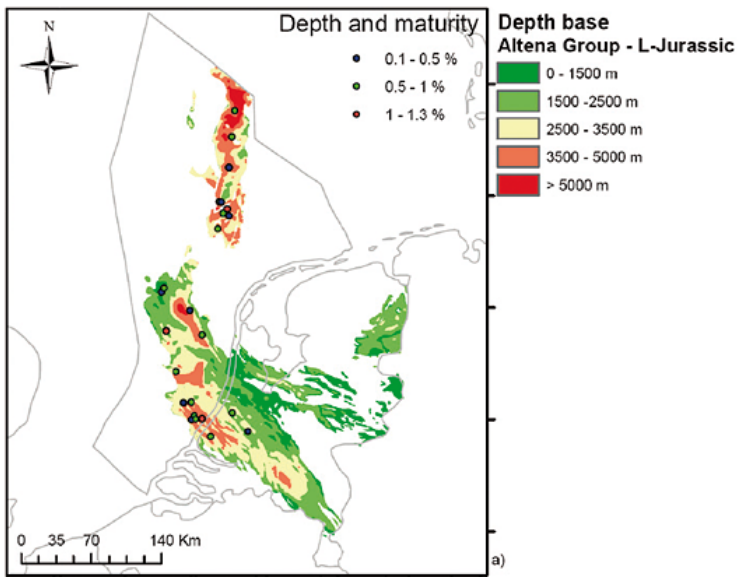
At a German quarry where Posidonia is located at the surface, the skeleton of an Ichtiosaurus has been perfectly preserved. In the Netherlands, Posidonia can only be found in core samples.

Geo-energy

New research progr unconventional gas

For almost the entire past 50 years, the Netherlands has been extracting natural gas from a number of fields. These gas fields will be depleted by around 2050. To prevent the country becoming entirely dependent on imported gas, it is important to start using new sources of gas.

Researchers at the Geotechnology department have high hopes for what is referred to as unconventional gas. They have developed a research programme to ascertain how this new natural gas can be extracted in an efficient, environmentally-friendly manner.



Depth of Posidonia in the Altena Group in the Dutch subsoil [TNO].

The Posidonia shale is approximately 175 million years old and contains relatively high quantities of organic material.
The latter is one of the sources of shale gas. The core samples to be taken by Cuadrilla Resources this autumn near Boxtel will go through the Posidonia shale and will also focus on the rich shale layer immediately beneath the latter. The well will drill down to some 3.5 to 4 km.

"The Netherlands is a true natural gas country," explains Ruud Weijermars. He leads the new research programme, the Unconventional Gas Research Initiative (UGRI). "We have an extensive gas infrastructure and 45% of our primary energy supply depends on natural gas. The Netherlands is the sixth largest natural gas producer in the world and the seventh largest exporter of this fuel. However, the country will rapidly lose its leading position if nothing is done. In approximately 40 years' time, the Groningen field - the largest gas field in Europe - and the other Dutch gas fields will have been emptied. If no new gas reservoirs have been tapped by then, the country will become entirely dependent on imports. And this does not just apply to the Netherlands, but also to all the other European countries that currently produce natural gas with the exception of Norway."

Locked up

"What the current gas fields have in common is that they consist of quite porous rocks. This allows the gas to move through the rocks making it relatively easy to extract. However, natural gas does not only occur in these conventional gas fields, but also in other geologic formations. Take, for example, coal layers, compact sandstone and shale. As far as its composition is concerned, the gas from these formations is the same as that of traditional natural gas from, for instance, the Groningen field. The only difference is that it cannot move freely because it is locked up in the rocks. Extracting this unconventional gas is therefore much more complex. There is, however, considerable potential.

A recent TNO Bouw en Ondergrond [Building Construction Division] study indicated that the Dutch subsoil contains approximately 1,000 to 2,000 x billion cubic metres of gas in coal layers, 150 to 230 x billion cubic metres of gas in compact sandstone and 50 to 230 x billion cubic metres in shale. These figures are still subject to discussion, but even if we could only extract part of the estimated quantities, this would make an important contribution to our existing, conventional gas reserves which amount to 1,400 x billion cubic metres.

Knowledge

"In the US and Canada decreasing gas production from conventional sources has, in recent decades, largely been accommodated for using gas from unconventional sources. As the Geotechnology department we assume this is also possible in Europe. Precondition being that more knowledge is generated, particularly about how this gas can be extracted in an efficient, environmentally-friendly manner. This is why the faculty's four research groups - Applied Geology, Petroleum Engineering, Applied Geophysics and Petrophysics and Geo-Engineering - jointly developed the UGRI research programme. We are searching internationally for international industrial partners to fund this programme and hope the Dutch government will recognise its importance. The programme is intended to start in 2012 and will continue until 2020 so that at least two PhD terms can be completed."

Tiny bubbles

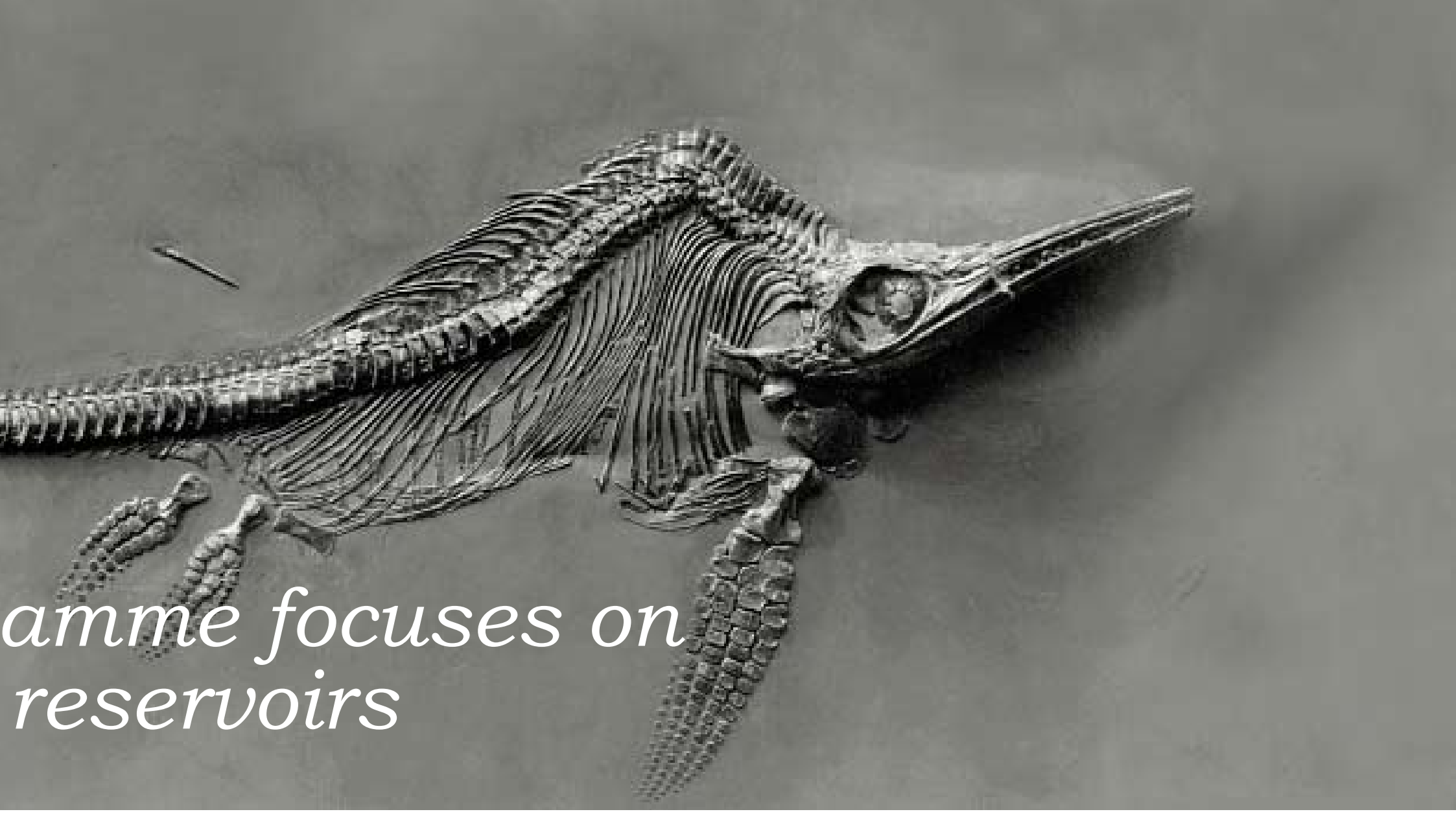
Weijermars continues: "An important aspect of the UGRI is research into methods for extracting the gas from the rock. Take, for example, Posidonia shales which occur in the Dutch subsoil. The shales are approximately 175 million years old and rich in organic material. They developed from finely granulated, clay-like deposits. The gas is lodged in the shale in the form of small bubbles. In order to retrieve it the rock has to be 'cracked'. The technology used to do so is called hydraulic fracturing or fracking. This involves injecting water, sand and a number of chemicals under high pressure into the rock through a horizontal bore hole to create cracks in the rock which release the gas."

Optimisation

"Although fracking has been used for the extraction of shale gas in the US for years, there is still plenty of room for improvement. For example, how do you ensure you achieve the cracks in the desired locations and how can the 'architecture' of the cracks be optimised. As the Geotechnology department we are well equipped to study this. For example, our laboratory has unique research facilities which allow us to model the process of hydraulic fracturing deep underground." Interest in the Delft research programme is already high. This spring, Weijermars was one of the guest speakers at the annual conference of the American Association of Petroleum Geologists in Houston. On the basis of his ground-breaking theoretical research in the field of fracking architecture, he has also been invited to be a keynote speaker at the 55th US Rock Mechanics symposium which will be held this summer in San Francisco.

Preventing environmental damage

Weijermars: "We also want to study how hydraulic fracturing can utilise natural cracks in the rock as much as possible and how the 'gas release' process really functions. Furthermore,



amme focuses on reservoirs

we wish to develop new techniques to get the gas in the rock moving, for example, by using vibration sources. Another important problem is how to prevent the extraction damaging the environment. Chemicals in the fracking liquid in the US have, for example, led to environmental contamination on multiple occasions due to, for instance, the well's seals being faulty causing the liquid to end up in ground water. Furthermore, surface water was contaminated at various locations after the fracking liquid used was discharged to waste water treatment plants which proved insufficiently capable of removing the harmful substances."

Biodegradable

"Naturally, before we start extracting unconventional gas we need to know how to prevent this type of environmental damage. Among other things, our research programme focuses on the development of biodegradable fracking liquids, but also on techniques aimed at properly monitoring any possible effects on the environment. Furthermore, we wish to assess which options there are for containing the liquid in a closed system thereby enabling re-use."

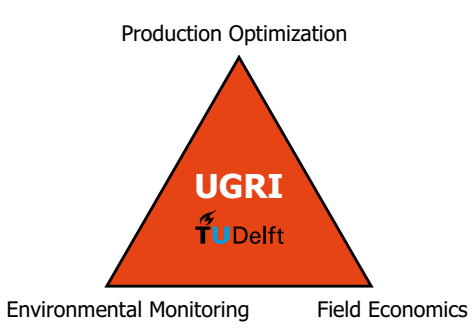
Characterisation

"A subject which we are also going to pay ample attention to as part of UGRI is the characterisation of the subsoil. For example, we would like to develop techniques which allow the accurate determination of where gas is present in high concentrations and where there is none. Such techniques are indispensible to enable the profitable extraction of unconventional gas. In order to extract the same quantity of gas you will have to drill a lot more wells than in a conventional gas field. After all, you can only extract the gas from the area fracked immediately surrounding the well. And because the costs per well are also substantially higher due to the necessity of fracking you cannot afford to make mistakes which yield little or no gas."

Getting to work quickly

"Another subject is the development of geophysical techniques to enable the gas to be 'tracked' after fracking. For example, in order to optimise the extraction methods we want to know which tears release the most gas. In short, there are countless questions left to be answered before we can benefit from unconventional gas reserves."

Weijermars is convinced that the Netherlands should make haste seeking the answers: "The first trials have already started. For instance, in Boxtel in the province of Noord-Brabant explorative drilling will be carried out soon to drill into the Posidonia shale and a rich shale layer immediately beneath that. This means that the first commercial gas extraction can start in a few years' time. Before then we should develop knowledge which guarantees that the extraction of unconventional gas will take place in an efficient, environmentally responsible manner."



"Contribution from unconventional sources set to increase"

Douglas Gilding with girlfriend Klaartje Wiggers (also a TA graduate) in their home town Harstad, Norway

Or so Douglas Gilding, who graduated in June 2010 in Delft as a Reservoir Engineer, thinks. He currently lives 200 km above the Arctic Circle in Harstad in Norway where he works for Statoil. He is responsible for re-injecting the CO_2 released during the extraction and processing of natural gas from the Snøvhit field in the Barents Sea.

"Snøvhit is a large offshore gas field at which all the production platforms stand on the sea floor which is located 250 metres or more below sea level," explains Gilding. "The natural gas is transported to an LNG plant on an island off the coast down a well over 140 km-long pipeline. There the CO_2 is removed from the natural gas. It is subsequently pumped back to Snøvhit down another pipeline where we inject it back into the field. I am, among other things, responsible for this CO_2 injection."

Existing systems

"The natural gas from Snøvhit belongs to the conventional gas category. Norway still has an enormous reservoir of this type of gas. Statoil is nevertheless also looking into unconventional gas reserves. I think that is very worthwhile. Not only because the contribution from unconventional gas is set to increase over time, but also because the extraction of unconventional gas is most feasible if you can utilise existing systems and infrastructure.

Knowledge development

"Besides, I think you should use what is near at hand. It was from this perspective that I set up the Delft Aardwarmteproject [Delft Geothermal Project] or DAP for short, while I was studying. We knew there was warm water in the subsoil near Delft. Using our knowledge of reservoirs and oil production, we subsequently examined how that warm water could be utilised. Since then, the project has led to a number of successful applications at market gardening companies. Furthermore, DAP enormously stimulated the knowledge development surrounding geothermal energy."

Less dependent

"The Netherlands' subsoil contains substantial quantities of unconventional gas. Simultaneously, we know that the conventional, easily extracted reserves will be depleted over time. It therefore seems prudent to seriously examine how these unconventional gas reserves can be taken into production over the coming years. That would be good for knowledge development and ensures that - in the future - you are less dependent on gas imports."

Compulsory

Gilding continues: "As far as this is concerned, I would consider it logical if the Dutch government - which is putting its weight behind making the Netherlands Europe's gas hub - would make it compulsory for a certain percentage of the gas flows than run through this logistics hub to consist of unconventional Dutch natural gas."

Covenant reinforces ties between the faculties

Thanks to the covenant between the sector and the civil engineering faculties of TU Delft and the University of Twente, funds have been made available for innovation - despite government cuts. More importantly, discussions have started between the sector and the universities concerning the future of civil engineering in the Netherlands.

"The initiator and the covenant Dean of CEG at TU Delft," according to Prof. Rikus Eising, Dean of the Faculty of Construerende Technische Wetenschappen (CTW) at the University of Twente. We immediately recognised its value and are enthusiastic partners in its substantiation." A covenant has been signed involving 25 different parties including engineering firms, building companies and Rijkswaterstaat (Directorate General of Public Works and Water Management) in which the partners will, over a five year period, invest at least 13 million euros in the civil engineering faculties in Delft and Twente in order to safeguard and further develop the civil engineering study programmes.

Dynamic

The covenant was signed in December 2009 and the first evaluation with the sector was held in April of this year. The meeting was characterised by intense discussion and enthusiasm, and Prof. Louis de Quelerij looks back on it with satisfaction. "The sector has become interested in the faculties' research and education again. In part thanks to their support, we can submit break-even budgets and achieve the sector's wishes such as a two-year design study programme the Professional Doctorate in Engineering (title PDEng). We will be starting with ten selected master's graduates. The first year will be theoretical and during the second year they will carry out a design assignment at a company." This design study programme will be provided in both Delft and Twente, though each programme will have its own specific accents.

"Thanks to the sector's support, we can now present a break-even budget and achieve the former's wishes such as a new, two-year design study programme"

The covenant has created a new dynamic in the organisation, Eising has noticed. "The lack of funds stopped us implementing various educational innovations and that paralyses a study programme. Thanks to the sector's support we are now able to achieve our ideas and we are, for example, currently busy with a municipal engineer's study programme. The four major cities need civil engineers specialised in urban problems. Interested master's students can add the title of 'Municipal Engineer' to their master's diplomas at UT and TUD by taking specific subjects. Everyone is excited that new initiatives are once again an option."

Research

The covenant has only improved the excellent cooperation between the two faculties, according to Eising. "We have always collaborated extensively, but thanks to the more direct contact with the sector our ties have strengthened." Cooperation has become more efficient, at the sector's request, relates De Quelerij. "Meetings between TU, UT and the sector concerning the Delta Technology theme and the Deltares sounding board groups usually attracted the same people, and the technical universities and Deltares organise these meetings together."

Eising and De Quelerij's ambitions and dreams for the coming years are very realistic. Eising would like to give daily practice a bigger role in education. "We would like to invite engineers working on exceptional projects such as the Noord/Zuidlijn [North-South metro line project] in Amsterdam, to tell us about their work. It is important for future engineers to know more about a project than what they can glean from the newspapers."

After nine years as dean, a successor for De Quelerij will be appointed on 1 October 2011. Deans are usually appointed for two four year terms, but in this case the term was extended by a year due to the financial situation and the covenant. "Before I leave, I would like to ensure the last few companies turn their promises in the covenant into contracts. This will give my successor a strong financial basis for the coming years."

De Quelerij hopes his successor will achieve one of the covenant's principal goals. "Our aim is to get the companies who are primarily interested in education to invest a lot more in research at the faculty at integral rates. So far, this only takes place at water technology, because the companies can gain immediate returns from the research results. The research into, for example, more intelligent dike bodies is very important to society, but does not lead to immediate increases in profits or turnover for individual companies. The trick is going to be to find a way to place this research with the faculties in such a way that it also benefits the companies. Then we would no longer have to rely on additional support from the sector."

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RIKUS EISING
(1948)
Position: *Dean of the Faculty of Construerende Technische Wetenschappen [Faculty of Engineering Technology] at the University of Twente since 2006*
Career: *studied applied mathematics in Groningen, obtained his doctorate from TU Eindhoven where he continued to work as a scientist until switching to Thales Hengelo in 1984 where he held numerous positions, among others, in upper management.*

Name:
LOUIS DE QUELERIJ
(1952)
Position: *Dean of Civil Engineering and Geotechnology (CEG) at TU Delft since 2002 and director of Fugro Ingeniersbureau [engineering firm] one day a week*
Career: *Studied civil engineering at TU Delft, worked for Rijkswaterstaat for ten years before switching to Fugro in 1986, initially as a consultant and later on as general manager.*

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