eindhoven university of technology
This book comes out during Dutch Design Week and the choice of projects relates to the content of that event in the sense that the book focuses on the type of research that (1) most explicitly addresses the refinement and innovation of designing the built environment or (2) (re)articulates the premises of environmental and building design.
BUiLT ENVIRONMENT

eindhoven university of technology
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As Dean of the Department of the Built Environment, I am very proud and honoured to be the one to write this foreword to the new version of our yearbook. As you can see, we have changed a great deal. First of all, the name itself has been changed to Built Environment. We have also changed the book’s format as well as its content: less documentation and more text in order to fulfil the ambition of becoming a more mature scientific publication. Many of our graduates, along with a student assistant, have worked very hard to make this beautiful book, but most of the effort has been put in by editor Jos Bosman and graphic designer Jac de Kok to whom I am very grateful for working night and day to create the first “Built Environment”. It is a reflection of all the beautiful work by the graduates during the academic year 2011/2012. In this first issue of Built Environment you can see the broad scope of work carried out by our department and read that integral design is the keyword to create an innovative, sustainable and healthy indoor and outdoor environment. We are convinced this book will make our world a little better.

elphi nelissen

*dean, department of the built environment*
introduction

The new concept for the Faculty Yearbook is motivated by the desire to present the results of graduate final projects at the level of a congress paper. This desire may not be realized all at once. First the participants must be polled to see whether this desire motivates them, for it is a great deal of work in addition to their final report (which has a completely different format). The makers of this book have the impression that such can be considered a success.

The new formula is supervised by two commissions. One consists of representatives from the four faculty units, Rijk Blok, Bert Blocken, Bernard Colenbrander and Harry Timmermans, who nominated the students to be presented here. The other is the editing committee, composed of (former) students Myrthe Buijs, Niels Groeneveld and Faye Hermens (today all alumni) who, together with student assistant Bas Jansen, guided the nominees during the development of each contribution.

The content of the submitted contributions provides three thematic links:

1. Studies dealing with the consistency of a model notion of a city and region. All these studies support the recently started research program ‘The Living City’ in which changes in existing cities and landscape organization are central.

2. Studies based upon didactic agendas in which a conceptual approach is used as a conscious ‘detour’ before programmatic points of departure are employed. A justification for this way of studying and researching was recently worked out by Jacob Voorthuis in his book Het Ontwerpgesprek – een filosofie van het ontwerpen (nai010publishers, 2012).

3. Studies which make use of computer, test and/or interview tools with the intent to enrich building practice with innovations. This group profiles Design Systems, Structural Design, Building Physics and Building Engineering. Some of the results published here consist of surprising experiments which promise to modernize the design basis of construction and building engineering.

Finally, a word regarding the choice of the two examples of built design which introduce the studies described above. The first is an extant example of a built prototype in which all the desires of the faculty that concern multidisciplinary cooperation are present. The second example comes from the earliest days of the faculty, 1970, and demonstrates as nothing else can the existence of the link between building and product design in those days. This link is once again current today because it has become customary to present the contents of the Yearbook as an exhibit during Dutch Design Week. “Show your design roots too,” advised Hans Robertus, director of this week, during a discussion organized during the preparation of this book. We thought this was good advice to follow.

jos bosman
chairman casa vertigo
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The recreational sector in the Netherlands has various types of accommodations for overnight stays. Among these, hikers’ cabins offer a good and affordable location for traveling tourists. The original hikers’ cabin is available in three different types. Apart from these hikers’ cabins, lots of other small buildings pop up everywhere across the landscape. Unfortunately, together they give a disorganized impression of the landscape. For this reason Stichting Natuurkampeerterreinen initiated the development of a new hikers’ cabin that provides an innovative and sustainable alternative for the outdated hikers’ cabin. The project was provided a subsidy by the Ministry of Economic Affairs, Agriculture and Innovation.

The original hikers’ cabin is meant for people who travel from cabin to cabin on foot or by bike. They stay in one place only overnight. This remains an option, but the new hikers’ cabin, the Trek-in, will attract a broader public. The additional target group exists of people who want to stay at one location in nature for a longer period of time. The new design is updated to meet the spatial and functional wishes of every target group.

**Design and functionality**

The Trek-in was designed by us, students at the University of Technology in Eindhoven. We started with an unknown location which required a strong shape, one that was recognizable on its own. Therefore we chose to create a pointy tent-like shape everyone knows from campsites. This ‘recognition by meeting’ plays a major role in the relationship between man, building and the environment. Another theme of the new design is the balance between open and closed; on one hand, the building is a shelter that provides privacy, on the other hand, the design opens up to the environment.

Together these themes result in a ground plan in which functions are housed in niches in the walls on two sides of an open, but indoor area. This area is the transition between the wide natural environment and the intimacy of the functional niches.

The facilities of the traditional hikers’ cabins were outdated which is why the Trek-in is more modern and luxurious. It is equipped with a kitchen with two hot plates, hot and cold water, a bathroom with toilet and shower, a settee bed and bunk-beds, each for two people.

**Materialization**

The Trek-in is executed with a wooden, insulated facade. This speaks to the desire to use the cabin not only in summer, but all year round.

Wood was chosen because of the pure and honest reflection of nature, the warm atmosphere, the recognizable sustainability, the renewability, the relatively small impact on the environment and the benefits of prefabrication. The execution of the exterior with the vertical installation of wooden laths enhances the shape. The Woodchallenge* jury praised this project for being a well detailed proposal which shows off the possibilities of making an exciting design with a timber-frame construction and a wooden finishing.

It is even more special that 2Life-Art builds the Trek-in with materials from demolition projects from A. van Liempd Sloopbedrijven. That means that all wooden beams and laths, but also many other materials such as plumbing, are reclaimed from other buildings which have been demolished. Hardly any new materials are needed and a second life is created for the demolition waste. Using demolition waste to create new Trek-ins, gives each one a very personal story.

Another advantage of these reused materials is that guests will contribute to the long lifespan of the building, despite or rather because their use will be visible. New scratches do not affect the Trek-in in a negative way, but tell an extra story. This will only strengthen the character of the building. As visible signs of use have no negative influence on the design, people will find it worthwhile to commit themselves to the preservation of this extraordinary, sustainable building, the Trek-in.

**Technical aspects**

The Trek-in is divided in two prefabricated parts and are optimized to the transport measurements of a flatbed trailer.

The two modules only have to be brought together on the foundation. This prefabrication guarantees a high quality and minimal use of labor, machinery, equipment and time on site.

That foundation is a new combination of existing elements in such a way that the height of each of the eight points can be adjusted with respect to each other and to the envi-
vironment. It is an assemblage of dry elements. These elements are also reclaimed from demolished sites. Another advantage of dry assembly is that the foundation and the modules can be installed on the same day. The foundation lifts the Trek-in above ground level with two purposes: to allow wind to flow freely underneath (to protect the wood from moisture) and to prevent wild animals from taking shelter underneath. The modules consist of panels with a wooden frame of I-shaped beams with honeycomb-core doors in between; this is an innovative, lightweight method to lower the requirements of the foundation and to simplify the construction and transport of the modules. These honeycomb-core doors come from demolition projects and enable the construction of lightweight, stable panels and modules.

**Conclusion**

One cabin cannot change the disorganized impression of the landscape, but the Trek-in is sustainable and innovative, compact but spacious and has a strong and recognizable appearance. The Woodchallenge panel of judges emphasized this in their assessment: “Everything is incorporated in the design, from that experience, functionality and aesthetics to the more technical aspects such as materialization, sustainability, prefabrication, transport and details.” For those reasons, the Trek-in was chosen as one of the two first-prize winning entries at an award ceremony on December 1st, 2011. This recognition confirmed the quality of the Trek-in and convinced the construction team** that many outdated hikers’ cabins will be replaced by a new Trek-in and that the natural environment will change into a harmonious whole.

* The Woodchallenge is a prize for Dutch students who focus their project on the use of wood.

** The construction team is an elaboration of Stichting Natuurkampeerterreinen (SNK), the University of Technology of Eindhoven (TU/e), A van Liempd Sloopbedrijven and 2Life-Art.
The design for a ‘cubiform, undulating pavement’ constitutes the most original and expressive example of the contribution of Jan Slothouber and William Graatsma to applied art. It consists of three different spatial elements and a flat tile which can be assembled to create a floor with seats. The realized prototype has a special place in the world of design. It embodies the zeitgeist of the transition from the 1960s to the 1970s. It was exhibited at the 1970 Venice Biennale.

The point of departure of the cubiform, undulating pavement is the cube’s rounded off edges. Thus first an explanation by Marina van den Bergen of the background of the fascination with the cube in Slothouber and Graatsma’s work:

Jan Slothouber (1916-2007) and William Graatsma’s (1925) choice for the cube as the basic form was determined by pragmatic consideration. Both designers had been working since the mid-1950s for the DSM (Dutch State Mines) and were responsible for the design of the domestic and international campaign to promote a new product, plastic. Until 1970 Slothouber and Graatsma had been designing packaging, advertising and exhibitions and thus had been setting DSM’s corporate image. DSM took their good representation very seriously and during its heyday as many as 17 people worked in Slothouber and Graatsma’s department all of whom were busy with cubes. The cube was chosen because it appeared to be the most economic form as regards transport technology and also the optimal basic form with which to build exhibitions. Later ‘the beauty of simplicity,’ ‘the universal form comprehensible by all,’ and ‘the democratic art form’ arguments were added.

In the early 1960s graphic arts in the Netherlands was increasingly interested in serial, concept and minimal art while within architecture it was structuralism. Slothouber and Graatsma’s work was plucked from anonymity when in 1965 Amsterdam’s Stedelijk Museum asked them to hold an exhibition. In this exhibition, entitled Four sides, they showed form, size, color and letter experiments whose basis was the cube. Their artistic highpoint was the exhibition they put together themselves of their own work in the Dutch pavilion during the 1970 Venice Biennale. Or did Slothouber and Graatsma take more artistic pleasure in the assignment to design children’s postage stamps in 1970? Their design philosophy was based on the conviction that art and design must be integrated into society, and what is more democratic than charmingly designed postage stamps? This conviction determined design work at DSM, but also lead to the establishment of the Center for Cubic Constructions (CCC) where they applied themselves to cubiform furniture design, among other applications. For example, they designed a cubiform furniture package: a frame that easily disassembles and using cubes of various sizes can be assembled into furniture simply. As an almost extreme consequence of their design philosophy Slothouber and Graatsma did not bother to copyright their design and went themselves with their furniture design to home fairs. After their contract with DSM was terminated, CCC furniture designs were not put into production and museums did not buy their work (despite exhibitions in Venice and Amsterdam), so both men decided to trade their design practice for jobs in education in the early 1970s.

The model of a cubiform, undulating pavement they designed in 1969 for the undeveloped Schouwburgplein in Rotterdam is particularly beautiful. It came to nothing, but the design was realized in Venice, albeit with paving stones of 35x35 centimeters rather than 32x32. After the exhibition and a tour through various European cities, part of the cubiform, undulating pavement ended up in Slothouber’s garden and another part in the public space in front of Graatsma’s house in Eindhoven.

The cubiform, undulating pavement: conceived for the Schouwburgplein in Rotterdam, shown as a prototype at the 1970 Venice Biennale, and ended up as public art in Eindhoven in 1979. What are the characteristics of this sidewalk? These were discussed on the TV program ‘Oog & Blik’ on RTV-10: “The curvature is determined by a three-dimensional grid and construction from spatial orthogonal and centrically sliced torus, spherical and cylindrical sections. (…) In other words: the curves are constructed from spherical, donut-like and cylindrical forms which are separated from one another centrically and perpendicularly.” Evidently it is not easy to define a cubiform, undulating pavement. What makes it difficult is the title, which indicates we are dealing with the idea of curves which are abstracted ‘cubically’. This takes place via a grid based upon cubic forms. The question is what “spherical, donut-
like and cylindrical forms” might have to do with the point of departure. Yet the makers of ‘Oog&Blik’ have a point: results evidence the impression of parts of elementary form which reference the cylinder, sphere and torus. It is not immediately clear how the idea of the image – the cubiform - and the analysis of it via the concrete product – in the way these forms would directly refer to cylinder, sphere and torus - relate to one another. However, the logic of a ‘curved’ grid helps to understand the relation. The grid provides a starting point for a tile which instead of the standard 32x32 cm is slightly larger at 35x35 cm. That grid is carried forward into the third dimension. In this way the implicit cube form is strongly rounded. Instead of a right angle the transition from horizontal to vertical is formed by a bent surface whose bend is determined by a segment of circle. Determinative for the total form is that it desires to present a continuous surface. And in order to be able to realize that principle in the diverse directions in which cubes can be rounded the principle of the circular rounding is combined with the principle of the orthogonal grid. The combination of these principles yields three spatial elements (in addition to the tile), which make possible varying combinations of forms which ‘rise up’ from the floor. The optic consequence of rounded cube compositions – as a free-standing cube, an attached row of cubes, or grouped together as a flat disc with a recess (a quadrant with a whole, a square ring) – introduces the reference to the impression of a sphere, cylinder or even a donut. The reference to the forms arises from the fundamental quality of the circular segment in which the starting point for the continuous surface is defined. In its drawn form this design calls forth the image of the cubiform, curved sidewalk because it is a visible form of abstraction which very much resembles later computer drawings. In these computer drawings we also find a continuous surface’s bends combined with the principle of a grid which gives the bent surface scale and direction. Thus Slothouber and Graatsma thought about specific forms which are neither cube, nor sphere, cylinder or torus. Yet the specific combinations of these forms brought forth cube, cylinder, sphere and donut-like characteristics. It is notable that by using only rounded surfaces adapted into an orthogonal system as a point of departure crooked surfaces are automatically excluded. As a consequence of this one form from the well-known series of Platonic fundamental forms set out by Cézanne and Le Corbusier was ignored: the pyramid. Put another way, by replacing the pyramid with a donut, a perception arose of a modern mutation of the doctrine of how basic forms lay at the bottom of the design of products and architecture. Their ‘rounded’ cube research and their morphology, which they both taught as members of the Architecture faculty at the Technical University in Eindhoven, provided the basis for a feeling for and comprehension of the affinity of product design and architecture. Mathematical insight is thus effortlessly addressed and activated.

What a better understanding of the combinatorial thinking behind the cubiform, undulating pavement can teach us is that this represents a sensibility which transformed the platonic universe of modern architecture. Thus it is the donut in Slothouber and Graatsma’s series of basic forms that brought about a specific turn in their grid exercise. A similar turn that played a role came about much later, namely in the period of computer aided design; it inspired even greater complexity. This complexity becomes clear when one inquires after the shortest distance between two points on a torus: one lies on the exterior and the other on the other half of the interior. In contrast to a sphere, this distance cannot be calculated with a straight surface cutting through the volume, but a different mathematical
approach must be employed in order to determine the shortest distance via a bend. In addition to a preview of later computer drawings, the donut also plays a role in the zeitgeist of that moment. Judy Chicago, a champion of feminist art, had a fascination for the donut and brought this to light in a series of drawings in 1968. The social overtones of her art certainly interfaced with Jan Slothouber and William Graatsma’s morphology from the moment they began teaching at Eindhoven given that they had employed the term ‘democratic art’ in their pedagogy. For that matter, Chicago’s torus form, which she called a donut, had a ratio of hole to outline which makes one think more of a rubber ring while Slothouber and Graatsma approached the typical form ratios of the donut shape much more directly (not only in one of the elements of the cubiform, undulating pavement, but also in other experimental designs from that period). For all of these reasons, a review of the cubiform, curved sidewalk fascinates today: as an expression of that zeitgeist, and as a somewhat more flexible modular thinking than had been the case until then, thinking which with the help of the computer would go even farther later. Just as Marcel Breuer’s chair design – the tube chair with no rear legs – was able to brand the Bauhaus as a new formula for design and architecture, just as Max Bill’s stool tradition, just as the Ulm school was able to breathe new life into design and architecture on a modern basis, so is Slothouber and Graatsma’s cubiform, undulating pavement the final lucid moment in which the tradition was given a new perspective to situate design and architecture in line with one another. During their study of architecture in Eindhoven both John Körmeling and Wiel Arets each in his own way took advantage of that perspective and each found a form of expression with which they enjoyed worldwide success. The role of principles became somewhat lost from sight. They were submerged when the role of a post-modern narrative approach consciously broke with the idea of a fundamental principle for design; this took place at Eindhoven in the second half of the 1980s. At the end of this book two chapters from Jan Slothouber’s morphology appear in English. No doubt these texts contribute a kind of understanding that comes across as somewhat instinctively nostalgic with its look back at a time when training still knew principles which could be used as the basis for design.

[1]: marina van den bergen, archined, 3 februari 2011
Slohouber and Graatsma's cubiform, undulated pavement: design and architecture, 1970
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**studies of cities and regions**

**ENVIRONMENT**
cultural heritage and sustainability
world heritage cities as case study
kevin claus and rob derks

background
The graduation studio ‘Cultural Heritage and Sustainability: World Heritage cities as case study’ investigated the balance between cultural heritage within an urban context and the need for cities to continue evolving as living environments in a sustainable way without negatively affecting cultural values. Specifically, ‘World Heritage cities’ are used as case studies to investigate this challenge.

‘World Heritage cities’ are “…settlements with properties inscribed at the World Heritage list, located in or at the outskirt of their urban areas” (Pereira Roders, 2010:5). Being listed as a World Heritage site by the United Nations Educational, Scientific and Cultural Organization (UNESCO) means that a property is considered to be of “Outstanding Universal Value” (OUV) and it is widely accepted that their unique cultural significance needs to be protected for the benefit of future generations worldwide (UNESCO, 1972).

With ongoing urbanization globally and a growing list of properties inscribed on the World Heritage List, cities containing World Heritage have become an increasingly relevant phenomenon (Pereira Roders, 2010). These World Heritage cities often face difficulties in reconciling conservation and development (UNESCO, 2011) and need to manage development without adversely affecting cultural heritage.

The permanent protection of cultural heritage is of the highest importance to the international community as a whole (UNESCO, 2008). Yet such protection efforts are often perceived as an obstruction to (socio-economic) development while at the same time development pressures and management deficits are common factors affecting the cultural heritage being protected (ICOMOS, 2005; Pereira Roders, 2010). Thus the challenge set for World Heritage cities is protecting the cultural significance of their World Heritage properties while retaining them as living parts of a continuously evolving urban context.

ouv
The term: “Outstanding Universal Value” (OUV) is used to indicate the cultural significance specific to World...
Heritage properties and this value is seen as “exceptional as to transcend national boundaries and to be of com-
mon importance for present and future generations of all
humanity” (UNESCO, 2008).

The OUV of World Heritage properties is defined in terms
of attributes, which are the tangible or intangible elements
that define cultural significance in categories such as
“form and design; materials and substance; use and func-
tion; traditions, techniques and management systems;
location and setting; language and other forms of intan-
gible heritage; spirit and feeling...” (UNESCO, 2008:22).

World Heritage properties are all affected by threats to
their attributes and thus their OUV. Van Oers (2010:7)
alerts us that these threats “rang[e] from traffic and tour-
ism pressures to high-rise constructions and inner city
functional changes, the issues negatively impacting on
the cultural-historic significance of urban World Heritage
sites are numerous, often interrelated and increasing in
complexity.”

Research and analysis can improve conservation measures
and assist monitoring and decision making processes by
locating and clarifying the attributes of a property and
identifying potential threats. Identifying and understand-
ing the attributes conveying OUV and the factors affecting
it is taken within this research as the basis of a discussion
on how to protect the unique value of World Heritage prop-
erties for future generations. Analysis further indicated
how attributes changed over time and provided insight
into the success and failure of past conservation efforts by
defining trends affecting the OUV of the property.

After conducting this type of research on multiple World
Heritage cities in previous years, this year’s studio uses
the city of Amsterdam and Ilha de Mocambique (Island
of Mozambique) as case studies. The two case studies
chosen differ in size, context and time of inclusion on
the World Heritage list. Amsterdam and its ‘17th century
canal area inside the Singelgracht’ consist of 263 hectares
of protected area and was added to the World heritage
list in August 2010, while Ilha de Mocambique, which is
located off the coast of Mozambique in south-east Africa,
contains 114 hectares of protected area and was added to
the WH list in 1991. The population these World Heritage
cities also differs: the metropolitan region of Amsterdam
counts almost 2.3 million compared to 14,000 on Ilha de
Mocambique.

The studio ‘Cultural Heritage and Sustainability: World Her-
itage cities as case study’ linked research to design. The
described methodology and results of the case studies are
therefore added with two individual graduation projects
exploring the problems of dealing with urban development
within the specific areas by making a design proposal.
This research project took as a case study the ‘17th century canal area of Amsterdam inside the Singelgracht’ also known as the Amsterdam canal district. We sought to contribute to the current management and research efforts of the Amsterdam municipality by identifying, locating and analyzing attributes that convey Outstanding Universal Value (OUV) and uncovering and investigating potential threats. The research was conducted in collaboration with Amsterdam’s local authorities including the City of Amsterdam, the Amsterdam Bureau of Monuments and their jointly established Amsterdam World Heritage Bureau.

As the Amsterdam canal district was only added to the World Heritage list in August 2010, under the classification of a “group of monuments in an inhabited historic town” (Kingdom of the Netherlands, 2009:18), not enough time has passed to evidence factors affecting the property. It was possible to try to uncover past and current trends that possibly affect the property.

Thus the state of property conservation was initially determined by identifying, clarifying, locating and mapping attributes that convey the OUV of the property. Attributes were identified during desk research and selected attributes were further clarified, located and mapped during fieldwork. Attributes related to visual appearance were identified by a content analysis of the official UNESCO nomination documents. Their evolution over time was

example of streetscapes
defined by creating maps and data that trace the changes to attributes over time and determine their level of integrity. The mapping was facilitated by making streetscapes over a time period between 1770 and 2011 using the Herengracht as study area. Results indicate extensive changes in categories such as facade, streetscape, style and silhouette. 72% of the facades were significantly changed since 1770 and large stylistic shifts were noticeable even as the gradual flattening of the silhouette.

These identified changes were all found before 1943, while no major changes to the facade were found after this period. However, building consolidation, the merging of multiple plots, was identified as a current threat by interviews and fieldwork. Building consolidation was mapped in the second phase of the research. The exact nature of building consolidations can vary: separate buildings could have been demolished and replaced with a single larger scale structure or a series of buildings could be connected to each other by creating internal openings between shared side or back walls.

Building consolidation as a threat affects the authenticity of the property by creating an unseen and disproportionate relationship between changes to and behind facades. In 2011, 38% of the buildings facing the Herengracht were part of a consolidation. This had a direct impact on attributes such as parcellation, facade, function and typology by the transformation of facades, the trend towards monofunctionality within buildings and the decrease in buildings that correspond to the canal district’s historic building typology, the Amsterdam canal house. Building consolidation was identified as a trend, linked to urban development, that can severely affect the OUV of the property and needs to be considered within Amsterdam’s management system.

In many cases building consolidation resulted in groups of historic buildings being replaced with ‘large scale’ structures. These ‘large scale’ buildings are currently common, but still a controversial and deviating type of building in the architectural ensemble of the Amsterdam canal district in terms of scale and appearance. Some of these buildings are likely to lose their tenants in the near future creating the opportunity for redevelopment projects. Following our research task, a design proposal explored this problem within the Amsterdam canal district where development needs to take place without threatening and preferably enhancing the property’s OUV.

As opposed to advocating the reconstruction of original buildings, this design project developed a strategy for the use of these ‘large scale’ buildings based on the allocation of scale appropriate functions and the adaptive re-use of buildings taking their intrinsic qualities and historic value as the starting point for design decisions.
Strategically allocating large scale functions to large scale buildings releases pressure for development of ‘small scale’ typical Amsterdam canal houses. Furthermore existing ‘building consolidations’ in the case where facades were not affected can partially be undone by displacing the ‘large scale’ functions of these existing ‘building consolidations’ to the ‘large scale’ buildings and reconstruct old building division walls. Large scale buildings can be used to enhance the valued functional mix of the area by accommodating functions that cannot be accommodated in the historic canal houses.

Our strategy was tested with a design proposal that redevelops an existing ‘large scale’ building (Herengracht 295) into the “Amsterdam Fashion Hotel”. The hotel combines a regular hotel program with a fashion program containing a fashion events center and designer studios. The main intervention of the design focuses on creating a new representative central space replacing the existing building core. The new central space creates an architectural and morphological division within the building. Two newly designed facades facing the central space will complete the building volumes and envelope for each of the two outer parts and enhance the division. These interior facades refer to their associate exterior facades. In the central space a play of ‘see and be seen’ is created which relates a fashion concept to the experience of the hotel. This play is facilitated by suspended bridges on different levels connecting the two building sides. The exterior facades of the hotel are, as the strategy prescribes, adapted in the new design without damaging its intrinsic and historical values.

The strategy and design proposal show that what initially was seen as a controversial and deviating type of building could in the end be seen as a type of building with a lot of qualities and potential in terms of urban development within the Amsterdam canal district as a UNESCO World Heritage property. The project strongly links research to design proving that by enabling urban development projects to take place through the critical and scale appropriate redevelopment of existing ‘large scale’ buildings they can contribute to the sustainable urban development of the Amsterdam canal district as a whole by enhancing the OUV of the property.
The Island of Mozambique, world heritage since 1991 (ICOMOS, 1991), is a small island near Mozambique. It is divided in two urban areas of distinct morphology: “Stone Town” in the northern part and “Macuti Town” in the southern part of the island. The report, “Island of Mozambique: Report 1982-1985” (Aarhus, 1985), generally known as the “Blue Book”, formed the basis of the islands inclusion on the world heritage list. This report describes the situation on the island, local customs, building techniques and methods, and is one of the few available sources on the island’s cultural heritage. Almost thirty years later another investigation was carried out related to this graduation studio “Cultural Heritage and Sustainability”. One of its main goals is to determine the evolution of this urban area.

The attributes conveying the OUV on the Island of Mozambique were found by analyzing official documents: ABE (ICOMOS, 1991), the Nomination file (Mozambique, 1991), the decision texts (UNESCO, 1991-2011) and the Periodic report (Macamo, 2000). In brief, what would be referenced as having significance has been considered an attribute, the arguments to justify its significance should help determine the value(s).

The attributes elaborated most during this investigation are those that contribute to “the incredible architectural unity of the island” which according to the ABE is derived “from the uninterrupted use of the same building techniques with the same materials and the same decorative principles” (ICOMOS 1991). Some examples of these attributes are the consistent use of flat-terrace roofs, white window-borders on colored facades and a strict use of coral limestone masonry.

Information on these attributes is available from 1982-1985 research (Aarhus, 1985). Comparison of this information with the current situation (2011-2012) provided insight into certain trends on the island.

Just as any other historic urban landscape (UNESCO, 2011), the Island of Mozambique has evolved ever since its nomination. Whether caused by natural or human influence this evolution should be kept under control. On Mozambique Island, however, when comparing figures from 1982-1985 with figures from 2011-2012 it is clear that this evolution was not kept under control and has negatively affected the island’s OUV.
Attributes are not the only thing mentioned in official documents. These attributes and their corresponding values are threatened. The main threats, filtered from the UNESCO documents, are new development and general degradation. According to the documents, “the lack of or insufficient regulatory framework” is the most important cause for the prevailing threats on the island. The factors which were found directly affecting the architectural unity are mainly “new development” and “general degradation”. New development normally does not comply with traditional building methods, materials and decorative principles as defined in the section “results.” New development occurs in the type of additions, interior changes, layout changes and complete new buildings.

The OUV of the island mainly emerges in the built environment of “Stone Town.” These tangible objects are subject to deterioration. Comparing results from 1982-1985 with those of 2011-2012 indicates an increase of the rate of deterioration. In thirty years the general condition score of 3.74 (on a 1-4 scale) dropped to 3.17. About 41% of the buildings in “Stone Town” are generally in good condition and 39% are deteriorating. The other buildings have structural problems: 17% are in poor condition and 3% are in ruins. There had been speculation that their general condition was getting worse, but now figures exist to prove it. Hopefully, local and national authorities will be alarmed by these numbers and take action. To improve the health care of Mozambique Island’s residents the government of Mozambique planned a new health center since the former hospital, due to the decreasing importance of the island as a trading capital, is now insufficient. The aim is to design a realistic health center which, unlike most new developments on the island, contributes to the OUV of the island. On this basis my project concerned itself with three points of view. The first of these approached this assignment from a World Heritage perspective, the second from a purely practical and functional point of view, and the last viewed the project as seen by the user, the island’s residents. Architectural principles are considered, but remain secondary to these points of view.
In conclusion, this project’s goal is to design a realistic health center without sacrificing architectonic wishes. The project is a solution that combines the island’s world heritage status and the pragmatism needed to design a fully functional hospital in accordance with local wishes and traditions. In other words, “Respectful Redevelopment.”


housing as the building block of the city
The atelier reopens the discussion of the relationship between housing and city form within the theme of ‘housing as building stone of the city’. Housing has a critical mass and is one of the most important elements of which a city is being made. It therefore assumes an important role in the system of our cities. It is important to realize housing isn’t just an address; it also encompasses neighborhood facilities, other residents, the way different housing units are designed and organized, and together with a large variety of other factors this forms a living environment. The constant reinvention of this living environment has led to the current patrimony of the city. Berlin, with her turbulent history of city development, forms an excellent topic for the investigation of different housing paradigms and the relation between city form and housing. Berlin as a model.

The city has already played an important role, both as topic and location, in urban planning and architecture on many occasions. Starting with the extremely dense 19th-century city consisting mainly of the so called ‘Mietskaseren’, followed by the modernistic views from the twenties, via the restorations in East Berlin, the building exhibitions IBA '57 and IBA '84/87 in West Berlin, to the highly polarized debate after reunification.

Time after time paradigms are exchanged thereby excluding, erasing or revising other visions. At the same time this process invokes the constant shifts of location where city investments are made. It is undisputed that the paradigms have had an indelible impact on contemporary Berlin.

It is exactly here where the notion of a secondary space in the city is interesting. The concept is derived from a type of city development which is profitable by using densification and intensification of certain central areas, thereby taking into account residual land values. This development is primarily localized at nodes which we consider to be the primary locations of the city. In the background of this development there are secondary locations, parts of the city which are no longer being considered for development. Areas existing in the anonymous periphery were nevertheless developed. This resulted in an aggregation of residues of the different paradigms which have led to a mosaic of urban fabrics with different characteristics. In these areas it is, even in the latest visions, very unclear what kind of city we should be making and how we can achieve this with housing.

secondary space in berlin
Berlin’s current form is the result of a variety of development periods. These periods of large city expansion, as for example the annexation of large areas at the beginning of Greater Berlin in the 1920s, led to the sudden enclosure of regions in between different centers. This resulted in an interesting structure of urban fabric enclosed within the boundaries of the region. Berlin as such can be described as a polycentric metropolis. This is an important conclusion which facilitates further investigation of the secondary space. Two different approaches are proposed in this article to expose the characteristics of this space. The first investigates this polycentric nature of the city while the second investigates the negative, spaces in between the different cores. This enables us to look at specific living environments which are potentially valuable for the future of the city.

polycentric berlin
The approach of looking at Berlin as a polycentric city comes from Kees Christiaanse’s description in the magazine Archplus in which he read the city as an archipelago. A polycentric city consists of a number of towns and villages that have physically grown together with population growth and expansion.

By using Paola Vigano’s book ‘I territori dell’urbanistica’ the polycentric character of the city is drawn by both historical aspects as well as the current situation. Three themes form the layers of the drawing: old villages that existed before Greater Berlin was formed, the spread of the population, and the actual centers mentioned by the municipality. This polycentric city shape is used to point out primary areas in the city and define the secondary spaces, which led to a city constructed from separated city pieces.
A place where this gathering of city pieces strongly emerges are the Großsiedlungen. This large-scale housing development forms high-density centers in a periphery with low density. Despite the diversity of urban elements these neighborhoods often have a strong centrality which is formed by the segregation of functions, one of the principles of modernism. This gathering of different living environments provides a layered urban tissue. The development potentials lie in the embedding of these residential areas in their urban fabric which should form the basis for the further development of this part of the city.

Approximately 700,000 people live in 350,000 apartments in these suburban neighborhoods; this represents 20% of the total housing in the city. Märkisches Viertel is one of these suburban residential areas and serves as a study case for this design research. As a major exponent of the polycentric character of Berlin, this area should be seen as part of a network of residential areas separated by green zones, railway networks and industrial areas. The district’s population and diversity provide a sufficient basis for large scale facilities and a well functioning public transport system.
**zwischenstadt**

An interesting analogy can be found between the formation of different types of gradually enclosed city areas described earlier and the situation Thomas Sieverts described as a ‘Zwischenstadt’ or an ‘in-between city.’ He describes a phenomenon which is clearly visible in the Ruhr-area. He observes that the ideal of the compact European city, in which city and landscape are opposed, is gradually disappearing. A new city form exists which doesn’t necessarily fit the traditional notion of city or landscape anymore. This type of city can be seen as a hybrid mix of ‘an urbanized landscape and a landscaped city’, the in-between city.

The in-between city structure finds its origin in a variety of independent public and private developments. The structure occurs where cities expand and merge into a mixture of different functionally specialized city fields. Exactly these areas are being developed due to lower land prices and often less strict regulations in comparison with the city centers. The nearby centers make these areas even more attractive. In this way a heterogeneous patch work of homogeneous neighborhoods, without a clear overall structure, is generated.

Taking into account the different characteristics important for the development of the city type, maps expose the secondary space of Berlin. A region in the city where regular city development is usually practiced in the city center perhaps isn’t the most fitting answer. In these areas the ongoing debate on how to develop is very urgent and current. Obviously there is no single answer to these issues. Different living environments each play a different role in the urban system and have their own logic.
strategy for a living environment

Adapted building block

It is important to note that the mixture of areas within the patchwork is rough, particularly at the level of neighborhoods for example. If we examine these parts of Berlin further we notice a peripheral type of building block. This block structure finds its place in the same plot system as those in the center though being in a more secondary location they are built from a large variety of different building typologies. These type of blocks are able to adjust and absorb a variety of buildings, typologies, functions and gradations of public space within their system. The result is an adapted building block containing the traces of earlier paradigms.

When we consider Berlin as a whole, the phenomenon appears on a large scale in the secondary space of the metropolis. It is an example of city development in the margin of structured development, one that is being made possible by the results of primary development and is able to cope with constantly changing conditions. It is this special type of building block which holds potential for living in the secondary space and ultimately the city of Berlin.

Due to how these blocks were created development took place in a plot-by-plot fashion. This resulted in housing projects which often neglect the fact that they are actually forming a block figure. Each housing project confines itself to its plots border and refuses to take into account neighboring projects. It is in this way that the potential of the space they enclose is not fully exploited. A strategy in this block figure is being proposed which gradually opens up this potential and starts a collective which makes it available for different residents. The adapted building block is now being looked at from a different perspective. It had been just a product of different individual developments, but in the future one should also consider larger entities of the block in order to exploit the collective space.
street view multi-family home (Robbert Peters)

plan multi-family home (Robbert Peters)
By choosing the multi-family home as a method for redeveloping the block structure, a typology is being used which has a rich history in Berlin. It is a collective housing type that has potential value for the individual dwellers and also the city and block development.

Housing projects from around 1900 are used as the basis for this typology. Interest in this period, just before twentieth-century modernism became the leading paradigm, lies in the critique of the profound rationalization of social housing projects plans. Much of the knowledge and refinement contained in earlier housing plans was taken out of modern ones. The rationalized housing projects were perhaps efficient, economic and probably provided an answer to demand, but they are hardly able to make, for example, differences in representative and private spaces in plans and collective areas. The qualities of the typology from around 1900 are being used to refine how people live in their apartment both individually as collectively. In recent times during which housing production is low, these lessons should be taken and turned into an improvement of living quality. In this way the proposed housing continues the high quality, multi-family home tradition in Berlin. It is a way of living which balances individual with collective housing, a valuable asset to the city.

großsiedlung
A proposal to develop important parts of the polycentric city of Berlin is evident in the large-scale housing development north of Berlin. The Märkisches Viertel is in many ways impressive. The scale of the area is enormous and the repetition rate is high. The core of the redevelopment vision lies in the decentralization of facilities in the neighborhood. The preservation of green areas in relation to recreation and sport as well as constantly optimizing and improving the public transport system are given priority in new projects.

The intention to organize horizontal layering and mixing can be achieved on the basis of a strategy for ‘the street’. The project of the street is formed by a dual strategy. The first layer concerns the public domain which displays the configuration and use of both built and unbuilt public space. The second layer is more conceptual and has to do with the slim high-rise structure and the framing of the spaces. The high-rise ribbon together with the interpretation of the low-rise form a network of enclosing and open spaces.

To show the potential of redeveloping this area by continuing building in the existing typologies, two projects have...
been designed: a low-rise environment on the north side of the street where the relocation of the public utilities will create space for a new parcellation and developments. Second, a collective residential building on the south side of the street within the existing high-rise ribbon which increase the density on the street and start becoming part of the public domain.

The center, which is slowly freed up by the relocation of the facilities, will be developed as an area with this intensive low-rise housing. The low-rise is achieved within a new subdivision principle and rules. The main function will be living, but further development can accommodate a diversity of uses. Districts are the result of a planning culture that separated functions; within these zoning and land use, mixing and diversity is desired. The basic conditions for an area to develop these multi-use rooms involves creating frameworks within the development.

The high-rise building shows the possibilities of collective housing with a high density in one building.

The interventions show how more can be built within the existing typologies of high-rise and the low-rise. This is a reflection on the development of these core areas in the urban fabric on the city, which after years of criticism and silence are in need of recognition and integration into the urban fabric. The thesis deals with many levels of scale in the city which is the direct relation between the realization of a project and a reflection on the urban form of the city.

How to rethink building housing in cities is recurring and should always be considered for the city as a whole, instead of only focusing on a few nodes. Both proposals answer how we can further develop the city of Berlin. The notion of great potential being available in areas which normally wouldn’t come to mind so quickly could be a valuable one. These areas provide more space to really explore and redefine the possibilities of living in a metropolis.
scale differences in märkisches viertel (loes martens)
In the last years Eindhoven and Brainport have become Holland’s own ‘Wirtschaftswunder’. The city has made an extraordinary successful transition from the old production economy to a new economy of knowledge, creativity and pleasure. Built on the old product industry of Phillips, DAF and others, technological pioneers and new innovative hybrids sprout from the combination of the old and new economy: knowledge-intensive industry like Hightech Systems and Automotive, as well as a large variety of smart crafts around design, fashion and the graphic industry.

Eindhoven is shaped by economic innovation and activity in architecture as in urban design. Hereby the city separates itself from other cities whose main body consists of large scale housing projects. This industrial background gives the city her spatial identity, something the economy still does today. It’s interesting to see that the new economy prefers to settle in the buildings and neighborhoods the old economy has left behind. In this way the new economy becomes iconic for the gentrification and future of the exiting city.

This studio focused on how urban economies form the architecture and urban design of the ‘company town’ Eindhoven. A sequence of varying stages in the development of the urban economy and the innovations they produced constantly formed new architectural typologies of the urban work building, typologies that were the basis of new urban structures. We investigated why private individuals within the new economy prefer particular spaces and buildings in the city. We sought to understand how they build on the historical qualities of buildings and neighborhoods transforming them to suit their own needs and wishes. In other words, what kind of different working environments are there, are they appreciated by pioneers of the new economy and how will they change the old working environment to make it suitable for the ‘new time’ in terms of use, perception/branding and meaning.

Eindhoven has a special quality to bring forth its own forms of work related architecture and urban fabric. This is a direct consequence of how the city grew on its fundament of sand and riverbeds. The urban fabric didn’t know a concentric but a radial spatial development. Classic fringe zones in which urban transition and gentrification take place didn’t form belts around the city, with each layer increasing distant from the central core. Instead the zones form wedges in the urban fabric that make gentrification possible from the heart of the city out to its edges. Settlement conditions fundamentally vary depending on their place in these radial wedges. The second special characteristic of the city, also connected to the fundament of the city on the sand, is the village-like urbanity of Eindhoven. This is the product of urban development having taken place along a web of ribbons, in essence these are reclamation lines on the far reaching ground of moorland and swamp. This structure of ribbons is responsible for the relaxed, green and fine grained urban fabric that characterizes Eindhoven’s radial urban development. This is true not only in the famous green fingers but especially in the fabric that exists between them.

These qualities and identities of the industrial city of Eindhoven are investigated by way of a radial section in the city, “the Westcorridor”. Beginning with the connection between the medieval urban center with the 19th-century plans for urban renewal where the avant garde of the old industrial economy found their place, to the spaces where 20th-century urban fabric meets with the modern infrastructure of urban ring roads and canals. Where Brainport Avenue is planned as a place for pioneers of the new knowledge-based economy. The section that was the focus for this investigation is indeed an example of a radial fringe zone that connects a wide range of urban fabrics with many different qualities and identities. The following pages present two studies that came forth from this design studio.
The creative industry is the driving force in Eindhoven and the engine for urban development in a city focused on innovation, technological and international orientation. Over the last decade Eindhoven has taken big steps in the field of innovation and design. Great names like ASML and Philips and a new generation of students at the Design Academy and the Technological University became important assets to the city. Eindhoven wants to make an effort for the creative class, to strengthen the identity of the city and generate new urban development.

The morphology of the city offers enormous opportunities to promote the image of Eindhoven as a ‘design capital’. From the edge to deep in the heart of the urban fabric new economy buildings can be icons for this new image. For this reason the Eindhoven city council should activate the creative class to provide a new identity and initiate urban development. With the Design Academy in the heart of the city and many annual recurring events, the city center is well on track to promote this image. In other areas of the city the drive to put ‘Brainport’ on the map is enormous.

Throughout the year the image of Eindhoven as a smart, productive city should have a place in the city center, not only to make design more visible in the city but also to give the new generation of designers and technological innovators a place to promote themselves. This project is a platform for a generation of innovators and designers operating in a new economy to present themselves. They exchange ideas, knowledge and designs with each other.

The project is situated at the old Fens field in the center of the city. The location is now a parking lot for the shopping public. It’s situated at the Keizersgracht between the main shopping area in the city center and the exclusive, fine grained area of the Bergen. Urban research shows the importance of bringing back green areas as well as solving the clash between public shopping routes and busy urban traffic, not forgetting the necessity of the existing parking spaces.

The project is a design gallery together with the present parking lot. Architectural research has shown that accessi-
bility, relation and integration of public spaces are important values for architectural design. By integrating the design gallery into the public space the gallery becomes a part of the pedestrian routes. The building has a direct relation with its context in which the spatial threshold become brushed and the accessibility reinforced.

The parking area and the design gallery are located below ground level in the architectural design. By doing this a new public space can be made at ground level. Vertical elements are applied in the design to connect the separate levels and integrate public space into the building. By using these vertical elements the various programs relate in a direct way to the public space and surroundings. The implementation of a new vocabulary of round forms in the design gives the building its own identity in the urban context. The building separates itself from the urban environment. This is the strength of its architecture. The architectural design becomes a focus in the urban context on a strategic spot in the middle of the city between the main shopping area and the Bergen.

At ground level the double facades of the round elements are exhibition spaces in which projects and ideas are presented to the shopping public. In the gallery below the same element is a public space where projects and new innovations are showcased. Because the design gallery is located between ground level and the parking area there will be an obvious route along which the gallery becomes part of the public space.

This architectural design gives the new economy a platform in a green landscape in which pleasure and engineering comes together and the image of Eindhoven as a design city becomes visible in public space.
This project focuses on the old village structures of Eindhoven. A majority of the plots in these former villages are privately owned. Each owner has their own idea about how, when and why they want to build. This has a slowing effect on the development of the structure as a whole. Plot sizes hardly change and big developments can’t get a foothold in these densely parceled out neighborhoods. On the contrary, development on the plots themselves is quick. Large, hidden back gardens provide the opportunity for owners to develop informal structures. This results in an urban fabric full of small sheds containing a large variety of different functions, from living to business and pleasure.

This design seeks to provide a strategy that makes use of this diversity in ownership and plot sizes. It provides people who live in the villages with an idea of how private investments can benefit the entire urban fabric. It builds on the idea of ‘the civic economy’. This theory centralizes personal involvement in the social and spatial structures of the environment. These small personal investments can make a big difference in the way neighborhoods work and look. They provide an alternative to big top-down development. In uncertain economic times when many big investments have been put on hold, this ‘civic economy’ can provide new opportunities for ‘informal’ bottom-up development. This places initiative and responsibility on the users. They are to be given the freedom to develop their own environment.

In this process the designer can function as the initiator and connector by showing how small and simple developments can add to the quality of the neighborhood. For this project two designs show simple ways to develop houses in a privately-owned back garden. By describing the design process the designs can be used as examples for new ways of using the space in this garden. The designs give an idea about the possibilities for the development on two types of plots. Both of these plot types are common in Strijp, a former village used as a case study in this project. These new building types can also be used in the village structures located throughout Eindhoven.

The first type is designed for a plot that is accessible from two sides. This building forms a new face towards the backside of the plot. It gives a new face to the already existing backstreets transforming them into new living and working environments resembling the famous London Mews. In these Mews old stable building have been transformed into popular living areas. The design example shows a way to develop this in combination with a garage without hindering the owners of neighboring plots.

The second development shows the design possibilities for a hidden house in the back garden. The design sets out to develop a second layer inside the existing building block. New connections can be made to the heart of the urban building blocks linking spaces that were hidden in the interior.

Both designs provide new solutions to the problem of parking. They do this by incorporating parking space in the building design. In addition to providing a pragmatic solution for this problem the designs show opportunities for residents to add new spatial qualities to their neighborhood by creating extra open space. The focus is thus on the development of new housing, for this is most challenging when condensing urban structure. Questions about privacy, ownership and nuisance play a big role in positioning the new houses. Economic and environmental difficulties also demand a new housing design. Smaller houses of higher quality can provide a way to reduce building costs as well as heating and electricity bills.

By providing ideas for small development participation in the project it becomes more accessible for plot owners. The designs form a starting point from which urban structure can be developed. Buildings can exist perfectly on their own, but when more people join in new opportunities present themselves. By using these designs as examples instead of making a ‘toolbox’ for development this strategy provides the freedom to use specific characteristics of the different plots while at the same time generating new ideas about what can be done.
01 | providing new parking inside the urban building blocks creates more space on the street which can be used to enhance the quality of the environment.

02 | openings in the ribbons of buildings alongside urban roads can be used to create a second layer of functions inside the urban block.

03 | existing back streets can be used for parking. they can be made into a secondary network within urban blocks.

04 | differences in use are hidden by the anonymous facades on the back street. showing variety gives the back street a new lively image.
garden homes | section of the long house, the section shows the split level, the small offset of the floors provides the separation between the rooms.
a platform in the city | section of the building, the section shows the different levels, the vertical elements connect the separate levels and integrate the public space into the building.

garden homes | the section of the transverse house shows a sequence of rooms. the spaces are ordered from private to open, thereby the house forms a barrier making the backgarden into a personal paradise.
metropolitan ensemble

The graduation studio ‘Metropolitan Ensemble’ focused on Cologne’s desire to improve urban space in the inner city. In particular, the studio concentrated on the necessary redevelopment of the area around the Maritim Hotel and Heumarkt square. Traffic has completely overwhelmed this area, stripping it of its former identity. Even worse, it has made this area unattractive to the public and has virtually isolated the Maritim Hotel. To determine what should be redeveloped first the studio delineated the perception of the Maritim Hotel, which is built according to postmodern ideals, and its surrounding area. Then the graduation studio formulated individual proposals to improve the area’s position in the city. This article presents two of these urban interventions which both strive for a sensitive approach towards context, the Maritim hotel and its surrounding environment.

maritim hotel – a postmodern problem

The Maritim Hotel sits on the site of what was once a well-attended market hall, one which contributed significantly to the liveliness of the inner city of Cologne. After the market hall was demolished during World War Two the city lost this active neighborhood and it lay undefined for a few decades. The Maritim Hotel was built as part of the Rhine riverfront in 1988. The concept of context was present in urban planning and redevelopment discussions of the inner city of Cologne at that time. This postmodern discourse led to a city hotel that is composed from figments of the past in combination with the advanced problems of an inner city road that runs along the hotel. The hotel accommodates a public space which stimulates a slow stream of traffic from Heumarkt square through the Maritim Hotels’ public space and to the quay along the Rhine.

Unfortunately, the hotel is suffering the consequences of two contextual approaches. One is a romantic approach
that desperately tries to embrace the qualities of the past all the while knowing that the hard and vast reality of the inner city road in Cologne cannot be denied. The other approach takes the inner city road as a potential quality that makes way for new forms of architecture and new ways of dealing with traffic. The dynamic diversity of the Maritim Hotels’ surrounding makes this place chaotic and complex, an adverse balance within the context.

On the Heumarkt side, architect Gottfried Böhm introduced the theme of landscape, the sloping roof of the congress hall wing of the Maritim Hotel complex. Böhm meant for pedestrians to enjoy the Rhine view. The motif of human figures at the sloping roof edge of this part of the hotel, facing the Heumarkt, may be compared with sculptures that represent human beings on the roof’s edge of the famous Biblioteca Marciana building, designed by Jacopo Sansovino, at the Piazzetta di San Marco in Venice. Unfortunately the image of the hotel in the urban context is in reality less poetic, even harsh, as the hotel closed this path to the public, so in reality there are no human figures to be seen with the exception of Thursday evenings during the summertime when the hotel organizes a ‘grill event’ on the roof. Moreover, on those evenings the roof is not accessible from the street but only from the rooftop restaurant. The architect’s motive behind this sloping garden was to frame the flow of cars in a way that it became part of an urban design solution that set Heumarkt square and the road next to the hotel in an acceptable relationship. However, as the intensity of traffic has increased appreciably over twenty years a new possibly to articulate this relationship must be found.

The architects realized another connection of the Maritim Hotel with the street, this time on the Rhine side, in the shape of a pedestrian bridge which runs from the middle of a gigantic glass-covered passage with shops and restaurants (designed by Gottfried Böhm with Stefan Schmitz). The pedestrian bridge was intended to be an accolade
kar within the city map of cologne, filling the wound in the city texture
between the Rhine promenade and the passage. This gesture does work in the sense of function, as the hotel opens the door to the pedestrian bridge from 6 AM to 11 PM. However from the Rhine side there is no information that this is the case. In order to reach the door one must cross a heavily trafficked road and, as the bridge does not appear to be used that frequently, one is not encouraged to even see if the door will indeed open. In other words: the pedestrian bridge does not function as a gesture of invitation to enter the passage to Maritim Hotel from the Rhine side. This side of the hotel also demands a new solution in order to relate it to public space use.

Both challenges – to 1) articulate a relationship between Heumarkt square, the inner city highway and the Maritim Hotel, and 2) find a solution to the problem of how the hotel relates to the use of public space on the Rhine side – are answered in the two projects documented and explained on the following four pages.
The current Deutzer Brücke is the third bridge to span the Rhine at this location within the last century. At the beginning of the 20th century a boat bridge was used and the municipality of Cologne decided between 1913-1915 that it had to be replaced with a fixed bridge, the Deutzer Hängebrücke. This decision is crucial to understand the complexity of the location at the Heumarkt we face today. In order to make the bridge landing for the new suspension bridge an entire urban block had to be demolished. This shows how society and thus the municipality embraced the potential of personal transportation at that time and that much was subordinate to the improvement of the infrastructure. Many plans were made in the following years but none ever realized.

When the Second World War was over Cologne was 90% in ruins, including the Deutzer Hängebrücke and the Markthalle at the Heumarkt. In 1947 a new bridge, the current Deutzer Brücke, was built and most of the urban blocks within the city were also reconstructed. The open ‘wound’ in the city texture caused by the bridge was doubled by the demolition of the Markthalle which was never rebuilt. The open terrain served as a parking lot a long time until the Maritim Hotel, build in 1988, closed half the ‘wound’. Closing a large part of the wound ought to be a good thing, but because of its dominance and post-modern architecture it also influences the Heumarkt negatively. The previously mentioned wall towards the bridge landing works in terms of traffic control, but lacks the architectonic quality to actively attract visitors of the Northern part of the Heumarkt to walk further towards the Southern side and to explore the passage within the hotel.

The current gap in the riverfront of the cityscape has a negative impact on the Heumarkt area, but at the same time it also generates potential for an architectonic intervention that strengthens the connection between the Rhine and the Heumarkt and makes the riverfront complete again after almost a century.

KAR is a contemporary design proposal that ‘fits’ in the location at the Heumarkt. Not only does it complete the riverfront and the texture of Cologne as a whole, it provides useful space and functions for Cologne. The seed of this building was planted on top of the traffic and it grew, strongly influenced by the context in terms of traffic flows and the layered build-up of the location itself, to become a full-grown building with a large congress hall and exposition space. The building is in balance with two parts of the Heumarkt, the leisure part at the Northern side that connects the Rhine promenade with the inner city, and the Southern side which is dominated by traffic. On the Northern side it offers new ways to connect with an elevated street between the Deutzer Brücke and the Heumarkt and by bringing back the street atmosphere between the Rhine promenade and the Heumarkt, which was lost after the demolition of the urban block in 1913-1915. On the Southern side the building receives and directs traffic flows in and out of the city in dialog with the Maritim Hotel, creating a ‘gate’ to the inner city of Cologne with its closed angled facade. The bended and introverted wall of the Hotel was on its own a negative element for the Heumarkt, yet in relation with KAR it becomes a positive, traffic guiding element. Together they form an ensemble that receives and guides traffic. Where the Maritim Hotel acts as a hinge for the fast traffic, KAR acts as a hinge for the pedestrians.

Cologne is a city with a rich history and lots of contemporary culture. Not only do old and new stand side to side, in many places they actually merge. KAR is nothing like the existing buildings, but it still references them. It respects existing buildings and alters the context on the Northern side with its expressive contemporary architecture by introducing moments of pause and by actively blocking traffic on the Southern side in order to restore the equilibrium of the location.

A parallel can be drawn between KAR and the 1964 Economist Building in London designed by the Smithsons. Their building contrasts with the historical buildings in its context, but the Smithsons also preserved. They achieved elegance and structure within the sensitive context of the location by applying a daring but simplistic design language. The building is direct in its organization, construction and use of prefabricated materials. KAR takes a similar approach within the context of Cologne and the Heumarkt. It shares the same simplicity in its facades, apart from some complex geometry in certain planes, and it is evident that the simplicity in its character seems connected to business, an aspect that can be found within the functions of both buildings. The part of KAR with the restaurant adjacent to the Rhine promenade bears a strong resemblance to the facades of the Economist Building. Both buildings had to find their way within the context of location and the social views of their own periods. Both show that a fresh and daring, yet respectful approach is able to create an architectonic solution that brings equilibrium to those unbalanced locations found in many cities throughout the world.
kar seen from the rhine promenade receiving the pedestrians

kar seen from the heumarkt displaying elevated street

kar at the deutzer brücke visual guidance towards the inner city

kar’s inner space seen towards the rhine displaying the street atmosphere
Cologne’s South quay was once a busy inner harbor responsible for active life in public squares and alleys. Until the disastrous consequences of World War II, the quay was an urban public space which captured a dialogue between pedestrians and the majestic Rhine. The varied heights of the quay made this relation possible. Unfortunately, these varied heights did not remain after the reconstruction of Cologne which has resulted in a detached dialogue between pedestrians and the Rhine. For that reason a water taxi line will be introduced which increases the use of the Rhine and increases the accessibility of places along its banks. The urban implementation of this water taxi line energizes the connection between riverbanks; the Rhine is no longer a demarcation of Cologne and Deutz. The buildings and public spaces on both sides of the river provide convenient hop-on / Hop-off services at tourist spots. The brewery takes part of this local water taxi line and stimulates the use of the Rhine.

The presence of the brewery enhances the value of a temporary stay along the southern part of Cologne’s quay and creates a unique place at the back of the Maritim Hotel. The South quay finally gets a destination along the Rhine which stimulates the use of this public space by the stream of pedestrians from the inner city, the Rheinauhafen and by the stream of pedestrians from the Maritim Hotel’s pedestrian bridge.

The urban intervention of the brewery together with the addition of a lower embankment reflects on the romantic contextual approach as mentioned in the first part of this article. However, the design approach of the brewery is not only focused on the past but particularly on an attitude in which existing qualities and developments set the tone within the design process. The term ‘context’ in this sense was suggested in the 1950s by architects Alison and Peter Smithson. According to their vision, the concept of context embraces not only the physical but also the social space, implemented within the design process by ‘contextual thinking’. This point of view formed the base for the design of the brewery; the physical and social spaces are like guidelines. The physical space has showed that the design of the brewery should invest in options for pedestrians to temporarily stay at this southern part of the city and be aware of the Rhine’s water levels. The social space permits the brewery to retain the existing historic and cultural values. It ensures that an intensive dialogue between the Maritim Hotel, pedestrians and the Rhine will be as much loved by the public today as it was before the World War II.

‘Brauhaus am Rhein’ will be a beloved spot along the Rhine which represents the urban character of the lively inner city of Cologne via its concrete appearance. Together with the lower embankment, the brewery will give flaneurs the opportunity to continue their route in, on and around the brewery. The building’s shape plays a game of composition with the shore of the Rhine and use the dimension of height to let the building fall naturally within the parameters of the quay. The contours of the Brauhaus respond to the curiosity of the passing pedestrians and let the passing spectator discover the surrounded environment. The doors and windows are like perforations. The window frames are only visible from the inside because the sculpture of the building forms a solid shape with perforations which are not interrupted by the presence of window frames. Window frames will accentuate the view towards the quay and the Rhine from the inside. They will reflect daylight into the building and make the perforations even stronger. When drinking a ‘Kölsch’ in this brewery people can watch the Rhine stream by thanks to a large acrylic window. At the same time people can see how their ‘Kölsch’ is brewed. According to tradition the brewing process and the wooden furnishing are important parts of the nostalgic atmosphere of the protected culture of Cologne’s beer.
Perhaps this building could be an exponent of the Maritim Hotel because its function could be a valuable addition to its isolated placement. Visitors and residents of Cologne love the Rhine and take advantage of the fine weather. The urban intervention of the brewery gives pedestrians the possibility to briefly stay along the Rhine; it provides identity to the quay and the chance for pedestrians to discover the qualities of the environment.

The project can be characterized as the possible pursuit of an urban intervention which deals with a sensitive and neglected approach towards context. This approach permits the pedestrian of Cologne to forget the rush of passing cars. It creates its own romantic truth in a society from which romance has flown and Cologne is no more than an inner city highway in which neoliberal principles dictate the destruction of romance and the creation of more asphalt and the obduracy of society.
The “Noorderruimte” (northern space) graduation studio concentrated on historic and current developments in the most northern part of the Netherlands. This increasingly forgotten region struggles with a shrinking and aging population. The studio has investigated present-day, global topics with strong, local implications. Through these topics opportunities have been sought to raise awareness about the possibilities and qualities of the region. The two graduation projects which are presented here accommodate two different forms of modern-day tourism and present different ways to contribute to the local community.

Noorderruimte - a production landscape
The most northern part of the Netherlands consists of a vast open space, adjacent to the Wadden sea. The two northern provinces of Friesland and Groningen are famous for their never-ending agricultural landscapes. They are a product of centuries of battle between man and the sea. Large tracts of land have been claimed from the sea, sometimes more than once. Before man arrived in this area it was a dynamic tidal landscape. A vast area of creeks, marshes, lakes and estuaries was the continuously changing result of the interaction between water and land. This ecological diversity brought enormous prosperity to the first settlers, although living on the marshes made them vulnerable to periodic flooding and they were driven far inland often. In these times one could hardly speak of a border between land and sea. This slowly changed when people started to build dikes to protect themselves against flooding. The building of dikes permitted a new era for human settlements in this area. Fishing was still an important economic activity, but soon agriculture began to gain economic and cultural importance. Dikes made it possible to claim more and more land from the sea, resulting in a growing area of extremely fertile soil. Agricultural settlements increased in both number and size, but were heavily dependent on the strength of the dike, as they continue to be. A dynamic, natural ecosystem has become a rigid, manmade production landscape.

Two global issues - salinization and monoculture
The above-mentioned process of coastal cultivation is taking place all over the world today, although the local implications of this process differ strongly. The dire consequences of climate change puts our intensifying use of coastal areas for agriculture in the spotlight. With sea levels rising, coastal areas are beginning to suffer from a process called salinization. Sea water is pushed into coastal freshwater...
aquifers. This accumulation of salt in the groundwater of agricultural lands makes it harder for many crops to grow, resulting in lower yields for farmers.

In addition, farmers are increasingly suffering the consequences of hard competition on the flattening world food market. They are being forced to continuously expand, intensify their use of the land and grow only a single crop (monoculture), causing the biodiversity and resilience of the agrarian ecosystems to suffer drastically. In the case of the Noorderruimte, this has had a direct effect on the image of the landscape as perceived and cherished by tourists. If tourism is to contribute to the weakening economy of this region, this is an important aspect to think about.

Two graduation projects from this studio address both these issues and focus on the local effects. They try to provide answers and create opportunities for the local community.

Two local opportunities - saline and diversified agriculture
The issues discussed here are happening on a global scale, but their local consequences are often hardly understood. Intensified land use and the trend towards monoculture are developments that are directly influenced by the daily food choice of the consumer in the supermarket, though this is barely known. Neither do most people know that rising sea levels are already damaging agricultural yields.

Thus these graduation projects focus firstly on raising awareness about these issues. Their programs offer attractive ways to present these topics to the tourist. This way tourists are introduced to the Noorderruimte’s key issue: increasing understanding and involvement.

Apart from raising awareness, the projects investigate new ways to deal with these topics. The first project, located in the province of Groningen, presents a way to use salt water for algae production using excess energy from nearby industry in order to work with, instead of against the process of salinization.

The second project examines the development of agriculture and its impact on the local landscape. It offers visitors cooking lessons and insights into the sustainability of their food choices and the fragility of the local agricultural economy. Local farmers and villagers are invited to participate and stimulate sustainable, diversified agriculture.
For centuries people have fought against the saltwater from the sea. Instead of fighting against the water we should be thinking with the water and use these circumstances to look for new future opportunities. North-east of Groningen the presence of many dikes shows the history of this fight against the sea. In this area the space between Eemshaven and Oudeschip, the most northern village on the Dutch mainland requires a future-proof landscape. Two dikes, a kilometer away from each other mark the north and the south border of this location. It lies between the booming energy industry in the Eemshaven and the small village Oudeschip. While this corner of the Netherlands is very remote, at the same time it is a very important place for energy and other supply networks.

In this graduation project the opportunities for a wetland where the warm cooling water of the power plants can be used are investigated as an alternative to the agricultural land of today.

This has resulted in a new multifunctional landscape which includes farming. It is an experimental place, used both as inspiration for the future and to explain the possibilities of these salty wetlands. This ‘new’ landscape is in fact a regulated version of this location as it was formed when man first started making dikes. This project investigates the opportunities of one-cell algae production in combination with recreation and nature development.

Compared to our consumption, the Dutch have too little arable land. Multifunctional use of land is necessary. This could be met by a combination of production, recreation and nature development. Nature development is possible along the banks of the old gullies and creeks of the Wadden sea which are still visible. These are the only historic elements in this landscape from the time when this was a tidal area.

As for production, the algae will be used initially as food for livestock. Future uses include the production of bioplastics and biofuels.

The proposed algae basins, combined with rural and natural areas close to shore, result in a more diverse landscape, yet the typical emptiness of this flat land is protected.

In the middle of the salty wetland a road connects the farm to nearby villages. The smallest scale is created by the paths near the old gullies, these can be used to stroll through nature, a place to see the green sludge, the birds, the windmills or the emptiness. This makes it possible to connect the smaller scale networks of the countryside to the larger ones at Eemshaven.

This project also investigates the use of low temperature (warm) cooling water from the immense power plants in Eemshaven. Irrigating the basins with warm water stimulates the growth of algae. This in turn cools the water to be used again in the power plants which has a positive effect on the amount of cooling water taken by the power plants from the Wadden sea’s fragile ecosystem.

Highways and dikes form the boundaries of the experimental salty wetlands. Parallel to the coastline lies a remainder of the early salty marshes: an elevated strip of land which offers a safe location for the farm. This is a hybrid location between industry and agriculture; immense windmills are situated to the north and the renowned Oldamster farms to the south. These are famous for their huge barns for grain storage during the period of the Grain Republic[11]. The sharp contrast between the huge industrial structures and the small village of Oudeschip can be observed from here. A more detailed design is made for a region of approximately 100 hectares, a small part of the total area. Only the algae farm and adjoining dwelling will be designed in this area.

The futuristic industrial structures form sharp silhouettes on the horizon. A clear shape is designed for the algae farm to fit in this image. The production of algae is completely different from traditional agriculture and demands a different type of farm. The silhouette of the farm refers to the old image of industrial buildings with the typical sawtooth roof.

The three halls housing the different production processes of algae sludge (pre-growth, drying and storage) are ‘glued’ together. This makes it possible to cross the halls with a public route at a higher level. It gives visitors - for example residents, tourists and students - an overview of this relatively unknown production process and provides a view of the surrounding landscape.

A bicycle path connecting Oudeschip to the ‘Waddenzee-route’, which runs along the dike, crosses the farmyard creating an opportunity for people to take a rest or walk around the farm and learn about algae and perhaps even buy an algae face mask. As on traditional farms, the farmer and his family live on the farm. Traditionally, farms have different layers of privacy, separating the working area from the living area. In the barns/halls smaller scale spaces are specifically designed for people instead of machinery. The difference between the smaller human and larger industrial scale, created by the more generic covers for machines, is clearly visible in this farm.

Salty wetlands have different visual qualities compared to dry land. Large basins for the production process are filled with a thin layer of water, reflecting the colors of the air and surroundings. The translucent cladding of the farm reflects these colors as well. The wind changes the water surface in the basins from a mirror to a waved surface. Between these water basins the strong silhouette of the farm interrupts the horizon, marking a place for new opportunities.
1. schematic view

2. salty wetland with the farm as a silhouette

3. algae farm
The romantic rural landscape of the Dutch province of Friesland conceals a serious development from the outside observer. Holland’s richest arable lands have been shaped by food production for ages. However, recent developments in our global food chain have led to an uncertain existence for the Frisian farmer. This threatening situation is disguised by the apparently idyllic, small scale of the rural landscape we have romanticized. Typical old farms are still present in large numbers, but they aren’t used as farms anymore.

The qualities that tourists enjoy in Friesland at the moment, like quietude and open space, exist by the grace of the agricultural use of the landscape. Thus in addition to the farmer being a food producer, he is also guardian of the aesthetic landscape. This is a worrisome thought, for farmers are increasingly suffering the consequences of competing in an unstable, flattening world food market. They are being forced to continuously expand, intensify their use of the land and grow only a single crop (monoculture), causing the biodiversity and resilience of the agrarian ecosystems to suffer drastically. This has had an especially strong effect on the cherished image of the landscape. That these developments are directly influenced by the daily food choice of the same tourist as a consumer in the supermarket is barely known.

The decreasing economic vitality caused by the expected population decrease in Friesland will put pressure on community spirit. Because of a growing dependence on developments that can’t be overlooked, this community is increasingly experiencing a sense of nostalgia. Intensification and mechanization have reduced labor demand in this area, causing many to flee to the city. As in many peripheral areas, tourism could contribute to the economy. This is the research topic of this graduation studio investigation.

Well embedded touristic initiatives build on the character of rural life. Or, as the Swiss architect Caminada said: “The challenge lies in strengthening local communities in ways that make sense to the inhabitants of peripheral regions.” This tourist project tries to create a strong rural identity, contributing to a cultural anchorage for the local community.

An annual, polished form of “fine weather tourism” will not strengthen the local community’s identity, pride and spirit. This form of tourism is completely strange to the people of rural regions. They are used to a life in all sorts of weather, in all four seasons. The influence of the climate on daily life in cities has diminished, since urban life is increasingly taking place indoors in climatized spaces. In the countryside however, the influence of the climate and seasons remains. Crop yields - and with them farmers’ income - are still directly dependent on weather and climate conditions. This strong dependency is often overlooked by urban consumers who often see little more than the abundant food supply in supermarkets. The apparent self-evidence of this wide range of food offered daily implies a loss of basic food knowledge. Within a few generations the knowledge and skills to cook with fresh, seasonal and local ingredients have almost completely disappeared. If our capacity to prepare fresh food continues to decrease we will be at the mercy of supermarkets who will offer us more and more ready-to-eat meals and make us more dependent on things only they can deliver.

In this context it is important to stress the social function of food: food confirms and expresses our identity. The kitchen has always been the place where cultural identity and values are expressed in the food prepared within them. The kitchen is the place where changes in our food choice have ultimately changed the food chain.

For this graduation project a kitchen was designed in a former farm, as a metaphor for these changes and as a platform for a transition towards a responsible, sustainable diet. The Frisian landscape forms an inspiring background for a project about food and cooking in relation to the local, rural culture. Here a place can be created where urban citizens can learn to cook again with fresh, often forgotten ingredients. It is a place in a small community where local values offer an interesting alternative to the uniform, global values that mark life in the metropolis. This can become a place where visitors can feel the influence of the elements in all four seasons. A place where people work with things that are at hand, where the season and surrounding landscape once again dominate our eating habits. Kitchen table conversations provide food for thought.

In a small Frisian village with only a few inhabitants every relation counts. A new addition automatically changes the community’s center of gravity. The disruption of the critical social balance in a small community can put more pressure on an already challenged community spirit. These observations have led to the choice to fit the project into the existing, vacant building stock.

A vacant farm building next to the hillock in the village of Wanswerd offers an inspiring location for this project.
model of the kitchen volume as positioned within the existing barn structure

clay pots represent the development of the global food chain.
Wanswerd is one of the smallest villages in Friesland with only about 200 inhabitants. In consultation with the inhabitants, certain functions have been added to the program that contribute to local public facilities. A small store provides fresh products and kitchen meals are delivered to the elderly. One of the newly added buildings can be used for annual community festivities.

In this project the kitchen plays a central role in the public debate about agriculture and food. This central role is translated into a physical appearance: the kitchen is placed in the center of the existing barn as the new heart of the building. An obvious - and simplistic - contrast between new and old is avoided. The impressive wooden barn structures are often wrapped in a smooth layer of white stucco. This approach alienates the existing structure from its original, load-bearing function and context. This obscures the building’s tectonic clarity and often results in an artificial appearance. In this project a different approach is used, one in which tectonics and functional aesthetics are respected and historic continuity is deliberately sought.

The thatched roof of the Wanswerd farm has an impressive appearance on account of a rich sequence of spatial dimensions determined by diverse structural elements. The functional tectonics of the building’s skin and supporting structure form a starting point for the architecture of the intervention. The intervention seeks to build upon the tectonic sequence, using modern dimensions and connections in wood. A new layer is added without freezing, framing or upstaging earlier historic layers as ‘vestiges of the past’, as Caruso St. John called it. This concept is expressed in the tectonic articulation of the newly added volumes.

An important aspect of the architectonic concept is to express daily life on a farm. The desired expression is not that of the nostalgic image we like to think of all too often. The project aims to express the uncertain and fragile reality of modern farm life through concepts of exposure and material transience. To accentuate the mere protective function of the barn’s thatched roof as ‘rain cover’ the kitchen inside the barn is not clad on the outside since it is protected from the elements by the barn’s roof. So the external wooden structure of the kitchen lies bare and in doing so it enters into dialogue with the barn’s own structure. This dialogue creates a historic continuation which articulates the tectonic qualities of new and old.

Outside the barn used to be two annex buildings containing a small stable and storage shed. They were in a deteriorated state and so they were torn down. Roughly on their footprints two new annex buildings have been built containing a guest house and an equipment shed. The volumes are derived from the elementary typology of farm buildings. The typical gable roof is particularized which forms a double curved roof creating a clear begin and end to the building ensemble. The two annex buildings stand as protective shelters on a 60 centimeter high plinth of rammed local clay and earth which anchors the buildings in place in the Frisian clay.

The annex building’s wall and roof structure is an exact inverse of that of the kitchen. This creates an architectural coherence between the new additions and emphasizes that the kitchen is being protected by the thatched roof while the annex buildings are exposed to the elements. The smooth surface of the cladding material, consisting of a copper-zinc-alloy, shows the thinness of the water tight layer which is folded over the building volumes. Exposed to the weather, the building skin will slowly get a dull, bronze colored patina which will merge the buildings into the brown clay landscape. The same cladding material is used for the inside of the kitchen creating a easily washable surface. Used inside, the material will age more slowly. Through the years a difference in surface appearance between the inside and outside application of the same material will become evident. This transient quality expresses the influence of the weather and time. The architecture of the intervention creates a relevant and inspiring background for a program about food and agriculture. The idyllic, rural landscape around Wanswerd appeals to the imagination. Yet there is no place for nostalgia here.
cooking studio inside the existing barn (left) and guest house (right)

building ensemble: new storage shed and guest house will blend into the colors of the landscape over time
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**design agendas**

**BUILT**
introduction
After the completion of ‘t Hool in the 70s, the press spoke of an unique project. Unique for its planning, architecture and the form of collaboration between the architect and the occupant.
The selection of the district by the National Cultural Heritage, to be of national, cultural and historical importance shows that even today, the district still has an important status. The urban architecture, the coherent design of home and community, private and public green spaces, its robust appearance and detailed materials are some qualities that make the area of national importance.
Despite these promising words, the district suffered over time. Just like every other post-war district, ‘t Hool is likely to become a victim of impoverishment. In a district with such a rich history and characteristics, we cannot allow that to happen.

huis & wijk
Because of their resentment against the returned compartmentalisation after the Second World War and the large scale of unimaginative housing that was being realised in the Netherlands to solve the housing shortage, a group of people started the Housing Association ‘Huis en Wijk’ in 1961.
The initiative for the housing association started in the Physics Laboratory of Philips with Frans Schijf and Kees van Es. They wanted to create a residential district in which they could influence the entire district instead of just the direct surroundings of their home.
The main goal of the housing association was to create habitability. They wanted to create a district with a wide range of comfortable housing which could be flexible in the future and ensured enough privacy for its owners. Contact with nature was important and had to be encouraged. In the search for an architect, ‘Huis en Wijk’ found a lot of similarities between their views and those of Jaap Bakema architect of the Architectural bureau ‘Van den Broek and Bakema’.

planning
Bakema presented the first plans for ‘t Hool in November 1961, using a sample project, with which he explained his views on variety of types within the neighbourhood.
This first sketch was the start of a design process which lasted for seven years. During these years, besides political and economical influences, the future residents from the housing association ‘Huis en Wijk’ had a strong influence on the design, both at home and at urban level.
The urban structure of the district can be seen as an orthogonal stamping using different stamps, consisting of a group of housings situated around a court. The high-rise buildings embrace the low-rise buildings like adults do their children.
The district contains 14 different typologies that can be grouped in terraced houses, patio homes, the detached house, split-level house, the drive-in house and flat-types. Each group had its own design process of which a part took place within a so-called type committee. These committees consisted of some members of the housing association who where planning to live in that type.

bakema
Bakema called himself an architect-urbanist. He found that urban planning and architecture where inextricably linked. People should be given options in shaping their environments. He wanted to create different types for one audience: the family.
According to Bakema, consistency in design between large and small scale was of great importance. The transitions between the different scales were of even greater value.
The most important transition was the ‘threshold’ between private and public.

The transition of this ‘threshold’ is most visible in the terraced houses. The garden area is the mediation between private and public. Through a passage between the garden wall and the storage, the visitors enter the private domain. The Western Red Cedar storage wall leads them to the recessed entrance of the house. On the other side, this movement is enhanced by the folded kitchen window. The transparency of the window in the façade is the beginning of a visual interaction with the inside of the housing.

’t hool 2012
Sadly, ‘t Hool was not able to adjust to the changing needs of its owners, despite the wish for flexibility from both ‘Huis & Wijk’ and Bakema. Besides the obvious problems in post-war buildings concerning the building physics, technology and influences of the users, there was one more problem. All the 14 typologies where built just for the family, while nowadays many different groups require living. Because of the mono-function in the area, the district is deserted during the day. This is really sad, because during the day, the large amount of green in the area causes the district to bloom.
concept
The district ‘t Hool had a great historical value. It was unique for its planning and unity in architecture. Nowadays, the district still has this status, but no longer shows it. This historical value needs to be restored by revitalising the area, which requires an approach on urban and home level. To tackle the mono-function in the area, the function-mix strategy will be used. Function-mix is the combination of working and living in one area, for instance on city level, district level and building level. By integrating a work-function across the district, combined with living the density in the area will increase. To realise this, additions to the existing buildings and new builds responding to the changing needs of its users will be created throughout the area.

design
Adding a work-function to an existing dwelling with a living function requires a set of rules. To create optimal privacy for both the working and living, each function should have its own entry. For the owner of the building, it is useful to have a passage between both functions. Keeping these rules in mind, additions for the existing dwellings were created. Within the context of Bakema, the types differ in form, but everything is created with equal materials and detailing, creating unity and representing the new era for the district. Within the same context, new-builds will be created throughout the entire district. On the east side of the district, near the entrance, a concentration of the new-builds will be located and will in that way create the landmark for the new era. In reaction to the 2Dimensional stamping in ‘t Hool, a 3D translation of the district is created in the new build. A number of characteristics of the district can be found in the new build. Jaap Bakema devoted much attention to the transitions between scales. This is translated into the whole building by entering the building from public to semi-public to private. This last transition is enhanced by setting the route to the dwellings loose from the actual dwellings, creating a thermal buffer around the dwelling.
structure
The value of ’t Hool decreased due to its inability to respond to the changing needs of its users. The additional buildings therefore should be designed to be able to adapt to the future needs of its users.
This asks for a flexible structure and detailing. Therefore, the load-bearing structure will be realised in steel. Taking in consideration the aspects of flexibility, assembly and of course durability, steel is the best material to use. The best suited flooring for the building is the Slimline flooring. This floor makes it possible to change the installations within the flooring.
In the future, the dwellings will be able to change function, when the company grows and moves to a bigger office, the work-function can easily be transformed for living. In case the users need additional space, it is possible to expand outside the glass-facade, just like the additions to the existing dwellings. This way, the building is able to respond to the future needs of its owners.

conclusion
By creating an addition to the district ’t Hool, the area will revitalise, due to the changing of the mono-function. This revitalisation will be able to last for a very long time, because of the engineering. The elements and detailing are done in such a way that it is relatively easy to maintain or replace building parts. The option to expand the houses in the future creates the extra space people may need. With this strategy, the future of ’t Hool is secured, not just for the upcoming years, but for many years to come.

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The reuse of buildings is a common good. A lot of buildings of previous times now have new functions and with that a future. Monasteries, churches, monumental buildings and more recent industrial buildings: it is very normal to reuse old buildings that have a long history, but how do we treat young heritage and young industrial heritage in particular? Built in the 60s and 70s, they often do not have an appealing history and most of the people do not like their appearance. Besides that, there is a larger problem with these buildings, namely that they were built for a very specific function. They are tailor-made solutions designed for one specific purpose. And when the function is outdated due to industrial development, the building remains. The good location of these buildings is often an opportunity. The industrial areas of that time were located near the city centre and connected to good infrastructure. At present, in a time of sustainable development and rapid changes, we can ask ourselves what we can do with these buildings. An easy solution would be demolition, but this does not seem to be a very sustainable one and is that all we can do? ‘Slim-reuse’ focuses on the reuse of young industrial heritage and on how we can approach the reuse of this type of young industrial heritage. On the basis of a case study, grain silo Middelburg, the feasibility of ‘Slim-reuse’ is investigated.

The medium high grain silo is a tailor-made object for the storage of grain. Built in 1962, it is now 50 years old and has been waiting to be demolished for 8 years. Located at the bank of the canal through Walcheren and nearby the centre of Middelburg, this is young industrial heritage with potential. The site, which is an industrial area, benefits from the new infrastructural developments. A new aqueduct that connects the popular beach locations to motorway A59 makes this industrial area the new show-piece of Middelburg. At this point, there is no clear vision for the development of this industrial area. In what way can this building be reused to support the development of this area?

How do we approach the reuse of this young industrial Heritage? For the more appealing buildings there are often visions and future plans. The reuse of young industrial heritage is not that simple. Most often there is no vision and there are no future plans. This was also the case with the grain silo Middelburg. The question therefore rises what the starting point will be. In the more standardized reuse approach the starting point is formed by an urban plan based on a vision of an owner.

The research method is based on three main aspects, namely: social aspects, architectural aspects and structural aspects. Every main aspect is divided into sub-aspects and -levels. The matrix covers all aspects and levels, including the aspects that are less relevant for future developing. Because this is only a short essay, the detailed outcome of this analysis will not be further elaborated on. The interesting part of it is covered in the conclusion.

‘Het gaat hierbij echter niet om iemand die voor een bepaald doel de stukken vormt, maar om iemand die reeds gevormde stukken net zo lang in de hand draait, tot hij ziet waarvoor hij ze kan gebruiken.’

Citaat Jos Naalden (Schulte, E. (1997))
necessary adjustments
As soon as the opportunities and functions were mapped, there was not one clear function. A lot of functions would fit into the existing structure of the grain silo, but none of them without adaptations. The necessary adjustments have to be made in the façade (daylight), services and structure. The adjustment are necessary because this tailor-made object was built for the storage of grain only. The concrete façade and the fact that there are no services and insulation, makes that this building is not very easy to transform. The necessary adjustments become the first step in the process of ‘Slim-reuse’ of this grain silo. Not a function, but the adjustments guiding the reuse serve as a design for this silo.

When studying in the Slimbouwen studio, it was obvious that these adjustments had to form a ‘Slim’ layer in which different functions are possible. The necessary adjustments were therefore designed to support the development of the building, to realize a building which is flexible and can adapt to future changes. The concrete façade is replaced by an aluminium curtain wall. In the silo cells, a steel structure is placed and the roof is insulated and replaced. Because of the original height of the silo cells, the floor package was no problem. The floor package is built upon a wooden structure with enough space for future installations. With these necessary adjustments, the first step of ‘Slim-reuse’ is made. The building is ready to function as a platform, a platform for activities that stimulate the development of the area.

“We should not try to forecast what will happen, but try to make provision for what cannot be foreseen.”

In the first stage of the transformation, the building is made ready for new temporary functions. With the new façade and new installations, temporary functions as atelier, studio, meeting room or party location are all possible. The temporary functions will boost the development of the area. A desolate industrial area is not the A1 location that consumers and businesses have in mind, but with some infrastructural development, this area has potential. By stimulating activities through the temporary functions, new industries will develop in this desolate area, resulting in a multiplier effect.

The steel structure, which will be embedded inside the silo cells, creates another flexibility that will represent the second phase of the platform function. The steel structure facilitates the introduction of flooring. The silo cells are 12 metres high with no flooring lying in between. This makes the cells feel like a tube. The steel framework enables the realisation of floors at +3m, +6m and +9m.

These floors will be made out of wood and easy to mount. This way, the user is able to use a split level principle or a more traditional infill, making the silo cells very flexible.

final phase
The 3rd part of the ‘Slim-reuse’ process is the final phase. This phase is very unpredictable. It is conceivable that the final phase will end with a final function. During the platform function, the building has developed itself and its context in parallel with an urban plan and a vision for the future. The plan and vision are based on the activities stimulated by the platform function and perhaps these activities will even become the final function. It is also possible that the building will keep the platform function in its final phase, continuously adapting to the area through its functions.

Another possibility is that the ‘Slim’ layer will become a starting point of a new form of reuse based on new insights.

In normal reuse programs, the development starts with the final function as the main goal, creating a new custom made design for a specific function. The process of ‘Slim-reuse’ has its strength in the fact that we do not know what the final function will be. We anticipate on that which cannot be foreseen. That is the power of ‘Slim-reuse’.
slim reuse
To conclude, ‘Slim-reuse’ focuses on reuse without a final function. It is reuse through development instead of targeting on a final function. The building as a starting point with a functional (‘Slim’) layer that offers the building the possibility to develop itself and its context together with its users. The first step is formed by the required adjustments, after which the building will develop itself and its context in its platform phase. After this phase, it is very likely that there will be a final function as a final phase, but it is also possible that the building is reused in a different way based on new insights.

vertical quality
The temporary functions do not need flooring in the cells, because their stay is temporary. When they want to stay for a longer period, flooring can easily be added to the cells, realising more space. To give an idea of the possibilities within the ‘Slim’ layer, different options were developed. From a residential infill to office spaces. Every infill is based on the architectural concept in which the vertical quality of the silo cells is preserved as the leading characteristic.

grain silo
What is it like to reuse a building without a function as a final goal? The research of this development process is applied to a case study which makes it theoretical and therefore very interesting to work on, because you are not bound to requirements of a third party.

The grain silo Middelburg consists of two parts. The first part is formed by the silo cells. There are 24 cells of 5 x 5 metres, which are accessible through a central corridor. The height of this part of the building is 12 metre. The second part is formed by the elevator tower. This is where the elevator installations are located. The elevator installations were used to clean and transport the grain to the silo cells. The elevator tower is 18 metres high and, as opposed to the silo cells, has flooring. The silo cells are made of concrete and the elevator tower is built out of masonry.

When the required adjustments are made, the building is ready to have a platform function. This will take some time, because the building contains a large surface area. It is very likely that there will be a lot of different temporary functions. The building is already subdivided in cells of 5x5 metres and is therefore easy to fill in. For a small function, 2 silo cells can be merged to form space for one function. For a large function, 4 cells can be merged. For the elevator tower, a different approach is used, because the levels are already one huge space. Every floor will have a different function which will be accessible through a main entrance.

In order to maintain this vertical quality, the space is organised around a functional core. This functional core contains the necessary (closed) functions such as a toilet, a bathroom or storage rooms. These cores can be various forms depending on the function. In this way, it is possible to implement both residential and work functions. These cores can take a rectangular or block shaped appearance. It is also possible to implement other functions based on the functional layer, but in this project the choice was made to elaborate on some options in order to provide understanding of the flexibility and possibilities.
This flexibility has to be mirrored into the façade. In addition to the internal steel structure, there is an external structure. With this external structure, functions are able to create balconies. These balconies can be realised on the 1st, 2nd or 3rd floor depending on the internal organisation. When there are different functions facilitated in the building, this will also be visible on the outside, through the diversity of the balconies in the façade. For example, an office function can create a balcony on the first and third floor, while a residential function can create a balcony on the second floor. This results in a view as shown in the illustrations below.

reuse through activity
Realising a ‘Slim-reuse’ strategy for a building that was marked for demolition was the challenge of this project. What was interesting was the fact that a function is not a requirement for realising reuse. Industrial heritage is historically created by development and progression. What started in the industrial revolution has in the time of the information revolution been marked as undesirable and ready for demolition.

It is strange to stop the development of this heritage in a time in which more knowledge and resources are available. The ‘Slim-reuse’ strategy might be the solution for buildings for which there is no clear vision or function. Development through activity, by the realisation of the required adjustments and the introduction of a platform function will stimulate activities and start a new development. The building makes space and is an opportunity for the development of the area. With that, the building itself will create its new future. Due to the organisation and materialisation, the flexibility of the building is shown on the outside. The building shows that it manages its own development. The ‘Slim-reuse’ of industrial heritage takes industrial heritage as the starting point for development.
Jacob Voorthuis, Jan Schevers and Bernard Colenbrander supervised an investigation into the meaning of perfection and its role in the design process. The gradation studio “The Naked Architect” undertook a philosophical search for a definition for perfection. Their result is a variety of philosophical, and sometimes contradictory statements. In this maze of different perspectives it is difficult to make a universal statement about perfection. Although this search does not lead to general design rules, it forms the starting point of a discussion about perfection. Although this search does not lead to general design rules, it forms the starting point of a discussion about perfection. Although this search does not lead to general design rules, it forms the starting point of a discussion about perfection.

Philosophical exploration

Perfection sounds like a severe theme, one that asks for a superhuman performance. It gives a utopic impression and at the same time feels like a straitjacket, a rigid situation that offers no space for an alternative. It is so complete that is takes away all freedom of choice. It seems paradoxical in that it strives for perfection without a true desire to achieve it. This architectural investigation is connected with the knotted theme of perfection. Since it not only investigates how the environment functions but also tries to indicate how to improve it. In order to make any improvement it is necessary to know what the ideal image is. By questioning perfection insight is gained into the complexity of architecture.

Questioning perfection

During this questioning of perfection a variety of viewpoints were put forward in the design studio. Our conclusion is that perfection is about the goals one sets for oneself. When using the term as a value judgment it represents a moment in which everything exactly satisfies our desire. At such a moment there is complete satisfaction. However one is only able to desire form within a personal perspective that is colored by a personal reference frame. All desire is based on these variable reference frames. Only because something is desired from the environment it is possible to distinguish good and bad. From this perspective the knotted character of perfection becomes visible. A designer must discover what he desires most from the environment and must try to sculpt this. This
desire is based on a constantly shifting perspective and is only knowable in the act of being. Therefore it is important to integrate the creation process with the investigation of guidelines in the context of the problem. It is almost inevitable that this theme of perfection constantly returns to the question of what is wanted from the world in a broader perspective and how architecture is able to contribute to personal ideals. The profession of architect is regarded in a most naked existence. In the design process goals are constantly questioned and rethought; every design decision is reconsidered. That is where the name of the graduation studio, “The Naked Architect”, becomes relevant.

the paradox of perfection

perfection in the design process

It is easy to get lost in abstract discussion, yet that discussion has a very useful retrospective function in a specific design task. Every design decision calls forth the question of the goal and why one option is preferred above another. After the philosophical exploration, a specific interpretation of perfection in the form of a full-scale alter design[1], is detailed. This assignment reveals that a common starting point, the creation of an alter, can produce extremely varied results. These results can be seen in the images on these pages. The design of a personal alter was interpreted differently by every participant in the studio. They varied from a wooden box in which a Koran and a Bible are united to a passage in the landscape to experience silence. Some found perfection in the precision of a connection and others in the expression of materials. The results reveal a difference in perspective and reference frame and show the variety of personal interpretations of perfection.

graduation investigation

Finally all graduating students from the studio formulated their own personal goals for a final design project. The goals of these projects are defined by regarding research in light of personal idealism. Two of these projects are shown in this booklet.
In an attempt to define a method to search for beauty, I questioned the practice of architecture and have tried to define my craftsmanship as an architect with it. Believing that there is no such a thing as a blueprint for beauty, I came up with an essential question for architecture: “how could we reach for beauty, if the foundations for it are rooted in personal experience”.

the role of architecture
In an attempt to define architectural research one could state that it concerns itself with human experience which involves the subject as an emotional entity. In order to make a statement about experience emotions such as intimacy, fear and tranquility are related to sensory qualities such as color, proportion and scent. Beauty is hereby not only limited to visual aspects such as harmonic proportions and correct color schemes, but includes all the sensory experiences which can please a human being. This means that beauty is inseparably connected with pragmatic use. The foundation for beauty lies in the fact that it is experienced. Beauty is closely linked to the one who experiences it. A particular experience of beauty can therefore never be viewed as untrue. In other words, beauty can never be certified by knowledge. Our observations only acquire meaning because of the knowledge we use interpreting them and it is possible to research how these conditions for experiences are set. The role of the architect is to understand beauty through the eyes of others, as well as convey one’s own experience so we can share it with them.

the role of abstraction
Everything acquires meaning for us because of the relations we establish between everything we experience. In our search for those connections we categorize certain phenomenon and create a network we refer to as knowledge. The abstraction can be seen as a view with which we categorize concretely perceived phenomenon. We use this to process our observations and it is part of our perception. Yet it is an illusion to think that we can grasp the essence of an observed object or even its pure nature via abstraction for it is just a tool we use to make sense of the world around us.
In our quest for abstraction in the analytic process of decomposition and contextualization we can risk losing the richness of a complex and ambiguous operation or at least be at odds with it. The schematizations we construct are supposed to serve as a tool to make sense of the complexity around us, but increasingly seem to become an aim in itself to which reality is supposed to conform. I have attempted to accommodate to a desired way of doing as we seem to have distanced ourselves from the actual user and therefore must capriole to rig the actual situation in our own favor.

resulting methodology
As stated by Marice Merleau Ponty (2003), experience is the product of a total constellation of perceived phenomenon. Within this perspective one has to use appropriate caution when unraveling an architectonic problem. To prevent losing the richness of an existing situation like TAC (the case study for this project), a 1:20 model was used from the very start as it most closely matches the current situation. In a constant interplay with this representation the existing elements are investigated based upon how they can serve the desired target, namely the creation of the ideal entrance for TAC. By conceptualizing certain expectations in the representation, the abstract ideas could be tested for their effect on the overall image while also helping to specify the desired target. With the emergence of different variations it became clear what the influences of the various factors were. These factors were never analyzed outside their context which prevented deduced frameworks (which should serve only as a tool to make sense of complexity) from becoming a target to which the existing situation should conform.

The starting point of every design decision (every judgment of beauty) is personal experience and this is not always supported by a clear explanation. Our experiences are built upon many unconscious associations. The use of implicit knowledge could be seen as an intuitive aspect of the design process. It does not always require a clear explanation to make a decision. It could however be useful to retrieve and articulate this knowledge since it could give the designer clear guidance for other design decisions. Moreover, it could help others to better understand the world as the designer experiences it.
In the end, the design process can be seen as a form of research in which experience is tested in representative models. This makes the design process much more expansive than just an attempt to translate values that defined in a prior theoretical design investigation. The goal and solution were defined in an interaction between searching for a solution and questioning the goal. Architectural study is not only concerned with achieving stated objectives, but also examines the goals we strive for.
The design of a community building can stimulate the transition from emergency aid to rebuilding activities in the urban context of Port-au-Prince, Haiti. It is easily forgotten; Haiti is not just a tropical country, but was heavily damaged by the devastating earthquake of January 2010. This investigation focuses on the situation of the tent camps that emerged spontaneously and rapidly all over Port-au-Prince, the capital of Haiti, after the emergency. Two years after the earthquake these tent camps reveal their permanent character.

The permanency of tent camps is generally seen as negative. However, it can also be regarded as a positive form of self-reliance. A long time ago Europe emerged like this. [2] It is an opportunity to create a vivid new part of the city with an active community. This is a different strategy from aid organizations, however, which are increasingly interested in combining emergency aid with rebuilding activities in response to diminishing economic resources and critical sponsors. This investigation shows how a community building can stimulate the transformation of the tent camps into a full-fledged part of the city.

These tent camps are known for their poor conditions for women and children including molestation, rape and human trafficking. It is therefore a goal to create a sense of freedom and protection in the tent camps. This research is relevant in Haiti because it has a history of natural disasters, such as hurricanes, floods and earthquakes, and is one of the poorest countries in the world, a country in development. It is therefore important to design buildings that can be used long-term and develop a sustainable solution.

temporal shelter + time = slums
This research project forms part of the graduation studio “The Naked Architect” whose theme is “perfection”. The studio focused on defining what is good or bad in a specific design context. This reveals the significant role of the designer’s personal frame of reference in the design process. This project therefore focuses on defining the boundary conditions for a community building in the specific context of the tent camps in Port-au-Prince to stimulate the transition from emergency aid to rebuilding activities and support the changing demands of the community with a special focus on the demand for freedom and protection. To investigate these boundary conditions the investigation is divided into four aspects: the transforming program of demands, the architectural means, the geographical context, and the technical transformation. A literature study and interviews with specialists on this topic were also conducted. The interviews serve as a reflection for research decisions.

The transforming program of demands facilitates in the local needs and in the tent camps during and supports the development[3]. One important aspect was to focus on the needs of children because over half the population is less than twenty years old. Children are the future and education is therefore highly important. The program of demands is divided into three phases of development: emergency, transitional and permanent. It starts off as an emergency hospital and later expands to include a school and a market. The market is an important source of employment and bring life into the tent camp thus stimulating economic development. The building later expands to include a women’s house in which women who have been violated are protected. In Haiti women play a main role in the community and the market is also mainly controlled by them.

Another focus point of this investigation is how architecture can increase a sense of protection and freedom. As concerns rebuilding activities, a sense of protection and freedom supports the ability to take steps in personal
development. A philosophical investigation results in various architectural ideas to stimulate these feelings. A sense of protection is provided by degrees of individuality and community and at the same time opening and closing spaces, binding them to interior and exterior. These degrees can be formed by in-between zones and defining rooms for specific target groups. The creation of order from chaos, and the integration of the building into the community, are important architectural tools as well.

In order to make a durable building in Haiti one must take into account Haiti’s geographical context – earthquakes, tropical storms and floods – and its tropical savannah climate. This climate demands sufficient ventilation, spaces protected from direct sunlight, and roof drainage of rainwater. In order to make buildings earthquake proof a construction technique has been developed that permits the building to move with the vibrations of the earthquake without resulting in irreparable damage. Apart from a symmetric building geometry, it is important to divide the forces at work. In order to deal with tropical storms the building can be designed with a patio to improve air circulation. Normally this is convenient. However in the case of storms the patio should be closed on the lowest level[4] to prevent extra internal air circulation. Flexible walls are used which can be removed in case of heavy flooding in order to lower the water pressure.

In order to facilitate the changing program of demands, a technical transformation has to be made. A transformation model has been developed which enables the transformation from a relatively small emergency hospitable into a community building with a patio. To make this change the connection of beams and columns should be reversible. A wooden connection has been chosen that scores well on durability, sustainability, execution, use and profit objective. It is easy and fast to assemble without the use of external expertise and is able to provide local work. The connection is made by hanging a beam in a column and simply securing it with a plug. To enable the placement of the beams, a facade frame has been developed that can be used as a ladder. The building gets its sustainability from the use of only four strips in the inner space which make the building flexible in use.

These boundary conditions result in a final design of a building system that enables the temporary program to transform into a durable solution while taking into account the architectural needs for freedom and protection. An alternative strategy has been translated into a realistic design for a community building that combines emergency aid with rebuilding activities and stimulates the transformation of the tent camps into a full-fledged part of the city. It is a strategy that can be used in situations with a similar context and a building system that is able to flexibly adapt to a different program of demands.
The graduation studio “R.Key.Text.Ure” bears the name of its equivalent design studio from 1985. Twenty-seven years ago we focused on the close relationship between technique and architecture within design and research.

This 2012 studio took Richard Benders’ 1973 book, “A crack in the rear view mirror”, as a starting principle to research that close relationship 27 years later: “R.Key.Text.Ure Revisited”. Richard Benders’ book emphasizes industrialization within the built environment as an upcoming and inevitable industry[6]. In addition to new techniques, methods and invitational ideas, he also describes three future scenarios for the construction industry. This exploring attitude defines the students’ assignment to re-write the book “A Crack in the rear view mirror” based on the building industry of the 21th century. The scenarios written by Bender, obviously without any knowledge about the future or the economic recession of that period and its forthcoming social events in the ‘80’s, serve as an example for students to envision their own future as architects in a period of economic recession and an uncertain professional future. The design studio started their assignment with this attitude. As the Dutch “Museum of National History” officially collapsed in 2012, it abandoned plans to erect a new museum in Arnhem. According to Benders’ thoughts on industrialization, the studio contacted the Museum of National History with their plan to design fifteen different portable pavilions that could go across the country. This would solve the museum’s problem of having a fixed location in Arnhem. Industrialization with all of its characteristics, e.g. repetition, smart assemblage, portability, was used to guide the design process. Each pavilion will be relocated to different provincial capitals in the Netherlands and host their own exhibition to the public. The students were looking for a solution to a paradox of industrialization, designing a generic object with the ability to be embedded in every possible location throughout the country. They continuously sought balance between industrialization and adaptability.

This project took a turn when students became more interested in questions about their future as an actual architect. Architecture as a profession has become a world of uncertainties in a period of economic recession, concluding Richard Benders’ theory as less applicable nowadays. The slow developments of the built environment as compared to the automotive, airplane, and other technological industries may be disturbing, but it opens up new possibilities with different perspectives and encourages a critical attitude towards the profession. How does the slowly adapting industry react to developments by the digital architect? On the other hand, how do architects address the industry? Perhaps our thoughts about the industry are worn out? Instead of rewriting Richard Benders’ book, each student contributed to a collection of essays about the future of the profession. These essays, entitled “Playing the Architect”, refer to the role future architects should play within the industry. With the industry already changing, raising the question whether architects should play the same role as 40 years ago is inevitable. What role does the architects play in present-day design processes and what role should they play in the future? This is an urgent question that has to be raised in periods of economic decay, with more than 50% of the architectural firms closing their doors, while the popularity of architecture is still rising. Nevertheless, architects will always be the caretakers of innovative ideas for the built environment that deal with all kinds of difficult social topics.

A situation such as the creation of the National Historical Museum, or rather the failure to do so, provided the request for the design brief. The itinerant pavilion is designed as a semi-annual highlight in the city where it will connect to existing cultural and historical activities. Many students proposed housing these in vacant buildings. Once again, this is a situation in which the role of the architect is to be determined.[7]
The assignment provided a separate collection of fifteen very different designs for the National Historical Museum: a Bid Book. The ‘Crack’ served as inspiration for the design of the pavilions and the generic ideas behind transport and assembly, but is not rewritten in either collection.

After the failure to set up a new Museum of National History, the studio took the opportunity to make several proposals. The touring pavilions will appear every six months in various Dutch cities linking their exhibitions to the local culture and history of that specific area. As already mentioned, many students chose empty buildings as a starting point for their new design. The large number of empty buildings once again prompts a discussion of the role architects plays in modern society. Every individual project produced a booklet, eventually brought together as the “Museum of National History: Bidbook”. These projects, with the “A crack in the rear view mirror” as driving inspiration, resulted in fifteen booklets on various topics, each a complete design of a generic pavilion.

During the first six months of research the two collections and the different topics for the pavilions produced various outcomes. Both, the bundle with essays as well as the pavilion designs, are unique and give a broad perspective on the future of both the profession and the Museum of History.

Eventually the collective research of the studio R.Key.Text. Ure provided a wide range of results which developed into unique graduation projects. Within the studio every student got the chance and freedom to define their graduation project pursuing their own interests and fascinations. This was their final project, their final chance to define their own assignment and vision about the future of the architect, and to create a representative project for a successful start as a professional.

‘On behalf of studio R.Key.Text.Ure we present you brief summaries of two projects in this collection[8]. Their great diversity characterizes this final studio. The first project will be presented by Sean Diederen. It has a cultural/historical focus, linking psychology and architecture in the rural scenery of South Limburg. In addition to the beautiful scenery, this area bears a horrible history of sexual child abuse by Catholic priests, a fact which convinced Sean to design a special place for these victims, an unconventional mental institution, caring for those who need it. The second project presented by Bastiaan Göttgens and his transformation of a desolate industrial area alongside the Meuse in Maastricht. Specifically, he redevelops a former factory, called “Landbouwbelang”, into a new arts school, iArts. By adding this new function this abandoned industrial area is upgraded and it creates new possibilities for Maastricht’s creative industry.’

cover “museum of national history: bidbook”
As I started my final studio I wanted to guide this project according to my own fascinations in a world of social problems by exploring a special topic. After designing a new pavilion for the Museum of National History, I was looking for a new assignment that fit with this prior research. My first choice, to design a new museum, was logical in that it was suited to the research assignment, however it was not satisfactory and therefore I continued to define my assignment. After deciding on a redevelopment project I started to explore the area where I’d grown up, looking for abandoned buildings, especially any with heritage status. As the hilly scenery of South Limburg and its wide views are quite rare for the Netherlands; I immediately felt the possibilities of creating something new that could benefit the area. Finally, after several years of doing projects throughout the world, I was able to do a project in the area I was so familiar with. While exploring parts of South Limburg known as “Mergelland”, a desolated monastery caught my attention. Surrounded by the beautiful landscape of “Cadier en Keer”, the monastery “Huize St. Joseph” carries an awful past. Five years ago many children were sexually abused by several Catholic priests. I found this extremely compelling and after reading several experiences on the Internet I decided to embrace this topic and use it to define my final assignment. I immediately began to explore the possibilities of combining child abuse within religious settings with the original idea of designing a museum, such as the Jewish Museum in Berlin, by Daniel Libeskind. Here, Libeskind found a way to translate pain and grief of Jews during the Holocaust into architecture and make it tangible for others who do not know this past. After some more research I could only conclude that it’s not yet the right time to present the grief of this horrible past to the public, but to focus instead on the people who still suffer from this quiet past and give them the collective place they need.

the catholic church and its child abuse

Child abuse within the Catholic Church is an extremely emotional topic that is increasingly in the news. Although it happened decades ago, it’s only now that we are confronted with awful past acts. Only recently have some victims started to open up and find out about how many others suffered as they did. This reopens grief from their past, but is outweighed by the possibility of being heard and perhaps even helped. The fact that people are being heard and thus acknowledged might convince other victims to open up and also come to terms with their grief.

'‘miserere nobis’

sean diederen
People process grief very personally. Some seek contact with fellow sufferers, others go through their grieving process by writing letters or books, some don’t want or are not able to talk about the past. Their mental damage is incomprehensible. Some victims have kept this horrible secret for more than 50 years, others have been victimized ‘just’ recently. Finally the time has come to open up, to be helped and acknowledged. Social acknowledgment of victims is very important. Ever since this achievement more and more people seek contact and tell their own story, unraveling the horrible acts of the past and getting assistance from a psychiatrist. Extensive analyses of current victims have proven that most victims’ grieving processes are still in an early stage and therefore will take a lot more time. For some victims full recovery may no longer even be feasible.

**the objective**

They way victims process the grief resulting from such horrible experiences varies and therefore each individual must be treated differently. Reading many victims’ stories helped me understand their situation personally, but also generally which made it possible to adjust the objective of my final assignment. At first, I had planned to design a place where victims could meet physically instead of just meeting virtually on the internet, i.e. website KLOKK.

After digging into the topic I realized I had underestimated the risks run when fellow suffers meet each other in person. Since the anonymity of the Internet gives them some protection, bringing them together in one space might lead to a negative outcome. Bringing them together might result in a situation in which victims share their stories and comfort one another, dealing with all kinds of different emotions including pain, fear and anger. It is possible that two victims who feel a lot of hate and anger might meet and have a strongly negative influence on each other resulting in more anger and hate. Thus it is not easy to categorize victims without checking each individual thoroughly.

**past reality integration = pri**

At this point understanding the different victims and the necessity of individual methods of healing, I started to look more deeply into the grieving process in order to create a place for victims to better process their grief. Architecture can affect mental health. The right space – one that involves hearing, feeling, smelling and touching – can better permit patients to ‘feel’ a treatment with their whole body.

A modern psychotherapy called ‘Past Reality Integration’ was developed twelve years ago by Drs. Ingeborg Bosch and is still highly regarded by many psychiatrists. Although its success has not been proven scientifically, many think it has proven its success in practice. PRI is a modern therapy for victims of sexual abuse at a young age by people they have trusted. It pays close attention to those hidden and denied feelings from someone’s youth that define peoples’ soul and actions when they have matured. Throughout the project I have used the principles of PRI therapy as a guideline for the grieving process.

The human mind has several natural reflexes to quickly adapt to certain situations. When incidents remind victims of pain in their past as a child, a natural defense mechanism takes over. Victims build this defense when victimized to soften the pain of the moment. This makes it possible for victims to bear the horrible experience or even suppress emotion or pain. Dr. Ingeborg’s PRI categorizes several kinds of defense mechanisms: fear, guilt (primary defense), (false) hope, (false) power and denial. Victims are unaware of any of these intuitional defense mechanisms. With PRI therapy psychiatrists try to reach victims’ self-consciousness to help them understand their own behavior in order to accept the pain of the past and eventually let it go.

**a place to process**

These five defense mechanisms, called the ‘five guards’ by specialists, and the ‘old pains’ are fundamental for my
final design. It is primarily a place to help victims with their grieving process by letting them walk a path along which are several of the grieving process guards; eventually one reaches the old pains of the past. This results in a sequence of spaces visited together with the psychiatrist. This confrontation, you can call it a test, is a path victims must walk in order to reach the old pain, re-experience it and eventually learn how to handle it by providing insight into their own situation.

The physical ‘path of guards’ is sunken in the hill of Gulpen (known locally as ‘Gulperberg’), a little town in the hilly landscape of South Limburg. The concrete path connects the isolated five guards, making it look like five separate objects steadily blending in the green environment. In order to reach the old pain located at the end of the path, victims must pass the five guards. This does not imply that each victim must enter each space, for their path depends on the primary emotions they are feeling. Although victims may suffer from several difficult emotions, one is inevitable: guilt. Every single victim encounters a deep feeling of guilt, making him or her feel as if it were their own fault they have been hurt. This guard is sunken within the ‘Gulperberg’ and placed such that everyone must enter this space of guilt. Each of the guards designs is based upon a specific emotion, one that must be ‘conquered’ by victims; eventually they should be able to control their emotions and understand their defense mechanisms more clearly. Ultimately they are being prepared to enter the last room which will remind them of the Catholic Church, confronting them with the deepest of pains.

The materials used to erect the guards and the connecting path create a huge contrast, combining on one hand the solid, strong concrete together with the soft, regional sandstone. The yellowish sandstone is a regional product that is often used by locals in their homes, mostly because of its insulating quality. Its grainy, soft texture adds a human touch to the cold concrete structures and is likely to be carved by those who make use of this space. This makes the sandstone, specifically called “Mergel”, a great metaphor for the victims’ soul, carved by past acts. The open and natural structure will be taken over by nature as the days pass. The weather will leave its mark on the concrete and the sandstone causing the solids to blend in with its rural surrounding defining the slope of Gulpen’s hill. Time will be visible on the outside of the objects as a symbol of the intense and eroded soul of everyone victimized by Catholic priests, giving them a place to leave this awful past behind and start over again.
In the second project a former factory, widely known as “Landbouwbelang” in Maastricht, is transformed to accommodate the new school of arts: “iArts”. During earlier research this location was chosen for the museum pavilion on account of its strong characteristics as an abandoned industrial building. The pavilion explicitly connected to the former factory making a clear statement about the value of this abandoned industrial terrain which has great significance in the history of Maastricht.

“Landbouwbelang” has been abandoned since 1987 and because of its deteriorated state it faced possible demolition. In 2002 artists and students squatted the building, sheltering in it a great number of cultural activities. Although squatting buildings is against national law and current activities are against local development plans, the municipality tolerated the squatters of the “Landbouwbelang”. Current activities somewhat match future plans for renovating the (inner) harbor area. The former factory is located between the head of “Maasboulevard” and the historical inner harbor making it a desirable area to exploit. Because of its past and due to its industrial appearances the area has a strong connection to an important fundamental period in Maastricht’s history as a city: 19th-century industrialization. The hoisting cranes alongside the Meuse represent Maastricht’s history as an industrialized city. The “Landbouwbelang” was given a new chance by the squatters, since their creative industry made it a well-known and beloved building in Maastricht’s underground scene. Even several art schools have occasionally made use of the building’s spaces. Due to its location and its strong character, the building has created a great potential to help resurrect this beautiful area alongside the Meuse and permit it to once again flourish.
By locating the new arts school “iArts” in the old building it will be able to use the current presence of culture and art in and around the building. Within the area known as “‘t Bassin” several other factories are defining the area’s industrial character. These factories often host conferences, exhibitions and fashion shows by art schools. Regarding the successes of these events, a timber factory is being transformed into the new ‘cultural factory’ for Maastricht.

The new school “iArts” will be the successful sequel to other redevelopment projects turning the area into a place that will unite the arts and society. iArts will teach students how to apply art to social topics. In addition to ‘technical’ training, students will also be taught how to execute their projects. By transforming the “Landbouwbelang” into an art school I deliberately use a bottom-up approach as an incentive for the area. The fact that the area has been neglected for more than 20 years permits a certain flexibility which will let students explore and develop their freedom in arts. With many possibilities in the area, students are being challenged to ‘take over’ the “Landbouwbelang” pursuing similar activities that have led to transforming other buildings in the area. Eventually the iArts’ program will facilitate education and cultural activities for students and will also address a social aspect by attracting locals and tourists to the area.

The actual design of the transformation of the “Landbouwbelang” is based on several ideas. First, it addresses a social topic on how to transform abandoned and deprived areas into a unique atmosphere. This project tries to incorporate several extant elements, for example graffiti, although at first glance they might looks like rubbish.

Second, the former factory is a great source of inspiration due to its deterioration and even challenges students to make the best of it. By leaving several parts of the building untouched it keeps traces of former users and offers students a nice ‘canvas’ to practice their arts. Third, this project brings life to the building again. The new transformation opens up the dark nature of the building’s interior, bringing light back in to serve the functional spaces. Light will enter via the main (rehearsal)spaces which are central elements in the old building as well as via the newly built spaces. These suspending volumes will illuminate the inner building. As soon as someone enters the edifice, something surprising becomes visible. An illuminated volume that seems unreachable from the ground floor. As in many elements within the building, people are being challenged whether any activity is going on in the newly added spaces. A semi-translucent façade covers the activity inside, with only rendered shadows revealing any motion, keeping the secret.

To actually find out what is going on, people have to find their way up. The vertical circulation is located at the same place that was responsible for vertical transport many decades ago, the old silos and clay-bunkers. The old vertical tunnels will lead visitors via several dark spaces toward the newly built volumes, exposing their true quality. The existing ground floor will host public activities, e.g. “iArts” exhibitions or even recreational and/or professional artists. These public functions are designed for people to visit the area more frequently in order to keep it lively.

The newly built ‘top-up’ defines a sort of internal square. This square acts as an open place for students to gather. Classrooms are randomly placed as volumes on the square with many open spaces to be taken over by other students.
This permits space for the exploration of their own interests in arts and sets them in the same location.

After hours the squares will be closed off, leaving just a north-south strip. This helps to separate the unused classrooms at night from the other spaces that are available for recreational visitors. By keeping the volumes in use during the evenings, they will illuminate the inside of the old factory. Together with any activity inside the volumes the central void will become lively with educational and cultural activities.

As the redevelopment makes a statement to the public it is given a symbol for recognition, a fingerprint. In many different cultures the fingerprint means identity, something that can be seen as unique and has a strong connection to its subject. It is so unique that it is linked to your passport and thus being used by authorities. Unique identity can also be applied to the development as an artist at the “iArts” school of art where every individual is trying to find their own way to translate everyday topics into artifacts. In this initial concept students will leave their own imprint on the redeveloped building.

We leave visible imprints, e.g., a clear fingerprint, on a glass of water and regard them despicable. Without directly cleaning the imprint we leave and thinking about the bigger picture on an urban level we must conclude that every cultural imprint is a part of the city including the houses we erect, infrastructure, etc., and even give it its specific character. Imprints make one city different from another, giving it its own identity, thus like a fingerprint. This project shows how we should handle forgotten and deteriorated buildings and work with these different imprints such as “Landbouwbelang”. This is a redevelopment that continues to build on these old imprints, without wiping them away, as human beings naturally tend to do.
The term ‘Poëtisch Ingenieurschap’ ('poetic engineering') describes the relationship between poetry and engineering, between intuition and reason, dreaming and doing. It is a nuanced design attitude that integrates knowledge of spatial quality with knowledge of construction. Applying knowledge of a variety of disciplines allows the architect more control of the expressiveness of the morphological language he or she uses. The term was used as the title for the graduation studio in which an interactive exchange took place between students in the master courses Architecture and Structural Design. This constant interaction throughout the project challenged the structural designers to formulate strong fundaments for spatial qualities using the building structure, whereas the architectural designers were inspired to make their images realizable.

The subject of the graduation studio was the theme ‘bathing’. The study ‘Baden’ (which in Dutch means ‘to bathe’ as well as ‘baths’) investigates a diversity of perspectives on the theme. It covers research on bathing cultures, sensory perception, engineering of swimming pools, sustainability and context, with a concluding chapter linking all the research together using case studies.

Some emphasis was put on the subject of sensory perception. Often architecture is communicated through images, but perception goes further than what the eye can see. It is the accumulation of the stimulation of every sense. Different acoustics can trigger different types of social behavior and certain smells can make you feel welcome or at home. Sensual perception is not always considered in the design process, though it is of crucial importance when finding your way and in your appreciation or memory of a building, for example. For an architect it is important to gain knowledge of sensual experience and consciously apply this to make spaces people can relate to.

It is difficult to investigate perception through only one sense. What you hear is immediately connected to what you see. In an attempt to objectify this complex issue, the bathhouses Therme Vals (Vals, Switzerland) and Gellert (Budapest, Hungary) were analyzed using a specific methodology. During the excursions different groups of students focused on perception with a particular sense. One group paid attention to sightlines and lighting, another group listened to the sounds of the building, another investigated the tactility of the materials, water and air, and the last of taste and smell. Afterwards these one-sided experiences were put into words and mapped using different colors signifying different intensities of sensory stimulation. In this way the perception of a building that has been documented as a continuous sequence of different sensory stimulations.

Another important topic in the study was the research on bathing cultures. In many Asian and Arabic cultures visiting a bathhouse is a self-evident part of daily life. Either for social, financial, spiritual or religious reasons people...
go to bathhouses according to their own cultural rituals. In the Netherlands there is no typical bathing culture; it is a mix of various treatments ripped from their context without any underlying proportion or ritual. This last conclusion has driven most of the students in the studio away from the standard approach to the Dutch bathhouse and inspired them to design one for a specific context. Both designs covered in this text react to the direct environment of the building sites. Maurice uses the different characteristics of the sandstone quarry in which he designed a thermal complex as the starting point for the spatial atmosphere; Mike reacts to a specific group of people with a shared interest in technology by making all the technology necessary for a swimming pool experiential.

2. islamic hamam in istanbul

3. ‘therme vals’ designed by peter zumthor
bathing in technical space
an encounter between technicians around the technology of swimming pools

mike van houtum

The age-old tradition of concealing all service elements of a building has led to a state in which even the greatest technicians are not aware of all the technology in buildings. All of them know there has to be a cable connecting the light switch to a light bulb, but that has been driven into their subconscious for that banal connection is never made visible. This graduation project investigated the quality of technical spaces in swimming pool design. At the start of the project I analyzed my fascination for the architectural qualities of blast furnaces. A few fascinating characteristics of this heavy industrial architecture include its massive scale opposed to infinite details, that although everything is one big color family no two spots are of the same color, that numerous chaotically placed linear elements are packed into recognizable forms and the expressive and tectonic way everything is connected. I turned the design process around and took the structural and servicing elements as the starting point for a new swimming pool design. The goal was not to suggest to the visitor that they should bathe in a blast furnace, but to take the spatial qualities of this type of architecture and translate them into a swimming pool in order to make the technology of bathing experienceable.

Considering the technological character of the concept, a location was sought where a high potential for visitors with a passion for technology is present. This collection of technicians can be found at the High Tech Campus in Eindhoven. This 101 hectare terrain in the south of the Netherlands houses over a hundred high-quality Research and Development companies. In 1997 a new master plan was made for the area which sought to stimulate knowledge sharing between companies. Central to this master plan is ‘The Strip’, a long chain of facilities such as canteens, a supermarket, congress rooms, a gym, etc. The swimming pool adds to this facilitating character of The Strip and is also placed centrally on the terrain (2). With a view to future development, the gym in The Strip was added to the schedule of requirements of this project.

Reacting to this specific demographic context, the technology of bathing is made more experienceable. Four components make up the basis for the elaboration of this concept:
- The baths appear as concrete tanks in the open space.
- All installations with accompanying ducts and piping are visible in that space.
- A network of footbridges makes a more extensive experience of the parts of the machine possible.
- A three-dimensional, orthogonal structure of columns and beams acts as both physical and spatial carrier of the concept.

Based on some ground rules these four elements were combined into a building in which two worlds exist. The one in between the tanks (3) accommodates the routing, where visitors are surrounded by all sorts of piping, ducts and cable gutters. You can hear the water rush through the

2. the swimming pool as seen from ‘the strip’
3. the world in between the tanks accommodates the routing of both people and servicing elements

4. inside the tanks are the baths, dressing rooms, a meditation room, and other functions
pipes, feel the air come out the ventilation ducts and see the route of the water passing through the pumps, filters and baths. The world inside the tanks (4) contains the functions like the baths, dressing rooms, an instruction room, a meditation room, a staff room, etc.

The main structure of the building is roughly made up of three components: a pile foundation, the concrete tanks and a steel structure. This steel structure is a relatively dense, three-dimensional grid of bars with hinged connections which receives its lateral stability from the concrete tanks. This stability concept has had an important influence on the spatial configuration considering the need of a tank somewhere on every horizontal and vertical gridline. The entire steel structure is built up with only one type of bar (HFRHS 100x100x10) and one type of joint, both composed from steel sections and plates welded together. In line with the concept of making the technology of bathing experienceable, the joint is turned inside out so you can see the order of assembly and becomes an accent in space (5). The bars and joints are delivered on site prefabricated and are assembled with bolts. Both parts are completely symmetrical so the chance of error during the assembly is negligible.

The conclusion is that the translation and application of a certain perception that is odd to the intended function of a building is possible after a solid analysis of that perception. The role of the piping, routing, materials, textures, detailing, etc. in the perception of a blast furnace were studied separately for their characteristics and then translated for application in designing a swimming pool. This strategy is applicable to every design process provided it is used in the right context. The ‘industrial’ pool as a public pool would not work in the center of Eindhoven, for example, due to a lack of support and interest from the community. So by reacting to the specific demographic context of a building site, a new design can have a better chance of being embedded within the local community.
In the Netherlands (industrial) areas and various sorts of buildings often fall into disuse. Our country not only possesses unoccupied offices, but also characteristic cultural heritage buildings such as churches, post offices, farms and factories that have lost their function. Inoccupation is undesirable for social reasons. It threatens livability and damages capital assets. The special identity of these disused industrial areas and heritage buildings can in some cases act as a strong driving force for their redevelopment.

This situation is applicable to the ENCI-site in Maastricht. The impressive limestone pit and nearby industrial area will be retrofitted from 2018 as public space. For instance, space for new recreational and tourist activities will be created. An innovative thermal bath with its own identity well related to the surroundings, perfectly suits this scenario and the new building could develop this extraordinary location into a fantastic spa at the border of the pit. The goal of this graduation project was the development of an innovative bathing concept that takes full advantage of the qualities of the unique context.

After years of speculation about the future of the ENCI marl pit on the Sint-Pietersberg the transformation of one of the most remarkable spots in the Netherlands will be a fact as of 2018. This impressive landscape will be released and given back to the inhabitants of the city and to the many tourists who like to visit this location to enjoy the beautiful natural surroundings, the distinctive limestone pit, the many hiking routes, the extensive recreational opportunities, the rich history, and the delicious local products cultivated on and around the hill. People come to this location for many reasons, but the various areas and recreational facilities around the quarry are not integrated into a whole and do not provide a substantial economic backbone for this area. A new feature is needed that provides contextual connection and new forms of employment. A thermal bath is the new feature that can introduce cohesion to the area. A unique thermal bath will be the link between fragmented areas and tourist facilities. The new spa and leisure resort should also provide employment and have a positive influence on the further development of the area.

The architectural concept is based on the optimal use of the contextual properties present in a specific area of the building location. There are a large number of starting points in the immediate surroundings which are processed in the building design such as the appearance, the routing

6. exterior of the “terrace bath” with an amazing view over the encl limestone quarry
and atmosphere of the marl caves. Differences in altitude, breathtaking views over the quarry and local materials (such as marl and flint) are carefully interwoven into the architectural design. By maximally incorporating the context into the building design a unique bath house is given form, one which stands apart from existing baths in the Netherlands. It certainly has a positive influence on the bathing experience too.

The new thermal bath is situated on the edge of the quarry and will evolve into an enjoyable refuge for guests. It will be a thermal bath related to the environment where bathing can be enjoyed in a refreshing and surprising way. One will find tranquility in a limestone-like environment with different special baths and bathing functions situated between massive columns. It is an extraordinary bathing landscape that expands over several terraces, one inspired by the subterranean and above-ground limestone quarries of the Sint-Pietersberg. In this “Terrace Bath” every sense will be stimulated and bathing will be a thrilling experience!

In addition to the attention paid to contextual characteristics, the poetic aspect, that is, the stimulation of the human senses, was an important part of the graduation studio and was used in the concept of this new bath house. This is accomplished by stimulating different senses on each of the various terraces. In addition to different temperatures, levels, views and variation in the intensity of daylight, there is a deliberate variety of materials, textures and colors. Also the smell, sense of touch and sight are excited by applying aromatic baths and breathtaking sights between the different bath terraces, for example. All of these intensify the bathing experience.

Another important aspect of the concept “Terrace Bath” is the use of a wandering bath course, realized by inventive positioning of the pools and baths and the application of many stairway elements. Visitors can plan a path through the different leveled platforms and encounter changing bath impressions by doing so. Finally the visitor will descend to the bottom of the building where the outdoor pool is situated. There bathers can enjoy the striking view of the rugged ENCI-quarry.

The bath house offers many bathing facilities dispersed over the different terraces. Near the entrance lies the ‘Districtoria’ (treatment room) where those hiking the Pieterpad can take a quick shower or footbath, enjoy a refreshment or have their overloaded muscles massaged. The ‘Frigidarium’ (cold bathing level) includes changing rooms, showers and restrooms. It is followed by the ‘Tepidarium’ (medium temperature level). This bathing terrace is intended to acclimatize the visitor’s temperature. By means of a foot bath and a water staircase guests have an initial interaction with the bath water.

Centrally located within the building is the sauna level, where different saunas (Finnish pouring sauna, panorama sauna, and patio sauna) and cooling down facilities (ice cave, patio bath and patio garden) are situated. On a lower level terrace of the building visitors will find the ‘Caldarium’ (warm temperature bathing level) where the big indoor pool can be enjoyed or the treatment, scent,
flower or sparkling baths can be used. Here the content and temperature of the area and thermal bathing water changes per season.

At the very bottom of the building the ‘Sudatorium’ (experience level) is situated. In the steam room you can warm up and then cool down in the outdoor pool and then enjoy the beautiful panoramic view of this extraordinary location.

This graduation project has resulted in a thermal bath design with an innovative bathing concept where bathing takes place on different leveled terraces and the senses will be maximally excited before, during and after the bath course. This design concept optimally utilizes the qualities of the local environment. By incorporating these aspects into the architectural design a comfortable and special bathing experience is given form. The building has developed its own identity and distinguishes itself from other standard spa resorts in the Netherlands. It is an innovative bath house which takes into account town planning requirements, in particular by assigning the building the role of an interconnecting center for the area. These ingredients contribute to an extraordinary bath experience. The ‘Terrace Bath’ is thus a creative and innovative example how a future bath house should look and feel.

8. view from a higher bathing platform over the lower pools and bathing landscape
How often does one come across a building that does not feel right, which has the eerie feeling of rejection clouding its presence? One of the problems designers of cities and buildings encounter is the issue of how to deal with local history and regional familiarity. What does the city’s form actually mean to the people who live there? What can the city planner do to make the city’s image more vivid and memorable to the city dweller?

To answer these questions, the graduation studio ‘Industrial Water Street’ explored the theories of Lynch, Levebvre, Certeau and others, and developed a narrative approach to spatial practices and representations of the urban landscape on their basis, widening its sense of reality to a sense of possibility. The theory became practice by implementing guidelines to further evaluate and redesign several industrial buildings along the canal in Helmond.

Sensing is the quality of perceiving, conceiving and understanding an environment. From this perspective, making sense is based on the engagement of a dialogue within the context. Design is the direct result of it. When transforming defunct industrial sites for new uses sensitivity and creativity play key roles in interpretation and intervention. Both sensing a particular historical context and projecting an appropriate intervention in it should be equally considered as deliberate actions. The former is expressed through the particular setting of the context of intervention (analysis); the latter is accomplished by fitting our design intervention into that context (synthesis). These actions bridge the gap between theory and praxis since analysis and synthesis are part of the same design activity. Thus sensing and making sense represent a further step beyond analytical skills and personal empathy.
This narrative approach to industrial heritage was adopted by the atelier for several reasons. In the first place it serves to get to know the inhabitants, who do not give in to nostalgia but convey a matter of fact historical conscience. Consequently a narrow restoration approach is avoided. Further, tracing the history of industrialization proves indispensable to understand the invisible meaning of space and its divisions in everyday life. Map the gap! Last but not least - and this is important not only for architects but for politicians, owners and inhabitants too - the stories of Helmond may be revealed in the canal and the buildings and their mutual relation. Using unique clues from local narratives may prevent the blind adoption of general trends in industrial heritage planning and the imitation of the state of the art in the reuse of factories. By positioning the canal in the heart of Helmond, as the students propose in their Master plan, its potential as collective memory, as 'lieu de mémoire', is activated. Crossing it, wandering along its quays, or lingering at a terrace, those who use this space will feel and recount the history inscribed in the section and mirrored in the water. The students' interventions are attempts to give a new, integral sense to water management in the urban landscape, taking into account water quality in relation to quays, bridges, sluices, buildings, districts, and the city as a whole. Thus, for instance, the memory of the colorful pollution by the textile industry may be recalled (every day another dye) rather than forgotten. The water is indeed a mirror: the buildings are literally reflected in the water, while it figures their stories. More than a decorative reflection pool, it will actually carry the image of the city and be a metaphor in the original Greek sense of transport – the transport of meaning and sense through words and figures. If it both connects and confronts public and private, interior and exterior, as well as city and landscape the Zuid-Willemsvaart may justly be called a ‘water street’. The old industrial artery will be busy again, serving everyday life, tempting the fancy tourist, and pleasing the musing wanderer.

K. Lynch, The image of the city

Research structure

“The environment suggests distinctions and relations, and the observer — with great adaptability and in the light of his own purposes — selects, organizes, and endows with meaning what he sees. [The environmental image is thus a two-way process.]” - Kevin Lynch

Throughout the studio’s work different theories about the narrative combined to become its backbone. We asked ourselves how do stories relate to buildings? What is a building’s noticeable history and how do we, the observers, perceive this? This investigation produced two important results. Based upon the information collected in the literature and a study trip to Italy, the studio constructed a theory on the motives and strategies to reuse industrial buildings. This theory was put together in a matrix (I), indicating the relationship between a reuse strategy and its motive. The other result was constructed from several other theories combined with the Lynch map and its information along with our own observations of Helmond. A vision (II) of how to solve Helmond’s urban problems, to wit: adding a new urban route adjacent to the water to resolve the apparent fragmentation of the city center by using the canal as a new backbone.
The challenge in reuse is that there is no one perfect solution for every project. Each building, location and client provides designers with different possibilities and motives. Nonetheless, there is a link between a possible strategy and the motivations behind it. The strategies of the possible goals and actions in reuse are arranged according to the most extreme possibilities: to renew, to refrain or to restore. The second part of the theory consisted of the possible motivations behind the strategies. These motives were arranged according to their economic, social, aesthetic or historical background. This link is the result of the theory. In this matrix, strategies and motives are set out against each other. For example the neo-19th century quarter ‘Brandevoort’ in Helmond could be described as a ‘New building with historical references’ of which the motives are of a more social nature, such as ‘populist sentiment’.

This overview is as complete as this research allows and still leaves room for additional contributions and comments. In total the matrices are useful instruments for designers interested in industrial reuse to check an idea or find inspiration.

II

By synthesizing the analysis the resulting design becomes a route which connects every part of the city center, not only by creating a passageway but also by highlighting their individual strong points. This route creates a unity, using the potential of the canal as an ordering element. The canal route tells its passenger the story of the city by referring its materiality within each different area to the adjacent atmosphere and by attracting different functional aspects related to textile and design towards this route. The concrete floor changes along the route by adding different elements for each different area. Starting from the north, the “Havenplein” with its many cafés will retain its character and connect to the plans for the new city center. Second, the quadrants around the intersection of the canal and fly-over Traverse will be joined together by emphasizing the direction of the canal. At this point the route is located on both sides of the canal. Third, the building block facing both the busy shopping street, the “Veestraat”, and the canal, will be continued underneath and on the other side of the Traverse in order to create a smoother transition towards the attractive castle area. The fourth intervention concerns the Vlisco area. This area, experienced as closed and unattractive on one hand and as historically viable on the other, will be opened up to the public. The last but perhaps most important intervention will be to move the Helmond train station towards the city centre along the canal banks. This intervention strengthens the new heart of Helmond by adding a new center of gravity at the spot where the water and the railway meet. In order for a clearer structure to be built in Helmond it is, simply put, a matter of redefining and accentuating borders while simultaneously providing easier access. We foresee that the image of Helmond as an historic place will increase together with the activities in the different city zones that will then be vividly connected by the canal route.

During the second phase of the studio individual students followed their own paths. Four students chose buildings on the factory terrain of Vlisco and made proposals for the reuse of these impressive former industrial edifices. Three of them also cooperated in formulating a master plan for the entire Vlisco area. These plans envision a future development in which the Vlisco company will require less factory space. The fifth student chose a more theoretical path and worked on a building further along the canal, the Bots building, near the city center. This research, by Myrthe Buijs, explored the idea that buildings are more than functional constructions. They provide the spaces in which people live, work and die, and are therefore inhabited by stories. Through our stories we connect to buildings. The research sought to reveal the industrial narrative and its relationship to architecture by the use of theory, analysis, experiment and design. Thus this project was a nice example of an alternative path: a different type analytic synthesis.

dérive

In the new mapping one area is regarded as a very unpleasant zone by the citizens of Helmond: the Vlisco Factory. The Vlisco factory creates exotic fabrics for the West-African market but is completely shut off from the rest of the city. The old Vlisco area has a beautiful structure and some impressive monumental buildings, a few from 1911. What could then be more exciting than discovering these old industrial buildings in a labyrinthic manner? To preserve and intensify the existing qualities of this industrial maze we designed simple, yet effective urban additions. Observer and environment need to be understood properly before new plans can be made. Often subtle references are noticed by the real experts, the people who have to do with the building on a regular basis. The main goal of our master plan was to use the present narrative to seek the full potential of the given parameters of the industrial area and use these in its transformation. It is a place where people can take a stroll while exploring the small alleys or follow the main route, giving place to the dérive idea of Guy Debord. By giving space to chance and coincidence the Vlisco area will become a place where your mind can wander off while you walk, a dried-up waterscape following the flow of time.

The additions of the Vlisco site can be divided into horizontal and vertical elements. One of the new horizontal additions was based on the structural plan of the area. A grid was created that emphasizes the two main directions in which the buildings of Vlisco are ordered. The old tiles are brown and rusty while the new ones are still clean and grey. Such a simple notion already tells a story: these old tiles were used by heavy trucks to transport their loads. These notions of passed time show the aesthetic part of decay, formulated as patina in the essay “Sleeping Beauties”, which is actively and functionally used all over the Vlisco ground. As in the so-called ‘fabric route’, a route will be created by adding prints and texture to some tiles. They will be strategically placed near buildings in which certain treatments were applied. They invite the curious spectator to wander around.

The wandering effect is strengthened by adding a vertical element: a so-called ‘route + 1’. This route is above the ground floor and it will follow the old pipes which are still visible throughout the area. The light construction and translucent material enables you to visit places you could not have explored otherwise.
The inhabitants of Helmond and other visitors are thus invited to come explore the new Vlisco area. Not only are the functions attractive enough to pay the new area a visit, but the excitement of entering the slightly opened up area also makes it worthwhile.

Because the buildings were built according to their own logic, the overall structure looks like a small urban labyrinth. This holds certain important qualities for the reference towards the previous function, but it can be used to set up a different area within the city center. It gives place to the creative sector of Helmond, using the present buildings with high ceilings and giant structures. For both reasons the decision was made to keep many of the buildings and limit our plans to one part of the reuse strategies matrix. In addition to creative ateliers, the Vlisco area holds other supportive functions matching the creative vibe. Small retailers, greeneries, creative education, a bath house and urban farming all find a place in the new Vlisco area. Three buildings were chosen for further development: the old Ketelhuis (boiler house), Building North and Building 1911. They are all strategic buildings on the site, ensuring the functionality of the new Vlisco area. Three buildings were chosen for further development: the old Ketelhuis (boiler house), Building North and Building 1911. They are all strategic buildings on the site, ensuring the functionality of the new Vlisco area. In the old Ketelhuis, water, gas and electricity were pumped through the area of Vlisco like a heart would pump blood through the body. Today the oldest parts of the building serve no true purpose anymore, but by carefully reconstructing the interior of the Ketelhuis a story was discovered. How the building works, what atmosphere it has had and what story it could tell in the future are all intermingled in Rik Verhalle’s re-design.

Water was heated in large kettles on smoldering heaps of coal. In the new Ketelhuis people will be able to bathe in these same kettles. The building will get a complete new function but does not have to be altered much. Walls will be torn down, new floors laid and a complete new equipment installed. A communal bath house makes for another chapter in the life of this building and it should be visible as well as the older stories. By adding and showing the new shiny, black, mosaic floors, the new openings in walls and floors and the new tubes and equipment the story can continue until the bath house becomes history as well and another page in the life of the Ketelhuis will be turned.

Building North and Building 1911 have a very different relation towards the Vlisco area as both buildings stand on the edge of the area. They ensure the entrance as much as the enclosure of the site. The design target set was to transform Building North from a closed and distant separating border to an open and approachable connective element. This was realized by adapting the perception of proximity from a distant to near via architectural interven-
tion. These included a transition in the experienced scale: phasing the approach by creating a transitional, teleologi-
cal pattern in openness, interior, routing and approach.
This pattern builds up towards the one point where the
enormous scale is experienced as incomplete. The differ-
ent areas within the building as well as the characteristic
building itself and the varying surrounding areas can be
experienced altogether, in strong relation with each other,
as they interconnect at this point.
The architectural interventions result in a more proximate
perception of Building North, in an approachable building
functioning as a connecting element within the building
itself as well as in its surroundings.

building 1911: decoration and mean time
One of the oldest buildings on the Vlisco terrain is a white
plastered concrete structure only used for storage, but still
in a very good state. This eye-catcher for Vlisco is named
after the year of its erection: Building 1911. It is an indus-
trial and functional building, but enriched with several
small decorative elements. The building holds a prime
spot on an urban level; it can link the newly designed
dense urban route with the more labyrinthic inner area.
A gate ensures people are attracted towards the different
world on the other end, but camouflages the area enough
to let the mass pass along.
The design is set by combining two different theories
which work together to get people more involved with this
piece of Helmond history. This is accomplished while keep-
ing Kevin Lynch’s question about what city planners can do
to make a city’s image more vivid and memorable: by not
denying a building’s narrative. Yet how does one include
this piece of history without destroying the historic and
cultural value? On one hand it is the role of decoration in
contemporary architecture. As industrial architecture can
be seen as the prime example of functionalistic Modern-
istic architecture, their buildings are almost completely
devoid of ornament. They lack a certain human touch. But
as the function shifts from industrial storage towards other
functions it is the role of decoration that holds the trans-
forming key. As the building clearly references the history
of both Helmond and Vlisco and the concrete structure has
been awarded heritage status, there is very little reason to
to completely alter the present structure. This concrete struc-
ture also holds some decorative aspects which might be
hidden to most as they concern the beautiful renovation of
the column structure. It is architectural decoration that can
bring out the strong elements of the present structure and
change certain elements without destroying them. It is the
missing piece which creates a newly formed architecture.
The other theory used is the importance of mean-time
when reusing a building. This concerns the period between
functions, when a building is being prepared for its new
role. Most of the time buildings are shut from the outside
world, hiding the transformation process and only showing
the final result. Especially in these difficult times of crisis,
more and more buildings are becoming vacant. They are
rapidly decreasing the living environment of the area
they stand in. But buildings do not have to be useless
during renovation; mean-time periods can also be used
to enhance social, cultural and economic value. By letting
people use the building to implement their own ideas the
relationship between this distant building and citizens
can be shrunk. The distant area will become vivid instead
of an enclosed hub! It can become a new, multifunctional
building for the community of Helmond, one which shows
off the potential of its location to a new owner.
The outcome of this design is an evolving building, one
that uses the idea of transforming a distant, industrial
building into a human, friendly reminder of history. The
design is about accentuating some of the building’s strong
points, such as showing the decorative elements like the columns as a communicator to new users in order to overcome certain internal trafficking problems. New elements will be added to ensure better functioning. They are mostly decorative, meshes and patterns, which refer to the previous function of the factory and create a new architecture at the same time. Building 1911 will become a place that stimulates individual ideas while dealing with the current crisis. It will be functionalistic architecture enhanced with the role of decoration. The design result is not a result of just examining the problems of a building on an urban and architectural scale. It is enhanced with the theory of narrative, the idea that buildings are part of the collective memory of a city. The theories implemented have been used to make sure that Building 1911 will become part of the collective memory of the future Helmond: a place where industrial history lives with its brothers along the canal.
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**Built Environment**

Technology for innovating building practice
information architecture

floor frings

stills from the film
The computer gives access to a vast amount of information, creates an enormous amount of applications, and makes entire new forms of representation possible. The most beautiful images and insights can come into existence by the use of the computer. Furthermore, on the basis of computer rendering and mathematical formulas spatial designs can be created. With all these possibilities I can hardly image my design process without the use of my laptop. The technological idiom brings unprecedented enrichment, but does this enrichment not bring with it a concurrent impoverishment? The omnipresence of the technological idiom rearranges the design process. Design models move into the realm of the computer. Consequently, design ideas are explored and elaborated within the pattern of computer programs. The technological revolution has changed our perspective. This change in perspective can create wonderful things or untold damage, and the tipping between the two outcomes is fragile. In architectural design the information produced by the computer process can inaugurate great things, but it can also impoverish entire parts of the spatial experience in architecture.

The computer generates a far-reaching ‘more’, but the goal of this graduate investigation is not merely looking for a ‘more’, but looking for ‘better’. The ‘more’ generated by the computer sits in the unprecedented increase of possibilities in the design process. But the question is whether this increase in possibilities leads to better architectural design. For the transfer from ‘more’ to ‘better’ in terms of architecture a serious examination of space is needed, as is an equally serious examination of the experience of space. In this regard the importance of the body emerges and the paradox becomes apparent why the ‘more’ generated by the computer does not necessarily mean ‘better’ within the field of architecture. The meaning of a space grows within and because of the body. Matters have meaning because we have a physical relation to them. The meaning of space is produced in concert with the symphony of bodily perception and the stratification of space becomes apparent. So for example, the stone interior of a church obtains its use and meaning in interaction with our body. Use arises in the corresponding observation of the stone floor, the cool air, the rhythm of the columns, and the changing of the sound of your footsteps when you move through the space. Both the visible and the invisible observations of the church interior merge together in the physical interaction and from this meaning is formed. As a result of the computer a technological complexity and immateriality rises. The physical component of the design process is getting smaller, whereas the meaning of space is produced within the interaction of space and the body.

Within the realm of the architectural design processes, I am critical of the technological idiom. I have focused my project on the technological idiom, whereas I’m inclined to think that precisely that technological idiom threatens to impoverish architectural space through its influence in the design process. I can see value in the technologically generated images and information, but I’m suspicious. The question is how the ‘bodylessness’ of the technological idiom influences the architectural design process and in the end architecture itself. In the presumption that the information generated in the technological idiom impoverishes architectural space, the graduate studio ‘Information Architecture’ was my biggest critic and formed a background which was greatly beneficial.

beleefde ruimte en architectuur
In the individual project ‘Beleefde ruimte en architectuur’, the title of the graduate studio ‘Information Architecture’, is translated into how information generated within the technological domain can be harnessed for the benefit of architecture. The project questions if and when the rational and visual structures of the technological idiom can substitute or serve bodily experience in architecture during the design process. The objective of the project and final design is a thorough contemplation of the technologically created images and information in relation to the architectural design process and subsequently relative to architecture itself. My research has focused on questions as:

Can the impoverishment and enrichment of the technologically generated images and information relative to sensed space be harnessed to form a design process beneficial to architectural space?

The research methodology is divided into two parts. The first part consists of a theoretical framework in which the impoverishment and enrichment of the technological idiom is considered. This theoretical framework is founded on the idea of the computer in light of machine intelligence as discussed in ‘What computers still can’t do: a critique of artificial reason’ by Hubert L. Dreyfus (1992). The bigger picture in which this graduate project can be seen is the problem of the interrelation between the body and thought as well as the possible consequences of this relationship for the architectural design process and furthermore for architecture itself. The second part of the research is twofold and consists of different experiments. On one hand it researches the possibilities of an enrichment of architecture affected by the technological paradigm, and on the other it investigates the danger of an impoverishment of architecture due to the influence of that same technological paradigm. The means used are film and a cardboard-installation. The third part of the project is an architectural design which gives concrete form to the conclusions of the research. First, a short description provides the theoretical framework and describes the experiments designed to identify impoverishment and
building process cardboard-installation

building process cardboard-installation
enrichment. These three parts of the research expose the main aspects of the problem addressed and provide the final design with its context and embedding.

1. the bodylessness of computer programs

‘De lichaamloosheid van computerprogramma’s is de voornaamste reden dat ze zich niet met de menselijke intelligentie kunnen meten.’

The body is more often referred to as something that gets in the way of reason and intelligence rather than as something that is necessary for it. In ‘What computers still can’t do’ Hubert L. Dreyfus describes the fundamental difference between human intelligence and machine intelligence: the body is cooperating actively in the formation of a context horizon against which the awareness of relevant information takes place. Intelligent behavior is formulated from this embodied awareness of information. Intelligence is only intelligent within the context-horizon of a body.

Intelligent use of the computer in architectural design can therefore only take place within the context of our body. It is remarkable how the paradigm – that the computer should be used to rise above human reason and intelligence – leaves a mark in contemporary architecture. The ‘scripting’ of a building seems to imply that use of a computer raises us above human reason producing a more eminent building. Yet this paradigm – the computer eventually surpassing human reason and intelligence – flattens the embodied experience of space in architecture.

The danger of the impoverishment of information lies in the infinite faith in the possibilities of technology. ‘If the paradigm of the computer becomes so dominant that humans start to see themselves as digital machines after the example of artificial intelligence, then – because machines cannot become humans – humans might increasingly become more like machines. The danger that threatens us is not super-intelligent computers, but sub-intelligent humans.’ In order not to be reduced to ‘sub-intelligent humans’ with ‘sub-intelligent architecture’ the body is crucial.

2. enrichment vs. impoverishment

On account of the embodied experience relative to the enrichment and impoverishment of the technologically generated images and information, an embodied experience of the images is indispensable. A model on a reduced scale would never quite suffice. The vacant ‘Schellens’ factory in Eindhoven is therefore used as a 1:1 model. This old textile factory was made into a research-model in which different experiments were conducted.

One of the experiments sought the enrichment, the other impoverishment. The enrichment experiment examined whether the technological idiom can prolong our body during the design process and subsequently enhance architectural space via the design process. Film is therefore used as a concrete example, with the text of film director Dziga Vertov as inspiration: ‘I’m an eye. A mechanical eye. I, the machine, show you a world the way only I can see’.

Film is part of the technological idiom and allows us to write the symphonics and embodied perception of space as separate parts and address the perception of space as a polyphonic ensemble. The enrichment of the technological idiom in a qualitative sense occurs in the possibility of technology generating a polyphony of images and information. Intelligence on space can be synthesized through the study of its individual aspects. On basis of the film-experiment in de ‘Schellensfabriek’, three architectural themes became apparent in which the technological idiom can harnessed to enhance the architectural space via the design process: 1. light and spatial quality, 2. sequence, and 3. spatial hierarchy. This takes concrete design form in the interrelation of the different parts.

In the experiment with a cardboard-installation I searched for an impending depletion of architectural space. The installation consists of 300 m2 cardboard and is made out of 1070 x 1230 mm sheets with a thickness of 3 mm. The cardboard is fixed together with 4,5 liters of wood glue and 200 meters of duct-tape was used to temporarily stabilize parts during the construction. This cardboard-installation in the empty ‘Schellensfabriek’ was used to gain insight into the aspects of architectural space that are in the danger of being lost due to the influence of the technologically generated images and information in the design process.

I solicited opinions on the spatial experience of the cardboard-installation from participants via a questionnaire. First, participants answered questions about the space without having been in it physically, but on the basis of material samples, a 3D computer model, two floor plans, one section, three renders, and three pictures of a scale model. In the second phase of the experiment participants entered the cardboard installation. Here the same set of questions as in phase 1 were posed again. This investigation did not concern itself with personal judgments, but with changes in judgment; the embodied experience was compared to the notion of that same space before having experienced it. The experiment was not conducted to discuss the extent to which the technological idiom gives a truthful representation to use as a communication tool between different disciplines in architectural engineering, nor to test the advantages of the technological idiom for communication with a commissioner, but the aim
was to achieve insight into those aspects of the spatial experience that are under threat of getting lost during the architectural design process. This research focused on the effect of the technological idiom on an architect’s ‘internal’ considerations of spatial qualities during the design process.

Building the installation turned out to be almost as its execution. The differences in participant answers between phase 1 and 2 lead to a crystallization of those things most threatened by impoverishment. But the crystallization of these spatial matters could only occur as a result of building the cardboard installation myself. The implications of the participant answers would otherwise never have been recognized.

A compilation of answers from phase 2 of the research includes the fragility of the material, the beauty of temporality and impermanence, the serene atmosphere, and the dirty footsteps symbolizing the beginning of memories. Three sorts of generalities can be distinguished in the comparison of responses from the two stages. First, the description of the space as ‘white’ or ‘sterile’ in phase 1 versus a notion of a serene atmosphere in phase 2. It is also remarkable that in the first phase the senses are separately accounted for, while the answers in phase 2 give an overall impression of the space. Finally, the role of impermanence in the notion of space in phase 2 is remarkable, as opposed to the perfection that was characteristic for the computer generated information in phase 1. For instance, one participant wrote: ‘I was shocked to see that someone left dirty shoe prints, but was quickly able to put this into perspective when I realized they were the beginning of memories.’ Another participant described the cardboard installation as ‘esoteric, the floor is pleasantly sensual. The combination of the smell and sound produced a feeling of alienation; everything is familiar, but not in that ratio and intensity. Serene, but fleeting.’ The impoverishment of architectural space as a result of the technological idiom originates in the specificity of the body in the experience of space and in the role of imperfections within the spatial experience. The affairs in the experience of a space are largely as one would expect if the characteristics of the space were told to you beforehand, but in their physical experience they are much richer in their specificity.

The technological idiom can impoverish architecture if we try to build a mere likeness of the image shown by the computer. This does not mean that technology diminishes architecture, but it implies that the innumerable insights provided by technology will only be beneficial to architecture if they are not mistaken for a final product, but as a methodology in which the sensing of space by the human body is taken into account. The perfection of the technological idiom is doomed to diminish when the architectural ideas it represents materialize. The way the imperfections occur is decisive for the experience of the space. Initially this may seem contradictory, but it’s not. Opposed to the perfection that rules within the technological idiom, the imperfections in the materialization produce a dialogue with the person in the room. In this area between perfection and imperfection the specificity of body emerges and materiality is given meaning. Proceeding from the cardboard installation, the beauty of impermanence, imperfection opposed to perfection, and the rich specificity of bodily experience relative to materialization were the starting points for the architectural design.

The quality of architectural space originates in directing the perceptions of space. This directing of perceptions takes place between the perfection of the technological idiom and the imperfection of architecture grasped in material. The details are crucial, even though they are small. Through the details the specificity of the body in the experience of space becomes noticeable. In order for the technological idiom to be beneficial for architecture the discrepancy between the body and the ‘bodylessness’ of technology is essential, however complex this relation between the technological idiom, intelligence and sensed space may be.
Symfonie – samenklinkend overeenstemmende meerstemmigheid, samenkomen tot een harmonisch geheel – muziekstuk voor een vol orkest.


Vertov, D., 1923.

Polyfonie-veelstemmigheid waarbij elk der partijen zelfstandig wordt benaderd.
towards intuitive communication with our built environment

**introduction**

Digital communication techniques enable the expression of the relation between a user and a building. This continuous relationship between the individual and, in general, his environment is what digital architecture seeks to express (Picon, 2010). This study explores the dynamic nature of the interaction between user and building by relating the user’s experience to the building’s experience. The former is investigated through psychological research or from a phenomenological point of view. The latter is investigated by mathematics and physics. Since Einstein’s special theory of relativity (Einstein, 1905) the description of both experiences has changed.

The existence of one space-time continuum influenced the modernist, who coupled the experience of space and time by emphasizing the movement of a user through space (Giedion, 1941). From this point the user is seen as a dynamic entity. In contrast, buildings are mostly regarded and designed as static entities. Their relation to time and consequently their actual use is neglected, and only a static form is designed. In dynamics form is only a snapshot and results from behavior which includes time and change. When designing behavior, it is not only about the system’s current state, but also about how it acts. The architect Heatherwick used this way of thinking when designing the Paddington Bridge. He stated: “Instead of what it is, our focus was on the way it worked.” [1]

Change is inherent to dynamics and also an important characteristic of the bit, which is the corner-stone of the digital age. Bits are easy to change and are transported with the speed of light (Negroponte, 1996). Machines use these properties in order to exchange information and accommodate contemporary architecture effortlessly (Shepheard, 2003). Buildings struggle to use these new techniques because of their opposing static, atomic and heavy nature. This physical condition is the reason for the importance of load bearing structure. Schopenhauer (1997, orig. 1818) even suggests that the dynamic interaction between support and load is the most important esthetical theme of architecture. The structure shapes the building’s spatial configuration to which the user emotionally relates. In contemporary architecture, structure as an emotional experience remains elusive; a far too abstract notion to be emotionally felt. In this paper, the user is seen as a dynamic load and the relation between user and structure is expressed. By means of a psychological and phenomenological study, I demonstrate that the user can communicate intuitively via forces. The goal of this investigation is to explore how digital communication techniques can be used to express the fundamental physical interaction with the building. A conceptual design is presented in which the dynamic nature of the interaction directly is expressed and also is incorporated in the physical shape.

**dynamic user’s experience**

Psychology and phenomenology both investigate human experience. Visual perception plays a key role in this experience (Von Meiss, 1990). The German phenomenologist Hermann Schmitz (2005) describes perception as corporeal communication. He uses the concept of the felt body with its characteristic corporeal dynamics between expansion and contraction. His concept of corporeal involvement during perception links what we see to our own body and therefore how we perceive forces in an object. If we see an inflated balloon we experience intuitively the tension of the skin which reacts to the increased air pressure because our own body is also characterized by the dynamic interaction between expansion and contraction. The German psychologist Rudolf Arnheim (1974) also studied (visual) perception. He related physical forces to mental forces in order to explain how we experience the world around us. He states that we know from our own muscle sensations how to handle forces. Thus we directly experience the forces in an object. Forces give an event visual expression and endow it with life. He clarifies this statement by analyzing movement: an object looks dead if shown as mere displacement, but comes to life if the moving object expresses the forces acting on it. The human subject is seen as an active dynamic entity that grows, moves, changes, creates and explores. Schmitz and Arnheim both explain that humans intuitively relate to forces and that perception has a dynamic character.

**dynamic building’s experience**

Buildings react to environmental forces by adapting to them. When experiencing physical forces they change their shape to withstand them. In common practice, buildings are seen as static entities because they are designed as stiff structures and barely deform. For this reason structural calculations mostly neglect accelerations and only consider equilibrium. Users are simplified to generalized loads and the way it deforms is ignored. Yet it is possible to describe the interaction with loads by using time integration. In combination with Newton’s second law (1), accelerations can be calculated that result from the forces acting on it (2).

\[ \text{Force} = \text{Mass} \cdot \text{Acceleration} \] (1)

\[ \text{Acceleration} = \frac{\text{Force}}{\text{Mass}} \] (2)

Implemented in a mass-spring system these accelerations are converted into displacements. This of course, is still a simplification of reality, but more close to real behavior than the static description.

**intuitive relationship**

What can we learn from the new digital devices we use to
communicate with our environment when designing the ‘user interface’ of a building? The iPhone 4 shows that intuitive use is very important. It uses, for example, inertial scrolling to make it appear as if something tangible shifts (Isaacson, 2011). So if you swipe over the screen, software calculates representative virtual forces which stand for the mechanical forces that result when you push an object aside. The effects of your actions are instantaneously visible and you feel as if it is you who is making the physical action. As a result, communicating with the device is possible as it responds to your actions. Normally, when interacting with a building its reaction remains imperceptible. Communication is impossible, because it presumes two active entities. As the dynamic nature of the interaction is hidden, the relation between user and building is not experienced as continuous, but separate. When forces, resulting from the interaction between user and building, are expressed the user can then notice the continuity of the relation.

adaptation to forces
In addition to direct communication during interaction, long term adjustments can show the dynamics of the interaction. Amheim (1974) states that the shapes of natural objects are the traces of the physical forces that created them. This is because of the direct adaptation that Thompson (1992) mentions along with adaptation via heredity, described by Darwin (1859). For example, bone adapts to mechanical forces and as a result it has a structure which is optimized to the forces acting upon it (Cox, et al., 1990). Trees show a similar kind of adaptation to mechanical forces (Mattheck, 1998), but with the difference that wood cells die and harden while bone stays alive and completely regenerates.

adaptation in architecture
Adaptive architecture has many faces. A subcategory is transformable structures. On a small scale buildings use doors, windows and blinds to adapt to use and environmental influences. On a large scale Calatrava (Jodidio, 2007) and Hobermann [2] have shown in practice that it is possible to fabricate large transformative structures. Research and installations show that the building’s relation with the user is under investigation. For example, the design of adaptable or dynamic facades (Suma, et al., 2007) and installations by Roosegaarde (2011). As techniques are developed and research is ongoing, it is likely that this will lead to more practical applications. The design presented in this paper focuses more at the conceptual user-related level.

conceptual design
A conceptual interactive design is made that expresses the structural dynamic behavior. Its designed behavior is twofold. A short term effect is implemented that expresses the forces in the structure and is thereby able to communicate with the user. A long term effect is designed that adapts the shape to the forces the user causes in the volume and thereby personalizes the shape. The process of adaptation to forces is investigated with particle-spring systems and is based on the adaptation of bone and trees. Both adapt to loading by reacting locally to stress differences. The structure is transformed by moving the particles from places with low stresses to places with high stresses. The algorithm can be used for every geometry and topology. The procedure is as follows:
1. Setup: geometry is created by choosing particle positions and the topology of springs.
2. Calculation: spring forces are calculated and for every particle the sum of the absolute values of the spring forces in the connected springs is calculated.
3. Adaptation: for every particle weighted displacement vectors are calculated in the direction of the connected particle with the highest absolute sum of the connected spring forces. The position of the particle is changed according to this vector. The equilibrium length of every spring is adjusted with the difference in spring length caused by the displacement vector.

Steps two and three of this procedure are executed iteratively. Figure 1 shows a two-dimensional system that is adapted with this algorithm. For this structure, 9 nodes and 20 springs are generated. The nodes in the upper left corner and in the lower left corner are fully constraint. Every iteration, constraints are taken into account by deleting the displacement vectors. A horizontal force is applied at the middle right node as represented by the pushing person. The algorithm used to investigate the adaptation process in two dimensions is written in Excel VBA and uses the structural program GSA [3] to calculate the forces by means of a static analysis.

figure 1
principle of two-dimensional long term effect. the structure adapts to internal forces that result from interacting with the user.
The short term effect is investigated in three-dimensional space, as in this case the interaction with real users is essential. The programming language Python in combination with the virtual reality development interface Vizard [4], is used for this. To calculate the internal forces that arise during interaction with the user, explicit Euler time integration is used to determine the displacements (3) (4). Next, spring forces are calculated (5).

$$\Delta \text{Velocity} = \Delta \text{Time} \cdot \text{Acceleration} \quad (3)$$

$$\Delta \text{Distance} = \text{Velocity} \cdot \Delta \text{Time} \quad (4)$$

$$\text{Spring Force} = \text{Spring Constant} \cdot (\text{Spring Length} – \text{Equilibrium Length}) \quad (5)$$

As velocities of the particles are calculated the structure does not need to be in static equilibrium. It deforms, and this deformation process can be interpreted by the user as an effect of his forces acting on it. Every time step, forces are calculated and can be expressed. The user will experience the changes over time and is possibly able to understand the dynamics. To express the intensity of the forces, color gradients in combination with swelling nodes are used as can be seen in figure 2. The former is created by coloring triangular elements that are placed in between nodes. They don’t play a structural role. As the absolute sum of the connected spring forces is calculated at the nodes, the vertex of a connected triangle is colored red by linear interpolation between a lower and upper bound (6). The color red refers to the color the human face gets when lifting heavy objects and results from blood in the upper layers of the skin. Green and Blue = $1 - \left( \frac{\text{(Absolute Sum at Node - Lower Bound)}}{\text{(Upper Bound – Lower Bound)}} \right)$ (6)

If (Green and Blue) < o: Then (Green and Blue) = 0 (7)

If (Green and Blue) > 1: Then (Green and Blue) = 1 (8)

$$\text{VertexColor} = (\text{Red} = 1, \text{Green and Blue}, \text{Green and Blue}) \quad (9)$$

The swelling nodes refer to Schmitz’ (2005) characteristic corporeal dynamics between expansion and contraction. Sturm [5] used this principle for the installation Breathing Cloud. The nodes are drawn as spheres with a size calculated by linear interpolation in a similar way as the color interpolation.

3D simulation
A Desk-Cave is used for interaction between the presented conceptual design and real users. A Desk-Cave is a Cave Automatic Virtual Environment operated from a desk. The user can sit behind the desk and is surrounded by multiple screens onto which beamers project the virtual environment (Achten, et al., 2004). A mouse is used for navigation. This environment makes it possible for the user to examine the behavior of the structure. Namely, the visual experience of a building is not characterized only by looking at an image, but by looking around and looking from different observation points (Gibson, 1979).

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In Vizard the triangular planes can be switched on or off. Figure 4 shows the structure without the triangular planes. Every iteration, the algorithm calculates the short term and long term effects. The model only serves to investigate the relation between one user and the structure. Therefore, no relaxation techniques or similar methods to undo some of the deformation are implemented. As a result of this, when used, the structure will contract and after, it will change less in regard to new forces. Cause of performance issues, the maximum and minimum length of the springs is not constraint. This also generates a more expressive long term effect as the structure has more freedom to deform. The user is given the possibility to introduce vertical forces in the volume by walking and horizontal forces by pushing. By means of a small user survey, the interaction between user and adaptive structure was investigated. The resulting geometries after four runs are shown in figure 5. From observation of the author these four participants all intuitively experienced the forces by seeing the deformations and color gradients when they pushed against nodes. When comparing the long term effects to one another, they stated to recognize the user’s characters.

conclusions

During interaction between user and building, both are active, dynamic entities. Humans intuitively communicate with their environment via forces. In combination with communication techniques this can be used to create an awareness of an individual’s influence on the environment. A user can relate deformations and color gradients to the forces he exerted. By expressing the forces in a volume a dynamic structural expressivity is seen.

discussion

Relating psychological and phenomenological research to the way a building responds, is important when designing communicative architecture. An important theme of architecture, the dynamic interaction between support and load, is used in a new way. Communication by means of forces results in that both user and building are able ‘to speak the same language’. Both short term and long term effect, separated or in combination, can be implemented in future architecture. The short term effect, the expression of forces, can be used to create a user-awareness of the dynamic interaction with the building. The continuous relationship between the individual and the building will be visible. In practice, this could be realized with strain sensors linked to LEDs. The principle of the long term effect, the adaptation to forces, can be used to adapt to real use. Like bone tissue, structures could resemble their history of use and possibly self-optimize their shape. In this way an explicit expression of time will arise. Both effects can be realized as a synergy of the physical nature of the building and its possible digital nature. In the future, bits can be directly used to express physical data and therefore enable intuitive communication with their users.

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References

parametric design and calculation of circular and elliptical tensegrity domes

michael van telgen

introduction

The principle of tensegrity provides engineers with an efficient way of realizing structures. Tensegrity was invented by artist Kenneth Snelson [1] in 1948, but it was popularized by Buckminster Fuller, who not only realized the potential for architectural applications of the tensegrity, but also came up with the term itself. Tensegrity domes provide an efficient way of achieving a roof for large open spans, which can be useful for sports stadiums or exhibition halls.

A tensegrity structure is a system that is based on only compression and tension forces and that is loaded with a pretensioning force to ensure the stability of the structure. The compression elements in the structure cannot touch each other, but the tension elements are continuous (see Figure 1).

Tensegrity domes favorably combine a low structural mass with long spans. Only a few tensegrity domes have been built, for instance in Korea and the United States [2]. It is not a widely adopted roof structure.

A possible explanation for this is that the dome is most efficient when the compression hoop of the tensegrity dome, which is positioned at the outside of the structure, is based on a circular shape. The circular shape ensures equal normal forces in all the segments of the compression hoop. This is not the case for non-circular shapes, but a shape such as an ellipse may be much more practical. However, there is not much experience on how a tensegrity roof can be designed for non-circular shapes.

figure 1: a 3-strut t-prism tensegrity. three discontinuous compression elements and nine continuous tension elements are present

figure 2: georgia dome in atlanta, georgia, united states
In order to obtain more knowledge on non-circular tensegrity domes, the problems that may exist in the design of both circular and elliptical tensegrity domes and compression hoops are investigated. The sizes of the normal forces and the bending moments are hereto explored, since these properties determine the best possible variants. The investigation is done using a variant study, so that many designs can be included. A parametric model of a tensegrity dome is made to enable the variant study.

Parametric design
Tensegrity domes are very complex structures that need to be designed accurately. In the variant study, many tensegrity domes must be included. The thesis therefore depends on the ability of quickly and accurately designing tensegrity domes. This is made possible by the use of a design technique called parametric design. Parametric design is a recent development and it is possible due to the large and readily available computing power of modern personal computers. The technique is based on algorithms which are interpreted by software. These algorithms are a mathematical representation of the design, and they are built by the designer. Variables are added to be able to make variations to the model.

The choice has been made to build a parametric tensegrity dome model in Grasshopper [3], which is a generative modeling tool for Rhinoceros 3D [4]. With the use of Grasshopper, it is possible to make algorithms that can be programmed in a graphic, user friendly environment. To eliminate input error and to speed up the analysis process, the parametric model is linked directly to Oasys GSA [5]. This makes it possible to quickly perform structural analyses of the chosen layouts. The coupling of Grasshopper and Oasys GSA is performed by Smart Structural Interpreter [6]. This plug-in for Grasshopper sends structural data to Oasys GSA and returns the results to Grasshopper. The relations between the different applications can be seen in Figure 3.

The parametric model of the tensegrity dome incorporates a large number of variables which determine the layout of the design. By making variations in the layout, the different variants can be modeled and analyzed. The parametric model of the tensegrity dome is programmed to check the normative elements using structural unity checks for strength and stability using the analysis results. The results of the analysis are immediately displayed within Grasshopper to be able to judge the quality of the tensegrity dome. Usually, a number of iterations are needed to find the optimal design of a chosen layout.

Methodology for tensegrity domes
To find out what constitutes a well performing tensegrity dome, a methodology is set up, based on case-studies and trials in the parametric model. Initially, only tensegrity domes without the compression hoop are considered in order to be able to focus on the tensegrity itself. A number of different elements can be found in the tensegrity (see Figure 4). These are:

- a. Top cables (tension), b. Diagonal cables (tension), c. Struts (compression), d. Tension hoop cables (tension)

A number of possible geometrical and topological variations are outlined and incorporated. Small geometric variations are changes to the angles and lengths in the plane across the tensegrity dome. For instance, the angles of the top cable can be changed to make convex and concave shapes (see Figure 5).

![figure 3: relations between the applications](image)

![figure 4: planar section of a tensegrity dome. red indicates the cables in tension. blue indicates the struts in compression](image)

![figure 5: different possible angles for top cables result in different shapes. from top to bottom: concave, straight and convex shape](image)
A Change in span length is a large geometric variation. Changes in topology are also possible. These are changes in the total number of top cables or the number of tension hoops. The shape of the boundary can be changed when a non-circular shape is desired. Two different structural concepts, the Geiger tensegrity dome principle and the Fuller tensegrity dome principle (see Figure 6) are also included.

![figure 6: left: geiger tensegrity dome principle. right: fuller tensegrity dome principle](image)

Pretensioning can be applied by displacing the pinned supports outwards. Since this causes strain in the cables and struts, a pretension normal force is then applied to the dome. Different live and dead load combinations were applied to determine the normative axial forces in the elements and the nodal displacements. Other structural requirements include a maximum allowable deformation and a minimally needed pretension force. The mass of the tensegrity dome, as well as the needed amount of pretension decide the viability of the design. For different tensegrity dome variations, different masses and pretension forces are found, since the sections are chosen based on the occurring normal forces.

**results for tensegrity domes**

The stiffness of a tensegrity dome is largely influenced by the geometry of the dome. With regard to the geometric variations, it is found that the angles of the top cable influence the mass the most. This is the result of the more favorable angles for decomposing the occurring forces in the cables and struts. Choosing good top cable span lengths is especially important for Fuller domes. Strut lengths should be long enough to provide good angles for the top cable and diagonal, but should not be so long that they become sensitive to buckling. A topological variation such as increasing the total number of top cables barely influences the mass of the tensegrity dome. This is caused by a more evenly spread load on the dome, resulting in smaller cables and struts. The two structural principles that are investigated behave in a distinct manner. Fuller tensegrity domes are generally stiffer structures than Geiger tensegrity domes. Tensegrity dome performance is highly dependent on the chosen geometry. An elliptical tensegrity dome is found to be viable, but a circular tensegrity dome with an identical surface area performs better. The elliptical and circular tensegrity domes show similar effects when changing the geometry of the dome. The distribution of axial forces in the tensegrity is non-uniform in an elliptical tensegrity dome (Figure 7), and since the sections are based on the normative axial force, some over-dimensioning is present.

![figure 7: axial forces in an elliptical tensegrity dome with compression hoop. a symmetrical load is applied. the compression hoop is also displayed](image)

**methodology for tensegrity domes with compression hoop**

A methodology is also made for designing and calculating the tensegrity dome, including the compression hoop. The dome is pretensioned by copying the pretension normal forces in the tensegrity dome without the compression hoop as an initial load. The needed sectional properties for the compression hoop are found by simplifying the triangular truss section (see Figure 8) to a rectangular section based on the principle of equivalent stiffness, and by doing iterative unity checks using different section sizes. Buckling is initially included by choosing a safe, but realistic buckling length for the compression hoop. After finding the sectional dimensions for the truss, the model is verified in Oasys GSA using modal buckling analyses.

![figure 8: cross section of the triangular hoop truss with maximum dimensions](image)
**results for tensegrity domes with compression hoop**

The compression hoop adds a high amount of mass to the total structure. The mass of the compression hoop is about twice the mass of the tensegrity. The mass of the compression hoop is determined by the pretension force needed for the tensegrity. It is also found that buckling in the compression hoop is never an issue in the design process, since the buckling length is usually equal to the segment length of the compression hoop (see Figure 9).

**conclusions and recommendations**

The distribution of the normal forces and the mass depend on the chosen geometry. Steel mass can be saved by choosing good angles and element lengths for the occurring loads. Straight or slightly convex top cables are preferred. Circular tensegrity dome shapes perform better than elliptical shapes. An improvement to the methodology can be made by enabling sectional choices for the different compression hoop segments, as well as including sectional choices for the different tensegrity dome elements. Other non-circular shapes can also be investigated. The project goals are achieved. Using parametric modeling proved to be essential.

**references**

Tube structures have been widely used for tall buildings due to their efficiency in resisting lateral and vertical loads simultaneously. Many architects appreciate the aesthetics of tall buildings whose structure is visible in their facade. This paper investigates the structural stiffness properties of a variant of the award winning and highly efficient diagrid, the ‘hexagrid’.

The stiffness properties of a grid structure are translated into stiffness modification factors, which strongly simplify stiffness-based preliminary hand calculations of the horizontal displacement at the top of the structure. In order to calculate the stiffness modification factors of an infinite grid, the structure is split up into smaller pieces called ‘unit cells’. The similarity between the results of the proposed method and a finite element analysis is very acceptable, especially for slender structures. However, hexagrids can be used as a structural system, but diagrids and trihexagonal grids have superior mechanical properties compared to hexagrids.

1 introduction

In addition to the very common structural systems for lateral loads, such as concrete cores, shear walls and rigid orthogonal frames, there are other options to ensure structural stability and stiffness. Variants on standard orthogonal structures, such as the Swiss Re Headquarters in London (diagrid), the Hearst Tower in New York (diagrid), and the John Hancock Center in Chicago (mega-trussed frame), clearly show their distinguished structural stability system in the building facades, see Figure 1.

When the slenderness of a structure increases, the structural design becomes governed by the lateral stiffness of the structure. This paper focuses on the stiffness properties of the hexagrid and is therefore best applicable to slender structures.

A hexagrid is a variant of the diagrid, which has a triangular configuration of diagonal columns and horizontal beams. A hexagrid is a hexagonal frame built up out of beam-like elements with rigid connections between the elements. The lateral stiffness properties of a hexagrid have not yet received enough attention. A combination of the hexagonal and triangular grid, a trihexagonal grid, is also examined (see Figure 2). All grid structures in this paper carry gravity loads as well as lateral forces.

A distinction has been made between ‘horizontal’ grids comprised of only diagonal and horizontal elements, and ‘vertical’ grids comprised of only diagonal and vertical elements. The absence of vertical elements in the horizontal grids make them aesthetically more interesting than the vertical grids. This paper focuses on ‘horizontal’ hexagonal grids. The mechanical properties of various grid structures have already been examined in other fields of research, in two
and three dimensions. Two-dimensional, cellular materials with a periodic microstructure are called honeycombs. The two-dimensional honeycombs are often used as cores in lightweight structural sandwich panels, or in energy absorbing devices. Three-dimensional grid structures occur in foams.

The geometric properties of the cellular honeycombs are translated into effective stiffnesses of a corresponding solid material. The effective axial and shear stiffnesses of the cellular honeycomb material are calculated for triangular, square, and hexagonal cells with an arbitrary cell wall angle in (Gibson & Ashby, 1997), using Timoshenko’s beam theory (Timoshenko & Gere, 1961).

The set of different cells is expanded with mixed (square cell with an additional diagonal), trihexagonal, diamond and rectangular cells in (Wang & McDowell, 2004). Here, only regular grids are examined. The ‘beams’ of the cellular solids in both references are solid and slender. Hexagonal honeycombs are dominated by bending of the cell walls. Axial and shear deformations are excluded from the effective stiffnesses. The honeycombs built up with triangular cells, including the mixed, trihexagonal, and diamond cells, are dominated by cell wall stretching. All formulae in both (Gibson & Ashby, 1997) and (Wang & McDowell, 2004) are valid for infinite grids.

In this paper, linear-elastic deformations are assumed when determining the formulae of the effective axial stiffness and the effective shear stiffness of hexagonal grids and the elements are expanded with shear and axial deformations. After this, the application of these formulae is verified for a finite tubular grid structure.

2 In-plane mechanical properties of hexagrid unit cells
In this paper, the main purpose of the structural analysis structures is to compare them with a corresponding solid (see Figure 3). A corresponding solid in this case is a solid with the same total width, \( W \), height, \( H \), and depth, \( b \), as the grid-like structure.

The effective elastic bending stiffness of a grid structure ‘\( EI_{grid, effective} \)’ is comprised of an axial stiffness modification factor multiplied by the bending stiffness of a corresponding solid:

\[
EI_{grid, effective} = \frac{E_s}{E_t} \cdot E_b \cdot I_z
\]

(1)

The effective elastic racking shear stiffness of a grid structure ‘\( GA_{grid, effective} \)’ is comprised of a shear stiffness modification factor multiplied by the racking shear stiffness of a corresponding solid:

\[
GA_{grid, effective} = \frac{G_s}{G_t} \cdot G_a \cdot A_y
\]

(2)

These modification factors can be seen as additional material properties of corresponding solids that take the geometry of the grid into account. For tall buildings, the grid structure can be modelled as a solid with dimensions \( W, H, b \), effective bending stiffness and effective racking shear stiffness. Uniform deformation can be achieved for these structures (Connor, 2003). The effective elastic bending stiffness and the racking shear stiffness can be combined with standard formulae used for beam elements with a solid section to find the horizontal deflection of a structure.

2.1 Stiffness Modification Factors
To make it simpler, the grids are split up into smaller pieces. These pieces are called ‘unit cells’, see Figure 4. The Unit cells include all geometric parameters of the grid.
In order to calculate the axial stiffness modification factor, hinges are modelled at half the length of the diagonal and horizontal elements. Here, the bending moments are equal to zero (see Figure 6). The dashed rectangle represents the unit cell, the smaller hatched one corresponds to the mechanical model in Figure 8. The behaviour of the uniaxial stresses translated into concentrated loads acting on diagonal elements in the mechanical model of the unit cell can be seen in Figure 8:

The uniaxial strain of the unit cell is caused by bending, axial, and shear deformations of the elements inside the unit cell. The stress divided by the strain is the effective stiffness of the unit cell. The effective stiffness of the unit cell is divided by the stiffness of the used material to obtain a ‘stiffness modification factor’ of the grid. When slender elements are used, bending deformations are normative; axial and shear deformations of the elements are ignored.

2.1.2 shear stiffness modification factor
The shear stress acting on the unit cell in Figure 9 are translated to a concentrated load acting on the upper diagonal element in the mechanical model of the unit cell in Figure 10.

The shear strain of the unit cell is caused by bending, axial, and shear deformations of the elements inside the unit cell. The mechanical model is statically indeterminate. Castigliano’s second theorem is used to calculate the shear displacement $\delta_n$ at the location and in the direction of the force $F$.

3 parameter analysis
A parameter analysis can be performed for each individual parameter in the unit cell. The most important parameter in this paper is the angle of the diagonals, since the formulae of the stiffness modification factors are plotted with an alternate angle of the diagonals. The width of the unit cell and the length of the horizontal elements are kept constant (see Figure 11). The relative density decreases when the angle of the diagonal increases. The horizontal and diagonal elements have equal lengths in case of the regular grid with $\theta=60^\circ$. The length of the diagonals increases along with the angle of the diagonals. The use of unit cells with $\theta<15^\circ$ and $\theta>75^\circ$ is debatable.

The graphs of formulae of the modification factors in this paragraph are only valid for grids with slender elements. When axial and shear deformations of the elements are included in case of stocky elements, the graphs depend on the used sections of the elements and on the geometry of the grid. The axial stiffness modification factor is plotted for slender elements in Figure 12.

The shear stiffness modification factor is plotted for slender elements in Figure 13.
4 Verification Tubular Grid Structures

The stiffness modification factors are valid for an infinite grid. When the method of this paper is applied to a finite structure, some discrepancies occur between the simplified hand calculations and the response of the structure in a finite element analysis (FEA). A series of structures is calculated, once with the use of a finite element analysis and once 'by hand' with the obtained stiffness modification factors.

4.1 Input

Three different widths of rectangular tubular regular hexagrid structures have been chosen in compliance with an architectural scale. The geometric parameters can be found in Table 1. The height of the unit cell is equal to the story Height, which was chosen to be 4 m. The height starts with 5 unit cells in the vertical direction (NV=5) and increases with a step size of 5.

<table>
<thead>
<tr>
<th>Table 1. Geometric parameters for verification study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of diagonals; ( \theta )</td>
</tr>
<tr>
<td>Number of stories per hexagon</td>
</tr>
<tr>
<td>Height of unit cell; ( \text{UH} )</td>
</tr>
<tr>
<td>Width of unit cell; ( \text{UW} )</td>
</tr>
<tr>
<td>Length of elements; ( h-d )</td>
</tr>
<tr>
<td>Number of unit cells in vertical direction; ( NV )</td>
</tr>
<tr>
<td>Building Height; ( BH )</td>
</tr>
<tr>
<td>Number of unit cells in horizontal direction; ( NH )</td>
</tr>
<tr>
<td>Building Width; ( BW )</td>
</tr>
</tbody>
</table>

4.2 Output

The results of the finite element analysis and the hand calculations are shown in Figure 14. The displacements obtained with ANSYS are divided by the results of the hand calculations, see Figure 14. The relative slenderness \( \lambda \) is plotted on the horizontal axis.

The results converge to around 99% for slender tube structures.

4.3 Discrepancies

In Figure 14, the hand calculation behaves more stiffly than the FEA. When the slenderness of the tube structure increases, the results show more similarity. Here, the FEA is stiffer than the hand calculation. This makes it likely that the discrepancy is caused by the shear deformation. The discrepancy diffuses for extreme slender structures. Three causes are summarized in this paragraph:
1) The assumptions for the shear correction factor for the preliminary hand calculations only take the walls parallel to the wind direction into account; no shear correction factor is applied.
2) The lateral restraints at the bottom of the structures in the FEA make lateral contraction and/or extension impossible, resulting in smaller overall displacements.
3) Influences of shear-lag are not taken into account in the hand calculations.

5 Conclusions

The proposed method of the paper can be used to determine preliminary section sizes and accompanying horizontal displacements. The discrepancy between the hand calculations and a finite element analysis is dependent on the slenderness of the structures; the ratio converges from about 90% for stocky structures to almost 100% for very slender structures.

Slender hexagrid structures benefit from a relatively high angle of the diagonals. The optimum angle of the diagonals decreases along with the slenderness ratio of the structure. The optimal angle and accompanying optimal sections are dependent on the slenderness of the structure.

The axial stiffness modification factor of a horizontal hexagrid is dependent on the sections of the diagonal elements and on the geometry of the grid. The shear stiffness modification factor is dependent on both diagonal and horizontal sections.

A hexagrid is less stiff than a diagrid and a trihexagonal grid. It is hard to make a fair comparison between the bending dominated hexagrid and the stretching dominated diagrid and trihexagonal grid. Acceptable horizontal displacements of hexagrid structures can be obtained when using relatively stocky elements.

References

building performance simulation to assess building energy regulation

a case study for residential buildings in brazil

Arjan van der Knaap

Summary
Many countries around the world are introducing building energy regulations to increase energy efficiency in the built environment. But for effective regulation it is important to use an appropriate performance indicator that represents energy consumption and also an appropriate method to assess this indicator. Brazil recently implemented a building energy regulation for commercial and residential buildings. This regulation provides an energy label, which assesses the energy efficiency by using a simplified method. This research assesses the ability of this simplified method of the Brazilian regulation to represent energy efficiency of residential buildings. The assessment consists of comparing its results with results from building performance simulations in terms of (1) energy labels, (2) performance indicators and (3) sensitivity to parameters. The assessment consists of three steps. The first is creating samples, which takes variations in 23 input parameters into account. The second is simulating these samples parallel with the simplified method and building performance simulations. The last step is performing statistical analyses of the results from both methods and compare them. This research indicates that the simplified method underestimates energy efficiency of natural ventilated residential buildings and overestimates energy efficiency of air-conditioned residential buildings. The latter is a result of underestimating energy consumption for air-conditioning, due to taking a limited amount of input parameters into account. Therefore, the energy efficiency of air-conditioned residential buildings could be less in reality than the energy label indicates. This may lead to ineffective building energy regulations due to a lack of credibility of the label by not achieving real energy savings.

Introduction
In terms of implementing building energy regulations, Brazil is the leading country in Latin-America [1]. In 2009, Brazil introduced a voluntary label system for commercial buildings and in 2010, for residential buildings. This is a result of the Energy Conservation Act, implemented after a major electricity crisis in 2001 [2, 3]. This crisis was caused by fast rising energy consumption, due to increasing living standards and increasing connections of households to the power grid [4].

The energy efficiency of residential buildings in Brazil is indicated by means of an energy label, which ranges from A (high efficient) to E (low efficient). The method for this label is described in the Standard for Energy Efficiency in Residential Buildings (RTQ-R). It determines the label with a ratio between the efficiency of the thermal envelope (65-95%) and the domestic hot water system (5-35%). The efficiency of the thermal envelope is based on the performance indicators that represent the indoor climate. Thus, in case of a natural ventilated building, the performance indicators are the number of degree hours overheating and the annual energy consumption for heating. In case of an air-conditioned building, the indicators are the annual energy consumption for cooling and for heating. These indicators can be determined by a simplified method consisting of linear equations as prescribed in the RTQ-R [5]. However, in order to reduce energy consumption effectively by implementing building energy regulations it is important to use an appropriate performance indicator and an appropriate method to assess the indicator. An appropriate indicator has the following properties: (1) it indicates a quantitative amount of energy per year, (2) it includes basic elements of energy consumption, (3) it is expressed in primary energy demand and (4) it limits the total energy demand, from renewable and non-renewable sources [6, 7]. Important issues for an appropriate method for assessment are: accuracy, scope, reproducibility, complexity, sensitivity to energy parameters and user skills. These aspects should be considered carefully, because they have a great impact on success of the regulation [8].
Nevertheless, the success of a building energy regulation depends mostly on its impact, in terms of: (1) the ability to obtain better labels cost effectively, (2) the credibility achieved by real energy savings and (3) the degree of commitment to environmental problems of stakeholders in the building sector [7].

**methods**

This research assessed the simplified method of the Brazilian building energy regulation on its ability to represent energy efficiency of residential buildings. This assessment consists of comparing the results of this simplified method and the advanced building performance simulations. The comparison consisted of results for (1) energy labels, (2) performance indicators and (3) sensitivity to parameters. This research is based on three types of detached houses and twenty apartments and took variations in 23 input parameters into account. In total, this research created, simulated and analysed 13,800 samples. Figure 1 shows an overview of the process in which these samples were created, simulated and analysed.

The creation of the samples started with a typical design for detached houses and apartments in Brazil. Both types were modelled in with the simplified method and in EnergyPlus, which is advanced building performance simulation software. This became the baseline scenario because all properties for the 23 varying input parameters were similar. Based on this baseline scenario, the 13,800 samples were created using the Latin Hypercube Sampling method [9]. This method is able to create samples that takes the variations in input parameters into account based on their probability to occur in Brazilian residential buildings. Due to a division between air-conditioned and natural ventilated buildings in the simplified method, an equal number of samples was created for both types. After creating the samples, they were simulated parallel with the simplified method and in EnergyPlus. Both methods were used to determine the three performance indicators that represent the indoor climate and form the basis for the energy label. These indicators are (1) the number of degree hours overheating, (2) the annual energy consumption for heating and (3) the annual energy consumption for cooling.

The results of the performance indicators are used to assess the ability of the simplified method to represent energy efficiency. First, the performance indicators were combined to determine the energy label for each sample. This makes it possible to compare the frequency of energy labels per label category. Second, the ranges and distributions of the performance indicators were determined by using the statistics of their results. This makes it possible for the assessment to correctly represent the performance indicators.

Finally, a sensitivity analysis is performed to assess whether input parameters are taken into account properly. Sensitivity analyses lead to insight in the influence of input parameters on the results for the performance indicators. This analysis consists of expressing the correlation between changes in the input parameter and in the performance indicator. This research used the Spearman correlation coefficient, due to its ability to express single and higher order correlation between the input and output [9]. Afterwards, the results from these sensitivity analyses from both methods are compared to assess the simplified method.

![Figure 2. Overview of research process.](image-url)
results and discussion
The assessment of the simplified method covers (1) the representation of energy efficiency with energy labels, (2) the role of the performance indicators, in figure 3 and 4, and (3) the sensitivity to variations in input parameters in figure 5 and 6.

The results from figure 3 indicate that the simplified method underestimates labels for natural ventilated residential buildings compared to building performance simulations. This is a result of the simplified method overestimating the number of degree hours of overheating. The result of residential buildings having underestimated labels is that in reality overheating will be lower than expected. This is favourable for the residents and contributes to the credibility of the label by society. However, taking measures to improve the label are likely to be less cost-effective, because the potential for saving energy is lower [7].

The results from figure 4 indicate that the simplified method determines a high number of similar labels for air-conditioned residential buildings compared to building performance simulations. This is caused by the narrow range in the energy consumption for cooling, determined by the simplified method. The high number of similar labels results in an overestimation of the actual energy consumption in residential buildings. This is a threat for the successful implementation of the building energy regulation, due to a lack of credibility in society if higher energy consumption occurs. The effect of energy saving measures is also not likely to improve the label with the simplified method. Therefore, increasing the representation of the simplified method will improve the credibility of the label in the eyes of the residents and further the incentive to improve the label, which will both contribute to a more successful implementation of building energy regulation in Brazil [7].

The results of the sensitivity to input parameters in figure 5 indicates that the solar absorbance and thermal capacity are important parameters in the simplified method. Building performance simulations indicate that solar absorbance is an important parameter, but that thermal capacity is less important. Therefore, increasing or decreasing the thermal capacity will improve the label in the simplified method, but is not likely to improve the energy efficiency of residential buildings. This shows the need for reconsideration of how to take thermal capacity into account in the simplified method.

The results of the sensitivity analyses in figure 6 indicate that the set point for cooling is an important parameter. Therefore, taking the set points into account in the simplified method would improve its representation, but this is complicated due to the influence of residents on the set points. However, including a threshold value for nominal capacity of the HVAC-system per square meter of conditioned area is a possibility for increasing the representation of cooling. The nominal capacity depends on design indoor and outdoor temperatures and thus on the set point.
Combining this threshold value with the COP of the HVAC-system should thus be considered, since this is another important parameter.

**Conclusions**

This research assessed the ability of the simplified method to determine energy efficiency labels that represent energy efficiency of residential buildings in Brazil. Based on the results of the assessment of the simplified method, this research concludes that:

- The simplified method underestimates the energy efficiency of natural ventilated residential buildings, due to overestimation of the performance indicators for overheating and heating.
- The simplified method overestimates the energy efficiency of air-conditioned residential buildings, due to limited representation of energy consumption for cooling.
- The set point for cooling is an important parameter for determining the annual energy consumption for cooling.
- The simplified method is correctly sensitive to solar absorbance of the thermal envelope, but incorrectly sensitive to the thermal capacity of residential buildings.

**References**

climate change and heat stress in residential buildings

Anika Haak

Introduction

Our climate is changing and this results, amongst other things, in a rise in temperature in the Netherlands (Klein Tank & Lenderink, 2009). The magnitude of this rise in temperature is uncertain and therefore, the KNMI created four weather scenarios based on the change of two parameters; air temperature and atmospheric circulation patterns. The predicted influence of these four weather scenarios on the average air temperatures in the summer period in the Netherlands, is shown in figure 1: Climate scenarios for the Netherlands (Klein Tank & Lenderink, 2009).

Although it is uncertain what the exact rise in temperature will be in the future, it is known that a rise in temperature can have significant effects on the human body. Research of Beniston (2004) showed that the summer of 2003 was the warmest summer since 1540 in the whole of Europe. During this summer, more deaths occurred that were caused by heat (Robine et al., 2007). High temperatures during a heat wave, however, do not only affect death rates; they also have an effect on the functioning of the human body. High temperatures in the direct environment of a person have a negative influence on the sleeping behavior of that person (Daanen et al., 2010). When people cannot sleep well during the night, this also reduces the alertness and the cognitive functioning during the day.

Changing and adapting buildings to the predicted increase in temperatures could be a solution to protect people against heat, because people spend 80 – 90% of their time indoors (Boerstra et al, 2005). Dwellings in the Netherlands are typically not very well protected against climate change, mostly because in this type of building it is not common to have an air-conditioning system (Kempen, 2000).

Dwellings can be adapted to the predicted future climate change by applying climate adaptation measures to this dwelling. In this research, these climate adaptation measures are passive, which means that this measure does not use energy once it is applied. The aim of this research is to investigate what the potential of the different passive climate adaptation measures is, applied to dwellings in a future climate. This results in the following research question:

What are the effects of different passive climate adaptation measures, applied to a typical Dutch dwelling?

Method

The method that is used to answer the research question starts with placing a typical Dutch dwelling in a future climate. This situation is simulated with use of building energy simulation and the results, which are obtained by these simulations, are evaluated by a performance indicator. This process is repeated when applying the six different passive climate adaptation measures to the dwelling. The properties of all these parameters will be described in the following paragraphs.

Typical Dutch Dwelling

In this research a dwelling has been used which, ideally, represents a typical Dutch dwelling. Agentschap NL (an organization of the Dutch government) created six dwelling typologies, which are based on the requirements for dwellings in 2006 and function as guidance for newly built dwellings (Senternovem, 2006). The terraced house represents the largest part (36.5%) of the dwelling constructions in the Netherlands. Therefore, this is the type of dwelling that is used in this research.

The terraced house is also provided with certain insulation levels (Rc-value). These values are relatively high and represent dwelling properties for newly built dwellings. This means that this dwelling does not represent older dwellings. Therefore, three other dwelling types are also used, which provide an indication of older dwellings, with respect to the Rc-values of the walls and roof. The properties that belong to these dwelling types are summarized in (table 1: Properties dwelling types).

<table>
<thead>
<tr>
<th>Type of dwelling</th>
<th>Description</th>
<th>Rc-value [m²K/W]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Walls</td>
</tr>
<tr>
<td>Type 1</td>
<td>Reference dwelling</td>
<td>0.435</td>
</tr>
<tr>
<td></td>
<td>built before 1974</td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>Reference dwelling</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>1974 - 1991</td>
<td></td>
</tr>
<tr>
<td>Type 3</td>
<td>Reference dwelling</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>1992 - 2011</td>
<td></td>
</tr>
<tr>
<td>Type 4</td>
<td>Reference dwelling</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>built after 2011</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Table 1: Properties dwelling types
climate data
To create a simulation model, climate data is needed. For this research, climate data is needed that represents the future climate. Given the complexity and uncertainty in the future climate projections and lack of high-resolution data, it is decided in this study to use historical weather data of the summer of 2003 (May - September). Research of Scott et al. (2004) shows that the summer of 2003 is predicted to become an average summer in the 2040s. The biggest advantage of using these data is that they have certain accuracy, due to the fact that this summer actually took place.

building energy simulation programs
Two building energy simulation programs are used in this research; ESP-r and EnergyPlus. Building energy simulation is used to make a prediction in the design stage of the performance of a building. This type of simulation allows users to understand the interrelation between design and performance parameters, to identify potential problem areas and so implement and test appropriate design modifications (Clarke, 2001).

performance indicator
In this research, a climate proof dwelling is assumed to be a dwelling in which people feel thermally comfortable in a future climate. The performance indicator, which is used in this research, needs to express how thermally comfortable the dwelling is. Peeters et al. (2009) created the adjusted adaptive temperature limit, which provides boundaries for the thermal comfort in residential buildings. The boundaries for two residential functions (living room and bedroom) are used in this research to describe the requirements for the thermal comfort in the dwelling types. Figure 2 shows these boundaries for the living room and bedroom. The vertical axis shows the operative indoor temperature which is defined as “the temperature of a uniform environment with radiant black enclosure that transfers dry heat by radiation and convection at the same rate as in the actual environment” (ASHRAE, 2003). The horizontal axis shows the running mean outdoor temperature which is defined as the weighted average of the outdoor temperature of the preceding days (ASHRAE, 2003).

Every dot shown in Figure 2 represents an hour with the associated operative temperature and the running mean outdoor temperature. The dots, shown for boundary ‘living room’, indicate the hours between 06:00 and 23:00 and the dots, shown for boundary ‘bedroom’, are the hours between 23:00 and 06:00. Every dot that lies above the boundary, is counted as an overheating hour. The total amount of overheating hours, which is used in this research to present the results, is the sum of the hours above the boundary for the living room and the hours above the boundary for the bedroom.

measures
Six different passive climate adaptation measures are applied to the different dwelling typologies. Every measure has a value that is the maximum value that would be used in practice (feasible value for practice). The feasible values for practice of all the measures will be compared to one another and these results will provide a ranking of the performance of the measures. A short description of these measures is given in the following sub-paragraphs.
increasing amount of insulation

The first measure that is applied to the dwelling is the increase of the amount of insulation in the walls and roof. By increasing the amount of insulation, the heat flux through the construction will be decreased. This reduces the amount of overheating hours in the dwelling, which increases the indoor thermal comfort. The amount of insulation will be increased from 3.0 m²K/W (walls) and 3.0 m²K/W (roof) to a value of 5.1 m²K/W.

increasing thermal mass

The thermal mass of a construction can store energy (heat) when this construction is cooler than its direct environment and it can release this heat when the direct environment is cooler than the construction (Balaras, 1996). By increasing the thermal mass of a construction, temperature fluctuations during the day can be reduced (Al-Sanae et al., 2012). This might result in a higher indoor thermal comfort. In this research, the amount of thermal mass is doubled in the internal and external construction of the walls.

increasing the albedo value

The definition of the term albedo is: reflectance to solar radiation of the ground or the earth and/or its atmosphere (Iqbal, 1983). When reducing the reflectance of the outer surfaces of a building, less heat is absorbed into the dwelling. The effect of this process is that the heat flow through the building envelope is reduced, which results in lower indoor temperatures and an increase in thermal comfort. The albedo value will be increased from 0.3 (external surfaces wall) and 0.33 (external surface roof) to a value of 0.8.

implementing an overhang

The basic idea of an overhang above windows is that the sun is blocked from entering a building through the windows. Due to this blocking of the sun, less solar energy will enter a building. Therefore, the temperatures in this building will be reduced compared to a situation without solar shading. An overhang is not present in the base case dwelling. The overhang that is applied above every vertical window in the dwelling has a depth of 2 meters.

opening of windows

When people do not feel comfortable, they will react and try to change a factor that will restore their comfort again (Humphreys & Nicol, 1998). One factor that can easily be changed by people to control the indoor comfort is the opening of the windows (Rijal et al., 2007). This control device is easy to use and the effect can be immediately noticeable. By applying this measure to the dwelling, the windows are opened when the indoor air temperature reaches 24 °C. The windows in the base case dwelling cannot be opened.

implementing a vegetated roof

By implementing a vegetated roof, the heat flow through the roof can be reduced. There are three effects on the heat flux through a roof caused by a vegetated roof. The first effect is that the albedo value of the roof changes. The second effect is the extra insulation layer that is provided by the soil that is used for the vegetation. The third and most important effect that causes lower indoor temperatures is the process of evapotranspiration (Tabares-Velasco & Srebric, 2011). This process is caused by the vegetation that is planted in the growing medium. Evapotranspiration is a combined term which is extracted from evaporation and transpiration. The evaporation is caused by the soil, which evaporates water that has been gathered. The evaporation extracts heat from the surrounding air and therefore reduces the temperatures in the surrounding environment (Tabares-Velasco & Srebric, 2011). In the base case situation, no vegetated roof is present. When applying this measure, a leaf area index of 5 is used.
results
Figure 9 shows an overview of the results obtained by this research. The different figures show the percentage of reduction in overheating hours relative to the overheating hours present in the different types of dwellings (vertical axis): reference dwelling built before 1974 (Type 1), reference dwelling 1974 – 1991 (Type 2), reference dwelling 1992 – 2011 (Type 3) and reference dwelling built after 2011 (Type 4). The horizontal axis shows the passive climate adaptive measures in the following order: ‘Increasing amount of insulation’, ‘Increasing thermal mass’, ‘Increasing the albedo value’, ‘Implementing an overhang’, ‘Opening of windows’ and ‘Implementing a vegetated roof’. The length of the bar shows the range between the results of the two simulation programs and the dwelling oriented to four different directions.

conclusions
Figure 9 shows the effect that the different measures have with regard to the reduction in overheating hours. Dwelling types 1 (reference dwelling type built before 1974), 2 (reference dwelling type 1974 – 1991) and 3 (reference dwelling type 1992 – 2011) represent older dwellings which might need reconstruction. When reconstructing, it depends on the dwelling types which measures could be best applied to obtain the largest reduction in overheating hours. Dwelling type 1 shows the measure ‘albedo’ the largest reduction in overheating hours, while the measure ‘thermal mass’ shows the smallest reduction in overheating hours. The measure ‘opening of windows’ shows the largest reduction in overheating hours applied on dwelling type 2. The smallest reduction in overheating hours for this dwelling type can be obtained by applying the measure ‘thermal mass’. For dwelling type 3, the largest reduction can be obtained by applying the measure ‘overhang’ or ‘opening windows’. This depends on the orientation of the dwelling. When constructing a new dwelling (type 4), the largest reduction can be obtained by applying the measure ‘overhang’ or ‘opening windows’, depending on the orientation of the dwelling.

references
introduction
Nowadays mobility is a major problem. This is caused by many factors, e.g. city planning strategies like zoning and separation of functions. These factors have created a large demand for mobility. Furthermore, our society is changing. The digital era provides an unprecedented level of communication and an abundance of knowledge. The influence of technology has never been so evident. These developments take place in an extraordinary pace. Our society is nowhere without technology. Individualisation is one of the drawbacks of this development. The basic functions -working, living, recreation, and infrastructure- are inevitably influenced by the technological developments. The traditional office no longer meets the requirements of today. Work is changing more and more from labour work into knowledge work, transforming our society in an information or knowledge based society. Offices have become much more than just a space for administrative activities. This project is all about exploring the boundaries of the physical space. It is about the change of the way we use our spatial environment. A growing influence of the virtual world is inevitable. The Internet, smartphones and the virtual world have left a strong footprint on the ‘real’ world. The main research question is shaped around these developments. How can technology be used to exploit the capabilities of future space? Or, what can technology do for the building environment and architecture? What is the role of technology in creating a better living/working environment?

A lot of critics consider the technological developments to be a threat to human society. According to them, all the social aspects would disappear and would cause a retreat of the individual from society. Globalisation and individualisation are results of this technological revolution. Do we need to keep holding on to the past? Or should we focus on the possibilities of the future? I am a person who is fascinated by these technological developments, especially the endless possibilities they provide. Every innovation brings its own qualities. Take Siri, for instance, on the new iPhone. Siri is a voice driven personal assistant who can take over a lot of tasks, like converting currencies, sched-
uling appointments, sending messages, helping find your way and more. This relatively simple device shows a glimpse of the possibilities of the future. I think we do not need to be afraid of change but instead we need to embrace it and try to exploit the possible options. It is astonishing to watch the earth through the eyes of the Dutch astronaut André Kuipers in real time. I immediately wondered: What would the world look like in 20 years?

It is hard to visualise the consequences of the impact of technology in the future. Especially since the specific connection between the physical and the virtual world is kind of vague. The strong rise of the virtual world is causing a devaluation of the physical world. The challenge for future space is to make these two worlds into one. The addition of this virtual world could provide an endless source of knowledge. To create such a thing we need a new design approach based on the options of the virtual world.

Already in the late 90s, Paul Virilio emphasised in The Overexposed City that technology was changing the world drastically. The city was no longer bound to physical boundaries but it would be shaped by the systems of technology. The screen will become the new centre of the world. The overall connection between everything and everybody is causing the nullification of distance. ‘The near and far cease to exist.’ You can listen to an old concert of Miles Davis on YouTube while walking on Broadway via Google Streetview and meanwhile shopping for a new book on Amazon. As Virilio once quoted; “If architectonics once measured itself according to geology, according to the tectonics of natural reliefs, with pyramids, towers and other neo-gothic tricks, today it measures itself according to state-of-the-art technologies, whose vertiginous prowess exiles all of us from the terrestrial horizon.”

A big part of technology is heavily influenced by the Internet and even more recently by the rise of social media. These virtual connections have created an urge or desire to be connected to the system. Everyone wants to be connected, everywhere at any time. A connection with the outer world will mean a disconnection with the real world. Reality will be replaced by simulated reality. By merging these two worlds, this strange paradox will no longer apply.

The internet is swamped with information which was invisible for years. A gigantic network of knowledge has evolved between all kinds of things and persons. This virtual information layer is called information space.
Smartphones make these layers visible and accessible for the rest of the world.

The most mentioned negative consequence of individualisation and globalisation is the loss of face-to-face contact. People tend to isolate themselves. This is called cocooning.

People will never lose sight of strong personal contact, because we are social beings by nature. A lot of (the new) contacts will become more shallow but the most important contacts will intensify. Distance will not be the decisive boundary of contact. These developments are critical for the evolution of mankind, because stagnation means decline. The digital revolution has started and there is no way back, that is a fact. I strongly believe in the positive possibilities of technology.

**purpose**
The purpose of this study is to find new ways to create a better living environment by merging the two most important primary functions (living and working). This project gives an overview of possible future changes of our society which should enhance our understanding of future space. Summarising some of the important findings: the division of knowledge work in front and back offices, task-oriented work, the fusion of space and function, new approaches to knowledge/data, and an improved communication between objects/spaces such as “the Internet of Things”. Some research projects show creative ideas and possibilities, for example Seats2Meet, The New Way of Working, the F-Room, and Adaptive Space. The design of this study will combine the best aspects of these aforementioned research projects into a new building concept.

**result**
Technology always had a big impact on the way we used space in the past. The living room had a central function supported by the radio and the television. Every room in a ‘normal’ residence is designed for its own specific function. The link between space and function was very clear.

Nowadays it looks like these strict boundaries are starting to fade. Technology comes with a lot of flexibility and functions can therefore be taken from one space to the other. I call this the fusion of space and function. The well-known phrase in architecture, ‘form follows function’, will suddenly get a new meaning. A convertible function will need a convertible space.

**shared space**
The target groups -the knowledge worker, including an increasing number of freelancers- will be placed strategically next to each other in order to join forces. This creates the possibility of sharing three important aspects: space, knowledge, and technology. Interweaving plays an important role in this design concept and is thus the basis for the design. The interweaving takes place on different levels: between living/working, private/public, and physical/virtual. The appearance of the building is inspired by this main theme. The most important part of the building consists of the shared space which is within the spine or the aorta of the building. This symbolises the infinite continuous flow of knowledge. The urge to connect with the virtual world is enormous and therefore all functions are directly connected to it. By intertwining functions, multi-
functional spaces are created. These spaces could serve as flexible workplaces or as an extension of the living room. Because technology influences space more and more, it will eventually define space. Future spaces will then no longer be designed for a specific function, but constantly adapt to a certain function. The flexible workplaces in this concept are an example of such a continuously adaptable space. As soon as the private space is not in use, it will be returned to the common courtyard, in order to provide extra space for the development of knowledge and social interaction. As a result, the redundant space will be used for a different purpose. This will create a dynamic interaction between private and public space while providing an internal courtyard of high intensity knowledge sharing and interaction. The interactions between physical spaces happen in real time and are linked by technology and virtual space. By exchanging these spaces in a specific way, space can be interpreted differently. A pull and push system will merely give the impression of space pressed or pulled away. The desired gesture of such as system should ideally be that of an embracing movement. Embracing space creates a gentle gesture.

**Conclusion**

The main spatial change which will occur is the fusion of spaces. Spaces are no longer labelled as something intended for a single-sided function. In the future, spaces will be more flexible and overlapping in function. The role of technology in the spaces of the future is increasingly important.

A link between the physical world and the virtual world will be a great addition to our society and will contribute to a new perception of space. A combination between the new living/working environment and the interface with technology or virtual world eventually led to a unique design. This design gives a preview of how future space can be used intelligently and efficiently. The specific way to use space multifunctionally by connecting it with the virtual world is unique.

To answer the main question: How can technology be used to exploit the capabilities of future space?

The designer needs to be aware of the important value of virtual space. Spaces will become more exchangeable and will need to adapt to changeable functions. The combination of physical and virtual space provides an intelligent and efficient environment with endless possibilities.
<table>
<thead>
<tr>
<th>navigation articles</th>
</tr>
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<tbody>
<tr>
<td><strong>beeldvorming 1: feeling for form</strong></td>
</tr>
<tr>
<td>jan slothouber (1977)</td>
</tr>
<tr>
<td><strong>beeldvorming 2: comprehension of form</strong></td>
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<tr>
<td>jan slothouber (1977)</td>
</tr>
<tr>
<td><strong>graduates 2011-2012</strong></td>
</tr>
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</table>

**ANNEX**
In the spring of 1981 the TH Eindhoven publication ‘colour imagination – a colour system’ by Jan Slothouber appeared. It is the only English publication of his work. Remarkably the Dutch word ‘vormleer’ (‘Formlehre’ in German) is translated as ‘morphology’. This term may help to understand his 1977 texts better. It indicates that a linguistic meaning of morphology is at the heart of his notion of ‘comprehension of form’: the study and description of patterns, concerning the patterns of word formation in a particular language, including inflection, derivation, and composition. Slothouber is, indeed, very much concerned with patterns in this part of his teaching approach. In the ‘feeling for form’ part of his theory the use of the term morphology in biology is at stake: dealing with the form and structure of organisms, considering the form and structure of an organism as a whole. One could say the term ‘morphology’ tells us how Slothouber applied the term in linguistics and in biology as a conceptual approach to design. Thus two meanings of the term ‘morphology’ offer a perfect key to re-read the texts ‘feeling for form’ and ‘comprehension of form’ re-printed here with an English translation of the text. Slothouber’s approach evidences an attitude Colin Rowe defined as “the alternative and predominant tradition of modernity”, one that “always made virtue of irony, obliquity and multiple reference” (Collage City, 1978, p. 138).
FEELING FOR FORM
1.0 morphology

Course 7.070.0

0 perception of surrounding forms

- perception of form
  1 feeling for form
  2 comprehension of form
  3 use of form

g.j. slothouber
1 VORMGEVOEL
2 VORMBEGRIJF
3 VORMGEBRUIK

G.J.SLOTHOUBER

TECHNISCHE HOGESCHOOL EINDHOVEN
AFDELING BOUWKUNDE
GRACE VORMLEER
VOORLORIGE UITGAVE
JULI 77
surrounding forms are perceptible for us when we experience them instinctively
we then perceive forms of individual objects
we then imagine forms of local conditions
we then experience forms of successive events

perceiving surrounding forms is the intuitive experiencing of their differences
we assimilate forms of recognizable elements in our surroundings
their contrast is why we experience their difference intuitively
our suggestion concerns that contrast and is the perception of this difference

imagining surrounding forms is the intuitive experience of their coherence
we sense forms of perceptible patterns in our surroundings
their combination is why we experience their coherence intuitively
our view concerns that combination and is the representation of that coherence

discovering forms in our surroundings is the intuitive experience of their change
we are submerged in forms of perceptible processes in our surroundings
their variation is why we experience their development intuitively
our feeling concerns that variation and is the discovery of that development
GEVOELSMATIGE VORMBELEVEN

OMGEVINGSVORMEN ZIJN MERKBaar VOOR ONS ALS WE ZE GEVOELSMATIG BELEVEN
VORMEN VAN AFRONDENDE VOORWERPEN NEMEN WE DAN WAAAR
VORMEN VAN PLAATSelijke TOESTANDEN STELLEN WE ONS DAN VOOR
VORMEN VAN OPEENVOLGENDE GEBEURTENiZENN EERVARGEN WE DAN

HET WAARNEMEN VAN OMGEVINGSVORMEN IS HET GEVOELSMATIG BELEVEN VAN HUN VERSCHILLEN
VORMEN VAN MERKBare OMGEVINGS ELEMENTEN NEMEN WE IN ONS OP
HUN KONTRAST IS VOOR ONS DE AANLEIDING TOT HET GEVOELSMATIG BELEVEN VAN HUN VERSCHIL
ONZET INDRUK BETER N DAT KONTRAST EN IS DE WAARNEMING VAN DAT VERSCHIL

HET ZIJN VOORSTELLEN VAN OMGEVINGSVORMEN IS HET GEVOELSMATIG BELEVEN VAN HUN VERBANDEN
VORMEN VAN MERKBare OMGEVINGSPATRONEN WORDEN WE GENUAR
HUN KOMBIATIE IS VOOR ONS DE AANLEIDING TOT HET GEVOELSMATIG BELEVEN VAN HUN VERBAND
ONS BEELD BETER N DE KOMBIATIE EN IS DE VOORSTELLING VAN DAT VERBAND

HET EERVARGEN VAN OMGEVINGSVORMEN IS HET GEVOELSMATIG BELEVEN VAN HUN VERANDERINGEN
VORMEN VAN MERKBare OMGEVINGSPROCESSEN ONDERGAAN WE
HUN VARIATIE IS VOOR ONS DE AANLEIDING TOT HET GEVOELSMATIG BELEVEN VAN HUN VERLOOP
ONS GEVOEL BETREFT DAT VARIATIE EN IS DE EERVARING VAN DAT VERLOOP

JAN ELOTHOUWER

SEPTEMBER 76
1.0 perception of surrounding forms

1. form is something individual
   form has autonomy

2. form is finite
   form has a background

3. form is closed
   form has contour

4. form is composite
   form has parts

5. form is objective
   form exists outside of us

6. form is subjective
   we give form meaning

7. form is characteristic
   form has qualities

8. form is significant
   form has a reason

9. feeling for form
   feeling for matter
   feeling for space
   feeling for time

10. feeling for matter
    perception of difference as
        a form of emergence

11. feeling for space
    representation of coherence as
        a form of proportion

12. feeling for time
    experiencing development as
        a form of change

form definitions from gestalt psychology *
1.0 MERKBAREHEID VAN ONGEWIJSTE VORMEN

1 VORM IS JETS AFZONDERLIJK:
VORM HEeft ZELFSTANDIGHEID

2 VORM IS BEGREPEN:
VORM HEeft ACHTERGROND

3 VORM IS GESLOTEN:
VORM HEeft OMTREK

4 VORM IS SAMENGESTEELD:
VORM HEeft DELEN

5 VORM IS OBJEKTIEF:
VORM BESTAAT BUITEN ONS

6 VORM IS SUBJECTIEF:
VORM BETEKEND IETS DOOR ONS

7 VORM IS KARAKTERISTIEK:
VORM HEeft EIGENSCHAPPEN

8 VORM IS ZINVL:
VORM HEeft EEN REDEN

9 STOFGEVOEL
STOFGEVOEL
RUIMTEGEVOEL
TIJDGEVOEL

10 STOFGEVOEL
WAARHEID VAN VERSEL ALS VERSCHIL ALS VERSCHIJNINGSVORM

11 RUIMTEGEVOEL
VOORSTELLING VAN VERBIND ALS VERHoudingsvorm

12 TIJDGEVOEL
ERVARING VAN VERLOOP ALS VERANDERINGSVORM

VORMDEFINITIES UIT DE GESTALTPSYCHOLOGIE

vormleer | beeldvorming
1.1 perceptibility of the elements

Forms of surroundings and norms of perception

- weight
- color
- balance
- sound
- sight
- texture
- smell
- hearing
- touch
- smell
- taste
- smaak

past    now    future

past    now    future

(de appel)
(DE APPEL)
<table>
<thead>
<tr>
<th>1.2 conceivable forms of patterns</th>
<th>4 visible patterns</th>
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<td>2 slide</td>
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<td>positive</td>
<td>positive</td>
</tr>
<tr>
<td>real</td>
<td>real</td>
</tr>
<tr>
<td>granular</td>
<td>grid</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td>3 slide</td>
<td>4 slide</td>
</tr>
<tr>
<td>negative</td>
<td>negative</td>
</tr>
<tr>
<td>real</td>
<td>real</td>
</tr>
<tr>
<td>granular</td>
<td>grid</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>5 slide</td>
<td>6 slide</td>
</tr>
<tr>
<td>positive</td>
<td>positive</td>
</tr>
<tr>
<td>mirrored</td>
<td>mirrored</td>
</tr>
<tr>
<td>granular</td>
<td>grid</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7 slide</td>
<td>8 slide</td>
</tr>
<tr>
<td>negative</td>
<td>negative</td>
</tr>
<tr>
<td>mirrored</td>
<td>mirrored</td>
</tr>
<tr>
<td>granular</td>
<td>grid</td>
</tr>
<tr>
<td></td>
<td>Experiencability of forms of process</td>
</tr>
<tr>
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</tr>
<tr>
<td>1</td>
<td>Experience of changes in one’s surroundings</td>
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<td>Events in one’s surroundings and perceptions of experience</td>
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<td>Experience of changes in one’s surroundings</td>
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<td>View from a train compartment</td>
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<tr>
<td>3</td>
<td>Experience of changes in one’s surroundings</td>
</tr>
<tr>
<td></td>
<td>Demolition of church towers</td>
</tr>
<tr>
<td>4</td>
<td>Experience of seasonal changes</td>
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<td></td>
<td>Demolition of church towers</td>
</tr>
<tr>
<td>5</td>
<td>Experience of changes in light</td>
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<td>Day and night</td>
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<tr>
<td>6</td>
<td>Changes in one’s surroundings and changes from a distance</td>
</tr>
<tr>
<td></td>
<td>(Ruscha[15]: Dutch details)</td>
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</tbody>
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1.3 ERVARBAARHEID VAN PROCESVORMEN

1. OPMERKING VAN OMEGINGSVERANDERING
   OMEGINGSBEWAREND EN BELEVENISDIAGRAM

2. OPMERKING VAN OMEGINGSVERANDERING
   UITZICHT TEN TEN ZUID-ZUID

3. OPMERKING VAN OMEGINGSVERANDERING
   KARAKTERBEWAARD

4. OPMERKING VAN SEIZOENSWAPENING
   1. LEUGE
   2. ZOMER
   3. HERFST
   4. WINTER

5. OPMERKING VAN LICHTVERANDERING
   DAG EN MACHTE

6. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

7. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

8. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

9. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

10. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)

11. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)

12. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)

4. ZICHTBAAR PFCESSEN

7. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

8. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

9. OPMERKING VAN LICHTVERANDERING
   VERANDERING VAN KUURSTAND
   (RUSCH: NORDIC DETAILS)

10. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)

11. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)

12. OPMERKING VAN LICHTVERANDERING
    VERANDERING VAN KUURSTAND
    (RUSCH: NORDIC DETAILS)
COMPREHENSION OF FORM
2.0 morphology

recognizability of surrounding forms

Course 7.070.0

- perception of form
  1 feeling for form
  2 comprehension of form
  3 use of form

G.J. Slothouber
2.0 BEELDVORMING

0 HERKENNABILITEIT VAN OMGEVINGSVORMEN

1 VORMBELEYING

2 VORMBEGRIP

3 VORMGEBRUIK

KOLLEGE 7.070.0

G.J. SLOTHOUBER

TECHNISCH HOGESCHOOL EINDHOVEN AFDeling Bouwkunde GROEP VORMLEER VOORLICHE UITGAVE JULI 77
notional perception of form

surrounding forms are recognizable when we have learned to perceive them notionally we then have learned to differentiate forms of individual objects we then have learned to ascertain forms of local conditions we then have learned to explain forms of successive events

the discernment of surrounding forms is the notional perception of their differences we have learned to remember forms of identifiable elements in our surroundings their quality is the origin of the notional perception of their difference our knowledge concerns those qualities and is the distinction of that difference

the determination of forms in our surroundings is the notional perception of their coherence we have learned to see through forms of identifiable patterns in our surroundings their structure is the origin of the notional perception of their coherence our insight concerns the structure and determines that coherence

explanations of forms in our surroundings is the notional perception of their changes we have learned to contemplate forms of identifiable processes in our surroundings their system is the origin of the notional perception of their progress comprehension concerns that system and is the explanation of that progress

Jan Slothouber

september 1976
2.0 HERKENBAARHEID VAN OMEGVINGSVORMEN

BEGRIJSMATIGE VORMBELEVING

OMGEVINGSVORMEN ZIJN HERKENBAAR VOOR ONS ALS WE ZE BEGRIJSMATIG HEBBEN LEREN BELEVEN
VORMEN VAN AFZONDERLIJKE VOORWERPJES HEBBEN WE DAN LEEREN ONDERSCHEIDEN
VORMEN VAN PLAATSELIJKE TOESTANDEN HEBBEN WE DAN LEREN ONDERKennen
VORMEN VAN OPEENVOLGENDE GEBEURTENISSEN HEBBEN WE DAN LEEREN ONDERKennen

HET ONDERSCHEIDEN VAN OMEGVINGSVORMEN IS HET BEGRIJSMATIG BELEVEN VAN HUN VERSCHILLEN
VORMEN VAN HERKENBAAR OMEGVINGSELEMENTEN HEBBEN WE LEREN ONDERSCHEIDEN
HUN SOORT IS VOOR ONS DE OORDRAN VAN HET BEGRIJSMATIG BELEVEN VAN HUN VERSCHIL
ONE KENNIS BETREFT DE SOORT EN IS DE ONDERSCHEIDING VAN HAT VERSCHIL

HET BEPALEN VAN OMEGVINGSVORMEN IS HET BEGRIJSMATIG BELEVEN VAN HUN VERBINDEN
VORMEN VAN HERKENBAAR OMEGVINGSPATRONEN HEBBEN WE LEREN ONDERSCHEIDEN
HUN STRUCTUUR IS VOOR ONS DE OORDRAN VAN HET BEGRIJSMATIG BELEVEN VAN HUN VERBIND
ONE KENNIS BETREFT DE STRUCTUUR EN IS DE ONDERSCHEIDING VAN HAT VERBIND

HET VERANDEREN VAN OMEGVINGSVORMEN IS HET BEGRIJSMATIG BELEVEN VAN HUN VERANDERINGEN
VORMEN VAN HERKENBAAR OMEGVINGSPROCESJES HEBBEN WE LEREN ONDERKENEN
HUN SYSTEMIS IS VOOR ONS DE OORDRAN VAN HET BEGRIJSMATIG BELEVEN VAN HAT VERLOP
HET BEGRIJS BETREFT HAT SYSTEMIS EN IS DE VERKLARING VAN HAT VERLOP
2.0 Identifiability of forms of process

1. Atomic forms
   1. Hydrogen
   2. Lithium
   3. Sodium

2. Molecular forms
   1. Sodium chloride
   2. Calcium chloride
   3. Zinc sulfide
   4. Diamond

3. Crystalline forms
   1. Pyrite fluorite
   2. Anatase rutile
   3. Apatite quartz
   4. Brookite anhydrite
   5. Adularia titanite
   6. Albite axinite

4. Forms of crystallization
   Growth patterns of body diagonals

5. Forms of crystallization
   Growth patterns of body surfaces

6. Forms of crystallization
   Growth patterns of body ribs

7. Fruit formation
   1. Lime
   2. Sycamore
   3. Maple
   4. Birch

8. Leaf forms
   1. Lime
   2. Sycamore
   3. Maple
   4. Birch

9. Tree forms
   1. Lime
   2. Sycamore
   3. Maple
   4. Birch

10. Skull forms
    1. Fish
    2. Bird
    3. Mammal
    4. Human

11. Skeletal forms
    1. Perch
    2. Falcon
    3. Horse
    4. Human

12. Forms of evolution (Thompson)
    1. Fossil form
    2. Later form
    3. Current form
    4. Future form
2.1 discernibility of element forms

<table>
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<tr>
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2.1 ONDERZOEK 1 | BEELDVORMING 2

1. MATERIALISOORT
   THYMOL

2. MATERIALISOORT
   AMETHIST

3. MATERIALISOORT
   BATANT

4. MATERIALISOORT
   ZEEP

5. PLANTENISOORT
   LILIODENDRON

6. DIERISOORT
   RADIGLARIUM

7. DIERISOORT
   DIEPSEEORGANISME

8. DIERISOORT
   WESP
### 2.2 Determinability of pattern forms

<table>
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<td>7</td>
<td>Regular three-dimensional quadrangle with 60° angles</td>
</tr>
<tr>
<td>2</td>
<td>Ellipse polygons</td>
<td>8</td>
<td>Regular three-dimensional hexagon with 90° angles</td>
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<tr>
<td>3</td>
<td>Sectioned arc triangles</td>
<td>9</td>
<td>Regular three-dimensional hexagon with 60° angles</td>
</tr>
<tr>
<td>4</td>
<td>Complex arc triangles</td>
<td>10</td>
<td>Regular three-dimensional hexagon with 108° angles</td>
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<tr>
<td>5</td>
<td>Arc formed circle division</td>
<td>11</td>
<td>Regular three-dimensional decagon with 60° angles</td>
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<tr>
<td>6</td>
<td>Arc formed surface division</td>
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<td>Regular three-dimensional decagon with 108° angles</td>
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### Polygonal patterns

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<td>Arc formed circle division</td>
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<tr>
<td>6</td>
<td>Arc formed surface division</td>
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</table>
1. Division of surface patterns in elements
   - Transsection of a torus and corresponding spheres and cylinders in three orthogonal directions

2. Mixture of elements in other combinations
   - Exchange of elements with similarities peripheral measurements and curves

3. Connection of combinations in other patterns
   - Cubic single surface

4. As above

5. As above

6. As above

7. Division of a body pattern into elements
   - Transsection of a cube with a quadrilateral ruled surface in three orthogonal directions produces two kinds of elements

8. Mixture of elements in other combinations
   - The partial combinations provided here can be assembled into other patterns

9. Quarter-cylindrical transection of a cube
   - Cubic trihedron with three remaining patterns

10. Bisection and regrouping
    - From a dihedra to a single surface

11. Bisection and regrouping
    - 1+2 of a trihedron to a dihedra
    - 3+4 of a dihedra to a single surface

12. Bisection and regrouping
    - Of a tetrahedron to a dihedra
2.3 VERKLAARBAARHEID VAN PROCESVORMEN

4 VERDELING VAN OPTIPELMENTEN IN ELEMEENEN
   DOORSNIJING VAN EEN TUBUS EN CORRELATIE VAN RUIMTE ONS HUURRUMMEN IN DRIE ORTHOGONALE RICHTINGEN

8 VERVANGING VAN ELEMENTEN IN ANDERE KOMBINATIES
   UITWISSELING VAN ELEMENTEN MET OVERBLIJVERSTIGE KROMMEHYPERINGEN EN KROMMINGEN

9 KOMBINATIEBOUWDOORSNURING VAN EEN KUBUS
   KUBISCH DEELPLAK MET 3 RESTPATRONEN

12 HALVERING EN HERGROPERING
   VAN VIERFLAK NAAR TWEEFLAK

7 VERDELING VAN EEN LICHAMENFOUT IN ELEMEENEN
   DOORSNIJING VAN EEN KUBUS MET EEN VERRENGEREENYM
   IN DRIE ORTHOGONALE RICHTINGEN GEeft TWEE GOORTE ELEMENTEN

3 VERBREDING VAN KOMBINATIES IN ANDERE PATRONEN
   KUBISCH EENFLAK

11 HALVERING EN HERGROPERING
   1+2 VAN DRIEFLAK NAAR TWEEFLAK
   3+4 VAN TWEEFLAK NAAR EENFLAK

4 IDEM

10 HALVERING EN HERGROPERING
   VAN TWEEFLAK NAAR EENFLAK

5 IDEM

1 IDEM
graduates 2011-2012

architectural urban design and engineering

Aerts Robin Architecture
Bangma Remco Architecture
Beelen Hugo Architecture
Berg van den Bart Architecture
Beursgens Roel Architecture
Boxem Robert Architecture
Brans Tim Architecture Cum Laude
Buijs Myrthe Architecture Cum Laude
Bunningen van Bart Architecture
Burón Klose Xaviera Architecture
Buteijn Yuri Architecture Cum Laude
Chan Denny Architecture
Chênevert Milou Architecture
Chermin Bram Architecture
Claus Kevin Architecture Cum Laude
Coolen Floris Architecture
Coolen Inge Architecture
Coumans Serge Architecture
Demirel Merle Architecture
Derks Rob Architecture
Dijk van Bart Architecture
Donselaar van Willemijn Architecture / Structural Design
Elzen van den Rik Architecture
Évers Jeroen Architecture / Structural Design
Filippini Geert Architecture
Fringes Floor Architecture Cum Laude
Fuhr René Architecture
Geelen Dominique Architecture
Gerritsen Thomas Architecture
Gevens Mattijs Architecture
Gootzen Eveline Architecture / Structural Design
Grinten van der Tim Architecture
Groeneveld Niels Architecture Cum Laude
Haarink Henk Jan Architecture
Ham van der Matthijs Architecture
Hartman Ilse Architecture
Hazeleger Boukje Architecture
Hermens Faye Architecture
Holst van der Sander Architecture
Holweg Sem Architecture
Hooff van Viktor Architecture
Hoope ten Dave Architecture
Houben Maurice Architecture
Houtum van Mike Architecture / Structural Design
Hurk van den Hendrik Architecture
Jong de Erik Architecture
Jong de Mark Architecture
Jonkman Ilse Architecture
Kampen van Raymond Architecture
Keulards Mikel Architecture
Kevork Katia Architecture
Kool de David Architecture / Urban Design and Planning
Köpp Frank Architecture / Urban Design and Planning
Kortekaas Peter Architecture
Kramer Bellefleur Architecture Cum Laude
Lammers Harm Architecture
Lavrijsen Teun Architecture
Leeuw van der Eric Architecture
Lenders Sander Architecture
Maas Rikje Architecture
Magré Jort Architecture
Maier Tim Architecture
Martens Loes Architecture / Urban Design and Planning Cum Laude
Merks Leroy Architecture
Metgod Teun Architecture
Mohammadzadeh Sarab Marjan Architecture
Mourik van Arjan Architecture
Nijssen Eefje Architecture
Oostrum van Thijs Architecture
Peters Jacqueline Architecture
Peters Robbert Architecture Cum Laude
Piethaan Milou Architecture Cum Laude
Pijffers Eric Architecture
Pott Jasper Architecture
Prinsen Cyriel Architecture
Reinaerts Sanne Architecture
Rinsema Jelle Architecture
Rol Philippe Architecture
Spek van der Ruben Architecture
Sprangers Jeroen Architecture
Stevers Maud Architecture
Tilkin Thijs Architecture
Varathan Kavitha Architecture
Veen van der Bart Architecture
Verhalle Rik Architecture
Vlaming Percijn Architecture
Vleugels Raoul Architecture Cum Laude
Vogels Floor Architecture
Vos Marijn Architecture
Vries de Marieke Architecture
Westerhof Luuk Architecture
Wijnen Frank Architecture
Woensel van Alicia Architecture

Alewijnse Benny Building Technology
Arts Dirk Building Technology
Coenen Tom Building Technology / Architecture
Derks Mark Building Technology / Architecture
Domhof Nick Building Technology / Architecture
Frencken Annika Building Technology / Architecture
Gonenc Selcuk Building Technology
Hasanzadeh Lida Building Technology
Hermans John Building Technology
Hermens Remco Building Technology
### Building Technology

- Khademagha Parisa
- Kitslaar Koen
- Koenen Sander
- Kuijper Robert
- Lindenberg Angela
- Pagter de Robin
- Ros Erwin
- Schuurmans Willem
- Weed Joost
- Wouw van de Perry
- Zimny Roel
- Fonck Michelle
- Janssen Geert
- Leipsig van Martijn
- Meslec Mihaela
- Schacht Tatjana
- Zivkovic Iris

### Building Physics and Services

- Bakker Dolf
- Berk Alexander
- Boesten Ellen
- Bours Stefan
- Brink van den Alet
- Chen Chao Ming
- Doudart de la Grée Guillaume
- Gerritsen Esther
- Haak Anika
- Haaren van Mart
- Khayrullina Adelya
- Knaap van der Arjan
- Kramer Rick
- Li Ze
- Lieshou van Bart
- Maaijen Rick
- Mierlo van Peter
- Ning Zuokui
- Reinten Jikke
- Roelofs Jelle
- Sanden van der Nard
- Seo Desirée
- Uittenbosch Sander
- Vissers Derek
- Bakker Dolf
- Berk Alexander
- Boesten Ellen
- Bours Stefan
- Brink van den Alet
- Chen Chao Ming
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- Gerritsen Esther
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- Mierlo van Peter
- Ning Zuokui
- Reinten Jikke
- Roelofs Jelle
- Sanden van der Nard
- Seo Desirée
- Uittenbosch Sander
- Vissers Derek

### Urban Design and Planning

- Fonck Michelle
- Janssen Geert
- Leipsig van Martijn
- Meslec Mihaela
- Schacht Tatjana
- Zivkovic Iris

### Urban Science and Systems

- Heuvel van den Tim
- Krijnen Thomas
- Meinders Max
- Montfort van Paul
- Nijëinstein Sandra
- Heuvel van den Tim
- Krijnen Thomas
- Meinders Max
- Montfort van Paul
- Nijëinstein Sandra

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174
Aangeenbrug Henrike
Bollinger Daan
Buruma Jan Martijn
Damman Geert
Deurzen van Rob
Eijkeren van Joep
Geelen Nadine
Groeneweg Christiaan
Hooijdonk van Ronald
Horst ter Stefan
Jong de Mark
Jong de Richard
Kester Lotte
Kleef in den Dennis
Midavaine Nescio
Opbroek Nick
Pasmans Rutger
Pedd Jordy
Peeters Marwin
Pustjens Martijn
Raijkmaars Peter
Rietberg Paul
Rijn van Evi
Schouten Roger
Sengers Tom
Simons Thymen
Spork Arian
Tijssens Roel
Urlings Mariijn
Veltrop Urs
Vos de Stef
Westerhof Emiel
Witlox Karin
Zha Rui
Zoetemelk Alexander
Zöld Roy
Zwan van der Hanna

Real Estate Management and Development
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structural design

Bemelmans Marcel
Bernhart Erik
Boellaard Bas
Boer de Jouke
Dales Daphne
Heezemans Jeroen
Koets Ronald
Kuijper Marlies
Le Linh Sa
Meijer de Joost
Meijling Herre
Noteboom Chris
Pater Gerwin
Reitsema Albert

Structural Design
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Structural Design

graduates
Smittenaar Ruben Structural Design
Telgen van Michael Structural Design
Toonen Daniel Structural Design
Tossings Roy Structural Design
Uffelen van Koen Structural Design
Visschers Lianne Structural Design
Ban van den Ingeborg Construction Technology
Bogaerts Eric Construction Technology
Brink van den Stefan Construction Technology
Dam van Renée Construction Technology
Eikelenboom Sander Construction Technology
Evers Bert Construction Technology
Frijns Roy Construction Technology
Gilissen Björn Construction Technology
Haar ter Rutger Construction Technology
Hazen Rafke Construction Technology
Kauffeld Stefan Construction Technology
Kuijsten Daan Construction Technology
Pepels Ludo Construction Technology
Pijnappel Frank Construction Technology
Prins Jaco Construction Technology
Riemens Remco Construction Technology
Roumen Florian Construction Technology
Vierling Joost Construction Technology
Zuiker Anke Construction Technology

construction management and engineering

Bodenstaff Manon Construction Management and Engineering
Broersen Cathelijne Construction Management and Engineering
Duijvestijn Ellen Construction Management and Engineering
Giels van Ruud Construction Management and Engineering
Karimi Iman Construction Management and Engineering
Kavian Mona Construction Management and Engineering
Koops Jan Construction Management and Engineering
Kuijstermans Coen Construction Management and Engineering
Loo van Tom Construction Management and Engineering
Loon van Pim Construction Management and Engineering
Martens Pauline Construction Management and Engineering
Oberdorf Jim Construction Management and Engineering
Rijken Rob Construction Management and Engineering
Schoenmakers Dick Construction Management and Engineering
Schotsman Henk Construction Management and Engineering
Smeets Daniëlle Construction Management and Engineering
Tesselaar Gerard Construction Management and Engineering
Vrede de Victor Construction Management and Engineering
Wang Tong Construction Management and Engineering
Woestenburg Thijs Construction Management and Engineering

Cum Laude
The Design Research Yearbook of the Built Environment faculty at Eindhoven University of Technology presents a selection of graduation projects. In the case of architectural design, the format of the research is the graduation studio in which a common research project is carried out during a single semester before each student designs an individual graduation project during a subsequent semester. The research conducted by each graduation studio is described in this book and represented by one or two projects. The research projects in design systems, building physics and construction design are defined by themes staff and PhD researchers work on and whose subthemes are worked out in individual graduation projects.