DIPLOMA

DIPLOMA CANDIDATE:	ERLEND SØDERLUND
INSTITUTE:	IDE
FIELD:	PRODUCT DESIGN
TITLE:	A FORM- AND MATERIAL STUDY OF SOLID BENT WOOD AND PORCELAIN
SEMESTER:	AUTUMN 2017
SUPERVISOR:	STEIN ROKSETH
COMPANY COOPERATION:	MENT AS

ABSTRACT

THIS DIPLOMA IS A FORM- AND MATERIAL STUDY OF SOLID BENT WOOD AND PORCELAIN.

I WILL WORK WITH BENDING OF SOLID WOOD, AND COOPERATE WITH MENT, WHO WORKS WITH CASTING OF PORCELAIN. BY UTILIZING PROPERTIES AND QUALITIES OF THE MATERIALS, WE WILL EXPLORE POSSIBLE WAYS OF CONNECTING DIFFERENT STRUCTURES OF BENTWOOD AND PORCELAIN TOGETHER.

WHY

As a designer, I want to contribute with functional quality products that can be produced locally from natural materials. For a more sustainable environment, and added value in the form of local jobs.

I see possibilities in the area between cheap mass produced items and unique handmade craft: products with qualities from craft and simplification and rationalisation from mass production.

The goal for this project is to find interesting and functional ways of connecting structures of bentwood and porcelain together, that can be used in product development later.

Cheap mass produced plastic boxes

BETWEEN MASS PRODUCTION AND TRADITIONAL CRAFT

Typical traditional Norwegian tine

https://digitaltmuseum.no/021026490184/tine

WHY WOOD?

Wood is a natural and renewable material, with qualities that can be utilized in product development and functional products. Wood is fairly easy to manipulate, and we have great access to it in Norway. This means it´s possible to start a production with local materials without too big investments. Many people also tend to like to have wood in their surroundings.

"People react to the use of wood in a positive way both physiologically and psychologically."

("Psychological properties."2011)

- Wood is a renewable natural resource.
- Use of wood helps to counteract the greenhouse effect.
- The growth in the Norwegian forests is greater than the harvest.
- Norwegian forests are run according to principles that apply to sustainable forestry.
- Our wood industry is a clean and resource efficient industry.
- Wood have positive environmental properties.
- Wood and wood products have good durability
- Wood and wood products can be reused and recycled.
- Wood are positive for the indoor environment.

(Treteknisk. "Fokus 8 - Tre og miljø, 2017)

"Wood has been an important construction material since humans began building shelters, houses and boats. (...) Although plastics and other materials have replaced wood in many applications there are others, such as in musical instruments, that the qualities that wood brings cannot be wholly reproduced."

("Investigating wood". 2001)

WHY STEAM BENDING?

Steam bending makes it possible to shape solid wood to almost any shape. The wood is heated with steam from boiling water, without use of any chemicals. The technique maintains the woods original qualities and properties, since the grain structure of the wood follows the bent shape. This makes it possible to make both strong, lightweight and elegant structures, without anything else than solid wood. The technique allows use of green timber (fresh wood), which makes it easier to use local materials.

I see opportunities in the techniques of bending solid wood. Both when it comes to construction and aesthetics. What's written about the technique in Veritas instruction booklet for steam bending underlines my point:

> *"The ability to bend solid wood can give your projects both a structural advantage and an aesthetic appeal."*
>
> ("VERITAS Steam-Bending Instruction Booklet", 2011.)

http://www.thonet.de/ueber-uns/unternehmen/informationen.html

WHY COMBINING WITH PORCELAIN?

I see possibilities in combining solid bent wood with other materials, such as porcelain. Combining materials with different qualities and properties, gives possibilities for products with a wide range of functions.

Casted porcelain and solid bent wood are materials and techniques that´s possible to work with in Norway, giving a realistic dimension to the project when it comes to possible production. Ment already do casting of porcelain, and I do bending of solid wood.

In the process of making porcelain cups (by Ment)
https://www.facebook.com/ment.no/photos
/a.476954385670476.110882.464327720266476/1594440733921830/?type=3&theater

WOOD		PORCELAIN
DURABLE	⟷	FRAGILE
SOFT	⟷	HARD
MATTE	⟷	SHINY
ROUND	⟷	SHARP
HEAT INSULATING	⟷	HEAT CONDUCTIVE
ANISOTROPIC	⟷	ISOTROPIC
BREATHING	⟷	AIR TIGHT
MOVING	⟷	CONSTANT
LIVING	⟷	DEAD
ABSORBING WATER	⟷	WATER TIGHT

Different properties and qualities of wood
and porcelain, compared to each other

https://barmenbrekke.wordpress.com/portfolio/make/#jp-carousel-784

https://barmenbrekkte.wordpress.com/category/aktuelt/

Barmen and Brekke´s work is a good example of what aesthetically qualities you can get by combining ceramics and wood.

WHY FOCUS ON JOINING PRINCIPLES?

I will try to find good ways of connecting structures of bentwood with porcelain. I will do this because I want to work with bentwood after this project ends, and do product development together with Ment. We will design and produce products of bentwood and porcelain. Often the biggest challenge that rises when combining two materials in a product, is how to connect them together in a good way. And especially when you work with materials and techniques that makes every part slightly different from each other, meaning that you can´t work with very small tolerances.

Therefore, I will focus on different ways of connecting different structures and geometries of the materials together, producing a “library” of possible ways of do connections, to be used in product development after the end of this project.

WHY IS IT RELEVANT?

The knowledge I aim to get from this project, will help me (and Ment) in product development of products of solid bent wood and porcelain in the future. We will make quality products of nature materials, produced locally

https://www.ment.no

HOW

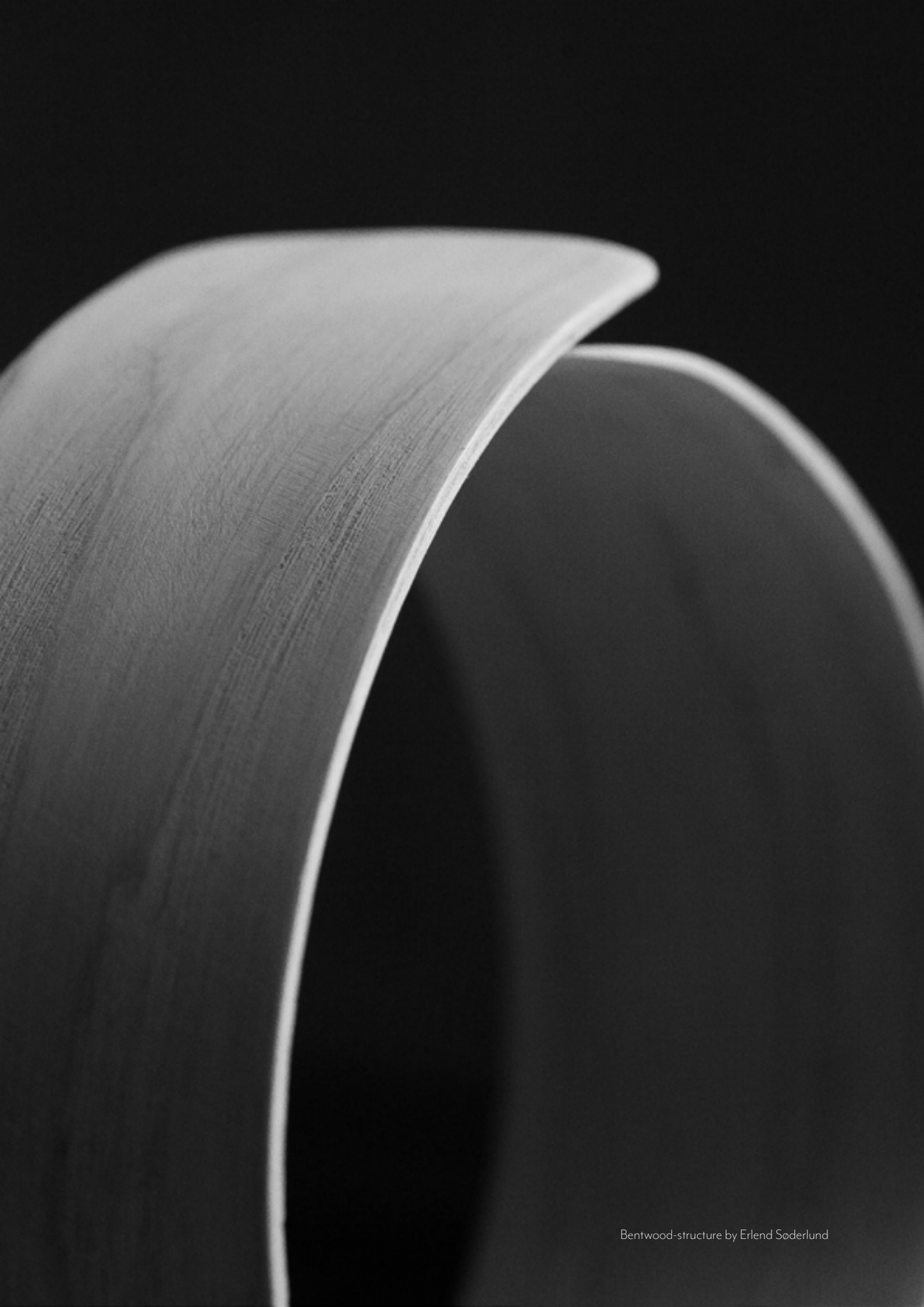
An practical approach through the materials.

By working hands on with the materials, we have already learned a lot of the materials, and will continue this learning through this experimental project. Properties, qualities, possibilities and limitations of the materials will be an important factor for how the materials will be used.

Working with bending of solid wood and connections between materials requires hands on experience and testing. And working towards a production in Norway, it will be important to understand how the products can be made.

I will cooperate with Ment, who design and produce functional product in ceramics and porcelain at Fåberg, outside if Lillehammer.

Ment sisters, Ingvild and Sidsel Hemma



Bentwood-structure by Erlend Søderlund

SOME FRAMES

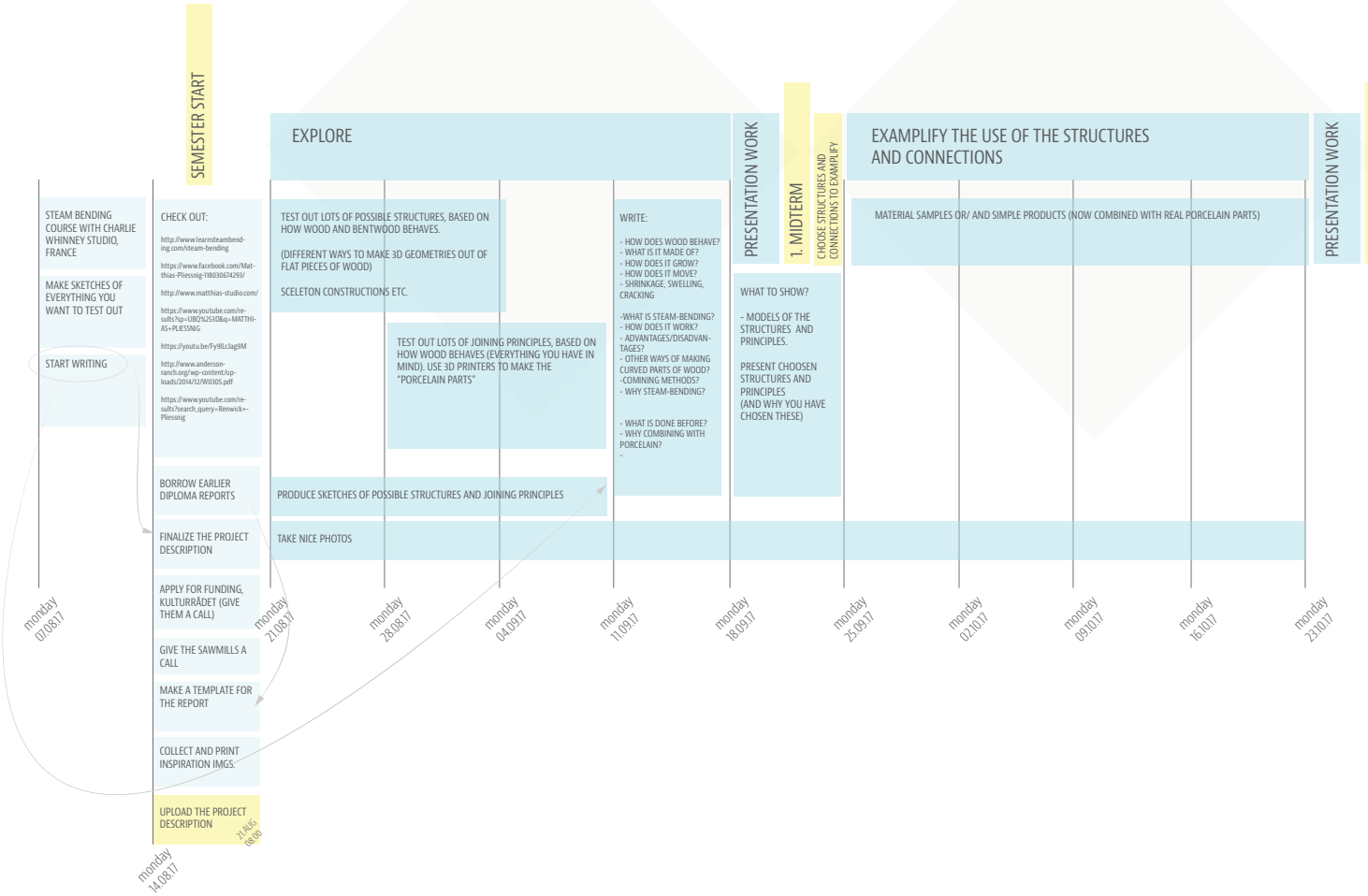
Materials: solid bent wood and porcelain.
I will prefer to use ash, since ash is great for bending, and the light colour goes well together with Ment´s coloured porcelain. I will also prefer to use local timber, due to environmental reasons.

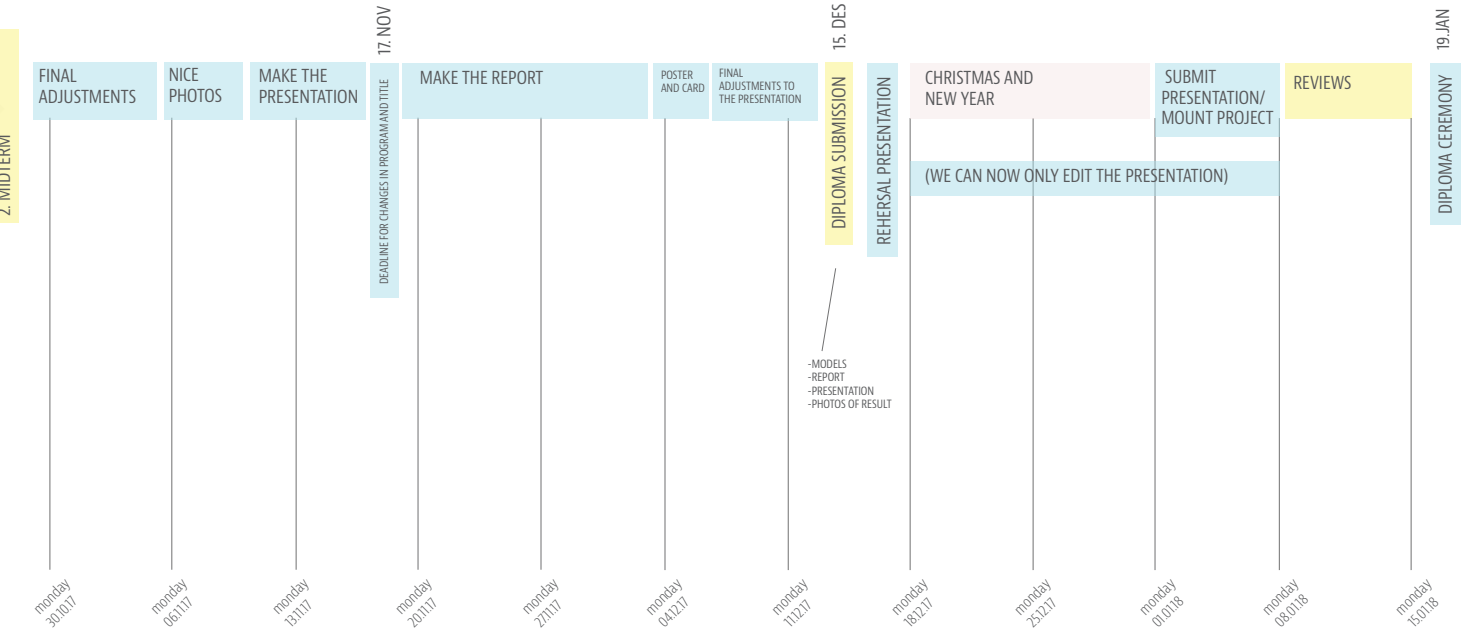
The porcelain Ment works with makes it possible to mix colour in the porcelain itself (not only in the glaze, which is more common). This makes it possible to make porcelain without glaze, or only partly with glaze. This gives opportunities for both a matte and glossy finish.

The structures and connections should be possible to use in product development, and in a relatively rational small scale production in Norway.

The connection principles should allow slightly different tolerances, since the production and the materials will not be exactly the same every time

TIMELINE


SEMESTER START
EXPLORE
PRESENTATION WORK
1. MIDTERM
CHOOSE STRUCTURES AND CONNECTIONS TO EXAMPLIFY
EXAMPLIFY THE USE OF THE STRUCTURES AND CONNECTIONS
PRESENTATION WORK
STEAM BENDING COURSE WITH CHARLIE WHINNEY STUDIO, FRANCE
MAKE SKETCHES OF EVERYTHING YOU WANT TO TEST OUT
START WRITING
CHECK OUT:
http://www.learnsteambending.com/steam-bending
https://www.facebook.com/Matthias-Pliessnig-118030674293/
http://www.matthias-studio.com/
https://www.youtube.com/results?sp=EIBQ%253D&q=MATTHIAS+PLIESSNIG
https://youtu.be/Fy9ILcJag9M
http://www.anderson-ranch.org/wp-content/uploads/2014/12/W0305.pdf
https://www.youtube.com/results?search_query=Renwick+-Pliessnig
BORROW EARLIER DIPLOMA REPORTS
FINALIZE THE PROJECT DESCRIPTION
APPLY FOR FUNDING, KULTURRÅDET (GIVE THEM A CALL)
GIVE THE SAWMILLS A CALL
MAKE A TEMPLATE FOR THE REPORT
COLLECT AND PRINT INSPIRATION IMGS.
UPLOAD THE PROJECT DESCRIPTION
21 AUG, 08:00
TEST OUT LOTS OF POSSIBLE STRUCTURES, BASED ON HOW WOOD AND BENTWOOD BEHAVES.
(DIFFERENT WAYS TO MAKE 3D GEOMETRIES OUT OF FLAT PIECES OF WOOD)
SCELETON CONSTRUCTIONS ETC.
TEST OUT LOTS OF JOINING PRINCIPLES, BASED ON HOW WOOD BEHAVES (EVERYTHING YOU HAVE IN MIND). USE 3D PRINTERS TO MAKE THE "PORCELAIN PARTS"
PRODUCE SKETCHES OF POSSIBLE STRUCTURES AND JOINING PRINCIPLES
TAKE NICE PHOTOS
WRITE:
- HOW DOES WOOD BEHAVE?
- WHAT IS IT MADE OF?
- HOW DOES IT GROW?
- HOW DOES IT MOVE?
- SHRINKAGE, SWELLING, CRACKING
-WHAT IS STEAM-BENDING?
- HOW DOES IT WORK?
- ADVANTAGES/DISADVANTAGES?
- OTHER WAYS OF MAKING CURVED PARTS OF WOOD?
-COMINING METHODS?
- WHY STEAM-BENDING?
- WHAT IS DONE BEFORE?
- WHY COMBINING WITH PORCELAIN?
-
WHAT TO SHOW?
- MODELS OF THE STRUCTURES AND PRINCIPLES.
PRESENT CHOOSEN STRUCTURES AND PRINCIPLES
(AND WHY YOU HAVE CHOSEN THESE)
MATERIAL SAMPLES OR/ AND SIMPLE PRODUCTS (NOW COMBINED WITH REAL PORCELAIN PARTS)
monday 07.08.17
monday 14.08.17
monday 21.08.17
monday 28.08.17
monday 04.09.17
monday 11.09.17
monday 18.09.17
monday 25.09.17
monday 02.10.17
monday 09.10.17
monday 16.10.17
monday 23.10.17


2. MIDTERM
FINAL ADJUSTMENTS
NICE PHOTOS
MAKE THE PRESENTATION
17. NOV
DEADLINE FOR CHANGES IN PROGRAM AND TITLE
MAKE THE REPORT
POSTER AND CARD
FINAL ADJUSTMENTS TO THE PRESENTATION
15. DES
DIPLOMA SUBMISSION
-MODELS
-REPORT
-PRESENTATION
-PHOTOS OF RESULT
REHERSAL PRESENTATION
CHRISTMAS AND NEW YEAR
(WE CAN NOW ONLY EDIT THE PRESENTATION)
SUBMIT PRESENTATION/ MOUNT PROJECT
REVIEWS
19.JAN
DIPLOMA CEREMONY
monday 30.10.17
monday 06.11.17
monday 13.11.17
monday 20.11.17
monday 27.11.17
monday 04.12.17
monday 11.12.17
monday 18.12.17
monday 25.12.17
monday 01.01.18
monday 08.01.18
monday 15.01.18

LEARNING OUTCOME

I aim to learn as much as possible of how wood and bentwood behaves. How the material can be bent and shaped into different structures, and how these structures can be connected to porcelain, by using the properties of the materials.

This learning outcome could most likely also be possible to adopt to a combination of solid bentwood and other static materials as well.

GOAL

The goal for this project is to find interesting and functional ways of connecting structures of bentwood and porcelain together, that can be used in product development after the end of this project.

DELIVERY

- Material samples of connected structures of bentwood and porcelain.
- Presentation
- Report
- AHO works diploma exhibition

In the process of making curved pieces of wood

MAKING A CURVED PART OF WOOD

There are mainly three ways of making a curved part in wood. You can carve out the curve from solid wood, laminate the curve, or bend the curve from solid wood, using steam or a similar heat source, to soften the wood enough to bend. Each method has advantages and disadvantages. A fourth way is to use wood that has grown in the desired curve. Often used in traditional boat building. This method gives probably the strongest curve, but is far from rational, since you have to find the right three in the forest, to get the right curve.

The methods can be combined.

Carving out a curve from solid wood can be done really rational wit CNC mills or similar. If the curve does not need to be strong, this could be a good option. But the method gives a lot of wastage, if the piece of wood around the curve cannot be used for something else.

Laminating thin strips of wood (they are so thin, so that they can be bent to the desired shape in dry state, without cracking) gives a stable shape. If the piece is exposed to moisture, it will not open or warp. The disadvantages of this method is all the glue you have to use. It´s often toxic, with a lot of chemicals. This means that the piece you are left with, are not a natural material any more, and should be treated as special garbage. The process of gluing is often a mess.

Steam bending by Matthias Pliessnig
http://www.matthias-studio.com/4y3ta5074fbiikmaon4sq2u06t3oy8

Steam bending is a technique where you heat the wood with steam from boiling water. This melts the lignin, the natural glue withing the wood. When the lignin are melted, the wood is quite flexible, and can be bent. When it dries, the lignin hardens, and the wood takes the new shape. You can also melt the lignin by boiling the wood in water, or by expose a piece of green (fresh) or soaked (wet) wood to heat. All of these methods tend to do the same: melt the lignin.

Using steam is great, since the moisture brings the heat effectively into the wood.
There are of course limits to what shapes and radii the wood can be bent to. It depends on several factors how tight radius you can bend a specific dimension to. Some rules of thumb are:

- Hardwoods bends better than softwoods
- Straight grained, knot free wood are important, especially if you want to bend big dimension over small radius.
- You have to heat the wood long enough to melt the lignin all the way through the wood. Steaming by one hour per inch of thickness is a rule of thumb.

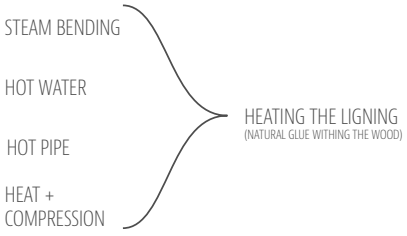
A steam bent piece of wood where the ends are not fixed to something (an open shape), tend to open again, if exposed to moisture.

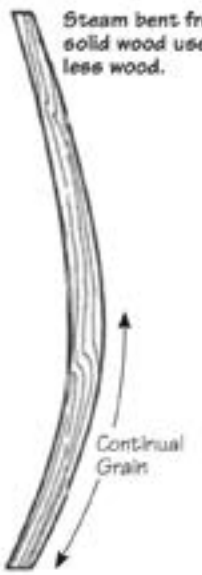
This steam bent piece will start to open, if exposed to moisture

SOLID WOOD BENDING COMPARED TO LAMINATING

SOLID WOOD BENDING

HOW TO DO IT:
There are several ways to bend solid wood. What the different techniques have in common, is that they heat the lignin (natural glue within the wood).





LAMINATING

HOW TO DO IT:
Cut out strips of wood that can be bent to desired shape in cold, dry state. Glue them together in desired shape, and the piece will take the shape after the glue hardens.

SOLID WOOD BENDING		LAMINATING
VISUAL QUALITIES (NO GLUE LINES)	→	YOU GET GLUE LINES
NO MATERIAL WASTE	→	50% MATERIAL WASTE (FROM CUTTING THE STRIPS)
100% RAW MATERIAL	→	NOT A RAW MATERIAL ANYMORE
YOU NEED REALLY GOOD MATERIAL (STRAIGHT GRAINED, KNOT FREE HARDWOOD)	→	MORE MATERIALS CAN BE USED
YOU REALLY NEED TO KNOW THE METHOD	→	EASIER TO LEARN THE METHOD
YOU NEED TO HEAT/ STEAM THE WOOD	→	YOU NEED TU CUT /BUY DESIRED STRIPS
YOU DO NOT NEED TO ADD ANYTHING	→	YOU NEED TO ADD GLUE
MOISTURE NEEDS TO DRY OUT (TAKES TIME)	→	DRYING OF THE GLUE GOES FASTER
THE BENT SHAPE WILL START TO OPEN, IF EXPOSED TO MOISTURE	→	YOU GET A STABLE CURVE, WHICH WILL NOT OPEN

I WANT TO WORK WITH SOLID WOOD, AND NOT LAMINATING,
BECAUSE OF THIS REASONS:

- IT´S A 100% RAW MATERIAL, WITHOUT CHEMICALS OR GLUE
- AESTHETICALLY QUALITIES (NO GLUE LINES)
- VERY LITTLE MATERIAL WASTE

A BRIEF HISTORY OF STEAM BENDING WOOD

Steam bending are the most common used techniques for bending solid wood. The technique had traditionally been used in making of snowshoes and canoes in United States: *"Steam bending is a pre-industrial fabrication process which was used extensively in the Great Lakes Region of the United States as a traditional method for fabricating canoes, snowshoes, barrels and even early automotive components."*

("Digital Steam Bending". 2017)

Michael Thonet had a great success in industrializing the technique during the industrial revolution: *"Steam-bent construction was lightweight, rigid, and compact, making it ideal for mass production. But unlike many industrial processes, steam bending used local and renewable materials, lent itself to easy disassembly / repurposing of material, and required no toxic adhesives."*

("Digital Steam Bending". 2017)

But when tubular steel, and better glue become available, the technique become replaced: *"While steam bending remains a viable craft-based practice its chapter in the history of early industrial production was relatively short-lived, having been quickly replaced with tubular steel and other more predictable, more thoroughly modern materials"*

("Digital Steam Bending". 2017)

But in a small scale production, I see opportunities in this kind of technique of working with wood. And in applications, where the qualities of the technique would be appreciated: a pure natural material, without any glue lines, bent to amazing shapes.

Figure 2: Barefoot workers at a Thonet factory. Source: (Vogesack 1997)

Michael Thonet´s success of steam bending furniture can serve as an example of how the technique successfully can be used in functional products for production: *"Chair No.14 cleared the way for Thonet to become a global enterprise, and numerous successful bentwood designs followed. Thonet's production peaked in 1912: that year, two million units were produced and sold worldwide."*

("THONET: Information". 2016)

chair no. 14 by Thonet
http://en.shop.thonet.de/classics/range-214?orderId=&a=526

SCANDINAVIAN TRADITIONS

In Scandinavia, there are long traditions of using wood and by bending wood. This is existing knowledge I can learn from and build on.

There are still some craftsmen using these techniques today, but due to competition from mass production, it´s most done as a hobby in Norway today.

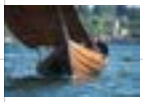
Old Norwegian solid bentwood “Hegd” (https://digitaltmuseum.no/021025594422/hegd?aq=topic%3A%22Hegd%22&i=2)

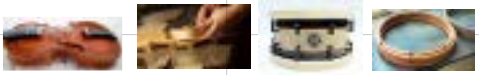
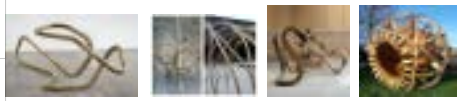
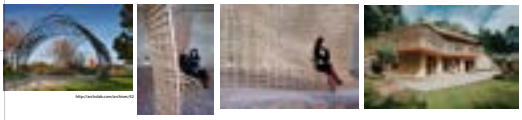
Traditional Norwegian box, made with a technique called “sveiping”. Sveiping is similar to steam bending, but instead of steaming the wood, it´s boiled in water.

https://digitaltmuseum.no/021026859400/butt?i=3&aq=technique%3A%22Sveipet%22

In the process of "sveiping"

The map on the next two pages, is a result from my gathering of images of solid bent wood objects. It´s arranged in a historic perspective It´s not ment to be a complete map of everything that´s done within the field, but to get an overview of different categories and areas where bending of solid wood are used.

	ANCIENT	STILL DONE TODAY	MODERNISED
KAYAKS		 	?
SNOW SHOES			
SKIS		 	
SLEDGES			?
BOAT BUILDING		 	
MAST RINGS			
"HEGDER"			
"SVEIPEBOKSER/ SPONESKER" SCANDINAVIA	    		
MAGEWAPPA - JAPAN	 	  	   

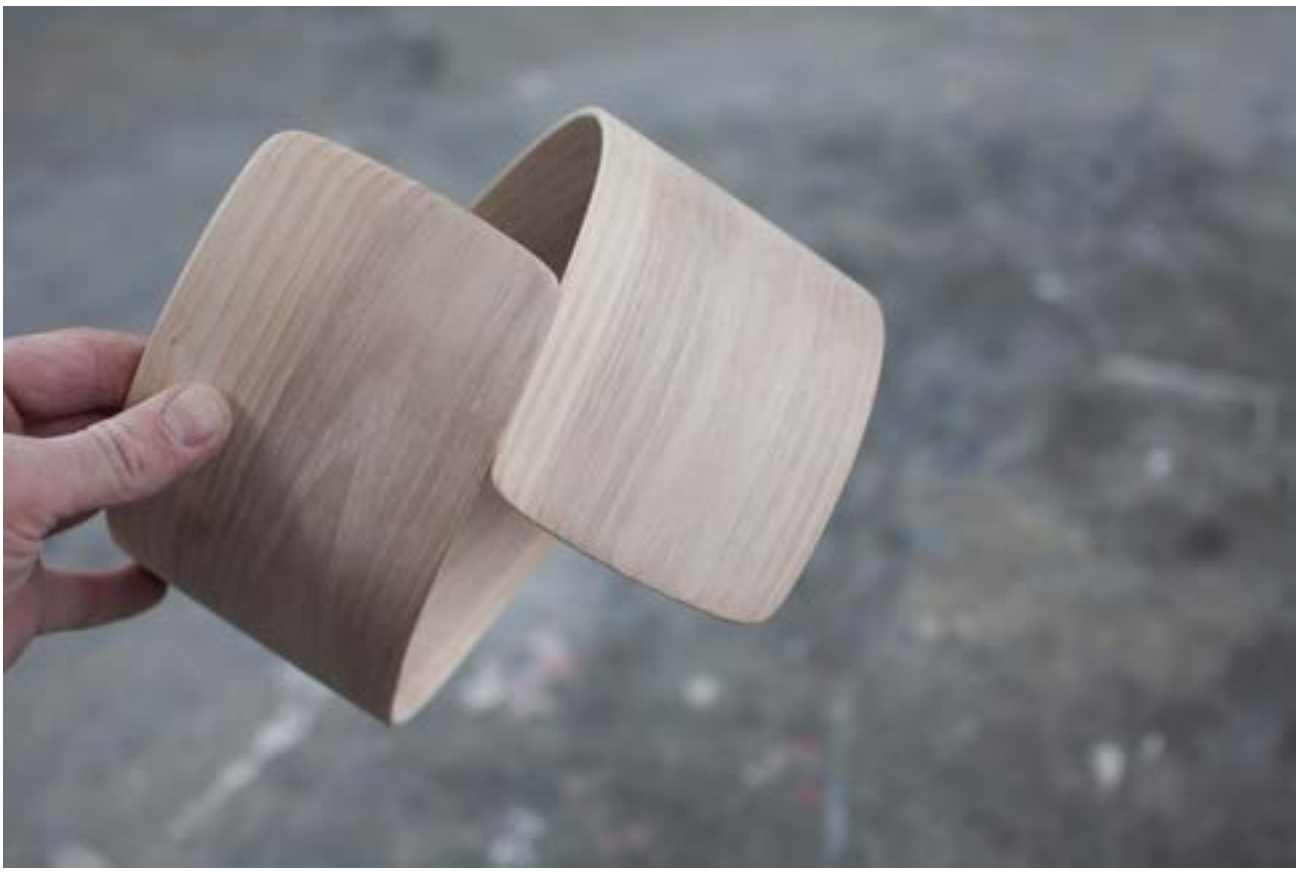
	ANCIENT	STILL DONE TODAY	MODERNISED
FOOD STEAMERS - CHINA			
SHAKER BOXES - AMERICA			
FURNITURE			
INSTRUMENTS			?
SCULPTURE AND INSTALLATIONS			
INTERIOUR			
LIGHTENING			
ARCHITECTURE			
JEWELLERY			
ETC			

OWN EXPERIENCE

During last semesters project (self-programming spring 2017), I developed knowledge and an understanding of how to bend solid wood. Through trail and error, I have learned how to get desired results within steam bending and bending with hot water (the Norwegian technique “sveiping”).

The project was a study of traditional Norwegian craft techniques within woodwork. The final goal was to have one or more suggestions of how a chosen technique could be used in a meaningful way within a small scale production today. I ended ut choosing “sveiping” as the chosen technique.

During summer 2017, I attended beginners and advanced steam bending course, run by Charlie Whinney. This gave me further experience with the technique.



Process images from my self-programming project

Process image from my self-programming project

REFERENCE LIST

Treteknisk. “Fokus 8 - Tre og miljø.” Accessed August 15, 2017. http://www.treteknisk.no/publikasjoner/fokus-pa-tre/8--tre-og-miljo

THONET: Information. September 13, 2016. Accessed April 26, 2017. http://en.thonet.de/about-us/company/information.html

VERITAS Steam-Bending Instruction Booklet. Veritas Tools Inc. 2011. Accessed April 26, 2017. https://www.leevalley.com/us/html/05F1501ie.pdf

“Hegd.” Stiftelsen Nordmøre Museum / DigitaltMuseum. Accessed April 26, 2017. https://digitaltmuseum.no/021025594422/hegd?aq=text%3A%22hegd%22&i=2.

“Investigating wood”. 2001. Accessed April 26, 2017. http://www.heritagewoodsonline.co.uk/Wood%20Investigations.pdf

“A Steam-Free Way to Bend Wood: The Hot Pipe Method.” Core77. Accessed April 27, 2017. http://www.core77.com/posts/36792/A-Steam-Free-Way-to-Bend-Wood-The-Hot-Pipe-Method.

Matthew Schulte, Steven Mankouche, Joshua Bard and Tsz Yan Ng The University of Michigan, Ann Arbor, M. “Digital Steam Bending: Re-Casting Historical Craft Through Digital Techniques” ARCC 2011 | Considering Research: Re ecting upon current themes in Architecture Research. Accessed April 27, 2017. http://www.arcc-journal.org/index.php/repository/article/viewFile/338/274

"Digital Steam Bending." Archolab RSS. Accessed April 27, 2017. http://archolab.com/archives/42.

"Psychological properties." Wood Products. August 11, 2014. Accessed April 27, 2017. http://www.woodproducts.fi/content/psychological-properties.

"MAKE." Barmenbrekke.wordpress.com. December 30, 2016. Accessed April 27, 2017. https://barmenbrekke.wordpress.com/portfolio/make/.

LITTERATURE LIST

Benson, Jonathan. Woodworkers guide to bending wood: techniques, projects and expert advice for fine woodworking. East Petersburg, PA, Fox Chapel, 2009.

Fine woodworking on joinery: 36 articles. Newtown, CT, The Taunton Press, Inc., 1997.

Fine woodworking on bending wood: 35 articles. Newtown, CT, Taunton Press, 1985.

Stevens, William Cornwall, and Norman Turner. Wood bending handbook. East Petersburg, PA, Fox Chapel Publ., 2008.

Hoadley, R. Bruce. Understanding wood: a craftsmans guide to wood technology. Newtown, CT, Taunton, 2001.

Noll, Terrie. The joint book: the complete guide to wood joinery. New York, Chartwell Books, 2006.

Schleining, Lon. The complete manual of wood bending milled, laminated and steam-Bent work. Fresno (CA), Linden, 2002.

McGraw-Hill yearbook of science & technology 2008. New York, McGraw-Hill, 2008.

Kucera, Bohumil, and Ragnar M. Næss. Tre: naturens vakreste råstoff. Oslo, Landbruksforlaget, 2000.