

Delft's integrated approach at World Expo Shanghai

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The professional career of former student Claire Boonstra has centred around infrastructure. Her specialisation at university was Hydraulic Engineering. Today, her company develops infrastructure for 'augmented reality'. **Page 2 >>**



How do large buildings affect the microclimate of our cities? Is rainfall heavier in certain places than in others? What is the effect of 'green roofs' and 'vertical vegetation'? Research into the urban microclimate is being conducted on the TU Delft campus. **Page 6 >>**

Companies and public sector organisations face the challenge of attracting talented young graduates. How does one engage students and spark their enthusiasm? Huub Savenije (Professor of Hydrology) is a past winner of the Leermestersprijs (Delft University Fund Masters' Prize), while Susanne Rudolph (Associate Professor of Petroleum Engineering) was voted 'Teacher of the Year' by students. They tell us about their successful approach. **Page 8 >>**



Dear reader, We are pleased to present the first edition of Contact, the newsletter of the Faculty of Civil Engineering and Geosciences. We shall use Contact to keep readers up to date with the latest developments in the faculty's education, projects and partnerships. And there is much to report. In the past year, we have devoted considerable energy to realigning the faculty's activities and establishing our position in the modern world, a process in which cooperation with the sector plays an important role. Our education and research are now even more geared towards the requirements of society. We shall actively seek partnerships with public and private sector parties, and with other research institutes, in search of solutions to the social issues of the day.

One such partnership is Climate City Campus, in which the TU Delft campus becomes a centre for urban climate research conducted in association with the private sector. Another is InfraQuest, an alliance in which TU Delft is joined by the Netherlands Organisation for Applied Scientific Research (TNO) and the Department of Transport, Public Works and Water Management (Rijkswaterstaat) in modernising the national infrastructure.

I hope that you will find the articles in Contact both enjoyable and inspiring. In the years ahead, we wish to enter into an ongoing dialogue with everyone who is interested or involved in our field. We therefore welcome feedback about this new publication. Please email your comments and suggestions to news-CITG@tudelft.nl.

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

RECENT PHD AWARDS

URBAN WATER

The role of interception in the hydrological cycle
Ir. A.M.J. (Miriam) Gerrits



'Interception' refers to that part of rainfall which is intercepted by the earth's surface and subsequently evaporates back

into the atmosphere. Although some 15% to 50% of rainfall evaporates in this way, the process is often overlooked in hydrological models or is included as a constant, compensated by other hydrological processes. This dissertation demonstrates that interception is a significant flux in the water balance, and that it influences subsequent processes in both quantity and timing. Interception is a major cause of the non-linear behaviour of catchments. By modelling interception correctly, the accuracy of high water forecasts can be greatly enhanced.

DELTA TECHNOLOGY

Probabilistic Analysis and Risk-based Design of Water Defences in Vietnam
Cong-Mai Van



This study further develops the method of probabilistic design and addresses a knowledge gap in its application

regarding safety and reliability, risk assessment and risk evaluation to the fields of flood defences. In this study, it has been proved that the specific reliability and risk based models already developed can be applied adequately to these situations in developing countries; the models are able to overcome problems of limited data.

CONSTRUCTION AND INFRASTRUCTURE

Low Adhesion in the Wheel-Rail Contact
Oscar Arias-Cuevas

It happens every autumn: slippery railway tracks caused by falling leaves. This research project examines alternatives to the conventional countermeasure of spreading sand on the rails. One such alternative might be 'adhesion enhancers', chemical substances applied to the rails, possibly as an adjunct to the sand. They may provide a better and more long-lasting effect, but are also more expensive. Another possibility is to use magnetic disk brakes. Almost half of Dutch trains are already fitted with such brakes, but they are intended only for emergency use. Further research is required to determine whether they will also be of use in increasing rail adhesion, with particular attention given to the durability and useful working life of the brake shoes.

Details of other doctoral dissertations can be found at:
www.promoties.citg.tudelft.nl

Alumnus Claire Boonstra: "Augmented Reality could become the new Facebook"

It is hard not to be impressed by alumnus Claire Boonstra. Ten years after graduating, she is the co-founder and co-director of Layar, a company that creates augmented reality (AR). Layar has the potential to be the next big technology company and she was a speaker at the recent World Economic Forum in Davos, Switzerland. And that is only the start.

Infrastructure is the main theme underlying Claire Boonstra's career from her student days to the present. It all started with her major Hydraulic Engineering and the company she co-founded is currently building the infrastructure for augmented reality. The second important ingredient: information technology. Boonstra was an immediate convert. "Internet, e-mail, mobile telephony and text messages all came to the fore while I was at university. It was a fascinating, unique period. The impact all this would have was one of the subjects of the thank you speech which I provided upon graduation, on behalf of my year."

Sparks

After an internship and graduation project at Interbeton, which took her to Venezuela among other places, Boonstra proved not to be able to shine in the somewhat conservative, old boys' industry. Luckily there were other opportunities. An eventful career followed both at corporate level (Unilever, KPN) and at smaller, innovative business units such as KPN's i-mode or the digital platform for Talpa [a broadcasting company]. "KPN infected me with the mobile virus," says Boonstra. She subsequently moved to her own company more quickly than she had expected. "In my spare time I worked on Mobile Monday which is an initiative aimed at bringing together the mobile industry. Together with Maarten Lens-FitzGerald and Raimo van der Klein we set up the Amsterdam version which became a huge success, in part thanks to the enormous rapport between the three of us. We generated sparks, there was so much inspiration when we met! After setting up a consultancy for mobile internet, SPRX (pronounced: sparks) we wanted to market a 'real' product. One of the ideas we toyed with was an augmented reality browser."

Rocket science

Layar was launched in March 2009. Layar was intended to add digital layers to reality i.e. to create augmented reality. Using mobile telephony, by now expanded to include GPS and a compass, you can add information to your environment. For example, where the nearest cash machine is, but also a



3D model of the historical environment. Infinite layers can be imagined: users themselves determine which of them are relevant to their situation. Boonstra: "It's not rocket science, it simply consists of combining the information available. However, when Layar was launched it became a subject on all the major internet forums inside 48 hours.

"My message is: train engineers to be team players, social, proactive"

Requests for a layer came in from around the globe. That made us realise we were onto something special." Due to the overwhelming attention it proved impossible to build all those layers ourselves. Layar decided not to be the maker, but the platform for makers. In

the meantime, thousands of companies around the world are already using Layar's infrastructure and the Layar app is already being supplied on millions of Samsung and LG mobile phones."

Kick start Delft

Back to TU Delft. When Boonstra talks about her student days it is clear she is enamoured with "the most beautiful of the three technical universities". "I learned an awful lot in Delft. Analytic thought, naturally, but also studying in a man's world. The many student society committees and boards also did a great deal to shape me. Delft gave me the basis for kick starting my career." Boonstra is not the type of woman to keep quiet if she is committed to something. During her time at TU Delft she regularly provided her opinion. "My intuition tells me there is too much emphasis on the 'hard' skills. We are trained to calculate a steel structure down to the smallest detail and that is also highly valued. But there isn't a single job profile that reads: 'must have knowledge of groundwater techniques', however they do demand that people are: 'team players, social, proactive'. My message is: train engineers that way! So they too can convince people that infrastructure needs to be structured in a particular way."

- Secondary education: European Baccalaureate, Europese School, Bergen, the Netherlands
- Graduated: Civil Engineering, Hydraulic Engineering & Civil Engineering Business Management stream (2000). Graduation thesis on: Document management on large Design & Construct projects
- Career: KPN (2001) Unilever (2003) Talpa (2006) SPRX mobile (2008) Layar (2009)
- Civil status: married with a son (2009)

New Facebook

Boonstra looks at home. "You're absolutely right. Through trial and error I have created an environment in which I can shine. I've been very lucky in life, but I also think that I am good at recognising opportunities and grasping them. I develop. I am one of those people that liked to do everything themselves and now suddenly I have to lead a team and give others the security and freedom to excel. That makes me really happy: the people on our team. You give them some responsibility and wow; they're getting better than us in what they do.

I can't imagine anything more fun than what I'm doing at the moment. I think Layar can have an impact on the world. We have the opportunity

"Delft gave me the basis for kick starting my career"

to develop into one of the giants like Google or Facebook. The opportunities that creates scare me a little sometimes. For example, there have been invitations to co-conceptualise with a European commissioner and to talk to world leaders in Davos as a Technology Pioneer at the World Economic Forum. Things that make you think: 'how the hell did we manage to do this?!' I still have to get used to it a bit, but I am starting to realise that I could acquire a role at a level much higher than the business community. What exactly, I don't know yet. I don't feel as if I have already achieved a lot. It's all only just starting."



InfraQuest keeps knowledge on board



Cooperation is now seen as the key to innovation, which is precisely why the InfraQuest partnership has been established. Max Hendriks represents the Faculty of CEG on the programme management team. He explains the rationale for InfraQuest.

Background

"The Dutch infrastructure network demands regular maintenance and modifications. This is particularly true now that the network is subject to even more intensive use. The major roads must remain open even while maintenance work is ongoing. In the past, the government itself took charge of all infrastructural development programmes. Today, both knowledge and responsibility for implementation are found elsewhere. The government is assuming the role of 'directing client', outsourcing projects on the basis of functional specifications. Rijkswaterstaat (the national Department of Transport, Public Works and Water Management) used to design roads and their related civil engineering structures 'in house', commissioning

TNO and TU Delft to perform the necessary research. Today, all design activities are opened to tender. If the government wishes to evaluate the tendering parties effectively, it is essential that knowledge is embedded and subject to ongoing development."

How will TU Delft benefit from InfraQuest?

"TU Delft has three key tasks: education, research and valorisation. InfraQuest will ensure that the research programme is more in line with societal demand. It will also generate extra contact between students and market parties, providing a good introduction to the profession and the employment opportunities that exist. InfraQuest will also promote the practical implementation of the specialist knowledge developed within TU Delft."

How will knowledge be embedded?

"InfraQuest will safeguard new knowledge and make it explicit through actual projects. By addressing the issues jointly, the three partners will share existing knowledge with each other, and will develop new knowledge based on both existing and new information. In doing so, we shall push back the boundaries and arrive at true innovation. The added value of InfraQuest is seen in its integrated approach, whereby all issues are viewed

from three perspectives: scientific and fundamental research (TU Delft), applied research (TNO) and practical experience (Rijkswaterstaat). Problems will be addressed more thoroughly, resulting in solutions of higher quality."

How will it work?

"The InfraQuest Expertise Centre was established in June this year, and has therefore yet to prove itself. Sharing valuable knowledge between several independent parties is always a sensitive undertaking. Nevertheless, if we are to maintain our leading position we must continue to develop. This demands that knowledge is shared. The distinguishing feature of InfraQuest is that it is a partnership of three organisations and can therefore address issues from three different angles. This not only provides a marvellous learning opportunity but is a highly effective way to arrive at solutions."

What is the focus of InfraQuest?

"InfraQuest is concerned with the road network and with all 'wet and dry' civil

engineering structures, with a specific focus on asset management and materials. For example, we shall research the most economical and technically responsible approach to outdated structures: should they be upgraded or replaced outright? We know that usage will continue to increase, while environmental legislation is becoming ever more restrictive. Choices must also be made in the light of new materials which can be applied when adapting or replacing roads and civil engineering structures."

What are the plans for the future?

"We are now developing the master plan which sets out the programme for the coming four years. There will be regular interim evaluations to determine whether we are still on course. Over time, we hope that InfraQuest will expand to include further partners, such as ProRail (managers of the national rail infrastructure), the large local authorities and private sector companies. We wish to grow to establish a broader international position."

InfraQuest is a cooperative alliance of TU Delft, Rijkswaterstaat, and TNO. Specialists in the field of road construction and civil engineering structures will work together to develop new knowledge and innovative, future-proof solutions. The partners will adopt an integrated approach, whereby problems and issues are addressed from three perspectives: scientific and fundamental research, applied research and practical experience

Further information www.infraquest.nl
Max Hendriks can be contacted on +31 15 278 6988.

So far, oil companies have only managed to recover a limited percentage of the oil present in oil reservoirs. Shell and TU Delft have started a new research programme aimed at increasing that percentage. The programme, the Recovery Factory, has a six-year duration and provides places for 8 new PhDs at TU Delft. It continues an existing collaboration and is entirely funded by Shell.

Shell and TU Delft invest in increasing the recovery factor

Experiment monitoring passage of fluids and gases through a porous medium



On average, only around slightly over two-thirds of the oil present in an oil reservoir can be recovered. Almost two-thirds of the oil remains behind. That may sound unbelievable, but it is less odd if you realise that an oil reservoir is not a hollow underground space filled with oil, but consists of rock, the pores of which are full of oil. Current technology only allows oil to be recovered from the larger, interconnected pores. It is still too hard or expensive to recover oil from the smaller pores.

Major effect

Together with TU Delft, Shell now wishes to develop an innovative technology to be able to recover part of the oil 'locked up' in those smaller pores. An important reason for doing so is the awareness that a higher recovery factor will be required to meet growing,

global energy demands. For example, it is becoming increasingly difficult to find new oil reserves and it seems as if the development of sustainable energy is not advancing rapidly enough to meet energy demands over the coming decades. Even a slight increase in the recovery factor has a major effect, which makes it appealing. For example, traditional oil reserves will increase by 88 million barrels if global oil recovery efficiency increases by one percent. At current production levels this amounts to the quantity of oil recovered over a three year period. Shell and TU Delft incidentally expect that efficiency can be improved by ten to twenty percent.

Combining

In the research programme, Shell and TU Delft will study how two promising technologies can be combined. This concerns 'Smart Fields' technology and

'Enhanced Oil Recovery' technology. The former concerns the application of smart measurement and regulation technologies that improve the monitoring and control of processes in an oil reservoir. Shell and TU Delft have been studying this for years and occupy a leading global position in this field. The second technology consists of techniques for reducing oil's viscosity so that it flows better and techniques to reduce oil's adherence to the rocks. This concerns, among other things, injecting steam, CO₂, surface surfactants (a type of soap) or polymers.

More effective and efficient

The idea is that Enhanced Oil Recovery techniques can be utilised more effectively and efficiently if more is known about which processes take place in the reservoir during oil

production. For example, the injection of surfactants can be optimised using advanced reservoir models and regulation systems combined with sensors that can detect fractions of these substances in the oil field. One of the options for increasing insight into the processes in the reservoirs is the combining of various measurement techniques. Think, for example, of fibre optic cables with optical sensors along the entire length of the oil field, seismic sensors in the sub surface and sensors in satellites that can detect minute deformations in the earth's surface.

Input from CEG, 3mE and EWI

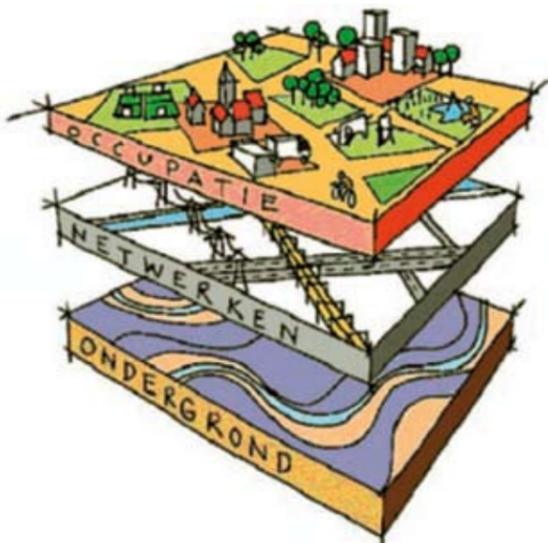
Three different TU Delft faculties participate in Recovery Factory. The CEG's department of Geotechnique, the Delft Center for Systems and Control of the Faculty of 3mE and the Delft Institute of Applied Mathematics of the EWI faculty provide expertise.

Further information

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Top: Dutch pavillion in Shanghai
Below: Multidisciplinary approach



DIMI at World Expo Shanghai

Sustainable solutions to spatial issues demand an integrated approach, with the various disciplines working alongside each other from the outset. This is the message presented by the researchers of the Delft Infrastructures & Mobility Initiative (DIMI), one of four such research initiatives at TU Delft, at a symposium held during the recent World Expo in Shanghai.

"China is currently working on an enormous land reclamation project to the north of Shanghai," states Hans de Boer, secretary of DIMI. "The plan is to create 1,800 square kilometres of new land. Chief adviser to the project is the rector of Hohai University, with which we have cooperated for many years in hydraulic engineering education and research. We would like to intensify this cooperation and are also keen to become involved in the land reclamation project. When we were offered the opportunity to organise an event at the World Expo in Shanghai with financial support from the Ministry of Education, Culture and Science, we seized it with both hands."

Multidisciplinary approach

"After some consideration, we decided to join Hohai in organising a symposium about delta and coastal development. This would offer us the opportunity to explain how we approach this type of project, and would allow our Chinese partners to present their plans in more detail. Our presentations emphasised the multidisciplinary approach which

DIMI always applies. It entails the involvement of all the various disciplines from the very outset of a project, each making a contribution based on its specific perspective. We firmly believe that this is the only way of arriving at solutions which are safe, sustainable, efficient and flexible, which enhance the quality of life and which have as little adverse environmental impact as possible."

Urban construction

"One question which demands a solution is how Amsterdam's housing requirement is to be met in the decades ahead. If you apply our integrated approach, it is soon apparent that redeveloping the former industrial sites alongside the IJ and Zaan rivers, where there is room for at least 45,000 new housing units, is a more promising solution than building 60,000 new homes as an expansion to Almere. Of course, building in the urban environment is more difficult than doing so in open countryside. However, there are a number of advantages which counterbalance the problems. The banks of the IJ and Zaan have all the elements required to create a very attractive residential environment. There would be no need for expensive transport links across the IJmeer (lake), and the existing industrial sites offer excellent opportunities for redevelopment. Building within the urban environment also helps to reduce traffic volume, creates a 'customer base' for high-quality public transport, avoids further encroachment on the rural landscape, and allows an adaptive, phased planning strategy to be adopted."

Concrete examples

"We presented our message by means of a multidisciplinary presentation. DIMI chairman Han Vrijling opened the

proceedings with an introduction to our integrated approach. He was followed by Han Meijer, Serge Hoogendoorn, Ties Rijcken, Michiel de Jong, Marcel Stive and Michel van Tooren, each of whom used concrete examples to illustrate the contribution made by their respective disciplines - urban planning, transport, water safety, harbour development, hydraulic engineering and aviation - to large-scale urban development projects."

More open planning processes

The audience, made up of representatives of Chinese universities, knowledge institutes, local and regional authorities, showed great interest in the DIMI presentation, reports Marcel Stive.

"Of course, the multidisciplinary approach in itself is nothing new for the Chinese. Even so, it seems that they are still trying to find ways of putting into practice effectively. There was a discussion about the desirability of more open planning processes, and whether the interests of stakeholders should be taken more fully into account. In general, however, there remains little for the Chinese to learn. They realise that knowledge development demands international partnerships, and they are certainly interested in further cooperation with us. In that context, I can report that we have welcomed yet another postdoctoral researcher and a PhD student from Hohai since our visit to Shanghai."

MSc Water Management student's team score at the World Expo

Pitch your solution to a water problem to an international audience in two minutes. That was the challenge facing five teams consisting of Dutch and Chinese students from water study programmes in June during the Holland Water Week at the World Expo in Shanghai. The Netherlands Water Partnership (NWP) organised this activity for the international promotion of Dutch water study programmes.

A few months earlier, every team of Rotterdam's municipal services organisation had been commissioned to start working on a concrete problem affecting delta areas around the world. What can you do to stop river mouths becoming blocked with sediment? How do you keep groundwater levels in cities stable? Which options are there for flood-safe area development?

Tim van Emmerik a MSc Water Management from Delft and his team were assigned the question as to how to guarantee future water safety whilst allowing densely populated cities such as Rotterdam and Shanghai to develop. His team's solution combined a multi-functional barrier with floating homes. They detailed their idea for the Maasboulevard in Rotterdam.

To create room for the water barrier-housing combination, the students

moved car traffic underground. To this end, their plan envisages building a tunnel using diaphragm walls. The water barrier also houses car parks and, for example, offices whose walls keep the water out. Making smart use of the subsurface enables the aboveground area to be laid out as a park. In front of the water barrier lie housing pontoons which rise and fall with the river's water levels.

The professional jury that assessed the solutions presented were impressed by the plan and awarded the main prize to it.

Tim van Emmerik (2nd from right) and his team



Flow: Far and Large Offshore Wind

Little experience has been gained in building or operating windfarms far offshore in deep water. The FLOW programme - Far and Large Offshore Wind - is to rectify this omission. It is being conducted by a consortium of private sector companies and knowledge institutes, including TU Delft. In addition to research, the partners will construct a demonstration windfarm.



"The Dutch government has stated the aim of generating 6,000 megawatts of offshore wind energy by 2020. It would be possible to achieve no more than half of this figure within fifty or sixty kilometres of the coast," states Jan van der Tempel of the Offshore Wind section at the Faculty of CEG. "The number of suitable locations is severely restricted by shipping routes and oil platforms, environmental legislation and the visual impact that a large windfarm would have. The remaining 3,000 megawatts must therefore be generated farther offshore, in water which is up to 45 metres deep. The knowledge required to do so in the most effective manner does not yet exist."

Cost savings

"For the time being, government policy will focus on the construction of nearshore windfarms, Jan van der Tempel continues. "Nevertheless, the FLOW consortium has already begun to develop the technology and skills required for windfarms at a much greater distance from land. This will enable us to establish a

leading global position and to offer various technological solutions which will reduce the costs of constructing windfarms in future. Substantial savings are indeed possible, as confirmed by our recent calculations for the Prinses Amalia windfarm off the coast of IJmuiden. The current knowledge suggests that the foundations and support structures could be built using 25% less steel."

Logistic considerations

A PhD student with the Offshore Wind section has now started a research project examining various types of support structure. He is not concerned solely with the best way of building the structures, but must also take logistical aspects into consideration. "A far offshore windfarm could easily have two hundred individual turbines. Ideally, all would be erected during a single summer. That means that all components must be readily transportable and that the installation process must not be too complex. We are therefore looking at the 'mono-mast'. It used to be thought that this type of tubular steel

structure was only suitable for use in shallow water, but it has since been used at a depth of 32 metres. We think it likely that the mono-mast could be used in even deeper water."

structure was only suitable for use in shallow water, but it has since been used at a depth of 32 metres. We think it likely that the mono-mast could be used in even deeper water."

New turbine concepts

"Of course, the consortium will also research many other aspects. We want to determine how best to construct and maintain a windfarm which is several hours away from the nearest port. We are also conducting research into new turbine concepts and ways of upscaling the existing turbines. Another focus is the interaction between the turbines and the wind. On land, buildings and trees cause turbulence which mixes the various levels of air. As a result, all turbines in a windfarm receive approximately the same amount of wind. Far offshore, there is no turbulence and each successive line of turbines will receive slightly less wind. We are studying whether this anomaly can be resolved by reducing the wind catchment of the first line of turbines, for example."

Monitoring mast

"Within a few years, we hope to start work on a demonstration windfarm 75 kilometres off the coast of Callants-oog. It will have between twenty and sixty turbines, each producing approximately 5 megawatts. The site will enable us to test our innovations and gain further experience. We already have the necessary construction permits and will soon erect a monitoring mast which will provide information about the waves, wind and currents at the site. During the installation, we shall measure the noise produced and test various noise-reduction measures."

The members of the FLOW consortium are RWE, Eneco, TenneT, Ballast Nedam, Van Oord, IHC Merwede, 2-B Energy, XEMC Darwind, ECN and TU Delft.

NEW PROFESSORSHIPS

Prof. Gert-Jan Medema

Chair of Water and Health, sponsored by KWR



There is a close relationship between the water cycle and waterborne diseases. A minor disruption to the normal functioning of the water cycle can lead to the spread of disease. In the past, we have seen outbreaks of cholera, typhus, dysentery, trachoma and malaria. The introduction of public drinking water supplies, sanitation and modern purification methods have eradicated these diseases from the Netherlands. However, there are new and re-emerging pathogens that can

be transmitted through water. My discipline, Water and Health, focuses on how these pathogens spread and the measures which can be taken to prevent them from doing so. The latest molecular-genetic technology enables us to detect and monitor viruses, bacteria and parasites in the environment. We can determine exactly where they multiply and thrive, and can identify the routes by which they spread. My research new technology which can eradicate or inactivate the pathogens, as well as conventional purification technology and small-scale applications for localised treatment of drinking water and wastewater. In short, we are helping to create a healthy water cycle.

Prof. Luuk Rietveld

Chair of Integration and Innovation in the Urban Water Cycle, sponsored by Waternet



Water management authorities, the utility companies which supply water, industrial users and regional authorities should join forces in a complete review and restructuring of the urban water cycle at the regional level. What are the available sources of supply, what is the demand, and how can the two be matched as effectively as possible? Greater cooperation will help to ensure a climate-neutral water cycle, whereby energy consumption can be reduced. Indeed, it may even be possible to generate energy from the various water flows. A good example is the system used by DOW Chemical in Terneuzen, which uses membrane filtration to convert wastewater from the region into process water for use in the boilers. This is less expensive than drawing salt water from the nearby Westerschelde. Attention must also be devoted to water and sanitation in the developing countries. Specifically, we must develop more permanent solutions for the management and maintenance of water and sanitation systems. People in the African interior have access to mobile phones. They should be able to use them to report a non-functioning supply point. IT companies have a role to play here. TU Delft is keen to pursue research into this type of problem, in partnership with the countries concerned.

Prof. Bart van Arem

Chair of Mobility



The car should assume more of the driver's tasks. No matter how good a driver we consider ourselves to be, we cannot match technology in terms of alertness and reaction time. Today's vehicles are becoming ever more 'intelligent'. Navigation systems not only tell us the best route, but inform us of the local speed limit, whether there are any diversions or roadworks, where to find a parking space, and so forth. 'The intelligent road' works in conjunction with the intelligent vehicle, exchanging information about position, load, destination, speed, accidents and breakdowns, enabling prompt action to be taken. The next step is 'cooperative vehicle-roads systems', in which vehicles communicate with the road and with each other. Lane Keeping Support systems warn the driver if he seems likely to stray out of his lane; the Adaptive Cruise Control maintains a safe speed and a safe distance from the car in front. Within the next ten to fifteen years, Intelligent Transport Systems can help to reduce congestion by 50%, accident fatalities by 25%, CO₂ emissions by 10% and overall air pollution by some 20%. TU Delft is among the world's Top Five in the field of Mobility, alongside MIT, Berkeley University and Imperial College London.

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Further information
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Live Love Levee

Project plan for flood safety with sustainable delta city development

Destination Rotterdam & Shanghai

Current levees in the delta cities will be reinforced and elevated. In the areas with no levees, new ones will be placed. For Rotterdam, this concept is of great value to redevelop and attract people to the South part of the city and reinforce the North part. Shanghai has the opportunity to expand its city in the ocean with an addition of land. Hereby, the current flood protection will be reassessed and increase the safety of the city. Because of the total range in the ocean, the project plan for Shanghai is without floating housing.

Living space

- New housing behind levees
- Floating houses on water
- Floating houses rise with water level
- Magnificent view on green and river
- Peaceful environment

Startup companies

- Startup company offices in new levees
- Live & work side by side
- No road traffic, less commuting
- Attract people to delta cities

Green environment

- New trees & plants & lawns
- Comfortable for families to live, play and relax
- Good environment for sports
- Live next to water
- Sustainability: green roofs, water energy, no green house gasses
- Safety without traffic

Traffic

- New housing behind levees
- Floating houses on water
- Floating houses rise with water level
- Magnificent view on green and river
- Peaceful environment

Construction costs

| | Rotterdam | Shanghai |
|-----------------------------------|------------------|------------------|
| Private house | € 100.000.000 | € 100.000.000 |
| Company parking | € 1.000.000.000 | € 1.000.000.000 |
| Tower | € 10.000.000.000 | € 1.000.000.000 |
| Portion | € 1.000.000.000 | € 1.250.000.000 |
| Levee with integrated small canal | € 1.100.000.000 | € 1.750.000.000 |
| Diaphragm | € 1.000.000.000 | € 2.000.000.000 |
| Green water | € 1.000.000.000 | € 1.000.000.000 |
| Water | € 10.000.000.000 | € 10.000.000.000 |

The estimated costs of Shanghai will be around 20% lower. This is caused by the lower construction and lower material costs.

Construction plan

Phase 1: Average situation next to the Maas River with 4 lanes.

Phase 2: (3 months) Start construction first two diaphragm walls, 4 lanes stay open.

Phase 3: (3 months) Excavation and construction of the lower floor.

Phase 4: (6 months) Completion of the 4 lane tunnel, constructed via the Cut & Cover method. Start construction last diaphragm wall.

Phase 5: (2 months) Excavation second segment. After 2.5m placing of pressure bars. This is needed because of the sudden lack of passive ground pressure.

Phase 6: (6 months) Completion underground three story underground construction and construction protection levee.

Total duration: 24 months

Contact details: Delta Design, deltax@tudelft.nl@gmail.com
van der Meer, Trijntje van Eemeren, Trijntje van Eemeren, W. J. M. S. Rijk



How do major buildings influence the microclimate in cities? Does more rain fall in certain parts of the city than in others? Which effect do green facades and roofs have?

Professor of Water Resources Management and head of the Delft Research Initiative Environment Nick van de Giesen tries to answer this type of question with help from colleagues at other faculties. To this end, they have transformed the campus into a laboratory for studying microclimates in cities.

Campus as urban trial setting



"Until recently, research into environmental and climate problems at TU Delft was rather fragmented. Research projects were underway at various faculties and researchers regularly conferred, but there was no structural consultation, mutual harmonisation or a joint research agenda," explains Van de Giesen. "The founding of the Delft Research Initiative Environment changed all that. For example, it was once discussed how more measuring would be a good idea, but it never got further than that. During one of our regular meetings we discussed the idea again and decided to substantiate it. We thereby consciously opted for urban measurements as almost nothing is known about weather in cities and the various microclimates in urban areas. That is hardly surprising as most weather stations are located in rural areas, among other things, because the World Meteorological Organisation demands that the distance between a

weather station and a building should measure at least ten times the height of that building."

The effects of climate change

"That is a very reasonable demand if you want to make weather forecasts for a large area. We are interested in something else though. We want to know what the interaction is between the weather and urban buildings and which differences occur over short distances. If, for example, cities prove to have large variations in precipitation quantities you can take these into account when dimensioning your sewerage. Another reason for deciding to measure in cities is that, by now, almost half the world's population live in cities. This is why it is becoming increasingly important to know what the effects of climate change are on life in the city."

Van de Giesen continues: "Initially we wanted to carry out measurements in

Delft. That proved difficult however. We therefore opted to structure the campus - which can be considered a small city - as a trial area and over the coming years we are going to fill it with measuring devices. This is the Climate City Campus project."

Wind meters

Over the coming years, Van de Giesen and his colleagues strive to initiate multi-disciplinary student projects in particular. In order to get students interested and to make them aware of the Climate City Campus project they organised a scrapheap challenge in June. Teams of bachelor students were challenged to create a wind meter from scrap inside a couple of hours. Rolf Hut, one of Van de Giesen's PhDs, collected unused equipment from the various faculties to this end. At the end of the meeting all the wind meters were tested in the wind tunnel. By now, the best wind meter is being

further developed under the auspices of an Industrial Design lecturer. The idea is to use this wind meter on campus atop 8 metre poles. The latter will change colour as the temperature changes to draw attention to the local microclimate.

Greeting cards

That Hut came up with the idea for a scrapheap challenge should come as no surprise. Among other things, he makes rain meters using the speakers from greeting cards. These speakers consist of a thin piezoelectric disk which deforms under the influence of a small electrical current and then produces a sound. The disk also does the opposite i.e. if a raindrop falls on it vibrations develop which cause electrical current to flow and it is this principle that Hut exploits. By measuring these electrical currents he can not only determine how many drops fall on the disk, but also what size they were and what

CLIMATE CITY CAMPUS AND IBM'S SMARTER CITY

"IBM is convinced that the world is increasingly being equipped with sensors and that by intelligently combining all manner of data you can create new, high-quality information," explains IBM Business Development Executive Djeevan Schiferli. "Information which allows you to make better decisions. An example: extensive monitoring provides improved insight

into a city's water system which can help to prevent major expenditure for new sewerage. An important precondition is that all data should be properly accessible. This demands a well thought out IT platform. We have noticed cities around the globe requiring such a platform. We are helping parties to develop one under the moniker Smarter Cities. The Climate City Campus project appeals to us as it allows us to show how we can support scientists and companies."



the ratio was between small and large drops. Initially, Hut developed the rain meter - which costs under ten Euros if he buys the Electronics required - for use in Africa, but he now wants to use the meter on the campus. He would, for example, like to map the rainfall variation around the Elektrotechniek, Wiskunde en Informatica [Electrical Engineering, Mathematics and Computer Science] (EWI) building. This requires a large number of rain meters and would be prohibitively expensive if commercially available models were used.

Advanced radar

The precipitation data collected using rain meters can provide an excellent addition to the data collected by Professor of Remote Sensing Herman Russchenberg's group using the Parsax radar. This advanced radar is located on the roof of EWI's tower block and can see into the clouds up to a height of fifteen kilometres. The great advantage of this radar is its high resolution. The Parsax has a resolution of a few meters as opposed to the Royal Netherlands Meteorological Institute KNMI's shower radar which has a resolution of approximately

one kilometre. "Our radar's resolution makes it possible to monitor the entire rain development process. We can determine whether it will rain, what happens to the raindrops on the way down and how much rain is going to fall," says Russchenberg. "The only thing we cannot observe is what happens to the rain during the last 100 metres. Luckily that can be deduced from the data collected by the rain meters."

Deluge of measurement data

According to Russchenberg measuring precipitation is just the start: "In the

meantime, a number of other student projects have started. For example, a group from Geomatics is developing a 3D model of the campus. Combined with the precipitation data this model allows us to 'fly' through the rain on campus. You can also use such a model to show where all the various measurement devices are located. Another group is studying how the radar data can be used to create a detailed campus-oriented shower radar. Furthermore, there are plans to start measuring wind, turbulence around buildings, temperature and humidity and, for example, to commence

measurements on green facades and roofs. All these projects create an increasing deluge of measurement data. In order to be able to deal with all this data properly we are cooperating intensively with IBM. The company is helping us to set up an IT architecture which not only ensures that retrieving all manner of data is easy, but also that data is stored properly and is properly accessible to users; whether they be researchers or companies."

Sustainable heat for TU and its surroundings

The idea developed three years ago in 'Het Noorden', the bar the mining students meet at. What if we study whether we could heat the campus using geothermal energy? The 'bar born' idea rapidly developed into a successful project.

For years, geothermal energy i.e. using warm water from the deep subsurface played a very minor role in the Geotechnology department's education and research. The student initiative which is known as the Delft Aardwarmteproject (DAP) [Delft Geothermal Project] has changed all that. Education once again pays serious attention to geothermal energy and approximately fifteen graduation research projects have been completed into this aspect of geotechnology. For example, an accurate model has been developed of the Delft area's deep subsurface. Research has also been carried out into the horizontal and vertical distribution of warm water in the deep aquifers and to what extent extractions in various locations influence one another. The latter has revealed that the rocks are sufficiently porous to be able to extract considerable amounts of warm water simultaneously injecting the

same quantity of cooled water elsewhere. After this became known, DAP applied to the Ministry of Economic Affairs for a geothermal energy source exploration permit. The latter was granted in August 2009. This made a trial possible.

In the meantime geothermal wells have been drilled at two market gardening companies. Drilling the wells on campus will also soon take place now that their definitive design has almost been completed. The plan is use an innovative technique to drill these wells. This concerns composite profile pipes which are substantially lighter than steel pipes. This enables a much smaller drilling system to be used, greatly reducing drilling costs. The idea is to pump up approximately 150 cubic metres of 75° C water from these per hour. If this is used to heat buildings it will annually save some five million cubic metres of natural gas.

The knowledge developed within DAP has been presented at various international conferences. Recently, Delft hosted the second DAP symposium. Students and researchers cooperate with the business community in DAP.

DAP members
Chris den Boer
(left) and
Douglas Gilding



Further information
www.delftaardwarmteproject.nl

The best teachers devote attention to the student

Motivating students is an art. Last year, students named two staff from the Faculty of Civil Engineering and Geosciences as the university's most inspiring teachers. How do they succeed in engaging young talent, and what can we learn from them?



'Surprised' is the best way to describe the two staff members' initial reaction to the awards. Dr Susanne Rudolph, associate professor of Petroleum Engineering had no idea that she was 'in the running' for the title 'TU Delft Teacher of the Year' until the official nominations were announced. Dr Huub Savenije, professor of Hydrology, was similarly unaware of his nomination for the Leermeestersprijs (Delft University Fund Masters' Prize).

Promises and interaction

"But I was of course extremely pleased, not least because students clearly realise that I am eager to help them," recalls Susanne Rudolph. When asked about her teaching style, she explains that she always thinks back to her own time as a student. She knows that students do not always speak the same language as the teacher, and may not share the same level of enthusiasm for the subject matter. "Some modules are really quite dull but they form part of the curriculum and have to be studied. I may not be able to make them any easier, but I do try to show the relevance to students' everyday lives so they do become more interesting. I also accept that I must sometimes spend time away from the lecture room filling in the gaps in my knowledge. I always try to keep my promises in this regard, even if it means that I have less time for my own pursuits. After all, students depend on us. This is an institute of education and teaching students is my number one priority, even if it is sometimes difficult to find the right balance. My colleagues often remind me that I also have to publish enough articles and papers."

"Conveying enthusiasm in an attractive way, while also pursuing the necessary depth." That is how Huub Savenije sums up his own successful approach. It earned him the Leermeestersprijs, awarded annually to a professor who has been a source of inspiration and knowledge for students and researchers. "Students want to be entertained. While entertainment must never be sole objective, you do want students to enjoy what they are doing. They will then try to do their best."

Savenije uses intriguing questions and voting boxes to promote interaction in large groups. He then examines the topic of the vote in greater detail. "Often, the students will then want to know every little detail. Our students are very intelligent young people. You can reach out to them by putting that intelligence to the test. Once you

"When people do work together and get to know each other, the processes run far more efficiently."

have their attention, you can deal with extremely complex theory in great depth." Prof. Savenije admits that engaging students' interest sometimes demands considerable effort. Nevertheless, like Susanne Rudolph he believes that it is an essential part of his work. "Moreover, it gives me immense satisfaction."

"After all, students depend on us. This is an institute of education and teaching students is my number one priority."

Human companies

It is not only universities which must address the wishes and requirements of talented young students. Companies and other organisations must also do so if they are to attract and retain graduates of the right calibre. Susanne Rudolph believes that many organisations fail to provide proper guidance and support. "Many are now having to do more work with less people. Time spent in mentoring younger staff is an investment which

he provides. This would make a company more 'human'."

Huub Savenije spent six months working in Australia, where he noticed that things can indeed be done differently, and not just in terms of training and mentoring. "Australians work extremely hard, yet have considerable time and attention for each other. I found this very inspiring. In the Netherlands, the attitude is often, 'go away, I'm busy, I don't have time for you.' However, when people do work together and get to know each other, the processes run far more efficiently. There are fewer misunderstandings and less frustration. Because processes are more efficient, the time devoted to personal interaction is recouped in other ways. I always try to apply this principle."

Huub Savenije has another tip for prospective employers: become involved in student activities, perhaps as a sponsor. "Student societies welcome your interest. You will have a front row seat at events such as debates, study days and graduation presentations. You then have direct access to the very best students when you wish to recruit new staff."

Name:
SUSANNE RUDOLPH
(b. 1967)
Position: Associate Professor, Faculty of Civil Engineering and Geosciences
Courses: Properties of hydrocarbons and reservoir fluids, rock fluid interactions I, conversions course thermodynamics and chemistry, and part of Introduction to Petroleum Engineering. Coordinator and lecturer in petroleum engineering special topics.

Name:
HUUB SAVENIJE
(b. 1952)
Position: Professor of Hydrology
Courses: Hydrology; Hydrology of catchments river basins and deltas; Hydrological models; Water quality modelling.

COLOPHON

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