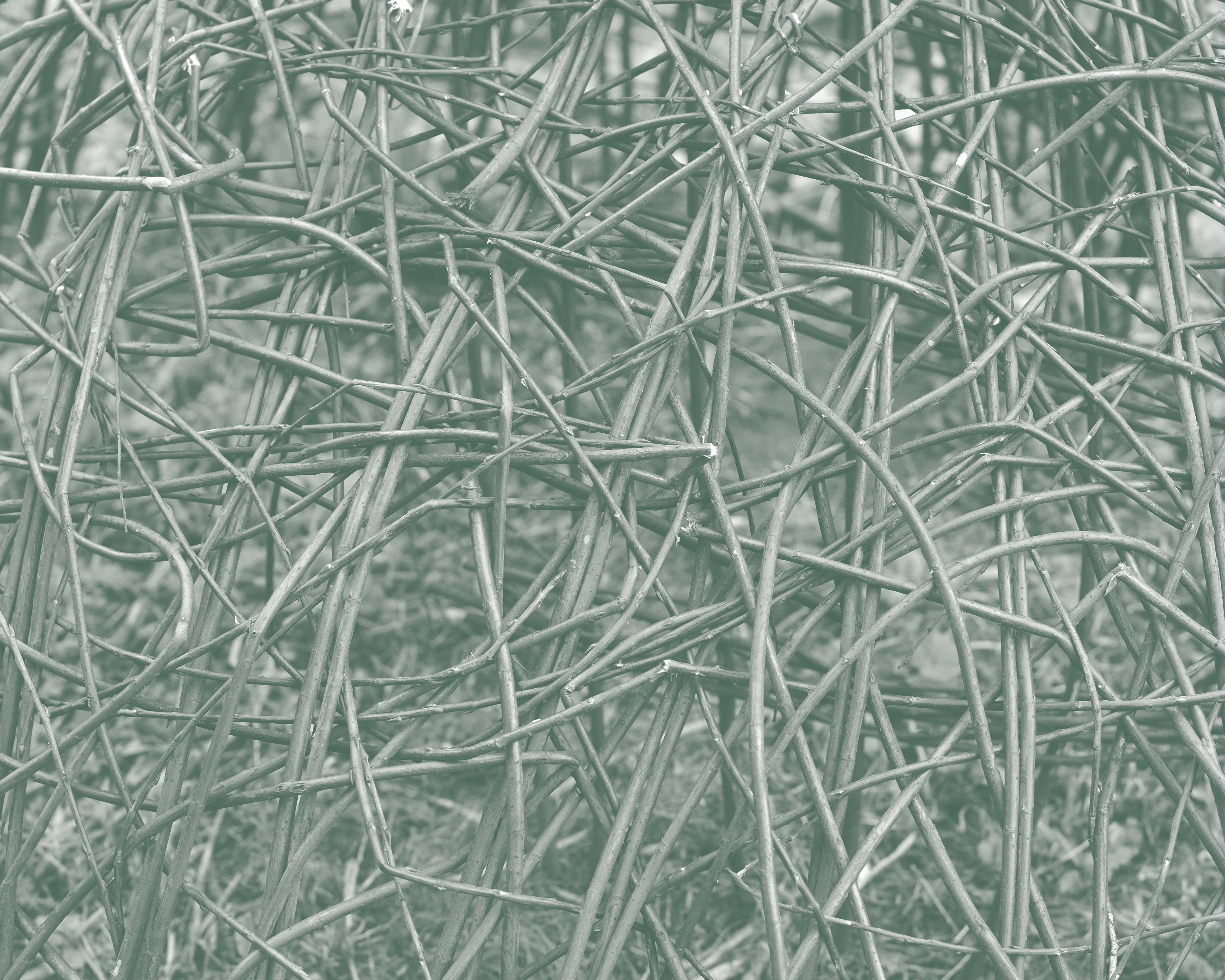
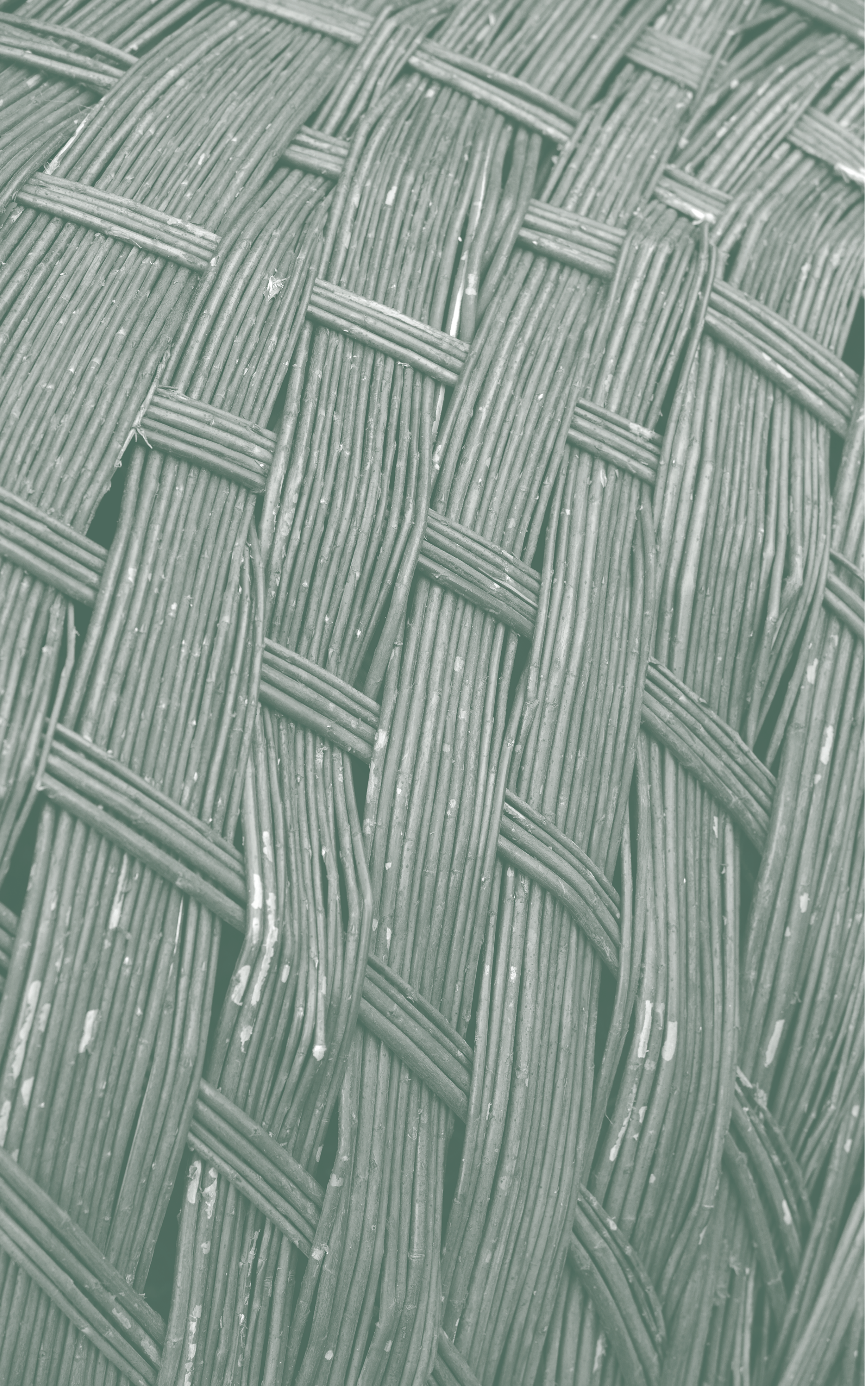
Structures in Building Culture II: Skin and bones





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1 Brick, 2008
2 Stone, 2009
3 Concret, 2010
4 Playwood, 2011
5 Wicker, 2012

Introduction

How far can we go with a lightweight structure that consists of almost weightless twigs? At what point does wicker need support from an additional structure? And how can we scale up a traditional technique, which is usually related to basket weaving and small objects, to the scale of architecture? These are some initial questions that arise while working with wicker. However, the context that brought us to work with this peculiar material is based on experience gained in a series of workshops over the previous five years. The project brief of the Intensive Program 2012 relates back to the TECTONIC series[1] of Erasmus Intensive Programs as well as to the STRUCTURE series[2] started last year. In the TECTONIC series, we have been working with massive building materials, in particular with stone in different conditions. First, with manmade brick made of clay, sand and shaped into convenient modules that are easy to handle. Due to its format and light weight, brick provided a powerful degree of freedom in experimenting with tectonics and sculptural aspects in a short and easy way. Second, with rough and archaic stone quarried out of the rocky earth, used in dry-stone walling. It forces the maker naturally into a decelerated process, to focus on finding the right stone that matches a precise place. Third, with concrete, 'liquid stone', a viscous conglomerate of sand, gravel, cement and water. Concrete tends to adopt almost any form but, poured into textile formwork, reveals unexpected qualities and offers a broad range of new possibilities. Looking to extend the field of the tectonic materials, we shifted our interest in research and exploring towards lightweight materials. With the STRUCTURE series, beginning with last year's Intensive Program, a whole array of new structural questions arose. Research into the tectonics of almost erratic materials moved towards an exploration of various aspects of structure, flexibility and bending while the topic of connecting became a major concern. With the use of wicker in this year's Intensive Program, our attention was driven to expand the experiences gained from working with plywood and OSB last year in a related yet very different technique.

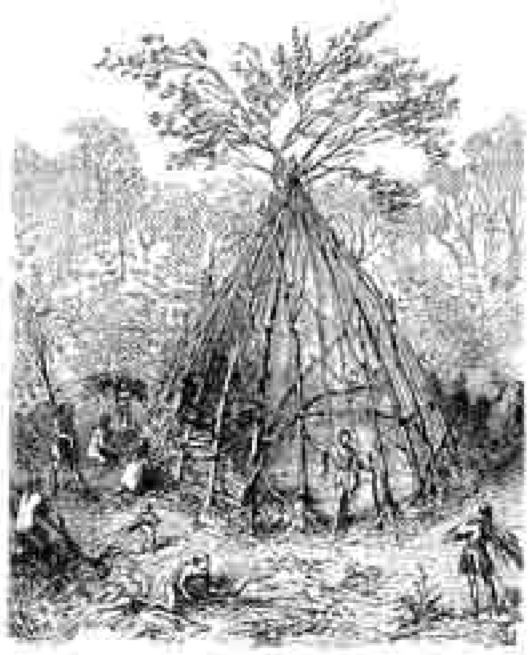
Urs Meister, Carmen Rist

1 'Tectonics in Building Culture I: BRICKWORK', Zeddam, NL, 2008; 'Tectonics in Building Culture II: TEXTILE BLOCKS', Letterfrack, IRL, 2009; 'Tectonics in Building Culture III: CONCRETUM', Bornhølm, DK, 2010

2 'Structures in Building Culture I: TEXTONICAL SHAPES OF WOOD', Amay, BE, 2011

wicker
pliable twigs, typically of willow, plaited or woven to make items such as furniture and baskets. Comes from Middle English and origins from Swedish viker 'willow'; related to vika 'to bend.' (Apple lexicon)

Wicker is a 'natural' material that refuses straight geometries and lends itself naturally to weaving, which is a textile technique. In an illustration about the origins of dwelling, Viollet-le-Duc draws a primitive hut built of trees still rooted in the ground, bending them together and weaving them with cut twigs[1]. This early hut is closer to a roof than to a real building and stands on the threshold between the



natural and the built. Another well-known reference for the use of wicker is the Mongolian yurt, a nomadic hut that is much more a piece of equipment or luggage than a firm dwelling. It consists of a wicker skeleton and a covering of rugs, mats or textiles. The 'clothes' close the space and stabilize the structure. Wicker structures tend to remain pure wireframe structures, but they receive textile qualities

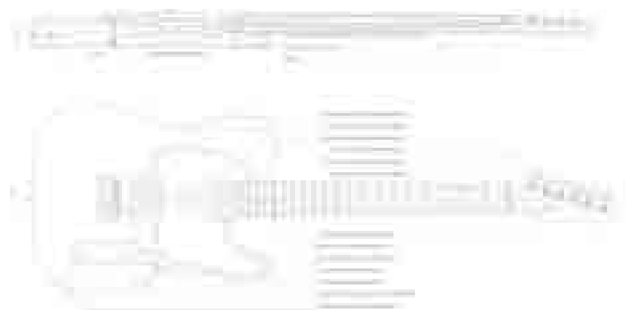
when woven more and more. Although it is not possible to cover an interior entirely, the structure draws the outlines of a room. The denser it is woven and the closer the structure evolves, the more it loses its primary skeletal clarity and tends to behave as a curved surface. In other words: wicker is a fine material without strength, unless it is bent and connected. Working with wicker inevitably reveals the intrinsic resistance of the material.

The Material as an Instrument
The process of building is comparable with the process of making music. If we relate the materials that we used in the two STRUCTURE workshops with musical instruments, the connection between music and material becomes obvious. Depending on how an instrument is made, its specific tone evolves in a distinctive direction, which we might call the 'colour of sound'. Here lies a close similarity to the character of building materials. Depending on its qualities and properties, we can use a material in different ways and achieve different bodies of structure and space. It is difficult to play rock'n'roll with a violin since it is simply not built for such a percussive kind of music. Conversely, a violin facilitates long and endlessly sustaining sounds that are impossible to play with an acoustic guitar. It is only with the invention of the electric guitar, and especially with the help of electronic devices, that sustained sound became possible and emerged as a major ingredient in most guitar solos. Chords are another trait of the guitar that are essential in creating a rhythmic song. If you compare this way of playing music with the building process, you can find similarities between a guitar and the material plywood. When bent under pressure and heat, plywood can take most shapes and uses, which we can perceive in particular in modern plywood chairs. Like a guitar which is able to play a chord as a single instrument, plywood furniture does not require another material to keep a shape and no additional structural support from any other material. The guitar and plywood are both able to stand for themselves; they both do not need another music instrument or material to generate an acoustic body or form. With a violin you are not able to play harmonies, but instead, if playing with an ensemble or even an orchestra, the voice of the violin

1 Viollet-le-Duc, 'Histoire de l'habitation depuis les temps préhistorique jusqu'à nos jours', Paris 1875

becomes multiplied and part of a bigger body of sound. This is comparable to the quality of wicker, where each fine twig becomes part of a structure. If a violin in an orchestra is part of the acoustic pattern, the whole wicker structure can only become stable when the single wickers are connected to one another in a certain mode, rhythm and density.

Towards a Material Path
Richard Sennett describes the role of practising and rehearsing when playing a musical instrument and wishing to reach a master's level in his book *The Craftsman* in depth. Without doubt, it is essential to use your hand and to touch the strings of a violin or a guitar for several hours a day if you are aiming to play your instrument in a professional and creative way. When we try to transpose this immensely close relation of a musician with his instrument to our field of designing architecture, we immediately feel the huge gap that exists between a student of architecture, willing to learn his profession in depth, and his instrument – the real, physical and present material that is the ingredient of the final product, a piece of architecture. To bridge this gap, we have two possibilities: either the student starts his education with an apprenticeship in a manual profession



as a bricklayer, a carpenter or a metal worker. It is not without reason that two of our teachers participating since the beginning in our IP series, Finn Hakonsen and Peter Sørensen, both started their career in this way and have both been successful in passing on their knowledge in all the workshops they participated in or organized[2]. The other and more practical way to tighten the relation of our students,

2 Finn Hakonsen learned the practise of a bricklayer before studying architecture, and organized the Erasmus IP 2007 'Building Anatomy: Wood Constructions' in Hitra, Norway. Peter Sørensen, an educated carpenter and architect, led the Erasmus IP 2010 'Tectonics in Building Culture III: CONCRETUM' in Bornholm, Denmark.

the future architects, to their instrument, the material, is to interweave the material experiences firmly into the curriculum of our schools of architecture. We understand our Intensive Programs as 'material lab' where a maximum number of teachers and students get in touch with the 'material virus'. Multiplying these material experiences, they spread this knowledge all over Europe into the various universities. In that way, we try to root and anchor the material approach into the DNA of our architectural schools on multiple levels, to create a material path that leads students through their whole education.

Genius Loci
Working with wicker in our 'Structures in Building Culture II: Skin and Bones' resulted in sculptural objects that relate to the surroundings in a very close way. We had the opportunity to locate our project in an idyllic ensemble consisting of an old brick church, a well-kept farmhouse – a heritage building that was removed from its original position and rebuilt again on the site in the last few years – and an overgrown garden adjacent to a dike of the old channel system of the drained area. Bushes and dominant trees enclosed the area tightly. Clearing the overgrown area around the house became a parallel project, which depended on care and patience. It resulted in a wonderful garden that forms a background for the four objects in wicker. Although crafted with a natural material that is hardly processed, the sculptures behave like self-confident beings, resting in the shadow of a huge tree or clinging to the rough wall of a former basement. They become driving forces for the atmosphere of the place and it nearly feels like each one is giving a specific sound to the place like a curious musical instrument.

Urs Meister, Carmen Rist

In architectural education today, 'project work' is a traditional and well-established way of teaching. Project work consists of one or more tasks in which students make proposals for a family home, school, factory or other building through drawings, models, photos and texts. This way of teaching often mimics how praxis works outside the studio. Characteristic of project work in teaching architecture is that the supervisor does not really teach about formal meaning and values, because the main task is to create an environment for teaching that relates to real life outside the studio. The tutor often aims to meet each student where he or she is, in an attempt to clarify the steps to be taken. In this process and with this help, the student is encouraged to formulate questions and answers. One example of this is the story of how, over 2000 years ago, Socrates taught a young slave boy geometry and mathematics just by asking him questions.

Representation

The architectural praxis of today has a character that is mainly representative. This means that it is based on developing representations of architecture. These representations are the most recognized way of containing the project, until the day it is built. Only when a person enters the real house is it possible to experience the room, the light, the materials, the use and the atmosphere.

Presentation

As soon as architecture is experienced it is no longer representative, but present. When teaching involves building at scale 1:1, the understanding of the creation of architecture changes on several levels. The creative process then changes its tools from computer and pencil to hammer and saw. The questions, the challenges and the solutions then become different.

Erasmus IP – Structures in Building Culture 2: Skin and Bones

A practical building workshop as a teaching method for architectural education is probably the oldest method. Today this method has acquired renewed importance in many schools of architecture. This might be due to the use of digital tools that, in spite of all the advantages they bring, suffer from the lack of scale. Different schools exist within this workshop method. One is based on starting the creative process by developing the project in drawings followed by constructing part of it at scale 1:1. Such a process has several parallels with the common building praxis of today. Another method stresses the creativity and development of ideas that emerge from the practical building process. In such a situation, tools of representation are accorded less importance.

Since 2005 the Erasmus IP workshops among Europeans countries have focused on the properties, the applications and the aesthetics of building materials, as a source for developing architecture. This form of tectonic thinking draws inspiration from the theories of German architect Gottfried Semper (1803 – 1879). Semper tried to find a universal meaning of architecture, something archaic. One of his theses was that architectural design has to grow from deeper human sources. For this reason he studied crafts like weaving, knitting, staking and knotting, because he thought these were naturally born skills, similar to dancing and singing. He is also known for the Bekleidungs-theorie and for the four elements of architecture: the hearth, the roof, the enclosure and the mound.

Gdansk, August 2012

The framework for the workshop in Gdansk was clear. The Cyganek site, wickers ready to use, a skilled wicker craftsman, 36 students from all over Europe and 9 teachers. There were no programs for building projects, but rather many programs in the wickers to be found. The days of building with wickers became a process in which different knowledge, skills, cultures and experiences came into play with craftsmanship. A process, sometimes with a pause and questions like: 'Why are we doing it like this? How can this be done? What does the wicker want to be? Such reflection is important because it brings the act of building into a relation with the original idea of the working team. There were no drawings to hold the vision or guide the actions. Ideas were not represented on paper but in each participant's mind.

When you saw and touched the wicker something happened to you. It affected you and made you see it in a certain way. The material acquired a voice. The smell of it, different when wet or dry. The stubborn resistance when you try to break it. The smoothness when you twist it. The willingness to be integrated into a construction. The hands become marked, a nail turns blue, the body aches, and you tire after a working day.

Everybody brought home knowledge and skills from Gdansk. It was a sensual experience that cannot be captured in an architectural drawing. On the site in Gdansk there was no representation, just presence.

Finn Hakonsen



















Fields of experimentation

For the past five years seven European design colleges have organized an Erasmus IP summer workshop that looks at how a material can generate a form. Each workshop involves examining a particular material for ten days within a specific 'Field of Experimentation'. The process of making is the driving force behind the study. The secrets of the chosen material are discovered through craft and experimentation. Awareness of the material, and of its structure and details, develops through the act of building. A material is therefore not forced to adopt a form. Rather, the form is derived from the material and its properties.

In November 2012 the IP summer workshops were presented at the *Scaleless-Seamless* conference in Münster. The themes of this conference touch directly on the objectives of the workshops. The organizers of the conference are looking for (digital) pedagogies that can best ensure the seamless and scaleless integration of the designer and the maker and how the computer could support this process. With our summer workshops we are searching for this *seamless and scaleless* integration of the designer and the maker, but we do not use computers or CAD in the process. Our tools are the materials we are working with.

'The computer is an indispensable and indisputable tool in designing. The computer is also a fundamentally different tool from the traditional instruments of drawing and methods of making,'[1] The way in which we can deploy the computer as a tool in the process of design and making is therefore not obvious. Depending on how we wish to shape the relation between the designer and the maker, how we wish to build up knowledge and resources, and how we wish to make students aware of this relation, we can determine why and how we deploy the computer.

The participants come from seven European countries, each with its own language and local material. That allows everybody to bring their own experience and expertise to the table, which are then exchanged through the material experiments. Communication is also conducted largely through the vehicle of the structures made. Participants talk through the material and with their hands.

1 The Thinking Hand, Juhani Pallasmaa, 2009.

To an Architectural Scale

After brick, dry-stone walling, concrete and plywood, the summer of 2012 focused on experimenting and building with wicker. The wicker weaving technique is associated with the traditional manufacturing of small objects, like baskets. This technique, practised in Poland for centuries, stands out for its potential to build complex and resistant shapes thanks to the flexibility of the fibre and rigidity provided by the weaving.

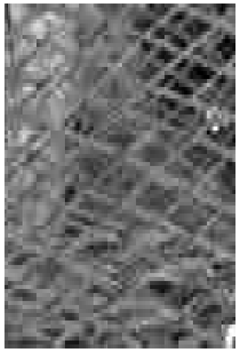
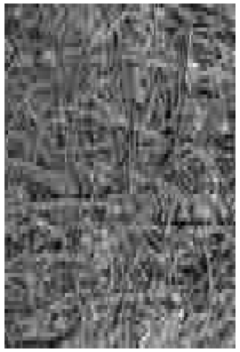
During the first two days of the workshop the technique of wicker weaving was explored and practised. After that, the students made architectural structures out of wicker. They developed various technical strategies to translate the scale of the object into an architectural scale.

Weaving easily produces rounded forms owing to the properties of the material and the technique applied.

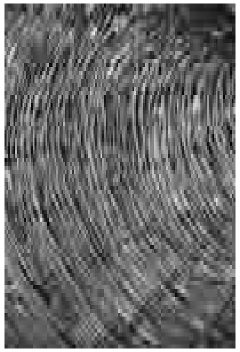
The process of weaving depends largely on the flexibility of the material. That allows forces to be absorbed by the structure through 'pre-stressing'. The curved wicker wants to 'return' to a straight position, and the resulting force released lends the woven structure its strength. This makes it difficult to coerce wicker into a particular form. Instead, the form emerges partly through the process of twining strands. You can guide this process to some extent, but in the end the power of the material determines the curvature and, hence, the form.

In scaling up the basket to an architectural structure, one must rediscover the technique of weaving, as has been stated. Wicker lends itself extremely well to making curved surfaces and arched sheet structures. These curved shapes help in making large spans. Adding tension to the material makes surfaces strong and sturdy. This can be done in different ways. A prefabricated plane can be bent into a shape. But tension can be introduced into a structure right from the start. During the wicker workshop the students tested a range of weaving and knotting techniques in order to make the jump in scale.

A dome. How do you make a round shape if the wicker does not let itself be coerced into a shape. The first efforts in making a spherical shape always led to impure egg-shaped objects. Inspired by Leonardo's dome made a year earlier,



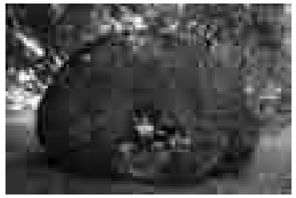












the students started weaving the dome from the centre. As a result, the form emerged of its own accord on the basis of the weaving method. The structure is a ‘randomly’ woven surface. Adding tension to this structure results in a sturdy rounded shape because the curved wicker branches press inwards. Weaving in a controlled manner results in a geometric shape.
A column. A tall structure becomes unstable very quickly. During the experiment a model emerged in which the wicker is woven, not straight up but warped into a column in such a way that triangles are created. Weaving the wicker at the intersections of the wicker branches into planes produces fixed-moment connections. These, in combination with the triangles, produce a sturdy structure that can easily reach a height of three metres. Making the knots very accurately results in columns with an industrial and organic character.
An arch. As the object increases in size, you need more material to maintain its strength. One way of achieving this is by grouping a number of branches together to form wider lengths. The students in this group developed a method of ‘extending’ the grouped branches. This enabled the creation of a construction taller than the 1.5-metre length of the wicker branch. Further development of this weaving technique ultimately led to an object with an arched interior space you could stand up in, but the object is also so strong that a number of people could sit on it.

Process of Making
Wicker connections are often derived from techniques of weaving and knotting. In these textile connections the hierarchy between the various parts of the structure is often not clear at a first glance. In the dome constructed, each branch of wicker is technically equal. Even so, the right sequence of adding each strand is essential in achieving the intended result. All wicker branches are also equal in the arch constructed, even though they join to form bundles in many places to create a stronger connection. In the column we can still see an architectural hierarchy. We can still recognize clearly different structural elements. Becoming aware of this order, or (precisely) the lack of any order, is

an important discovery and helps the student to establish the relation between the technique of making and the appearance of the design. Every decision in the process of making influences the appearance. Understanding the structure, the construction and the junction ensures that the process of designing and making becomes more precise, more discussible and more negotiable.

In this way, the studies of 'rounded' and folded forms do not emerge on the basis of an image defined in advance, nor on the basis of a computer exercise. Rather, the forms appear as one sketches with the material in the hand. The resistance of the material allows the maker to sense the shape the form wants to adopt. This gives the builder a physical awareness of the relation between material, structure and form. As a result, a vocabulary of forms we are familiar with from the computer-generated blobs and folds now becomes tangible, tactile and directly experienced at the human scale.

Drawing with the material

By experimenting with various materials, the Erasmus IP Workshops raise awareness among the students and tutors about the reciprocal relation between designing and making. This awareness is fed by repetition, intuition and reflection. The focus of all exercises is to foster an attitude of research and reflection in relation to designing and making. Can the computer act as a supporting tool here?

In *The Craftsman*, Richard Sennett writes in a section entitled 'Torn skills' about the complexity of Computer Aided Design. In addition to its qualities, Sennett lists the possible limitations of the computer in the creative process: the static and purposeful method of designing with the computer. Sennett quotes Renzo Piano, who talks about repetition and practice: 'You think and you do at the same time. You draw and you make. (Drawing... is revisited.) You do it, you redo it, and you redo it again'.[2] Sennett observes that the binding circular metamorphosis described by Piano is disconnected by the computer. If the computer is to fulfil a meaningful role in this cyclical process, then it will have to be able to integrate the circular movement into the CAD process.

2 The Craftsman, Richard Sennett, 2008 (quoted from Why Architects Draw, MIT press).

That brings me back to the question: how can we deploy the computer to enhance awareness among students of the relation between design and construction? How do we connect the designer and the maker? The 'CAD model' is just one possible connection between the two. This model or drawing lacks the genuine experience of gravity. The model lacks the resistance of the curved wicker, the sense of the tool, the feeling as the thumb guides the curving of the wicker. The CAD model does not permit intuitive actions such as these easily. Herein lies the challenge presented by the computer and CAD as a tool that can bring about an intelligent interaction between design and construction. How can the computer make the drawing less static?

A drawing as a fluid open product that offers space for experimentation and improvisation, space to admit intuition and tolerance and space for the designer and maker to embark on an interactive game to discover, refine and execute innovative architecture. The drawing as a space, and a field, of experimentation.

For me, the direct relation between hand, head and material still remains essential in connecting the designer and the maker in a meaningful way.

Machiel Spaan

Most solutions in architectural making seem fixed at first sight. Books are written about how to make buildings, how to calculate structures, and what standards and regulations to use to do it correctly. For educational purposes this model fulfils the needs well. Aspiring architects can learn from conventions and create a solid base to progress further. However, in professional practice, fixed solutions are less favourable. On the one hand designers risk knowing that a certain solution works, but are poorly informed about how it exactly works. On the other hand, the increased rate of technological change has destabilized our traditions in architectural making and therefore favours an adaptive and reflective approach (Waks, 2001).

To free solutions from conventions, 'frame-experimentation' is often used in cognitive psychology, media and political science studies and holds, in my opinion, great potential for studies in architectural making. By changing circumstances, frame or conceptual framework, you are capable to challenge older experiences in new situations (Waks, 2001). As a result, you are able to rethink and reconnect problematic situations, introduce new concepts and experiment with lesser preconceptions (Schön, 1983) (Östman, 2006). With this strategy, students are able to rework solutions bottom-up, and generate knowledge of knowing-how instead of knowing-that.

Like frame-experimentation, the frame and the concept of framing is of considerable importance in social sciences today. In this context, frames help to render events and organize experiences. In architectural making, frames are very promising in guiding action in reflective research (Benford, 2000).

The frame and the conceptualization of framing originate from the work of Erving Goffman. In his work Frame Analysis (Goffman, 1974), Goffman discusses the relevance of a condition in which a certain given is understood. By understanding within this 'world' or 'reality', selective attention organizes experiences and generates meaning within a certain event. In other words, the frame is understood as 'background', 'setting' or 'context'.

In architectural making today, framing is well used in, for instance, 'biomimetics' or 'biomimicry' experiments. The content of both concerns 'the abstraction of good ideas from nature' or 'learning from nature'. Compared to biomimetics, the biomimicry frame-set stresses the importance of sustainability. Biomimetic studies are more focused on the study of biological systems as an inspiration for design (Pawlin, 2011).

In biomimetics, models are often studied in micro scale and magnified into a macro variant for use in architectural making. Studies involve, for instance, the work of Frei Otto and Bodo Rasch. Their work shows important examples for lightweight engineering and membrane design (Otto, 1996). By studies in soap film, sand or foam, Otto was able to recreate and study biological phenomena. The studies still show their importance and value in progressive and lightweight architecture today.

Similar studies have been conducted in other small-scale techniques like textile arts and paper folding and are often inspired by biomimetics. Studies in the resemblance of weaving and molecular structures and diamond-inspired folding techniques serve as influential concepts in design and engineering. On the one hand, one can find solutions by studying architectural problems in these experimental frames. On the other hand, new problems are introduced simultaneously. Apart from a change in scale, for example, often the function also changes, together with material and properties as discussed in the Stoffwechseltheorie by Gottfried Semper (Semper, 2004).

Stoffwechselthese or Stoffwechseltheorie (roughly translated as 'change of material' or 'Rematerialization') is introduced in the book Style in the Technical and Tectonical Arts. Semper describes that by transforming a matter through a change in its original materialization, the object becomes a composite of both the primeval type and the current form. Changing the material multiple times generates a model consisting of all materials, techniques and transformations used in the procedure (Semper, 2004). The artist or craftsman who created the objects may be aware of the qualities through this metamorphosis indirectly. Semper's text doesn't describe the theory as being used as a design tool by its designer or maker, up front. Still, using Stoffwechselthese as an active design tool can be a constructive asset within the strategy of frame-experimentation.

During the Erasmus IP 2011 workshop in Belgium, the materials we used were wooden multiplex and chipboard. Because the geometry of plate materials greatly resembles that of paper sheet, studies were heavily inspired by origami and paper arts. In the experimentation process some challenges had to be overcome. While the geometry of both products is alike but scaled up, the properties of the material itself are very different. Where for paper, folding geometries are possible, for wood, bending is limited. Where in the scale of paper arts the material itself seems endless, in wood geometries the designer is limited to plate sizes. Apart from the change in material property, the function of the study changed as well. Where origami has mostly ornamental value, the wood studies had to incorporate structural stability, detailed connections and material extending solutions.

In the Erasmus IP 2012 workshop in Poland, the challenge was hidden in scale experimentation. With the basic concept of wicker, students were inspired by textile techniques like weaving and braiding. Challenges like material not being endless and bending being limited remained, but they were partially answered by an introduction to the rich tradition of basket weaving. Compared to Erasmus IP 2011 the scaling-up of the micro techniques into macro variants was not accompanied by a change in material. The same material as used in basket weaving was applied in studies on an architectural scale. In this situation the introduced conventional solutions didn't apply. Classical small-scale solutions had to be rethought and reworked into an architectural scale.

As shown in the Erasmus IP workshops, frame-experimentation can be a valuable asset in rethinking traditional techniques. With most applied frames being tacit or describing tacit knowledge, the practical approach is favoured to accompany head-knowledge with physical reflection. The applied frames may conflict in scale, medium or property, but with a challenging overlap, frames can resonate well into one another. In the cases discussed, challenges are resolved with interesting and promising solutions.

Ivo Vrouwe

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Teachers

Gdansk University of Technology, Faculty of Architecture
Justyna Borucka
Gary Johnson
Kasia Urbanowicz
Anna Rubczak

Sint-Lucas School of Architecture, Belgium
Ivo Vrouwe
Thierry Berlemont

Royal Danish Academy of Fine Arts, School of Architecture, Copenhagen
Peter Sørensen

Academy of Architecture, Amsterdam
Machiel Spaan

Norwegian University of Science and Technology, Trondheim, Faculty of Architecture
Finn Hakonsen
Are Øyasæter

University of Liechtenstein, Vaduz
Urs Meister
Carmen Rist

Universitat Polytècnica de Catalunya, School of Architecture of El Vallès, Barcelona
Raimon Farré
Claudi Aguiló

Coordinator: *University of Liechtenstein, Vaduz*
Organizer: *Gdansk University of Technology, Faculty of Architecture*

Students

Emilia Ewertowska
Justyna Mydlak
Liza Petruczynik

Lien Van Holm
Elyse Verstraeten
Dorien De Pauw
Marie-Julie De Doncker

Line Kjær Frederiksen
Fredrik Espe Christoffersen
Louise Vester
Heidi Schøbel
Søren Pihlmann

Maarten Vermeulen
Rogier van den Brink
Mark Spijkerman
Eva Engele
Onno Kramer
Ashkan Hashemkhani

Bjørg Helene Andorsen
Maya Laitinen
John Haddal Mork
Steinar Hillersøy Dyvik

Tawab Noor
Labinot Pacolli
Samuel Wust

Octavio Puente
Georgina Cortijo Arribas
David Viladomiu
Carla Llaudó

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