



inside information

MOLLIER | UNIT BPS | STUDENTS | ACTIVITIES | MEMBERS

Development of eco-concrete

Motivation and regulations in the Netherlands

De kracht van duurzaamheid

KP&T

Constitution 17th board

Foreword

**President and Commissioner Education
s.v.b.p.s Mollier**

Richard Claessen



Dear reader,

With the end of 2012 in sight we can look back at yet an interesting and eventful year.

2012 was the year in which the transition from 'Building Services' and 'Physics of the Built Environment' was finally completed and the master track 'Building Physics and Services' was officially launched. These changes at educational level also influenced our association. I think these changes have been tackled very well by the old board. With the change of boards in September (see also this INSide Information!) the new board took over. Having already three months behind us, our enthusiasm is still large and unchanged.

The end of 2012 also means a new INSide Information, the first of this academic year.

In this edition of INSide Information attention is paid to sustainability. With the current environmental problems, sustainability is becoming increasingly important. BPS engineers may contribute greatly in solving these problems.

With articles about eco-concrete, an energy neutral TU/e main building and two sustainable offices all aspects of sustainability are covered.

Further you can read about recent activities: the Start Activity to Warsaw and the End Activity to the Belgium Ardennes. Both Activities were very successful and well organized by the concerning Commissions.

At the end of 2012 we do not only look back, but we also look forward.

Some interesting excursions and workshops lie ahead. Keep an eye on your mail, our new Facebook page and our website to stay updated and to make sure you don't miss anything!

End of April it is again time for our yearly study trip. The BTL-commission is currently working hard to compile an interesting program for this trip, with destination Ho Chi Minh City (Vietnam).

For now I wish you many inspiring moments when reading this INSide Information.

On behalf of the entire board and the editors of this INSide Information I wish you Happy Holidays and an inspiring 2013!

Richard Claessen
President and Commissioner Education s.v.b.p.s. Mollier

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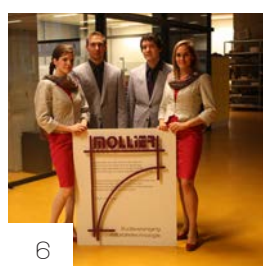
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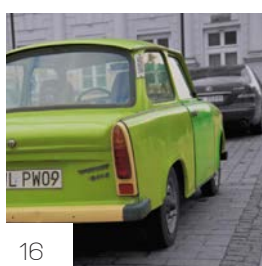
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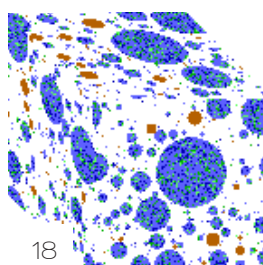


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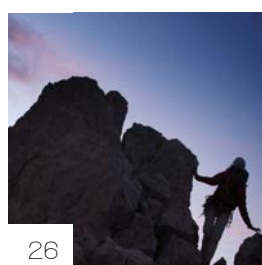


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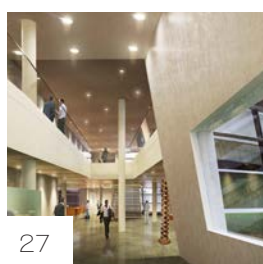


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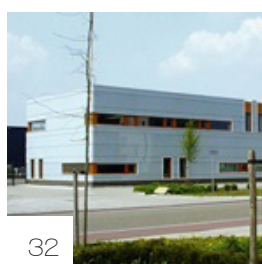


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Patrick Creemers, Ilse Schoenmakers, Karin Conen & Richard Claessen

New board of Mollier

Richard Claessen
President & Education
Commissioner

My name is Richard Claessen, 22 years old, born and raised in Geulle (Limburg) and since 2010 living in Eindhoven. I went to high school in Meerssen, after which I could finally fulfill my long-cherished dream: to become an architect. Well, things turned out differently, and here I am studying Building Physics and Services and being President and Commissioner Education of s.v.b.p.s. Mollier this year.

I am in my senior year now and currently busy with my graduation project. However, enough time remains for my tasks as board member. Of course I don't have to do it

all by myself; with Ilse Schoenmakers, Patrick Creemers and Karin Conen there is quite some team this year.

In my spare time I like to travel, to meet new cultures and to see beautiful architecture. This year I went, together with Patrick, to Australia for a conference to present our master project. There we traveled to different places, where we have seen beautiful things. When I have the time, I also enjoy to fitness a bit in the sportcenter at the TU/e campus.

I am very confident that this year will be an interesting and exciting year. We, as board, will do whatever we can to contribute to this. As association we want to be the link between students, companies and the university. I am looking forward to this year.

Ilse Schoenmakers
Secretary and commissioner internal relations

A new board means new people to introduce. My name is Ilse Schoenmakers, born on the 8th of February 1990 in a small town in Limburg called Herkenbosch. Before I came to study at the University of Technology in Eindhoven, I graduated Built Environment (Construction and Architecture) at HsZuyd in Heerlen. The objective of my graduation project was to make an energy-, water-, environmental and material neutral office building at 'De Wijk van Morgen'. Due to this project I became interested in Building Physics and Services. And now I am studying in this discipline.

Nowadays I live in the beautiful and lovely city of Eindhoven 3 minutes by bike from the university. In the past, in my spare time I was always swimming and playing waterpolo. When I was 10 years old, my competitor at the NK junior was the now famous Ranomi Kromowidjojo.

Since I'm living in Eindhoven, I play hockey at Donquishoot, a student hockey team. Being a student means also hanging out in the pub sometimes,

together with friends. In Mollier's pub 'de Spijker' at Stratum Eindhoven, almost always a member of Mollier can be found.

One day a week I am working for a technical consultancy company in Eindhoven. During the meet and greet of Mollier I met employees of the company and I became also an employee of this lovely company.

Mollier did a real good job for me, so what can I do for Mollier? Because I am a "bezige bij" as said in the Netherlands, the previous year I was much involved with Mollier, with pleasure I was organizing the studytrip to Mumbai, the beauty & poker event, I was concerned with the magazing INSide, helping the board with lunchreadings and the meet and greet. After all these experience, now I can call myself member of the board of Mollier and be secretary and commissioner internal relations.

Together with the board (Richard, Patrick, Karin), the companies and also the commissions of Active members of Mollier, I do provide a good year for Mollier as study association. I'm looking forward to a successful year, with a lot of knowledge, many activities and fun.

Finally, I wish you all a instructive year, with a lot of knowledge.

"Mollier version 17.0 is born with a mission: keep Mollier lively and enthusiastic."

Karin Conen
Commissioner external relations & Vice-President

A new year, a new INSide Information. Time to introduce the new board! To all who have not heard of us yet, which seems very surreal to me ;), and those who just want to know more about us: Enjoy! Unfortunately, we cannot fill the whole INSide with stories about ourselves, but I am sure that this year much more moments for juicy gossip will follow.

Anyways, let me introduce myself briefly. I am Karin, born on February 17th 1989, in a small but beautiful village in the south of the Netherlands called Hoensbroek. Even though it is a nice place to grow up, I decided to move to Eindhoven last May. So far, no regrets!

For me, moving to Eindhoven meant a whole new world of opportunities. It amongst others offered me the possibility to become more involved with the wonderful study association for Building Physics and Services, Mollier, and its great activities such as the starting activity to Warsaw the second weekend of October this year. I am looking forward to all the other nice things Mollier has to offer and meeting you all. If you are in for a chat, you are always welcome.

One of my hobbies is music. Unfortunately, I cannot play an instrument so it stays with listening to it. Another passion of mine is racecars, which is why I joined the Solar Team Eindhoven last June as an aerodynamics engineer. Furthermore, I like movies and good food.

My position inside Mollier is to form a link between the master students of our study association and the business world. I am the Commissioner External Relations, which means that I maintain old and create new (sponsorship) relations. Not the easiest job in financial times as these, but I am sure that also this year we will be able to organize a bunch of activities and parties you will like.

Hope to see you all there and if you have any ideas or other thoughts you want to share with us, you know where to find us!



Patrick Creemers
Treasurer

In this new, completely Limburgian, board there is still a semi-foreigner. My friends at home sometimes call me 'the Limburgian German', because I like to spend most of my time in this country for many different things. My real name is Patrick Creemers, born in Posterholt on the 6th of September 1990. I still live in the same house as I was born and not felt the need to change the travelling time of 50 minutes and the free dinner with a good cook for a life full of self-supplying meals, doing the laundry and other stuff.

After graduating from my high school in Roermond, I started the course 'Bouwkunde' at the TU/e in 2008. Since my first year I know that I do not want to be an architect, but someone who can communicate with architects to improve the build product. So I started with the master Building Physics and Services last year.

Last year I was also part of the Financial Control Commission and I think the experience I had there, and in other commission work outside the TU/e, will help me in my new function as treasurer. Hopefully, my team, consisting of Ilse,



Richard Claessen

President & Education commissioner



Ilse Schoenmakers

Secretary & Commissioner internal relations

ver vooruit in duurzame technologie

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who I know since our childhood; Karin; and last but not least Richard, the man who travelled to and across Australia with me last summer for a congress and some exploration of this country, will support each other through all the times that come.

Next to my life as a student and board member I can be found in a swimming pool. My great successes were alive when I was 14 to 17 year, but an injury (an infection on my appendix) held me from still being part of the National and International top. Currently I still swim 5 times a week and tutor young top swimmers for 2 days a week. This also explains why I have not moved to Eindhoven, but stayed at home.

The next step for Mollier is that we need to build further on the solid base the 16th board left for us. Inspired by Tom, Ellen and Rik we need to make sure that the new members of Mollier will be as a family; positive about the whole association, and join the commissions to make this a year to remember!



Patrick Creemers

Treasurer



Karin Conen

Commissioner external relations & Vice president



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Human centered energy control taking occupancy in the control loop of building systems

The energy use in the built environment accounts for nearly 40% of the total energy use in the Netherlands. Most of the used energy in the built environment (nearly 87% for non-residential) is used for building systems with the goal of providing comfort for the building occupants. In practice the intended energy efficiency as well as comfort level of the HVAC systems is not achieved, resulting in more sickness absence, lower productivity and higher energy costs. Here a new strategy is presented resulting in lower energy use with a higher comfort level: the Human-in-the-Loop approach



H.N. (Rik) Maaijen

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INTRODUCTION

During the 1970s and 1980s there became awareness that available energy (e.g. oil, coal) on our planet is limited, but also that the environment needs to be protected because the use of fossil energy sources causes undesirable greenhouse gases. This awareness resulted in a demand for energy savings in buildings. In the last decades the energy performance of buildings improved by better insulation of buildings, more efficient comfort installations and local production of sustainable energy. Still the energy use in the built environment accounts for nearly 40% of the total energy use in the Netherlands. Most of the used energy in the built environment (nearly 87% for non-residential) is used for building systems with the goal of providing comfort for the building occupants [Opstelten et al., 2007]. This emphasizes the importance of reducing the energy use for comfort systems. The EU Directive Energy Performance of Buildings (EPBD) concerns the use of energy in buildings and urges member nations of the EU to set stricter regulations regarding the efficient use of energy in buildings. Energy performance of buildings is key to achieve the EPBD objectives, namely the reduction of a 20% of the greenhouse gases emissions by 2020 and a 20% energy savings by 2020 compared to 1990 level, and even an energy neutral environment by the year 2050 [EC, 2012].

The satisfaction of the occupants with their thermal environment mainly determines the success of the application of HVAC systems. However, in practice the intended energy efficiency as well as comfort level of these HVAC systems is not achieved, resulting in more sickness absence, lower productivity and higher energy costs. To meet the demand for both a more comfortable indoor environment and building energy savings, it is necessary to implement knowledge of the building user in the building comfort control strategy. This section gives an introduction on the energy performances in the built environment, the building user with his or her need for comfort, and the proposed human in the loop approach.

With our current way of thinking and designing those future EPBD objectives will not be achieved. The urgency to bring all measures for improvement of the energy performance into action, and thereby connecting national and international policies, increases [Opstelten et al., 2007].

Therefore steps need to be made to increase the building energy performances which could be done by looking in more detail into the human comfort, the main goal of the energy consumption.

COMFORT PERFORMANCE LEADING

Traditional comfort control of the indoor environment has been focused on temperature regulation. This control objective often fails in achieving the primary goal of HVAC systems: a thermally comfortable perceived environment. The main reason is that the body thermal state not only depends on indoor air temperature, but also on other environmental variables (e.g. mean radiant temperature, air velocity, relative humidity) and personal factors such as clothing resistance and activity level.

This means that current building systems which rely on code defined occupant comfort ranges [Klein et al., 2012] are inefficient in their energy usage for maintaining occupant

WINNER REHVA STUDENT COMPETITION!

For a third time in a row (!) a student of Mollier won the European REHVA Student Competition! Rik Maaijen received his price at the REHVA annual meeting in Romania for this graduation project: Human Centered Energy Control. Hereby, he proposed a new bottom-up approach to enhance a higher comfort level, while saving energy by making the human central in the control of building systems. As Mollier we are very proud of this achievement, which also indicates that our level of education certainly belongs to the top of Europe!



comfort as they operate according to fixed schedules and maximum design occupancy assumptions.

In response to discomfort, the building user performs actions in an attempt to restore his individual comfort [Haldi et al., 2010]. These actions are diverse and can be divided into actions that change the occupants' environment (e.g. opening of windows) and so called personal actions (e.g. get a cup of tea). An undesired effect of these actions is that the energy use of the HVAC system often increases, especially in more energy efficient buildings [Hoes et al., 2011].

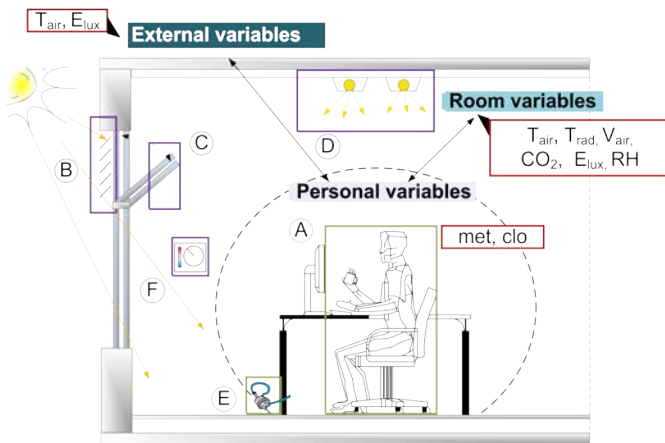


Figure 1. Parameters for human comfort (red box), with the user actions to influence the environment, B. blind control, C. window opening, D. lighting – and F. thermostat control (purple box) and user influence influencing indoor environment, A. user presence and E. use of appliances (green box). considering the lifetime of the building

To avoid energy wasting behaviour it is needed to deploy energy effectively for comfort on those spots where needed. To achieve this conveniently it is necessary that the HVAC systems automatically adapts to the actual individual needs. This requires a method where the user with his individual needs is included in the control loop of building comfort systems. Within this research this method is called the 'human in the loop approach'.

THE HUMAN IN THE LOOP APPROACH

A control strategy for HVAC control based on the actual demand by the individual users is proposed. It is necessary to look at what locations in the building there are momentary demands for individual comfort and related energy demand of appliances in an office building. Therefore this research looks at the needed energy flows from individual to floor level.

Literature shows that workplaces in office buildings are unoccupied for a large percentage of time, and differ between buildings [Mahdavi et al., 2011]. The coming and going of office workers is deterministic, varying from day to day and from time to time. In modern building an attempt is made to reduce the energy demand by occupant detection. Parys et al. 2011 divided the research towards user behavioural into six fields, shown in Fig. 1. Occupancy (A) can be considered as one of the research fields in user behaviour. Because being present within the building is clearly a necessary condition to interact with it, this is an important factor in the field of user behaviour [Madavi et al. 2010]. The other research fields are the control of solar shading (B), window deployment (C), control of the lighting (D), the use of electrical appliances (E) and the control of the thermal environment (F) by the occupant. This list is not exhaustive as it is restricted to actions that change the environment and thus influence the building's energy demands [Madavi et al. 2010]. Other adaptive actions like adjusting clothing, having a drink or changing the activity

level, better known as personal or intermediate actions, are not included. The interactions with the buildings' environmental systems are difficult or even impossible to predict at the level of an individual person.

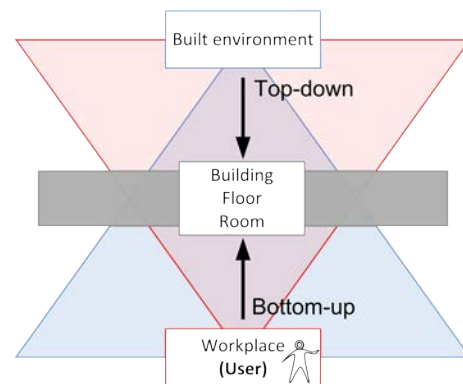


Figure 2. Traditional top-down approach for building system design and new introduced bottom-up approach with the human as leading factor.

The idea is that when the actual need for comfort of the individual building user is addressed, this will lead to reduction of the energy consumption by the building systems, schematically shown in figure 3. Thereby, the control objective is to look how the individual building occupants use their building and if commonly used occupancy spots can be recognized. RFID technology is proposed for building user indoor locating system, because of its accuracy for location estimation and possibilities for identification of the user [Li et al., 2012].

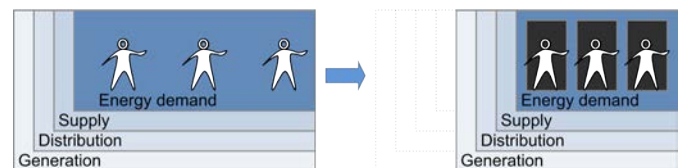


Figure 3. Schematic representation of the Human-in-the-Loop approach, with the focus on the user and decrease of energy use represented by the blue shells

Distributed information can be obtained by low-cost wireless sensor networks [Arens et al 2005, Tse and Chan 2008], low-cost infrared sensors [Revel and Sabattini 2010], and smart badges/portable nodes [Feldmeier and Paradiso 2010]. This distributed information could provide insights in the ongoing processes on different levels [personal-, local-, and room level] which can be used for user-adaptive comfort control. Wireless sensor networks become more popular for application in climate control [Neudecker 2010, Gameiro et al 2010, Kim et al 2010, Yu et al 2011, Rawi and Al-Anbuky 2011, Jiang et al 2011, Georgievski et al 2011, Park 2011]. Still there is a huge gap to practice as there is at the moment only one company which offers WSN for climate control in the Netherlands and has only realized a few projects in the last years [Octalix 2011]. It is necessary to come with new application of WSN, therefore a close look is needed into possible additional functionality of WSN in regards to human behaviour.

Arens [Arens et al 2005] proposes a distributed sensor network which might be found in an office in near future. At room scale, the control and actuation could take place within the room itself by a kind of remote controller. The person's thermal state [comfort stat] could be predicted from measured skin temperatures sensed through contact or remotely by infrared sensors. In the proposed concept user behaviour is only taken into account by an occupancy sensor. Feldmeier and Paradiso [2010] developed a personalized HVAC system consisting of

"The idea is that when the actual need for comfort of the individual building user is addressed, this will lead to reduction of the energy consumption by the building system"

four main components: portable nodes, room nodes, control nodes, and a central network hub. At the heart of the system is the building occupant; this is where the comfort information resides. To best assess the occupant's comfort level, a portable node was developed which senses the local temperature, humidity, light level, and inertial activity level of the user. It also has three buttons on the side, which allow the user to input current comfort state [one button each for hot, cold, and neutral]. The actuation of the various heating and cooling systems is achieved via control nodes. Energy savings of up to 24% over the standard HVAC control system were achieved during experiments on MIT University.

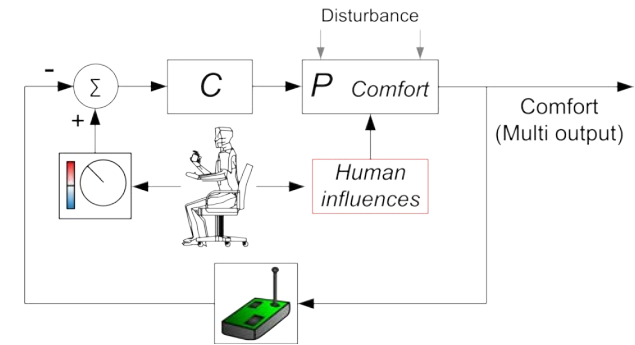


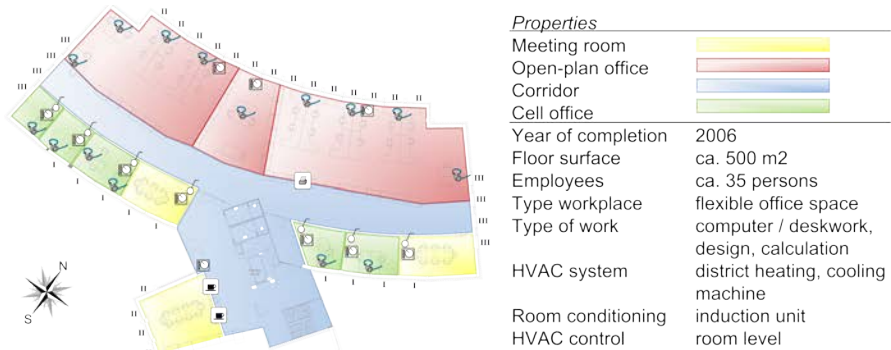
Figure 4. Proposed block diagram of the controlled system with the intelligent coordinator to take the human influences in the loop of building systems via feed forward control.

The studied recent developments regarding thermal comfort and occupant behaviour in the built environment lead to our human in the loop approach. In this approach the human is taken as the leading factor in the design and control of HVAC systems. Nowadays the user is not central in the design as building systems are mainly controlled on building level with (limited) possibilities for adjustment of the indoor conditions on floor and room level. As a result the considerable differences between individuals are not included in the HVAC control [Fanger 1972]. Our bottom-up approach is strictly focused on the well-being of the individual and the energy demand for optimal comfort of the individual. To enhance this bottom-up approach a new control strategy is introduced where the human is put into the control loop of the building services systems to enhance a more direct and better interaction between technological systems and the human being.

OBJECTIVE

The aim was to assess the energy saving potential when anticipating on the human influences by sending energy only to those spots where energy is needed to change the thermal conditions. Therefore the building occupant needs to be included in the control loop of building services. Non-occupied spots of the building can have low demands regarding the indoor climate and can be conditioned at a minimum level. It is needed to look at the possibilities to localize the occupant, with minimal or no hinder for the building occupant. The proposed principal is presented in figure 4. This figure shows how

“Big steps need to be made to reach future targets regarding energy consumption and comfort level in the built environment.”



the building occupant could be leading in the system control, applying the individual preferences by measuring the occupant position and behaviour. In order to control the operation of building systems an intelligent supervisor coordinates the system [Dounis et al. 2009]. The intelligent coordinator makes its decision and sends acknowledge signals to the individual building systems. Intelligent control systems are required to implement the actual dynamic changing individual comfort needs and the behaviour of individual building occupants. This results in intelligent control strategies for building services systems to achieve the highest comfort level and biggest energy savings.

BUILDING ANALYSIS

This research used a real building and user's behaviour: measurements were performed on the fourth floor of Royal Haskoning, an international engineering consulting company

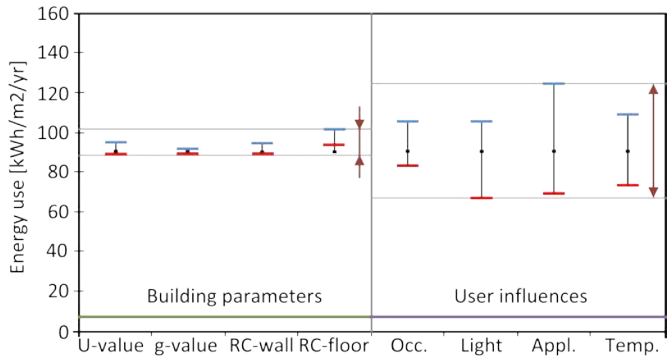


Figure 4. Proposed block diagram of the controlled system with the intelligent coordinator to take the human influences in the loop of building systems via feed forward control. in The Netherlands, Rotterdam (figure 5).

An analysis was made to look for the most influencing building parameters and user actions on the building performances. Via a walkthrough survey, consisting of interviews and measurements during a week, the bandwidth of the different user actions were determined. The observed data was converted to yearly data, using VABI Elements, the most common Dutch software tool for building energy performance analysis. The building parameters and user actions were varied within a predetermined bandwidth based on this analysis. The magnitude of human influences is on average 3-5 times higher than the building parameters, clearly underlining the importance of user behaviour (fig. 4).

MEASUREMENTS

Applying the bottom-up approach, with the human in the control loop of building services systems, can only be achieved if users can be located within the building. Low-budget wireless sensor networks with portable nodes show high potential for real-time localization and monitoring of building occupants [Feldmeier and Paradiso 2010]. Therefore static wireless sensor nodes were mounted on the floor and commu

Figure 5 Overview of the office case study office



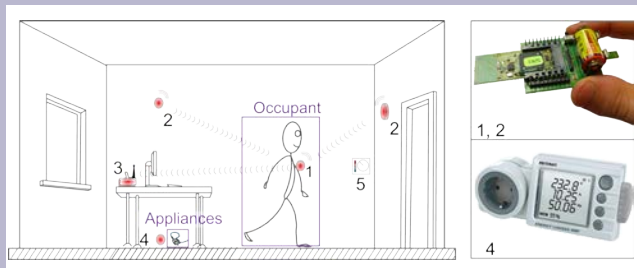


Figure 6. A wireless sensor network (2) tracks the mobile node (1) of the occupant and the energy use of appliances (4) and uses the real-time data for the building system control (3).

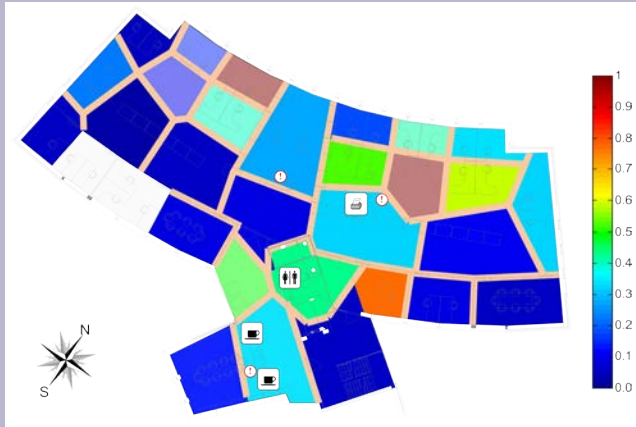


Figure 7: Occupancy intensity as percentage of the most occupied workplace, showing two hotspots and increased activity around the toilet, coffee machine and printer.

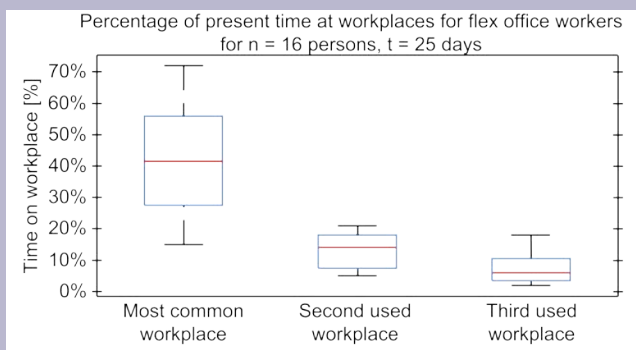


Figure 8: Percentage of time office workers are at their most common workplaces

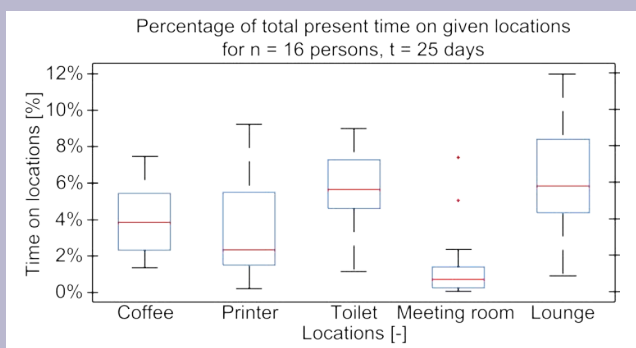


Figure 9: Percentage of time office workers are at a specified location on the floor

nicate with mobile nodes (or in the future smartphones) carried by the occupant to determine the position of the occupant on workplace level. The measurement set-up is schematically shown in figure. 6.

The wireless static nodes for position tracking of the occupants were placed on points of interest e.g. the workplaces, printer, coffee machine and toilet. Based on the signal strength the nodes locate in which zone the occupant is. With the nodes a mesh is created consisting of 30 zones. In every zone one power logger was installed, for measuring the energy use and to get an estimation of the heat production.

RESULTS

The measurement results were obtained for six weeks during winter period. During this period most of the occupants of the floor (20 employees) wore a node for localization. The average occupancy of the employees was approximately 40%. Occupancy hotspots can be distinguished as shown in Fig. 7. The amount of time of occupants being present in a zone is summed over the whole period. There are obvious favourite workplaces and higher occupancy intensities around the coffee machine, toilet and printer.

To get an estimation of the people flows inside the building, the occupants' position is closer looked into. In Fig. 8 it is shown that although there are flex workplaces, the employees have a strong preference for a most common workplace, where the second used workplace is occupied for on average 15% of the total present time on. Fig. 9 shows that the buildings users are a significant part of the time on other locations in the building (e.g. coffee machine, toilet).

APPLIANCES

The use of electrical appliances is the most influencing variable on building performance. In previous research Parys concluded that the operation of office equipment is obviously not driven by indoor environmental quality motives. Therefore it is more logical to link the ratio of internal heat gains over the nominal power of office equipment to the occupancy rate [Parys et al. 2011]

When the averaged profiles for occupancy and use of electrical appliances are looked into, there is a strong correlation between them with a determination coefficient of 0.94 on the floor level. Looking at workplace level there is no clear correlation. This is proved by figure 10 with the occupancy and appliance use for a reference day. Connections between the occupancy and electricity use are visible, but it does not correlate. An example is the gap between 9.00 hr and 11.00 hr where the workers were not at their workplace, but the appliance use does not decrease.

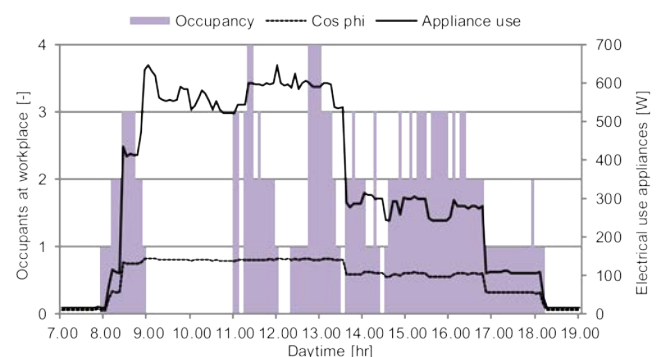


Figure 10: Occupancy for 4 CAD workplaces and total energy demand for those places for a reference day

ENERGY SAVING POTENTIAL

Data of the measurements are applied in a simulation to determine the energy savings potential compared to the designed energy demand. Three variations can be distinguished, B. the actual energy demand, C. send energy to spots only when needed (human in the loop) on room level and D. human in the loop on workplace level with individual climate control. The obtained energy saving potential by the profiles for the three situations is shown in figure 11. The measurements were during the winter, when there was only a heating demand. The acquired profiles for electrical appliances use and occupancy patterns are also applied in the summer situation. A sensitivity analysis is established by applying the standard deviation of the different profiles to the model, to ground the reliability of the results.

COMFORT OF THE BUILDING OCCUPANT

Based on the measured data also the comfort level was determined. The comfort level is determined on the PMV model of Fanger. As can be seen in figure 11 the building was designed to have a comfort level between minus and plus 0.5 PMV. In the actual situation 25% of the time this level is not achieved. Control on room level even decreases this comfort level. Since there is not a commonly accepted and used model for individual comfort it is assumed individual can be achieved with this model strategy.

CONCLUSION

Big steps need to be made to reach future targets regarding energy consumption and comfort level in the built environment. With increasing energy performances, the influence of the occupant becomes significant and should be looked into. In the used case study the human influence is 3-5 times higher than variations in building parameters. With the human in the loop approach energy is only sent to those spots where needed by localizing the building occupant and anticipating on its influences. From measurements of 20 employees during 6 weeks on an office floor it is clear that occupancy hotspots can be distinguished.

A strong correlation between the occupancy and the most important human influence on building performances, use of electrical appliances, is shown on floor level. However, on workplace level a relation can be noticed, but lets a lot of space for decrease of the energy demand / internal heat gains. Further research towards possibilities and advantages is needed.

With the human in the loop approach more than 30% energy savings can be achieved on heating demand and up to 40% energy savings on cooling demand compared with the actual energy demand.

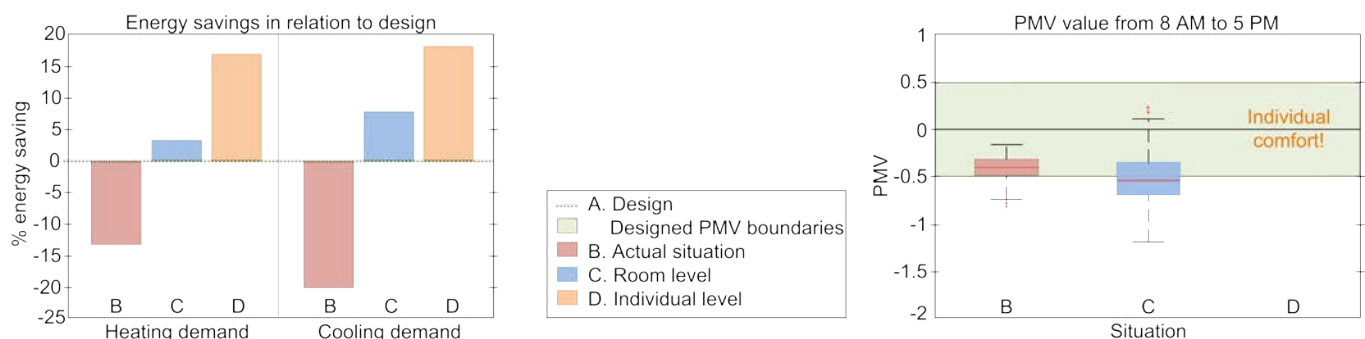


Figure 11: Energy saving potential compared with the designed energy use and actual energy use (left graph) and comfort level based on the PMV value as designed and in the actual situation. In the actual situation the desired comfort level is not achieved (right graph)

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PhD: Roel Loonen



My history with Mollier dates back quite some time already. As a member of last batch of students for the BSc. "Installatietechnologie", I had the pleasure to join the introduction week in the summer of 2004. Now, eight years later, I am still at TU/e, as a third-year PhD candidate in the group of prof. Jan Hensen.

The topic of my PhD deals with climate adaptive building shells, and builds upon the work I did to obtain my Building Services MSc. degree. That project was awarded with the first prize in the REHVA International Student Competition 2011 in Tallinn, Estonia – the second of three(!) consecutive BPS victories in this prestigious event.

Adaptability – signs of this principle are pervasive in nature, and many consider it a precondition for sustaining life. The vast majority of present-day building envelopes, however, is designed as static elements with permanent properties. Considering the continuously changing indoor and ambient environment, this is a missed opportunity for both energy conservation and improvement of indoor environmental quality. In order to break with this status-quo, we can observe a growing tendency for active façade elements that are capable of behaving in response to these changing conditions; think of switchable glazing technology, dynamic insulation or movable brise-soleils – see <http://pinterest.com/CABSoverview> for an up-to-date overview.



Such developments feed our intuition that there is quite some potential for optimal time-varying deployment and utilization of insulation, daylight, natural ventilation, thermal mass, solar shading, etc. At the same time, the latent potential of adaptable façades from a more holistic perspective is still unknown. By means of an inverse approach, my research tries to find answers to these questions. We do not pose the traditional if-then questions, but instead use simulation and optimization procedures to identify how the design and operation of (future) adaptable façades ideally should be.

As you know, doing a PhD is not all about research; there is also a part allocated to educational activities. Thus far, I have been involved in five final year master projects, and two projects in the framework of the TU/e Honors Program. Next to that, I use to give guidance with assignments during the building simulation courses. Every year, it is good to see how students successfully manage to transform from novices, to become the building performance simulation experts of the future, in a very short period of time. On the other hand, after seeing things for the fourth year, you may imagine that I'm sometimes almost dreaming about BESTEST case 600...

One of the things I like most about being a PhD student is the international character of the job. Apart from having chances to visit international meetings and conferences abroad, there is also a lot of intercultural exchange happening closer to home. Vertigo floor 6 accommodates a motley collection of many different nationalities. This offers lots of interesting opportunities to learn about the evident, but even more so, the countless subtle differences between different cultures. As the present chair of the PhD Network Bouwkunde Board, we aim to move this type of interaction forward by developing and sustaining a stimulating academic and social environment for PhDs from all units in our department.

Although a doing PhD is not always limited to a nine-to-five activity, there is of course also much flexibility for spending time on other things. Watching and playing football; both in my home town, and sometimes with colleagues at TU/e is what I like to do in my spare time. One of the most memorable matches was previous year's futsal clash between floors 5 and 6. Ask one of your fellow students if you want to find out who won ;-)

One can think of many arguments to advise both in favor of, and against starting a PhD after graduating. In this respect, I would like to quote the words Miruna used at the same place last year: "a PhD is in part a job and in part a hobby, because you have to be passionate about what you are doing". To me, this seems to be the number one question to ask yourself if you are considering this option.

Last summer, I was fortunate to get the chance to spend some months in Philadelphia. I worked in the Energy Efficient Buildings Hub, an ambitious multi-million project, organized by the U.S. Department of Energy. Awareness for the urgency and potential for changes in the built environment helped me to put things in perspective, and was among the main things I learned over there. Personally, I have a strong belief that there is a bright future for high-performance building and systems design. The master BPS offers an outstanding background for taking up this challenging task!

Start activity

A weekend to Warsaw

The start activity was successfully organized by Eva van Valderen, Finn Vossen and Claire Laudy

Friday afternoon, a group of BPS students arrive at the airport of Brussels/Charleroi, destined to depart on a plane to Warsaw, Poland. Like every year, in October a start activity of the unit BPS was organized for new and old members of Mollier to get to know each other. Everyone has high hopes for this weekend to be as successful as any year. It took some time to choose a cool European city to travel to and to book tickets for a group of 26 people. But after a turbulent evening, a trip to Warsaw was planned. Not an obvious choice and therefore all the more exciting. A lot of preparations were made; flight tickets were booked and a bus transfer to the city was arranged, a restaurant was chosen in the centre of the old city to dine together on Saturday night and reservations were made for beds in a hostel even though the program had little room for sleeping. The (short) trip started at Friday October 12 and students took

the bike, bus, train and car to get to the Brussels/Charleroi airport. There, some real Belgian fries were eaten and groups for the start-activity-activity-list were made. The purpose of this activity-list was to fulfill as much activities on the list as possible with a team of five people. This in order to gain points and win the 'amazing prize'. After some waiting at the airport the plane took off and two hours later we arrived at Modlin airport.

Every student was provided a booklet with all information, including the program. Friday evening we arrived at the hostel and most people went straight to the city centre to get a well-deserved beverage. The next day some die-hards woke up early to sight-see the city with its old city and beautiful parks in the autumn ambiance. Others woke up a little later to enjoy breakfast/lunch at 'the best lunchroom in Warsaw'. At 2 o'clock, we all gathered for the organ-

ized communist-walking tour through the city. A very enthusiastic polish guy with a nice English accent led us through the city and showed us the ugly and beautiful parts of the city and explained the influence of the communism on the people and the city and he gave us insight on all important communistic spots of Warsaw. Also some of his stories depicted life in Warsaw during the Second World War and the cold war.



Figure 1: Start activity tour through Warsaw

With a different view of the city and our heads full with information, we went back to the hostel, got freshened up and hit the city. With the whole group we went for a bite to eat at a typical Polish restaurant, which had live piano music to entertain us all. The atmosphere was very good and after dinner we went to a tiny pub for a beer and vodka. This bar was located at an inner courtyard with several other bars. From the main street, you can enter this courtyard through an opening in the large street façade. You wouldn't expect something to be there but behind this façade, a little night life centre can be found! The bar was so tiny; we almost didn't fit inside with the whole group. Later that evening, the group scattered and some of us ended up at a Polish nineties club, which was quite the experience.

We had to catch an early flight, so no sleep for the wicked. Straight onto the train which led us back to Modlin airport. Nevertheless, for some the waiting was too much and the benches at the airport were eagerly used for sleeping. After a turbulent flight, we were back in Belgium.

All together it was a very nice weekend and everybody had a great time! The goal of new and old members of Mollier to get to know each other was well achieved and that's what this trip was all about.



Figure 2: Nostalgia



Figure 3: Warsaw café



Figure 4: Warsaw architecture

Development of eco-concrete; Motivation and regulations in the Netherlands

The building sector, comprising both buildings and infrastructure, is the largest consumer of energy and materials. As well as the huge amount of raw materials involved, enormous amounts of energy are also used for the production and transport of raw materials, building materials and products [1, 2]. Among all building materials, concrete is chemically and physically the most complex, scientifically the most interesting, and its worldwide production is larger than all other man-made materials combined. In this paper methodologies and examples are presented of more environmentally friendly concretes. Also the EU regulations in regard to "non-standard" concretes are addressed, with special emphasis on the Dutch implementation.

INTRODUCTION

The building sector, comprising both buildings and infrastructure, is the largest consumer of energy and materials. Table 1 shows the global production of the most important man-made materials in 2008.

Some of these materials are exclusively used in the building sector; others such as steel and timber are also used in other industries. The numbers illustrate that building materials are globally of the utmost importance, both economically and environmentally, and their production may involve contamination and the depletion of finite resources. Contamination concerns emissions to water, air and soil, and the production of waste, stench, noise, and other forms of nuisances. This takes place during production, but also during the entire life-cycle (and beyond) of a material and object. In contemporary societies the aspect of 'contamination' has largely been solved in the past 40 years. The challenge we are now facing is a more efficient use of resources.

Many of the building materials contain irregularly shaped particles, of various sizes (polydisperse), mostly randomly packed as is the case in concrete. The particles need to be combined in a specific way to obtain the desired properties of the building material. In other words, there is a need for recipes according to which the raw materials are combined and processed into the desired materials or products. These products not only have to fulfill a broad range of technical demands, but must also meet requirements with respect to maintenance,

repair, recycling, sensory qualities etc. The raw materials and ingredients need to be available in sufficient quantities of constant quality, and the product should be manageable at the building site. A material that often fulfills these requirements is concrete.

Concrete is a spectacular material, not only because of its enormous production volume. A conventional concrete consists of cement, aggregates and water, and comprises grains with a size ranging from 300 nm to 32 mm, in massive constructions (e.g. dams) even to 64 or 128 mm. There is no man-made material in which such a broad range of particle sizes, comprising five decades, are combined. In fresh state it is fluid and enables a high degree of design freedom, while in the hardened state concrete is durable and almost maintenance-free, with a great architectural potential.

Cement is the most energy-intensive and costly ingredient of concrete, and also produced in huge quantities (Table 1). The manufacture of cement clinker in the rotary kiln is an energy-intensive process. In recent decennia the efficiency of these kilns has increased. Thermodynamically about 3.0 GJ/ton cement clinker is needed, the most modern rotary kilns can achieve 3.6 GJ/ton, and a typical average value for the already operating kilns in developed countries is 5.0 GJ/ton. The most modern kilns produce 10,000 tons of clinker per day. Energy efficiency is improved by replacing conventional fossil fuel with waste as a low-cost secondary fuel, e.g. ground car tires, bone meal, sewage sludge, paper sludge etc. When using

Table 1: Global production of materials in million tons (2011)

Timber	4000	Quicklime	130
Plastics and rubber	300	Glass	120
Steel	1400	Cement	3500
Gypsum	250	Concrete	21000

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alternative fuels, sintering temperatures lower than 1450°C can be seen, which is also beneficial for energy saving [3].

Savings and optimization are also possible on the materials side. By-products from other industries can be used as a substitute for the feedstock of the kiln. If these materials have cementitious properties, they can even substitute the end-product, clinker. Blast furnace slag (BFS) is a by-product from the steel industry and a common substitute for clinker. The use of so-called slag cement results in very durable concrete and comprises about half of the Dutch cement market [4]. Powder coal fly ashes have a very similar composition to clay, and class F fly ash is similar to OPC. These fly ashes are produced in huge quantities (Table 2).

Table 2: Global production of by-products in million tons (2008)

Coal ashes	1000	Blast furnace slag	120
Steel slag	140	Flue gas desulfurization (FGD) gypsum	50

Fly ash can also substitute clinker, and a substitution rate of 30% is already common. A recent study presented a substitution level of 50% [5]. Both slags and fly ash contain non-crystalline (amorphous) mineral oxides which, in contrast to their crystalline pendants, are reactive.

It has been seen that the cement industry is reducing the environmental impact of cement, for example by fuel and material substitution. The substitution of clinker is regulated by European cement standard EN 197-1. EN 197-1 defines granulated BFS, pozzolans, fly ash, burned slate, limestone and microsilica as substituents, see Appendix A for the (Dutch) list of blended cements that are formulated. In The Netherlands the use of CEM I (solely clinker based) is already reduced to about 30% of the total cement market, i.e. blended cements are dominating.

The building industry, and the concrete industry in particular, is also interested in the addition of by-products in concrete themselves. This offers them more freedom in regard to mix design, and the use of by-products that are not (yet) included in EN 197-1. The European concrete standards EN 206-1 and EN 12620-1 allow for the use of fly ash, silica fume and granulated BFS in a concrete mix. For this the k-value concept is introduced, which value depends on the specific addition, the type of cement it is combined with and the exposure class of application. The k-value times the amount of the by-product is considered as “cement” in the mix, and together with the “EN

197-1 cement” it is counted as in the computation of minimum cement content and the maximum water-cement ratio of the mix. Minimum cement content and maximum water-cement ratio are defined by the exposure class, see Appendix B.

One of the performance criteria that is gaining importance is the environmental footprint of the building material used. For concrete, these developments imply smart use of cement, which is the most energy- and cost-intensive component of concrete. A second, equally important motivation is cost reduction, as cement is the most expensive component in a concrete mix. For a sound concrete recipe, all the ingredients need to fit both physically and chemically: this is achieved by

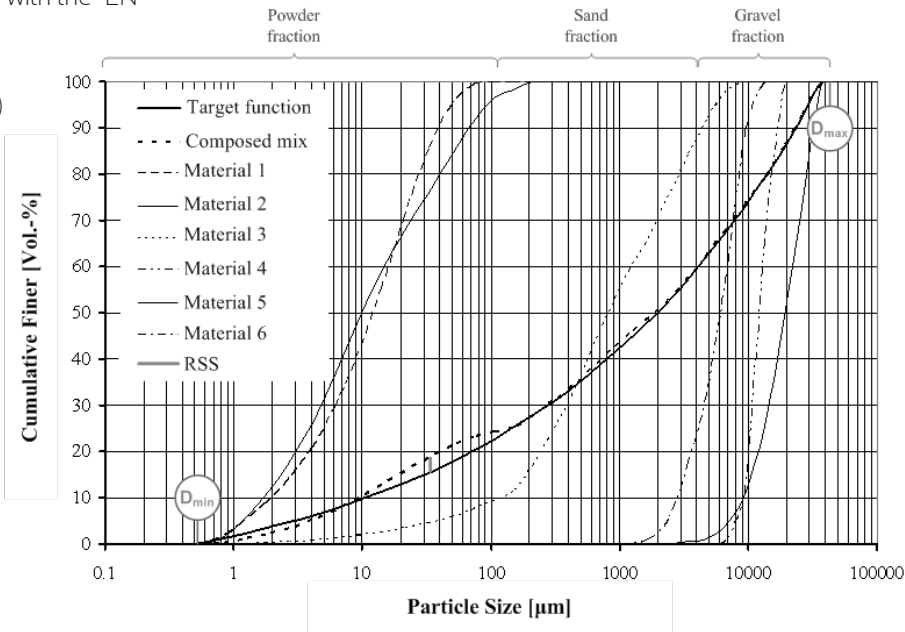
‘particle size engineering’ and ‘mineral oxide engineering’. In the following methods for designing alternative concretes are presented. Furthermore, the Dutch regulations for using “non-standard” are discussed.

PARTICLE SIZE ENGINEERING

Particles of various sizes are combined to produce the concrete mix. The combination of all individual particle distributions results in an overall particle size distribution of the mix. This overall grading of the mix, containing particles from 300 nm to 32 mm, determines the mix properties in fresh state: the flow properties and workability. But the properties of the hardened concrete, such as strength and durability, are also determined by the overall particle size distribution. A mix design tool has been developed based on the insight that superior properties of a granular mix are achieved when a so-called geometric particle size distribution is obtained considering all solids in the mix (so not aggregates only), an idea already put forward in 1950 [6]. Geometric particle arrangements had been proposed much earlier [7], in their study of aggregate packing more than 100 years ago.

Using linear optimization, a fit of a granular blend containing all the solids used, is made according to the defined distribution function [8-10]. Figure 1 shows the cumulative particle size distribution or PSD (close to lognormal distribu-

Figure 1: The cumulative particle size distribution (PSD) of all ingredients in a mix (measured with a laser granulometry and sieves), and the PSD of the mix (dashed line) composed with the help of the mix design tool. The target function (solid line) is also shown [8].



tion) of a number of ingredients (micro-powder, cement, sands, gravel etc.), which are combined in a way that their mix best approaches the geometric packing represented by the 'target function'. The logarithmic scale in Figure 1 again illustrates the enormous particle size range in this typical concrete mix, namely five decades.

The concretes designed with the presented approach show excellent properties in both fresh and hardened states. SCCs have been designed and produced with a D_{max} of 32 mm, with recycled aggregates, with microencapsulated phase changing materials (PCMs), with photocatalytic TiO_2 , with dimension stone 'waste' etc. Concretes with a specific density of 1100 kg/m³, a thermal conductivity of 0.27 W/mK and a 28-day compressive strength of 37 N/mm² have also been developed using lightweight aggregates [8, 10]. Recently, using lightweight aggregates, concretes with a specific density of less than 800 kg/m³, a thermal conductivity of 0.11 W/mK and a 7-day compressive strength of 10 N/mm² were produced.

A spin-off project, with the province of Overijssel, the municipality of Hengelo and Struyk Verwo Groep, concerns a street paved with 1000 m² TiO_2 -containing photocatalytic concrete, a patented technique [11]. In the DeNOx street, NOx concentrations were, on average, 19% (considering the whole day) and 28% (considering only afternoons) lower than the obtained values in the control street. The pertaining standard deviations (σ) amounts 18% and 20%, respectively. Under ideal weather conditions (high radiation and low relative humidity), a concentration decrease of 45% could be observed.

Compressive conventionally vibrated concrete (CVC) and self-compacting concrete (SCC) strengths of 30 to 60 N/mm² have been achieved with a total binder (cement clinker and cementitious by-products) content of 200-270 kg/m³ [8]. Earth-moist concrete (EMC) with a compressive strength of 100 N/mm² has been produced with 325 kg/m³ OPC as sole binder. More importantly, it was seen that the flexural strength hardly decreased when the OPC content was reduced to 175 kg/m³ [10]. Much better workability and higher strength were obtained compared with concretes with the same cement contents. In this regard, the property cement efficiency was introduced, defined as compressive strength (N/mm²) per unit of cement content in a concrete mix (kg/m³). Equivalently, it has become possible to design equally performing concretes with less superplasticizer (and without viscosity modifying admixtures) and high cement efficiencies.

For the design of concrete, traditional methods and prescriptions concern for instance the cement content, the total content of particles smaller than 250 μ m and the water-cement ratio. The developed design method allows for a more performance-based mix design. Many mixes of members of the sponsor group have been optimized with regard to efficient cement and admixture use. In many cases this has resulted in the incorporation of alternative ingredients, such as aggregates, inert powders (fine aggregate) and cementitious by-products. For use as binder in mortar, concrete or stabilized waste, insight into the hardening reactions of cement clinker, cementitious by-products and contaminants (if present) is required, which is the rationale for mineral oxide engineering.



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MINERAL OXIDE ENGINEERING

The hydration of the mineral oxides appearing in OPC, the most abundant binder, was first studied. Based on the water retention data provided by Powers and Brownyard [12], the hydration reactions of the four major clinker phases (C3S, C2S, C3A, C4AF) and their hydration products, such as C-S-H and CH etc., were quantified [13, 14]. Next, reaction models for alkali-activated slag and slag-blended cement were established based on stoichiometric calculations [4]. The models correlate the mineral compositions of slag and Portland cement clinker, and their blending proportions, with the quantities and compositions of the hydration products formed, including their rate (reaction speed) of formation.

Best furnace slags typically possess C/S ratios of about unity, and part of the CH produced by the hydration of C3S and C2S in the clinker is available to increase the C/S ratio of C-S-H formed from the slag. Chen [4] proposed that the fraction of consumed CH is proportional to the difference in C/S ratio of the slag and the C/S ratio of C-S-H produced by the clinker, namely 1.7, a concept that is compatible with reality (Figure 2).

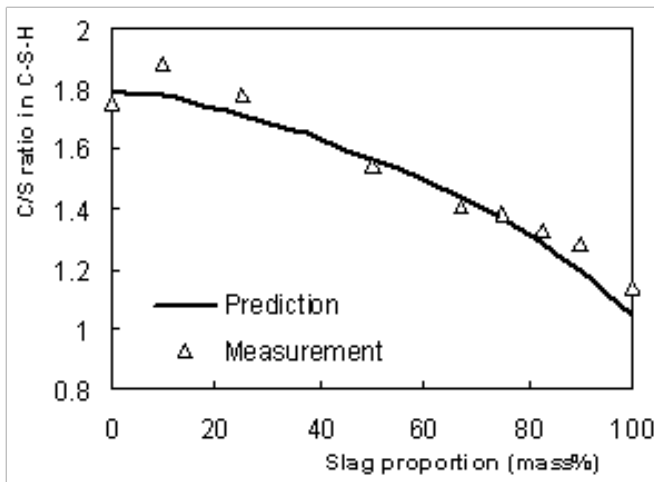


Figure 2: Predicted and measured C/S ratio in C-S-H versus slag proportions in blended cement [4]. C-S-H is the most abundant hydration product.

For the numerical simulation of the hydration reactions and the pore water composition, in the author's group a 3-D simulation model (CEMHYD3D) from NIST [15] was adopted and extended [4, 16]. Performing cellular-automata like rules on the matrix of voxels simulates the hydration (Figure 3).

Van Eijk [16] and Chen [4] modeled the pore water composition (e.g. pH), and incorporated the reactions of fly ash and slag. As well as the chemical extensions, the kinetics of the model has also been modified. In the original model the system resolution had considerable effect on the simulation results. The simulations performed with different system resolutions (from 0.5 to 2 μm) demonstrated the robustness of the improved model [4]. Currently, CEMHYD3D has been extended with several additional possibilities which enable the hydration of particles as small as 0.2 μm , designated as 'multi-scale' feature [17].

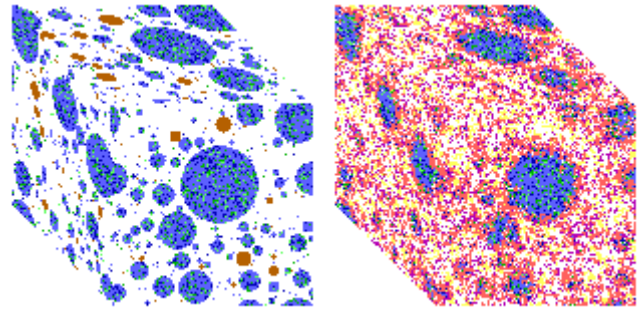


Figure 3: Development of OPC microstructure by CEMHYD3D in a 100 μm box, at the left the initial OPC/water system, and at the right the partly hydrated system [16].

APPLICATION AND REGULATIONS

Both suppliers and appliers (concrete companies) of by-products are assisted by investigating their suitability as binder. For their application as binder in concrete, three technical criteria are important as well as price (sometimes negative if it relates to 'waste'), constant composition and availability in sufficiently large quantities:

- i) The workability, hardening and related strength development.
- ii) The durability of the product.
- iii) The presence of contaminants.

A first indication for the suitability of a material as cement substitute is obtained by preparing standard mortars and studying the fresh workability, and the subsequent strength development during 28 days. For this purpose also CEMHYD3D is used. For these cementitious by-products, it can also be opportune to blend them to obtain a composition of particle sizes and mineral oxides with optimum reactive characteristics.

Several secondary binders have been included in concrete, and mixes have been designed and tested for members of the sponsor group. Motivated by clause 5.2.5.3 of the EN 206-1 standard, these companies dose cementitious by-products to the mix themselves, and follow the relevant attestation route. The procedure for quality assessment is described in BRL 1802 from KIWA-BMC (www.kiwabmc.nl), and the actual testing of the alternative concrete recipe is given by CUR 48 [18]. Suppliers of by-products can prove that their specific additive, in combination with a specific cement (type and origin), performs equivalently as a reference concrete meeting the requirements of EN 206-1; the comparison involves (compressive) strength and durability tests. The required concrete strength, for structural applications, follows from EN 1990 (Eurocode 1) and EN 1992 (Eurocode 2).

The test program is executed by independent accredited laboratories such as SGS Intron in The Netherlands. By following this attest route, the additive is fully counted as binder (hence one could say a k-value of 1) for this specific combination of additive and cement. However, k-values provided by EN 206-1, which are actually 'worst case' values and hence much less than unity, are more generally valid. For powder FA and granulated BFS, for instance k-values of unity are quite common, rendering them more valuable. This attest route has also increased utilization of cementitious by-products from other sources, so not only the traditional granulated BFS slag and powder coal FA, such as fly ashes originating from paper sludge incineration.

Durability, is for instance assessed by measuring water absorption, carbonation, sulfate resistance, water intrusion and freeze-thaw resistance, and by accelerated chloride migration tests. An emerging test is the rapid chloride migration (RCM) test [19]. The apparent diffusion coefficient determined by this method follows from assuming Cl^- concentration profiles in the specimen as shown in Figure 4 (left).

A typical example of a true measured profile, however, can be seen in Figure 4 (right). A new diffusion model based on non-linear (Freundlich) Cl^- absorption by the concrete and non-equilibrium with the pore water, yielded excellent agreement (Figure 4). This new model yields a more realistic diffusion coefficient together with the mass transfer coefficient.

As well as strength and durability, the purity and maximum level of contamination, both in composition and in leaching, are also relevant. Hydration models are also used to relate (Freundlich) binding and transport of anions (chloride) and cations (heavy metals) and microstructure, which govern the leaching. This is related to binder recipe and hardening conditions [22]. Fixation of heavy metals is important for the stabilization of waste, binding of chloride for stabilization and the durability of concrete structures, as seen before.

In the Netherlands, the Soil Quality Decree sets limits for the composition and leaching of granular materials, designated as 'non-shaped', with respect to organic contaminants, anions (chloride, sulfate, bromide and fluoride)

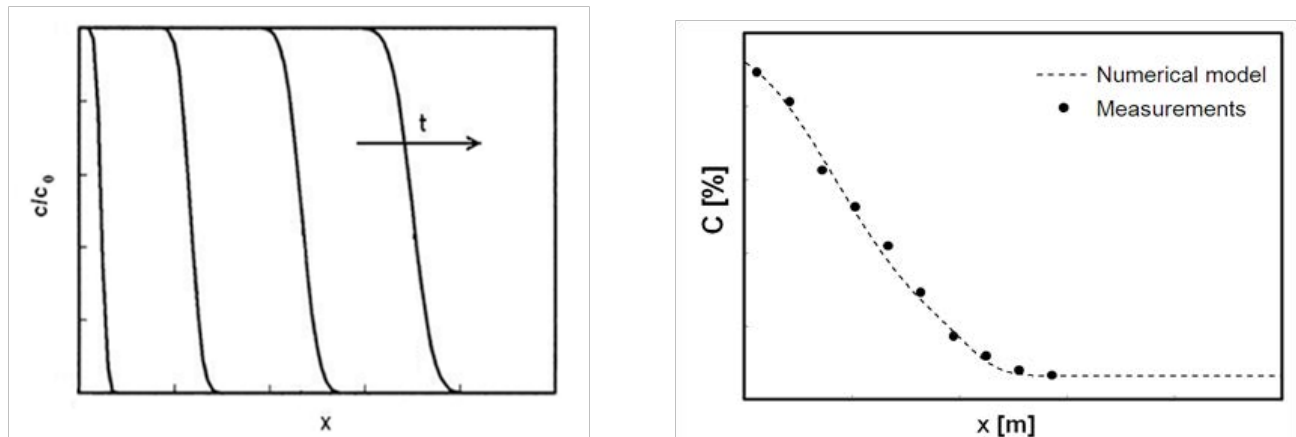


Figure 4: Chloride profiles in a concrete during RCM test: at the left the assumed profile, and at the right a measured profile and the model prediction [20].



Word jij het nieuwe bestuur van de Bouwkunde Bedrijvendagen 2013?



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and 15 heavy metals. If these requirements are not met, the granular material is considered as 'waste', and landfill of these materials is a remaining option. The composition and leaching are also leading in selecting the type of applicable landfill, namely for mineral or hazardous waste, and the relevant safety measures as laid down by the Landfill Decree.

By stabilization, e.g. combining different materials and adding primary binders (quicklime/hemi-hydrate/cement), another granular ('non-shaped') material or a shaped product can be obtained for non-hazardous landfill, and sometimes it is even possible that the treated material meets the Soil Quality Decree requirements of a building material.

Contaminated soil and dredged soil material are interesting 'wastes' that can be combined with primary binders and cementitious by-products (whether or not contaminated). Also by-products from municipal solid waste incineration (MSWI) and biomass incineration are a potential source for replacing primary aggregates, filler sand binders in concrete. By treatment of these 'wastes', cheaper landfill or even the application as building material becomes feasible. This saves the production of primary building materials, as well as the space and costs associated with landfill. A few stabilization projects have been carried out in which contaminated soil and dredged spoils have been made into acceptable building materials [17, 21]. Non-shaped stabilized wastes can be used as road base material, traffic noise barriers, etc. Shaped stabilized wastes may be used as plain (unreinforced) concrete products such as slabs and blocks.

For shaped products the diffusion leaching test according to NEN 7345 and NEN 7375 is executed. This test takes 64 days and the concentrations of 19 components in the eluate are measured at 8 time intervals. Non-shaped (granular) materials are environmentally assessed with the column leaching test, according to NEN 7373 and NEN 7383. This test takes about 20 days. To get a faster and tentative impression about the leaching performance of concretes containing 'waste' ingredients, instead of performing the 64 days 'shaped tests' they are crushed and subjected to the shorter 20 days 'non-shaped leaching test'. The column test is actual a worst case for the diffusion test and hence can establish the critical contaminants to measure in the diffusion test. Moreover, the column test assesses also the leaching of the concrete granulates in a second life (reuse).

CONCLUSIONS

Changing environmental regulations and technical standards enable performance-based recipes rather than prescriptive-based recipes of cement-based construction materials, driving product innovation. The scientifically and technically driven design and production methodology will be continued to obtain more sustainable, durable and functional concrete. There are still plenty of practical problems to be solved, scientific questions to be answered, new raw materials that enter the market, and conceivable product innovations. Furthermore, the present approach is used to develop architectural building products/components such as cladding materials. The sensory properties are then of special interest, and this is an endless source of new ideas for our research. The air purifying and self-cleaning concrete just referred to is already of interest to architects. This type of concrete has been applied in the Dives in Misericordia church in Rome (architect Richard Meier), and the George Harrison Memorial Garden in London. And the lightweight SCC mentioned above is suitable for monolithic concrete buildings.

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Appendix A The 27 cement products listed in Table I of NEN-EN 197-1.

5

Hoofd-typen	Aanduiding van de 27 producten (gewone cementsoorten)		Samenstelling (gehalten in massaprocent ^{a)})											Neven-bestand-delen
			Hoofdbestanddelen											
			Klinker	Hoog-oven-slak	Micro-silica	Puzzolanen		Vlieg-as		Ge-brande-lei-steen	Kalksteen			
			K	S	D ^{b)}	P	Q	V	W	T	L	LL		
CEM I	Portland-cement	CEM I	95-100	-	-	-	-	-	-	-	-	-	-	0-5
CEM II	Portlandslak-cement	CEM II/A-S	80-94	6-20	-	-	-	-	-	-	-	-	-	0-5
		CEM II/B-S	65-79	21-35	-	-	-	-	-	-	-	-	-	0-5
	Portlandmicro-silicacement	CEM II/A-D	90-94	-	6-10	-	-	-	-	-	-	-	-	0-5
		Portland-puzzolaan-cement	CEM II/A-P	80-94	-	-	6-20	-	-	-	-	-	-	-
	CEM II/B-P		65-79	-	-	21-35	-	-	-	-	-	-	-	0-5
	CEM II/A-Q		80-94	-	-	-	6-20	-	-	-	-	-	-	0-5
	CEM II/B-Q		65-79	-	-	-	21-35	-	-	-	-	-	-	0-5
	Portland-vliegascement	CEM II/A-V	80-94	-	-	-	-	6-20	-	-	-	-	-	0-5
		CEM II/B-V	65-79	-	-	-	-	21-35	-	-	-	-	-	0-5
		CEM II/A-W	80-94	-	-	-	-	-	6-20	-	-	-	-	0-5
		CEM II/B-W	65-79	-	-	-	-	-	21-35	-	-	-	-	0-5
	Portlandlei-steencement	CEM II/A-T	80-94	-	-	-	-	-	-	-	6-20	-	-	0-5
		CEM II/B-T	65-79	-	-	-	-	-	-	-	21-35	-	-	0-5
	Portlandkalk-steencement	CEM II/A-L	80-94	-	-	-	-	-	-	-	-	6-20	-	0-5
		CEM II/B-L	65-79	-	-	-	-	-	-	-	-	21-35	-	0-5
		CEM II/A-LL	80-94	-	-	-	-	-	-	-	-	-	6-20	0-5
		CEM II/B-LL	65-79	-	-	-	-	-	-	-	-	-	21-35	0-5
	Portland-composiet-cement ^{c)}	CEM II/A-M	80-94	←-----6-20-----→										0-5
		CEM II/B-M	65-79	←-----21-35-----→										0-5
CEM III	Hoogoven-cement	CEM III/A	35-64	36-65	-	-	-	-	-	-	-	-	-	0-5
		CEM III/B	20-34	66-80	-	-	-	-	-	-	-	-	-	0-5
		CEM III/C	5-19	81-95	-	-	-	-	-	-	-	-	-	0-5
CEM IV	Puzzolaan-cement ^{c)}	CEM IV/A	65-89	-	←-----11-35-----→					-	-	-	0-5	
		CEM IV/B	45-64	-	←-----36-55-----→					-	-	-	0-5	
CEM V	Composiet-cement ^{c)}	CEM V/A	40-64	18-30	-	←-----18-30-----→			-	-	-	-	0-5	
		CEM V/B	20-38	31-50	-	←-----31-50-----→			-	-	-	-	0-5	

a) De waarden in de tabel zijn uitgedrukt ten opzichte van de som van hoofd- en nevenbestanddelen.

b) Het gehalte microsilica mag niet meer dan 10 % bedragen.

c) In het geval van portlandcomposietcement CEM II/A-M en CEM II/B-M, puzzolaancement CEM IV/A en CEM IV/B en composietcement CEM V/A en CEM V/B moeten de hoofdbestanddelen, anders dan klinker, in de aanduiding van het cement vermeld zijn (zie voorbeeld in hoofdstuk 8).

Appendix B The exposure classes listed in Table F.1 of NEN-EN 206-1.

Table F.1 - Recommended limiting values for composition and properties of concrete

	Exposure classes																	
	No risk of corrosion or attack	Carbonation-induced corrosion				Chloride-induced corrosion						Freeze/thaw attack				Aggressive chemical environments		
						Sea water			Chloride other than from sea water									
		X0	XC 1	XC 2	XC 3	XC 4	XS 1	XS 2	XS 3	XD 1	XD 2	XD 3	XF 1	XF 2	XF 3	XF 4	XA 1	XA 2
Maximum w/c	---	0,65	0,60	0,55	0,50	0,50	0,45	0,45	0,55	0,55	0,45	0,55	0,55	0,50	0,45	0,55	0,50	0,45
Minimum strength class	C12/15	C20/25	C25/30	C30/37	C30/37	C30/37	C35/45	C35/45	C30/37	C30/37	C35/45	C30/37	C25/30	C30/37	C30/37	C30/37	C30/37	C35/45
Minimum cement content (kg/m³)	---	260	280	280	300	300	320	340	300	300	320	300	300	320	340	300	320	360
Minimum air content (%)	---	---	---	---	---	---	---	---	---	---	---	---	4,0 ^a	4,0 ^a	4,0 ^a	---	---	---
Other requirements												Aggregate in accordance with prEN 12620:2000 with sufficient freeze/thaw resistance				Sulfate-resisting cement ^b		

^a Where the concrete is not air entrained, the performance of concrete should be tested according to an appropriate test method in comparison with a concrete for which freeze/thaw resistance for the relevant exposure class is proven.

^b When SO₄²⁻ leads to exposure classes XA2 and XA3, it is essential to use sulfate-resisting cement. Where cement is classified with respect to sulfate resistance, moderate or high sulfate-resisting cement should be used in exposure class XA2 (and in exposure class XA1 when applicable) and high sulfate-resisting cement should be used in exposure class XA3.

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ICE-BREAKER

Krishan Boere



That's definitely a good name for a column to introduce new people. And a nice word to play with linguistically. In my case the first cracks in the "ice" already took place during the first several weeks. Given the fact that I already enjoyed some Mollier activities. And after being "asked" to write this paper, I know my anonymous days at floor 5 are probably over. Thanks Illy, you definitely put some fire under the ice now ;-)

I started thinking: How do I write an essay like this?? Well, the only way of finding out is starting to put something on paper I guess.

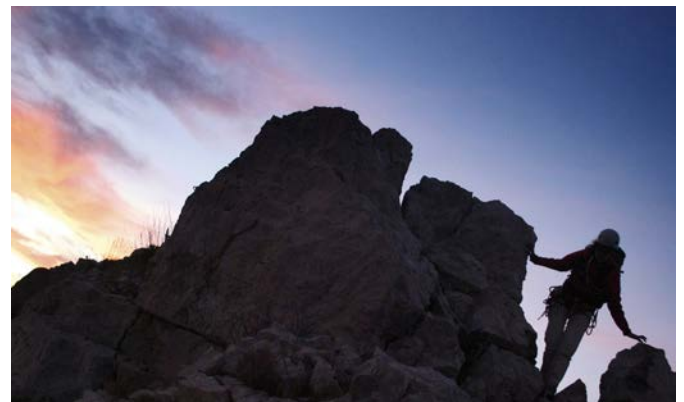
My name is Krishan Boere and I come from a small village 20 km south of Maastricht. Besides mom, dad, and a younger sister I also have a cat that's spoiled like hell. And would easily fit a nickname like "your majesty".

Some of you already know me as the guy with the merciless camera lens. Making photos of the pure happiness when a particular Mollier finds coffee. Luckily for some, my shots captured more than only the embarrassing moments. Would I consider photographing a hobby?? No. I just like to have nice photos as reminders of my travels around the globe.

Traveling is one of the things I really love. Exploring new cultures, trying foreign cuisine, visiting historical sites, or just surfing some waves and climbing a mountain. This "addiction" started with an around the world trip that I made a few years ago. It took me to some of the most beautiful and spectacular places in the world. Very special to me is the time I spent in an aboriginal reserve during this trip. It was a real eye-opener, but also a big culture shock. By now I visited most continents, putting Antarctica and South America on top of my bucket list. But first I need to obtain my master degree at our university. My favorite plane? Concorde off course!!

In my spare time I like to run, cycle, play golf and spend time with friends. I used to do a lot of rock-climbing and surfing to, but that has shifted more towards the summer Holidays. Besides this I am the president of a sports association and run my own company. I have always been a busy person and that's how I am at my best. I love to interact with people and make new friends with different backgrounds & ideas.

Friendship is maybe one of the main reasons I came to Eindhoven Technical University. For a long time I was not sure in what area I should specialize. I didn't really enjoyed my last 2 years at HBO and started thinking of continuing in a different direction. Even law and economics crossed my mind. However after a fellow Mollier member showed me around, I totally fell back in love with technology. What I love is the challenge of sparring with technical concepts, knowledge gain, the fantastic people around us, combined with the new insights



they give. Exploring the boundaries of the impossible, or challenging the foundations of what is known. Making Building Physics & Systems @ TU/e for me: the place to be. A feeling that only grew stronger over the last few months.

Flipping through the pages of the last edition of INSIDE Information I noticed its tradition to name a quote that inspires you. For me there are a few quotes that inspire me but the most important one comes from a commencement speech at Stanford University by Steve Jobs.

Stay Hungry. Stay Foolish.

Well I hope this gives a first impression of who I am. If you want to know more... just tap me on the shoulder at floor 5 If I'm not in a hurry; I will always make time for a chat, interesting discussions, a practical joke or a cold beer in the evening. Cheers....

Gerennoveerd provinciekantoor van Noord Holland wordt duurzame parel

Valstar Simonis is een onafhankelijk Nederlands ingenieurbureau op het gebied van duurzaamheid, comfort en veiligheid in gebouwen.

Door de combinatie van alle bouwkundige, werktuigbouwkundige en elektrotechnische maatregelen krijgt het gerenoveerde provinciekantoor van Noord-Holland een verbetering van de EPC score van 1,7 naar 0,52. Dit is bijna de helft van de huidige wettelijke eis voor nieuwe gebouwen (wettelijke eis EPC score is 1). Het gebouw bereikt een gemiddelde GPR score van 9,1. Dat opvallende resultaat is mede te danken aan een geïntegreerd ontwerpteam waarin ook Valstar Simonis een belangrijke bijdrage heeft mogen verrichten.

Adviseur installatietechniek Rico Logman van Valstar Simonis is enthousiast: "De bijzonder hoge duurzaamheidsambities die de provincie stelt, hebben ons zeer geïnspireerd. Voor het nieuwe kantoor worden daarom veel energiebesparende technieken en natuurlijke materialen toegepast.

Duurzaamheid heeft het ontwerptraject bepaald en past perfect in de visie van Valstar Simonis. Mede door het toepassen van energiebesparende installaties wordt een GPR waarde van 9,1 gehaald (max. = 10). Dat is een enorme verbetering ten opzichte van de oorspronkelijke situatie. Dit was alleen mogelijk doordat we echt als team hebben geopereerd om een optimaal duurzaam resultaat te behalen."

Het renovatieproject van het provinciekantoor van Noord-Holland op het Houtplein in Haarlem heeft van Agentschap NL een energielabel ontvangen. Het gaat om een oorkonde voor ingrijpende duurzame renovatie. Het pand is aangemerkt als voorbeeldproject voor kantoren op het terrein van energie en klimaat. Het bestaande gebouw is door architectenbureau Kraaijvanger aan een duurzame trans-

formatie onderworpen en zal een zeer hoge duurzaamheidsambitie waarmaken. Centraal in de ontwerpen staan het gebruik van duurzame materialen en het terugdringen van het energieverbruik.

Het provinciehuis wordt geheel gerenoveerd met aanvullend een deel nieuwbouw en geschikt gemaakt voor ongeveer duizend flexibele werkplekken. Het kantoor kenmerkt zich door een aantal belangrijke aanpassingen. Zo wordt het bestaande gebouw voorzien van een nieuwe gevel en wordt de huidige binnenplaats bebouwd met een regelvormige entreehal, die door de centrale ligging toegang biedt aan de werkvloeren. Door de nieuwe gevel wordt niet alleen een hoge duurzaamheid gehaald, maar ook een betere inpassing in de stad.



Figure 1: Render provinciekantoor Noord Holland

DUURZAME MAATREGELEN

Het toepassen van veel daglicht, een zeer goed geïsoleerde gebouwschil, driedubbel glas en automatische zonwering beperkt het primaire energieverbruik voor klimatisering van het gebouw al in belangrijke mate. Het hergebruiken van het casco zorgt voor een enorme materiaalbesparing. Daarnaast worden duurzame materialen toegepast zoals gecertificeerd hout, bamboe. Voor de technische installaties zijn verschillende duurzame maatregelen getroffen, zoals:

VERWARMING

Er is gekozen voor klimaatplafonds in combinatie met warmtepompen en warmte-koude opslag in de bodem. Met zeer lage watertemperaturen worden middels stralingswarmte de vertrekken geklimatiseerd. Deze methode kenmerkt zich door een hoge energetische efficiency maar ook door een hoog comfort voor de gebruikers. Weinig tot geen luchtstromingen en ophoping van stof maken het systeem tevens bijzonder hygiënisch en schoon. Het gebouw heeft geen lokale uitstoot meer, omdat er geen gasketels worden gebruikt. De gasaansluiting wordt daarom opgeheven.

VERLICHTING

Voor de basis verlichting is gekozen voor LED-armaturen. Bij de werkplekken wordt het lichtniveau verhoogd door werkplekverlichting. Alle verlichting is uitgevoerd met hoogefficiënte armaturen welke automatisch worden geschakeld naar behoefte. Zo wordt de verlichting automatisch in lichtsterkte teruggeregeld als er voldoende daglicht het gebouw binnenkomt. En bij aan- en afwezigheid van personen wordt automatisch de verlichting aan- dan wel uitgeschakeld. Niet alleen levert dit een verbeterd verlichtingscomfort op, de provincie bespaart hiermee ook een aanzienlijke hoeveelheid elektrische energie.

WATER

Het hemelwater wordt opgevangen en gebruikt voor irrigatie van de 'groene gevels'. Daarnaast is al het sanitair gekozen op minimaal watergebruik.

VENTILATIE

Een optimaal klimaat en comfort wordt bereikt door de ventilatiehoeveelheid af te stemmen op de behoefte van de gebruiker. Door een continue meting

van het CO₂ gehalte in de ruimtelucht wordt de juiste hoeveelheid bepaald. Daarmee wordt overbodige ventilatie en energieverspilling voorkomen.

BEDIENING

De integrale gebouw beheerinstallatie (GBS) zorgt ervoor dat alle systemen goed en efficiënt met elkaar samenwerken. Bijzonder is het feit dat de aanwezigheidsregistratie, de verlichting, de zonwering en de gehele klimaatinstallatie worden aangestuurd door één systeem. Dit voorkomt dat systemen elkaar nadelig beïnvloeden en verhoogt de totale energie-efficiency. Nabij de centrale entree van het gebouw worden op beeldschermen permanent enkele aansprekende actuele energiewaarden getoond voor publiek en werknemers.

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End activity

A weekend to the Belgium Ardennes

Written by: Tjeerd Spruijt
Master student in BPS

END ACTIVITY 2011-2012

In October, as usual an end-activity had to be organized to have some time together before the summer vacation. Not knowing about the end-activity of the year 2010-2011, a trip was organized to? Belgium of course. At the last day of the exam week, for some of the joining students even directly after their last exam we went to Vielsalm.

16 students in 5 cars, besides the usual sweets without any normal food or drinks, because there was only space enough for some clothing and other necessary survival stuff in the luxurious cars. The weather forecast was a disaster, rain for the whole weekend, but that couldn't bother anybody when they arrived at the beautiful Villa!

The first cars arrived around 5 o'clock, the sun was shining, and there was a terrace with cold drinks. So everybody took the chance to revive after the long and exhausting trip. When the rather cantankerous woman arrived with the key we could checkout the house. First impression: How low can you go! Ceiling height of around 2.0 meter and door heights of 1.8 meter, luckily we only had a few people that are over 2 meter with us, so that was no problem.

"How low can you go! Ceiling height 2.0 meter, door height 1.8 meter"

With a lot of people in a tiny kitchen we were able to produce a 3 star worthy spaghetti dinner that with again a nice cold drink fulfilled everybody's needs. After dinner a game was played called "the werewolves of awakercity" (weerwolven van wakkerdam) but nobody got it, so the game got stalled. In the back of the huge garden there was a fireplace, so the rest of the evening we enjoyed the campfire that got bigger by the minute.

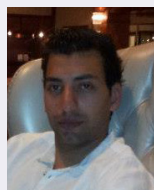


Figure 1. Waterfalls of Coö



Tjeerd Spruijt

Master student in Building Physics and Services at the University of Technology Eindhoven organized the End Activity of the year 2011-2012. Tjeerd wrote this article for the InSide information and was responsible for the accommodation this weekend.



Samir Halim

Master student in Building Physics and Services at the University of Technology Eindhoven organized the End Activity of the year 2011-2012. Samir was responsible for the activities this weekend in the Belgium Ardennes.



Suzanne Deckers

Master student in Building Physics and Services at the University of Technology Eindhoven organized the End Activity of the year 2011-2012 together with Samir and Tjeerd.

SECOND DAY

After a nice long sleep and a quick breakfast, Tjeerd went to the fire to see if it was extinguished because we had to leave soon. It was still hot and burning, so a few buckets were needed to extinguish the fire. Time to leave, Rik forgot a little ledge and got stuck before he even drove 5 meter. Luckily he got freed by some fellow students and could continue his way to Petit Coo. There after a quick search of about 30 minutes we found the canoe company. We went to canoeing at the river. We entered the river the Amblève and got stuck, within 100 meter Mark lost his paddle because

"In the 20 cm river of the Belgium Ardennes, Anika flipped sideways and sank"

he put it underneath a rock, Anika flipped sideways and sank (in 20cm of water), Tjeerd trying to help Anika found Mark's paddle and threw it to him, but missed so Mark had to be pulled for 300 meter. A lot of us got stuck on the rocks but were able to free themselves. Luckily it got a bit better after the first 100 meter so we could continue our trip of 9Km.

Because of the trouble in the beginning the group got split in 3 groups, 10 persons, 4 persons and Mark. After a few kilometers the 4 person group waited for Mark to show up, when he did they continued and found the rest that also had been waiting. We continued the trip and got to the end point just in time to take the bus back.

In the evening, a nice smoky barbeque was organized and with the sun still shining there was a great time just enjoying the food and some cold drinks. After sunset campfire was started again, and due to some wood gatherer experts



Figure 3. BBQ second evening

the campfire was immense, warm and cozy. At least, until the rain started and everybody got into the living room. We drank some more and got to bed.

THIRD DAY

Nothing on the schedule today so everybody tried to have a good sleep before cleaning and going home, for some this was impossible because of the woman shouting and banging the windows. Tjeerd got out of well not his bed but the bench in the living room and opened the door, and there the angry lady was, saying; blablabla voiture blablabla. So he went outside finding out that it was still raining and some French talking people arranged a market for second hand junk around his car. So he moved his car and started to clean the house. The rest got out of bed when they felt like it and got some breakfast and helped cleaning. The cantankerous woman arrived around 2, and the ones that stayed



Figure 2. Canoeing at the river in Coo





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Duurzaamheid
Energie
Gebiedsontwikkeling
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"Due to some wood gatherer experts the campfire was immens, warm and cozy"

behind to give her the key ran outside as quick as possible to get home. While driving it was still raining, but that didn't matter because everybody was still thinking about the wonderful day before when it was sunny and fun.



De kracht van duurzaamheid

Duurzaamheid is voor zowel KP&T als Unica een speerpunt in hun strategie. Waar Unica haar opdrachtgevers ontzorgt met innovatieve en duurzame oplossingen, staat KP&T voor duurzame relaties en persoonlijk contact. De duurzame relatie tussen Fred Borghouts, Hoofd P&O bij Unica en Tom Zentjens, Accountmanager Installatietechniek bij KP&T, zorgt al jaren voor een goede match.

Als allround system integrator en grootste zelfstandige technisch dienstverlener van Nederland heeft Unica alles in huis wat veeleisende opdrachtgevers in onderwijs, gezondheidszorg, industrie en overige utiliteitsbouw van hun installatiepartner vragen. Zij beschikken over uitstekende referenties en durven elke opdracht aan. Groot of klein; complex of juist eenvoudig. Hun kracht? Ze ontzorgen hun opdrachtgevers met innovatieve en duurzame oplossingen, optimale communicatietoepassingen en een comfortabel en vooral ook veilig werk- en woonklimaat. En dat al bijna 80 jaar! Met duurzaamheid als speerpunt in hun strategie waarborgen ze de toekomst van het bedrijf en hun opdrachtgevers.

Voor alle facetten van de gebouwgebonden techniek kunnen opdrachtgevers bij Unica terecht. Zowel voor een apart onderdeel als voor een geïntegreerd geheel. Door het geïntegreerd ontwerpen kunnen slimme installaties met minder energieverbruik en meer comfort gerealiseerd worden tegen lagere kosten. Unica is thuis in:

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Datacenters / Datarooms
Energieoplossingen
ICT oplossingen
Inspecties
Klimaatbeheersing / Airconditioning
Sanitairtechniek
Schone ruimten
Technisch Beheer
Verlichting en stroom

TECHNISCH SPECIALISTEN

Om hun opdrachtgevers van dienst te kunnen zijn en blijven, heeft Unica behoefte aan gekwalificeerde technisch specialisten. Specialist zoals jij, als jij dadelijk je Master hebt afgerond. Maar waar is Unica dan precies naar op zoek en hoe komen ze aan deze specialisten?

KOPLOPER

Fred: "KP&T is koploper voor wat betreft het vervullen van onze vacatures. Wij zoeken regelmatig hoger opgeleiden in de installatietechniek. Bijvoorbeeld werkvoorbereiders of projectleiders maar ook engineers. O.a. voor onze projecten maar ook ten behoeve van service en onderhoud. KP&T zorgt voor een gedegen voorselectie: heeft de persoon de juiste skills en past hij binnen de cultuur en groep? De kandidaten die door KP&T worden aangedragen, voldoen eigenlijk altijd aan die criteria. Dat betekent dat het aantal gesprekken bij ons minimaal is en dat scheelt tijd en geld. Daarnaast resulteert ongeveer 80% van de detacheringsoopdrachten in een vast contract."

Om ervoor te zorgen dat KP&T voortdurend kan voorzien in de personele vraagstukken vanuit Unica, is een goede relatie waarbij je samen op één lijn zit, essentieel.

Tom: "Ik heb wekelijks contact met Fred, dan nemen we vacatures of kandidaten door en praten we bij. Ook kom ik regelmatig bij Fred langs op de kantoren in Brabant (Bergen op Zoom, Oosterhout, Eindhoven) en de kantoren in Limburg (Venlo, Geleen en Maastricht. Bijvoorbeeld om te ondersteunen bij een sollicitatiegesprek of om de ontwikkelingen in de markt door te nemen. Dan maak ik vaak een rondje op de afdeling. Om bij te praten of om mensen te leren kennen. Zo krijg je een goed beeld van hoe de organisatie in elkaar zit. Ik ken dus niet alleen Fred, maar ook veel andere werknemers bij Unica. Daardoor krijg je een eigen visie en kun je goed meedenken over wie bij het bedrijf zou passen. Hoe ik dat doe? Voornamelijk vanuit mijn gevoel. Maar ook door bewust doorvragen en signalen herkennen."



Figure 1. Hoofdvestiging Unica Limburg

ZELF DUURZAME RELATIES OPBOUWEN

Je krijgt een duurzame relatie door beloftes waar te maken en betrouwbaar te zijn. Een goede relatie blijft bestaan omdat je je keer op keer bewijst. Dit geldt voor Unica, voor KP&T, maar ook voor jou! Als jij straks een 'relatie' aan gaat met een werkgever (of het nu is voor je afstuderen of voor je eerste baan) en eruit wilt halen wat erin zit, zul je vanaf het begin af aan moeten bouwen aan een duurzame relatie.

"ALLE RELATIES BEGINNEN MET NETWERKEN"

Het opbouwen van een relatie begint met netwerken. Om bijvoorbeeld het afstudeerproject binnen te halen of je droombaan te bemachtigen, zul je contact moeten leggen met de personen die jou daarmee kunnen helpen. Dat kan op allerlei manieren; via netwerkevenementen zoals de 'meet and greet' die Mollier ieder jaar organiseert, maar tegenwoordig zijn ook social media als LinkedIn een handige en professionele tool.

KP&T is specialist in het bemiddelen van technici op MBO, HBO en WO-niveau. Je vindt ons in Amsterdam, Apeldoorn, Breda, Nieuwegein en Weert. We zijn gespecialiseerd in:

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- Civiele Techniek
- Elektrotechniek
- Installatietechniek E/W
- Werktuigbouwkunde

Onze gespecialiseerde adviseurs zijn verantwoordelijk voor één vakgebied. Het voordeel hiervan is dat zij uitstekend op de hoogte zijn van de mogelijkheden in de markt. Hierbij kun je denken aan de aansluiting tussen vraag en aanbod maar ook aan trends en ontwikkelingen in de werkgeversmarkt.

Figure. 2 "Alle relaties beginnen met netwerken"



Belangrijke tip: ben je, in het opbouwen van je (professionele) netwerk, bewust van hoe en wie je benadert. Zoek niet lukraak contact maar doe dit met een doel en een boodschap. Hoe serieuzer jij je contacten benadert en je netwerk opbouwt, hoe professioneler en betrouwbaarder je overkomt.

Heb je inmiddels dat mooie afstudeerproject of die mooie baan bemachtigd, dan is het van belang je 'relatie' diepgang te gaan geven. Door jezelf, maar ook je werkgever, scherp te houden, jezelf te ontwikkelen en je toegevoegde waarde te laten zien.

Wil jij graag een duurzame relatie aangaan met Unica of één van de andere organisaties in KP&T's netwerk, neem dan gerust contact op met:

Tom Zentjens
Accountmanager Installatietechniek
06-13344939/ t.zentjens@kpt.nl

Benut je talent

en haal het beste **uit jezelf!**



... wij gaan voor 'n tien!

Aandacht voor onze kandidaten, weten wat er speelt en waar behoefte aan is en doelgericht oplossingen bieden. Dat zijn factoren die bij KP&T zorgen voor de perfecte match. Wij gaan voor een 10, bij alles wat we doen! En het resultaat? Jij als kandidaat kunt je focussen op waar je goed in bent... en wij ook.

KP&T, voor jouw baan in Bouwkunde, Civiele Techniek, Elektrotechniek, Installatietechniek en Werktuigbouwkunde.

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Kuijpers is een professionele technisch dienstverlener in gebouwen en industrie. Wij zorgen voor de initiatie, realisatie, het onderhoud en de exploitatie van technische installaties. Wij zijn een familiebedrijf dat van generatie op generatie geënt is op toekomstbestendige bedrijfsvoering. Onze missie? Dat is het bijdragen aan een aantrekkelijk milieu om in te leven en te werken.

Resultaat door betrokkenheid is een belangrijke drijfveer. We zijn persoonlijk betrokken bij onze medewerkers, we zoeken naar ontwikkelmogelijkheden om zo het beste in elkaar naar boven te halen. Technische oplossingen brengen we in overeenstemming met de wensen en mogelijkheden van klanten. Maatschappelijke betrokkenheid is voor ons als familiebedrijf een intrinsieke waarde. Enkele projecten waar Kuijpers aan heeft gewerkt zijn het Rijksmuseum - Amsterdam, de Aquanura - Efteling en het nieuwe ziekenhuis Bernhoven in Uden. Wij hebben vestigingen in Arnhem, Den Haag, Helmond, 's-Hertogenbosch, Roosendaal, Tilburg en Utrecht.

Binnen Kuijpers zijn er mogelijkheden voor traineeships, afstudeeropdrachten en stageplaatsen en zijn er diverse uitdagende functies. Ook bij Kuijpers resultaten behalen? www.kuijpers.nl



Kuijpers



Interview with: Jan Hensen

Inside Magazine has an exclusive interview with the head of the unit building physics and services at the TU/e, Joannes Laurentius Maria Hensen. He is responsible for the mission, vision and strategy of the unit. He coordinates the energy in the built environment team, advises and supervises master- and Ph.D. students in their research and is a full professor in Prague and Eindhoven.

J.L.M. Hensen

9 april 1953

Prof. Czech Technical University in Prague,
Mechanical Engineering
Doc. Czech Technical University in Prague,
Mechanical Engineering
Dr. Technische Universiteit Eindhoven,
Building Science
Ir. Technische Hogeschool Eindhoven,
Building Science

In 1981 you graduated at the Eindhoven University of Technology. What was your graduation research about?

Strangely enough I had two topics, the first was about numerical simulation of energy in offices, how to use simulations to optimize office rooms, for example, window size. Parallel I did experimental research on measuring convection in a Trombe wall, a passive solar device consisting of a concrete wall, a cavity and a glass pane, to store solar heat. Since then, the subject of free convection has crossed my path numerous times.

After you had graduated at the TU/e you started to work for TNO but after a couple of years you returned to the University to get your Ph.D, what was the reason you wanted a Ph.D now?

I had always known I wanted to get my Ph.D because it was necessary for an academic career and I wanted to see if I could do it, a personal challenge. Unfortunately, at the time there were only two positions and they were both taken so I had to wait 5 years. In the meantime, the research I did for TNO was a collaboration between TNO and FAGO so I was mostly at the TU/e.

A few years after you had got your Ph.D. You started teaching Mechanical Engineering at the University of Strathclyde in Glasgow. Why did you

make the switch from building science in Eindhoven to this?

It's not really a switch, what we did there is the same as what we do here, it is just in the mechanical engineering department. Other universities have it in civil engineering and here we have a built environment department.

"It's impossible to do research with people you don't trust."

You now also have a position as a full professor Mechanical Engineering in Prague, how do you combine this with your work in the Netherlands?

I only go there 6 or 8 days a year, so that is how I combine it. The course I run there is comparable to the state of the art in building performance simulation course here, were all the information is on the web and someone else delivers the actual lectures.

What inspired you to teach in general, and why in different countries?

When I graduated, doing research was my first interest and I preferred to do research at the university because we have more academic freedom. I can choose what interests me and I'm not

depending on other people. I believe that is why master students can do very interesting research. I feel very passionate about my area and then teaching is a powerful way to bring that knowledge into practice. So it is not as much that I like to teach in general, it is more that I love this field and want to help students discover new things.

And why in different countries? I just like to travel and got the opportunities to do so.

Could you explain the difference between working and teaching in Glasgow, Prague and Eindhoven?

The students in general are a little different but a strong point about Eindhoven is that the students learn how to think independently and on a more academic level. In other places, students are given more closed assignments. They can be quite complex but there is more a step by step guide on how to come to a solution. Apart from that there aren't many differences.

What do you do to improve your own knowledge?

I'm interested in many new things within the field so I try to read articles and go to presentations. Besides that I'm also asked to review papers for journals and that is an excellent way of becoming aware of what other people are work-

is to how to stop working, because I like it so much, my wife has to stop me sometimes or I could go on for hours reviewing papers and reading articles, it's more like a hobby to me.

Could you give an example of a mistake you made during your career?

I believe it is very hard to say that a decision is wrong. When I'm in the car and I'm driving the wrong direction, I won't turn around. I believe that might discover something else. That is the same with decision making, you have to make the best decision possible with the information available at the time and go with it. In hindsight it might be better to take a different direction but you probably also learned a thing or two.

What are your greatest strengths?

I'm an optimist, I try to look for opportunities

What are your biggest weaknesses?

Because I'm interested in a lot of different things, I have to be careful that I keep focused and not get sidetracked. Another weakness of mine is that there are many important things in life without a deadline that have to be done, for example, if you want to write a book there is nobody who tells you when it has to be finished but if you want to do that, you can't postpone it infinitely.

Also, I'm actually very proud that we now have a scientific journal in our field and my contribution to it. This didn't exist when I started out. The journal of International Building Performance Simulation Association, Journal for building performance simulation, has become a well-established journal over the years.

What are some of your personal and/or professional goals for the future? Where do you see yourself in 5 – 10 years?

In 5 years I will retire here. But I'm thinking about what will happen then, how can I combine the things I like to do with useful things for society, how can society best utilize a retired professor. Maybe some organizational work. And of course I still have a number of Ph.D students when I retire so I won't be gone from one day to the next.

Enjoy what you are doing. Try to find something that captures your imagination and do your best to be good at it.



Wordcloud of Jan Hensen



What was your last holiday destination and what did you do?

We went to the centre of Paris to see the Eiffel tower, Sacre-coeur, Notre dame and all those tourist places. And we visited Disneyland with the children.

What kind of car do you drive and how is your drive style?

I drive an Audi, which I got almost 10 years ago for my birthday from my wife. At least, that's what I tell people. It's a diesel and I like that, I prefer to drive long distances and it can be quick, especially on the German autobahn, but I don't have to be the first one over the line when the traffic light turns green.

What's the last book you read and did you like it?

Sturen of storen, leiding geven aan wetenschappers. It's a small book or guide for professors or unit chairman and it describes why people are the way they are. It makes you understand your own situation. This is a book that I wish I had read 10 years ago.

What magazines do you subscribe to?

Only professional magazines. But I have to read that much already here at the university that when I'm on a holiday or anything, I'll start the first few days without reading anything.

What's the best movie you've seen in the last year?

I'm not so much in to movies. I like to watch tv but I prefer detectives. Midsummer murders, Lewis etc. I never watch American detectives, the acting and the humor of the British is much better. In the UK, most universities also have a drama department so maybe that is the reason why they have a lot of good actors.

What would you do if you won the lottery?

I don't do lotteries because I think that most people lose money and the ones who win most of the times end up unhappy. But if I would win something, I would probably start a study fund for students who need it.

Who are your heroes and why?

I have people who I respect very much, from whom I learned a lot. My promoter Joe Clarke from the University of Strathclyde.

What do you like to do for fun?

I used to run but due to back problems that isn't possible anymore. Nowadays it's more spending time outside with the family, just walking or maybe play some games. We spend a lot of time inside so we prefer the fresh air.



Ir and then..

Written by : Ricardo Poortvliet

After finishing my thesis, I had about one month to enjoy the last moments of the life as a student. I finished my thesis but I still had one month to go before giving my presentation. While I was not really sure whether I would make it or not (finally I finished the presentation with a good grade, 8), these were some exiting times. Most of the time I could be found in the centre of Eindhoven between 10 PM and 3 or 4 AM. After this month I was totally done with being a student (after 4 years of HBO and 3 years of university).

Being graduated delivered some exiting moments as well. Could I be able to find a job? Would there be a company in the Netherlands (or even in the world) which would fancy hiring a guy like me? Because, let's be honest; I had graduated from University, I had been on the board of a great study association (Mollier) for 2 years in a row (being treasurer and chairman) and I had the looks of John Travolta (right now I'm not sure whether that is positive or not). After having some contacts with former colleague student Luuk Bouman at BAM Techniek, I dropped my CV at BAM Techniek and was invited for an interview the week after.

Being sure that the life of a working person would be really serious I started at the department 'Big Projects' of BAM Techniek. My first intuition was right; being a working person was really serious. I became a trainee who has 3 periods of 8 months on different departments with different responsibilities. I started as an engineer/calculator. After 8 months I

changed to work preparation in Apeldoorn, one of the regions where BAM Techniek is active and the atmosphere is more relax and more student-like. Enjoying the work in Apeldoorn, I decided to stay here and finish my last period here in Apeldoorn as a technological developer.

On the 15th of November I will be working at BAM Techniek for 2 years now. My traineeship will end this day and I will get a definitive job as a technological developer. A technological developer is like an internal advisor and mainly active in the stages 'beginning design' and 'temporarily design'. Furthermore I am no longer living in the city of Eindhoven. I live in Utrecht now and I'm looking for a dwelling in the city of Houten (near Utrecht).

For the future I still have some dreams (thinking that being a technological developer will not be my final job) to grow in the department of development. I would like to become a development manager or even a unit manager development. I think the education of Building Services is a great start for a professional career. Being one of the few graduated in this field of study makes it easy to find a job and to be distinctive from other people with similar educations like building technology of civil technology. Make advantage of this given point while looking for a job! Look around and inform at different companies and ask former students about the atmosphere at the company.

Looking forward to see everyone again at the next activity of Mollier where former students are also invited!



Constitution 17th board Mollier

Written by: Ilse Schoenmakers
Master student in BPS

On the 26th of September, 16 years after the founding of the studie association Mollier, the constitution of the 17th board was a fact.

During the General Meeting of Members, the old board is replaced. Tom Thomassen, Rik Maaïjen and Ellen Boesten terminated a fortunate year. Richard Claessen, Ilse Schoenmakers, Patrick Creemers and Karin Conen are the fresh and new members of the next board.

The new board announced that they will fulfill their duties as well as possible. This announcement was accompanied by much applause and ofcourse the Mollier Anthem. An evaluation of the previous year, new challenges and plans for the next year were presented by the board and several interesting and important subjects were discussed.



Together with another study association, Mollier celebrated the constitution of the new board. Old and new members met eachother in the 'Skybar' to have some drinks. After this party all (old) members moved to a tapas bar 'La Guitana' to enjoy a tastfull dinner.

This year Mollier counts up to 27 new members. A lot of them were at the constitution dinner. Also many members, alumni and family members were waiting to join with the newly appointed board to have a nice dinner.

The evening continued with many congratulations, the mollier anthem and a lot of fun. Due to the presence of both alumni and new members, the friendly atmosphere triggered interesting discussions between all parties. It can be said that integration on the highest level was achieved. Several drinks and a lot of tapas later the party continued in the 'Spijker' at Stratum where the evening was brought to an indescribable end.

Education in the academic year 2012 – 2013

Written by: Richard Claessen and Tom Thomassen

Education is a continuous changing process. In recent times both the faculty and our study have undergone major transitions. One example is the introduction of the new Bachelor College. In this article we will describe changes in education over the past years and we will mention upcoming changes.

Ending of master program Building Services

Readers of the INSide Information, (old) students, and staff of our unit all know the history of the 2002 change of the study Installatietechniek into the BSc Intallatietechnologie and the MSc Building Services (BS). The BSc Installatietechnologie was unfortunately prematurely terminated because of a too small intake students. The MSc Building Services survived for a long time. However also this program is about to be terminated. It is succeeded by the MSc track Building Physics and Services (BPS), which is a combination of the old Building Services program and the Physics of the Built Environment (PBE) program. For more information about the new track see below.

As of September 2012 no new students are allowed to start with the Building Services program. For students that are already studying Building Services, the following regulations apply:

- MSc BS diplomas are handed out till December 31 2013.
- BS students that graduate after December 31 2013 will graduate at BPS and will be given an MSc ABP track BPS diploma.
- HBO students that complete the transition program BS or PBE in 2012 have access to the program MSc ABP.

Mastertrack Building Physics and Services

In September 2012 the new study Building Physics and Services was launched. It is a track of the MSc program Architecture, Building and Planning (ABP). A long expressed wish of the branch organizations, a study with a coherent

building physics and building services program, became reality. Students of the new BPS track get a dedicated package of building physics and building services courses. Students have the opportunity to specialize in the direction Building Physics (BP), Building Services (BS) or a combination of both. This can be done by carefully choosing master projects, graduation project, and optional courses. Optional courses can be followed at the own faculty, but also at other faculties (especially Mechanical Engineering, Electrical Engineering and Innovation Sciences).

Intake Master track Building Physics and Services

Students who want to start the Master track Building Physics and Services need a bachelor diploma Built Environment or a completed transition program. HBO B students can do an intake of approximately 30 ECTS from which at least 75% has to be completed in one year [1].

Almost all other bachelor students (for example students from Mechanical Engineering or Electrical Engineering) cannot participate due to the current regulations. See for more information [2]. This also accounts for HBO students other than those of Built Environment. We hope that in the near future these

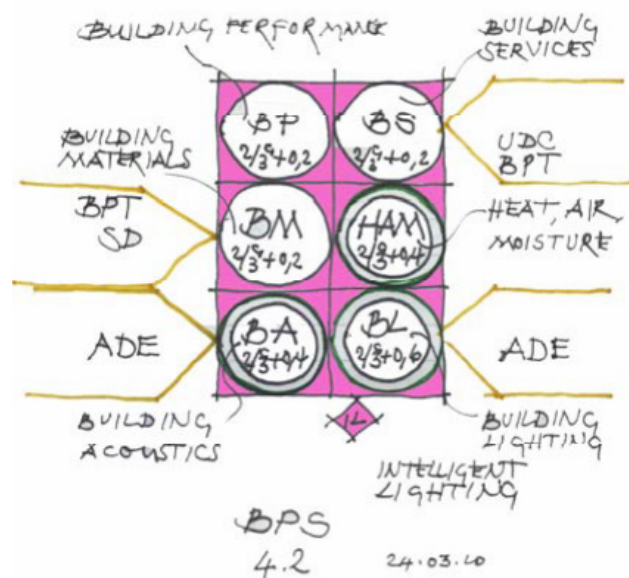
regulations will be changed, making it possible for students of different faculties to start with the Master track Building Physics and Services. Furthermore there is still a wish for part-time education.

Bachelor College

September 3rd 2012 was an important day for the Eindhoven University of Technology: the new Bachelor College (BC) officially started. Rector Hans van Duijn called it the start of 'the biggest educational revolution the Eindhoven University of Technology has ever undergone'.

Briefly summarized: all the old bachelor studies (e.g. Bachelor of the Built Environment) are bundled in one single bachelor. Every student has a number of compulsory courses, such as mathematics, physics and psychology. A large part of the program can be chosen by the students themselves. Students can decide they want to go deeper in specific subjects or they want to gain a broad knowledge on several subjects. Teachers and coaches are there to help students with their choices.

Currently only the first year has this 'Bachelor College structure'. The second and third year will get the BC look soon.



At the moment it is very difficult to say whether the Bachelor College is going to be a success. It is also difficult to say whether the new bachelor students will gain the knowledge they need to start with (and successfully complete) the master programs. This is therefore an attention point for the current and coming years.

Development Plan 2014 Department of the Built Environment

The Development Plan 2014 for the department deals with the education in 2014. The plan focuses on:

- More efficient education using a 'Smarter Curriculum'.
- Combining forces in research.
- More cooperation between the different units.
- Get the finances in order again.

Langstudeerdersregeling and sociaal leenstelsel

A time ago Rick van Pruissen wrote about the 'Langstudeerdersregeling' (long studying law). See the December 2011 edition of INSide Information for this article. The langstudeerdersregeling is legislation that limits the amount of time a student gets to complete his/her study: anyone who takes too long to complete their study will have to pay an extra 3,063 euros in tuition fee (apart from the regular tuition fee).

Due to the recent change in government this langstudeerdersregeling is now off the table. However now a 'sociaal leenstelsel' (social lending system) will be introduced, starting in 2014 [4]. The 'basisbeurs' (basic scholarship) will no longer be a gift, instead it will be a loan. It goes without saying that this has a large impact on the finances of students.

At the moment it is difficult to say what will be the effects of this measure on students and the student population. It is estimated that 15,000 students will not start with a HBO study because of the social leenstelsel. That is

quite a large amount, when you consider that each year 100,000 students start with a HBO study [5].

Already paid fees for the langstudeerdersregeling will be transferred back before December 1st [6].

Education visitation commission

On October 22 and 23 the faculty was visited by the education visitation commission. This commission is responsible for the accreditation of our study. All studies need an accreditation every six years. With an accreditation the faculty can continue teaching and handing out diplomas. On October 23rd the preliminary findings were presented: the commission was very impressed with the education and facilities of the faculty.

Education commission Mollier: from OCI to OCB and OMT-BPS.

For as long as Mollier exists it always had a board member with the title 'Commissioner Education'. The Commissioner Education always had a place in the OCI (Onderwijs Commissie Installatietechnologie, Education Commission HVAC technology) to represent the interests of the students. The past years the Commissioner Education was also invited to the meetings of the OMT-BPS (Onderwijs Management Team BPS, Education Managing Team BPS). The OMT-BPS is an informal group which monitors the developments of the education within the Unit BPS. When problems are foreseen or detected the OMT-BPS takes action through official commissions or commissioners. Since the influx of students for the MSc BS has been stopped the OCI was relieved of its duties.

The Commissioner Education now has a place in the OCB (Onderwijs Commissie Bouwruimte, Education Commission Built Environment) and the OMT-BPS. The Commissioner Education can inform these commissions about any

education related problems or comments you have and help you out. With the change of boards Tom Thomassen handed over his function as Commissioner Education to Richard Claessen.

We want to end this article by wishing all the students success with their study. Students with questions are welcome to contact us at education@mollier.nl

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Energy neutral main building

By: Laurens Ensink, Sjors van der Straten, Nikie van Veen & Bob Romijnders

The main building of the TU/e, originally designed by v. Embden, is part of a group buildings, named Campus 2020, which will be modernized in the future. The goal is to create a compact campus where all faculties are established around a green, car free zone. Renovation of the main building must lead to an energy neutral and innovative design. The assignment was to create this new design.

Figure 1. Concept

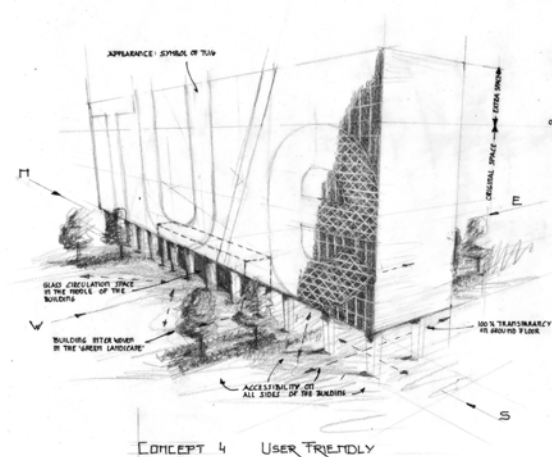
Program

The new design will have an extension on top and will be placed at the current location. The program of requirements asked for a conference hall with a capacity of 300 persons and an adjacent to the green strip. Further the main building has to accommodate the faculties Industrial Design, Industrial Engineering and Innovation Sciences. The executive board of the TU/e will be placed in the new extension.

Vision

The main goal of the renovation of the TU/e main building is creating a user friendly building. A building which reflects what the TU/e is standing for: innovation/progressiveness, a unique knowledge centre and a pleasant learning and research environment. Creating synergy between the main building, the campus and the masterplan 2020 is the most important starting point of the design. This should take a prominent place within both the campus and also the global architecture. Existing characteristics, like the concrete columns, are being respected in the design. The current building has many limitations, including the bad insulation, the massive appearance, the dating of materials and last but not least, it misses the mundane allure that the university, as archetype of innovation, wants to radiate.

Transparency is the key. The ground floor will change intensively by removing the low rise. A royal glazed meeting-routing space will be created below the table structure. An optimal use of daylight provides a pleasant working atmosphere and study climate. This is made possible by a completely new facade, with the latest techniques in the field of energy gaining sources, and the application of multiple atria. The usability of the building is emphasized by the flexible layout and individual regulation of comfort. To be adequate for the future roles, there will be multiple storeys added to the existing building. The transition and the difference between the old and the new volume is subtle, and will be barely noticeable for a spectator at first.



Design

Ground floor/low rise

The first aspect noticed in the new design is the transparency of the ground floor. By removing the low-rise, the large concrete table structure will be one of the highlights in the new design. The concrete structure is typical for brutalism. This architectural movement is used as a base by v. Embden for the design of the older buildings on the campus.

The removed low-rise results in a better view over the new modernized campus and green strip. The transparency also gives more opportunity to observe the spectacular and elevated appearance of the main building compared to the other buildings on the campus.

The rectangular glazed transport space gives the possibility to reach the different functions in the basement and high-rise without creating an enclosed area. The glass box is designed under the table between the concrete columns. In summertime, during the warmest period of the day no direct sunlight will make contact with the glass, because of the setback of the box underneath the table. Due to this a great deal of heating by solar radiation will be prevented.

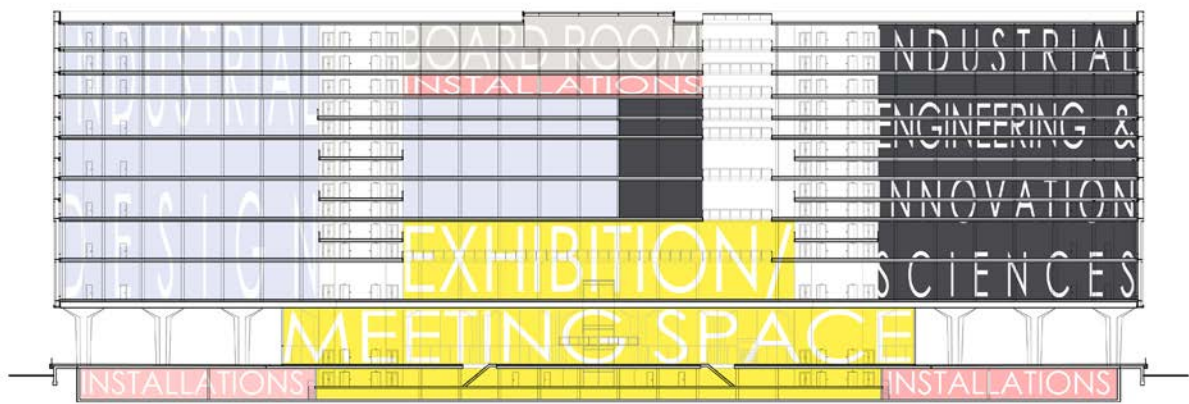


Figure 2. the program of demands in longitudinal section

Basement

New class rooms and lecture halls will be placed in the current basement. The location is fast accessible for a large amount of students. They can use the elevators in the glass box for quick transportation from basement to high-rise or campus and the other way around.

This is also advantageous in relation to fire safety, because a large amount of students will be in the basement at the same time. The constant temperature of the earth operates as a natural cooling for the new rooms. This results in less energy use for cooling. To create the lecture halls, a floor slab and several columns are removed. This results in a change of stress distribution in the remaining elements. The existed structure shall be modified to make the changes possible.

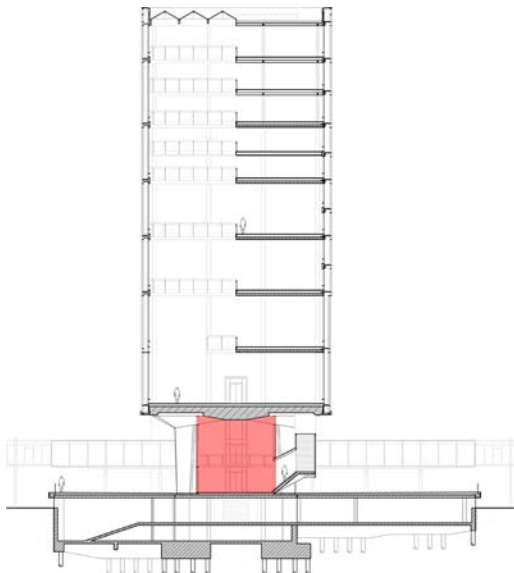


Figure 3. the glass box

Void and Atria

At the second floor a large meeting space will be created. A bigger storey height is made by creating a large void in the 4th floor. This void is connected with two atria. Together the void and the atria enclose the meeting space; this will form the heart of the new main building. The meeting space contains a knowledge centre and exhibition space on the 2nd floor and a canteen on the 4th floor. The roof and façade of the atria are made of glass, due to this an overflow of daylight enters deep into the workplaces. The ventilation of the meeting space en atria is based on the principle of displacement ventilation. Smart chosen dimensions and locations for the floor openings results in no change of bending moments and shear forces.

This theory is not usable for the void in the 4th floor. A part of this floor shall be replaced by a lightweight steel structure. The centre of the building serves also for a knowledge and information exchange environment between the different faculties. A few floors above the meeting space are combined for usage of all faculties. This will promote the possibility for information exchange.

Extension

The main building will be extended with three extra storeys on the current roof. These storeys contain installation space, offices, a conference hall and the executive board. The original grid of 1,24m that v. Emden used to organize the different elements in the current design is also used for the structure of the extension. The current structure is placed on a grid of 6,2 m, five times 1,24m. The new lightweight steel structure will be placed on the same grid. The consequence is almost no difference in vertical load distribution on the current structure. The increased load on the existed columns gives no extra problems.

The roof of the conference hall rises above the top floor but not above the roof edge. In this way daylight can enter the room when desired. A flexible layout of the hall gives opportunities for meetings, conferences and lectures. A gathering space for the guests is positioned at the floor below the conference hall.

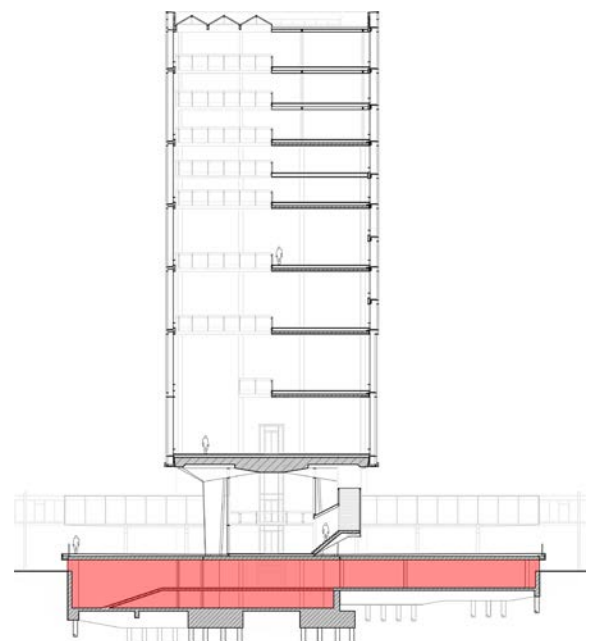


Figure 4. the basement

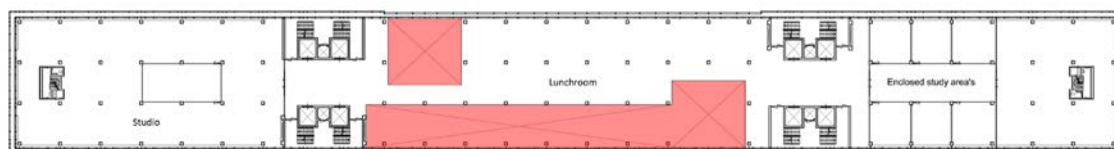


Figure 5. void and atria at floor 4

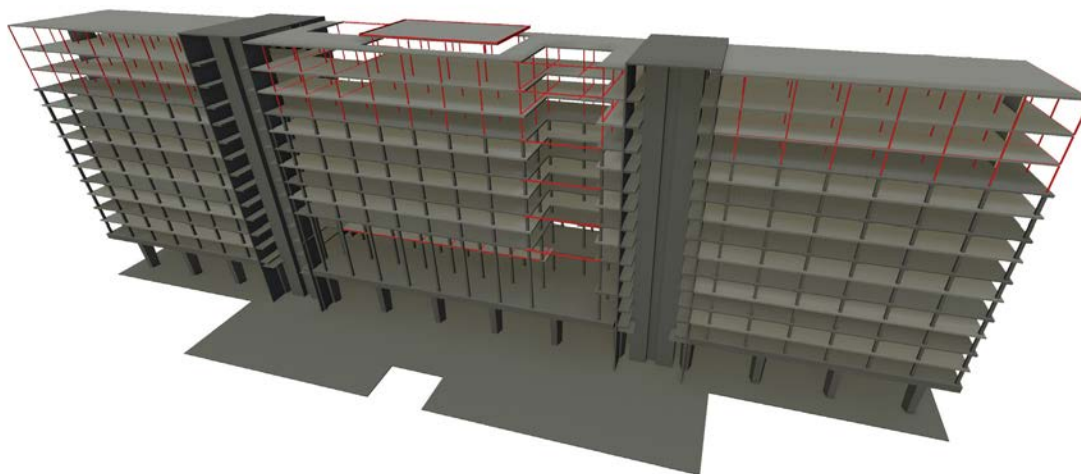


Figure 6. 3d impression of the current and (in red) the new structure

Work floor

The work environment for students, teachers and researchers is transparent and structured. Several non-structural floors are removed to gain more storey height and create better daylight conditions. The main design aspect is to create a user friendly building. The flexibility of the layout and the possibility to remove floors is one of the great original design aspects of the current building. This opportunity is important to keep in the new design. In this way, the building can be used for different functions in the future. The workplaces are individual controllable. The floor plan is divided in parts with a surface of 9m². The basic climate is overall controlled by a climate regulation system. This system controls basic temperature, humidity and artificial light.

At each workplace the user can control its own environment: I-climate. The user can change previously called aspects by using the I-climate system. Combine the I-climate system with a flexible layout and the possibilities for different users are endless.

Façade

The current façade was a great idea, different fillings in a curtain wall show the function behind it. Unfortunately the use of the building results in an incoherent elevation. The blinds are

often closed and give a deformed vision of the original design. In the new design a second skin façade with a random pattern of solar panels creates an image which is based on the grid that v. Emden used in the authentic design. The second skin façade decreases the energy need for cooling in summer situations by transporting the sun heated air outside. In winter situations the shutters in the second skin are closed. The space is now an extra buffer to decrease heat loss through the façade.

There are three types of panels used for the glass façade: a transparent glass panel, a semi-transparent solar-glass panel with a pattern of pv-cells and a solar-glass panel filled up with pv-cells that are small distances apart, so you can see through when you are nearby the façade. The usage of the three panels in the curtain wall results in a unique combination of lines and surfaces. In the second skin the vertical posts are emphasized and in the inner façade the horizontal styles. The transparent L-shaped form in the façade shows the atria and meeting space and is set back in comparison to the remaining façade. In this way a subtle difference in layers shows the important meeting space, which is the heart of the building. It also divides the large façade surface in parts which results in a less monotone image.

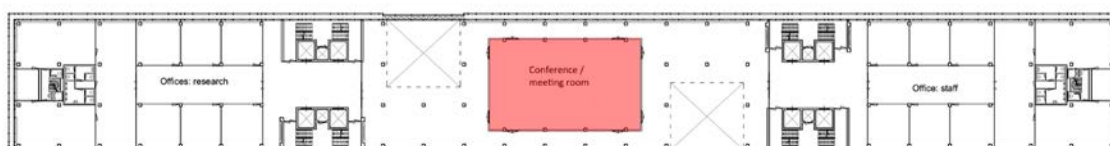


Figure 7. conference hall at floor 14

Durf jij in een dynamische situatie een sprong te wagen?



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Energy Neutral

One of the requirements is to create an energy neutral building. There are different guidelines for reaching a building like that. The following standard is used for the new design: The energy usage in one year must be less than zero. This could be reached by reduce the energy need and make use of additional energy sources.

In this design the RC value is increased to 5 m² K/W, a second skin façade and an aquifer in combination with a heat pump are added to the building. In combination with sustainable systems for lighting and ventilation the energy use is reduced to 4 million MJ instead of 43,3 million MJ. This 4 million MJ is generated by PV-cells on the façade and roof.

Conclusion

For this renovation group 6 thinks it is important to take the original vision of the architect into account, in this case the vision of Sam van Emden. The new plan is designed with the original architectural and structural aspects in mind. The new energy saving solutions make it possible to create an energy neutral building. By integrating different building aspects, this study proves that it is possible to create a green but still user friendly design. More buildings will be renovated in the future because raw materials are going to deplete. Use of renewable energy sources will be a main item for new buildings. The job of the new novice designers is to create these energy saving buildings and make a valuable contribution for a green earth.

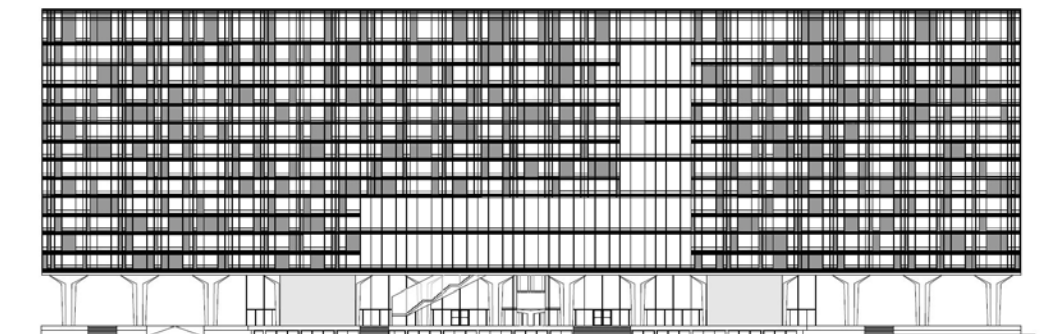


Fig 8. west side elevation, façade cladded with three types of glass



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**Het Mollier-lied wordt gezongen op de melodie van de 9e symfonie van Beethoven*

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