BENT FURNITURE COLLECTION

/ UNITY IN DIVERSITY

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This thesis is about the design of a furniture collection, meaning the prototypes of a stool, a simple chair, an armchair and a table. We call individual pieces of furniture a collection if they show some kind of unity or have the same origin. When designing a collection, the specific question is what can be the concept applied to all the furniture pieces, however, individually each piece has to fulfil the requirements of its own function. Generally expressed, what kind of unity can result in diversity?

The motivation of this thesis is coming from an earlier design concept of a chair which shows an answer to the question of how structure can be designed as the most organic part of a function. The relevance of this objective is its driving force toward clean solutions, facilitating harmony between function, form, material and structure. The result of the earlier project inspired more ideas and this thesis is aiming to extend the same concept to various functions, searching for new answers through the design of the BENT collection.

Since the topic is pragmatic, the findings are coming from real materials, physical objects and live experiences. The birch solid wood and moulded plywood material chosen, the standard carpenter’s machinery method used, and the simple joinery of the concept provide a relatively efficient way of prototyping, in line with the idea of mass production. During the process, all the ideas were tested and judged in reality using practice-led, empirical and experimental design research methods.

The paper part of the thesis is a detailed report of the process from the beginning to the realisation. It attempts to capture the decision-making moments of the design process by following the shaping interaction of the experiments carried out and the concept to be applied. The paper aims to understand more about the design and explain it again in a reorganised way by looking at the process through an aware, critical and analytic eye.

Beyond the physical outcomes of the thesis, the final concept of the design is maybe even more important than the prototypes themselves. The latter are representative enough to show the values of the concept, and with further development, the BENT furniture collection has production potential.
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We are surrounded by the built environment on different scales, such as city infrastructure, buildings, spaces, rooms, furniture, tools, decoration, and all kinds of objects. For me as a designer, the most fascinating is the furniture, being the closest to the scale of the human body. As with the smaller objects, furniture has a direct relationship with us, but at the same time, furniture also has a structure like buildings.

Usually, furniture is designed based on human aspects, such as function and role, comfort and ergonomics, cost-effective manufacturing and economic considerations. Those are all important to human needs. Structure in furniture usually has a minor, subordinated role, serving all the aspects mentioned above. This is of course self-explanatory since the purpose of the phenomenon called furniture is its function, which needs a structure, and not vice versa. No structure is made only for itself, its serving role is coming from its nature. But what if the structure gets the same importance during the design process as any other aspects? I have been always interested in looking at furniture as a built composition, forgetting its function for a moment, and analysing it only as construction. Especially chairs can be super interesting from this point of view because they have the most complex compositional requirements beyond pieces of furniture. According to my assumption, when designing a chair, the idea of function and structure being equal is relevant because it has a driving force toward clean solutions, facilitating harmony between function, form, and material, organised by the structure. [fig. 04] The conceptual aim was formulated, that is, to design furniture pieces with the structures as the most organic part of the functions, but not at the expense of any other consideration.

Initially, a design of an earlier project motivated this study. In that chair, the idea that the function and structure can be equal was realised. The success of the concept confirmed its relevance and inspired more ideas. This thesis attempts to extend the same concept to various functions, searching for new answers through the design of a furniture collection. [fig. 06]
When designing a collection, there is a general consideration the design requires. We call individual pieces of furniture a collection if they show some kind of unity or if they have a common identity. The identical feature usually originates from the way of manufacturing and the same available material, triggered by the well-known human approach, how can we get diverse solutions from the same conditions? In the context of a furniture collection, it means that while the concept applies to all the furniture pieces, at the same time, each piece has to fulfil the requirements of its own function. In other words, the design is a balance between unity and diversity.

I was aiming for a common identity, originating from the system of the design. If there is a toolset containing standard elements, and there is a suitable system for joining them, different kinds of compositions can be constructed and applied for the desired furniture functions, just as in the tangram puzzle game. [fig. 05]

In the context of this thesis, it is inevitable to mention Alvar Aalto’s name. The design heritage of him and generally the modern Finnish design approach have had an obvious impact on my design attitude. In line with the classic modernist mindset, my design aimed to be easily repeatable based on technology, instead of craftsmanship, so that it is suitable for production. In other words, I was not aiming to create unique artefacts, but the design itself is a unique product. Using bent veneers in furniture is one of Alvar Aalto’s iconic design actions. In my design, I also wanted to discover the possibilities of this way of making furniture. My attraction originates from the structural advantages of the plywood, and also from the mindset of using birch as a local material with modern technology. As with the typical Finnish design approach, my design is also intended to apply pragmatic solutions, not to be afraid of showing the structure and undertake the technical consequences of the look. This way of building furniture encourages the designer to think of the structure and technical details as organic parts of the piece, which I was exactly interested in. Considering the eco-friendly ways of production was also one of my goals, similarly to the general design ethics. I wanted to create simple shapes that are easy to produce, not only to minimise the expenses during the production but also for the easy look and clean visual message of the pieces. It is almost a cliché to mention that good design is long-lasting and has good quality. Still, it is not always the priority, especially in thesis work, when a concept can win at the expense of long-lasting quality. Since one of the important
goals was to design for the potential of production, the
design obviously aims to be long-lasting, reliable, and of
good quality. However, this study strives to present only
prototypes; the final quality depends significantly on the
fine-tuning process, which develops from prototype to
mass production. Another consideration derived from the
Nordic design attitude I was following is the design for
a comfortable and general way of use, which, without
being too specific, stays at the standard and simplest
ways of using furniture and provides the widest range of
applications.

After I got the goals established, the design process was
divided into the following steps: First, to materialise the
idea while defining the concept more specifically. The
concept would then be extended into a system by testing
and experimenting by letting the concept be shaped.
Finally, to apply the redefined concept to the collection’s
prototypes. In the meantime, I was also adamant about
finding and keeping the essence of the original idea.

The thesis proceeds along these processes: materialise,
extend and apply the concept. Before moving on to these
steps, next I describe the methodological choices.

[fig. 06]
Since the topic is pragmatic, the findings come from real materials, physical objects and live experiences. During the process, all the ideas were tested and evaluated in reality using practice-led, empirical and experimental design research methods. [fig. 07] Standard carpenter’s machinery method was used, and the simple joinery of the concept provided a relatively efficient way of prototyping, in line with the idea of mass production. [fig. 08]

The paper part is a report about the findings and documentation of the results. It focuses on the design process, observing and explaining, how the design concept worked out and how the process resulted in actual pieces. The observation is about my personal experience of designing, reflecting on my decision-making mechanism when doing design, detecting the aspects that influence the design, and becoming aware of how I prioritize. And all this with the aim that I can understand more about the design I am doing and explain it clearly. The more I understand the better I can explain, the better I can explain, the more I understand. The thesis is written from an individual point of view, from the creator’s own perspective, trying to look at the process through an aware, critical and analytic eye.

Though I am self-observing in the whole process, the thesis is not about me, and the thesis does not attempt to deal with the psychological mechanisms of decision-making, however, they strongly affect any kind of creative work. In the thesis I focus strictly only on the developing of the design, trying to explain the reasons for the design, by becoming aware of the nature of the design. At the same time, I can detect findings related to my own, hidden operations, but that is a topic for another genre and it is another scope. Even if I mention or refer to them, I am not trying to explain or analyse them.

Now we can move on to the next chapter and see the steps of the process in detail.
PROCESS

/ MATERIALISING
/ EXTENDING
/ APPLYING
The starting point of my work was an idea, a rule, a concept for how to design a chair. It is a general and theoretical hypothesis, becoming more interesting when it materialises, because then the question is how, and it results in interesting solutions.

As I mentioned earlier, I assumed structure in furniture would be the most organic part of the function. [fig. 10]

First, I am going to expound on the initial idea, and next, how it is embodied in the design of a metal chair, and last, how it was transformed in a wooden version. The idea was that all the elements in the furniture work both ways: functionally and structurally. In other words, there is no repetition of any compositional elements. What does it mean in the context of a chair?

If there is something already in the composition for a functional reason, e.g. seat, it has immediately and necessarily a structural role, since no seat can float by itself, ergo, it has a connection to other elements, e.g. legs. According to the idea, the functionally composed seat is supposed to serve all the structural reasons, possibly occurring in order to stabilise the whole construction. Since the seat connects the legs, no more connecting element is allowed between the legs only for a structural reason, e.g. stretcher, beam or brace. Only if other functional elements are needed, e.g. a backrest or armrest can be the reason for another connection between legs. So, in the given example, the challenge is to design the seat, backrest and armrests as braces, or vice versa, to design the braces as seat, backrest and armrests.

As an illustration for an easier understanding, next we will see the materialization of this concept. The actual design of the metal chair will be introduced hereunder, named FOLD Chair No 1. [fig. 10]
I will first analyse it as only a structure. There are two frames, made up of welded metal tubes. The frames work as truss structures, absorbing the longitudinal forces — the compressive and tensile forces. The three connecting profiles are made out of folded sheet metal, adding a new quality to the structure — the sheets with different planes prevent torsional movements of the piece. The way the three profiles are joined, the folded sheets form beam-like structures because of the edges of the folds. So, the two frames are connected at four points by four braces, stabilising the system. The formats of the materials — tubes and sheets — are in harmony with their structural roles. [fig. 11]

Next, I will describe the functional relations. The needed components are the seat, the backrest and the armrests, providing a general, non-specific sitting comfort. The seat and backrest require surface-like quality, so they are made up of sheets. In order for them to be at the right height, we need legs to fix them. According to my idea, it needs to be solved by the sheets functioning seats and backrest without additional braces. Since the sheets need to connect to the legs somehow anyway, the fold can be designed to provide both the joining possibility to the legs and braces between the legs. The leg role can be fulfilled by pole-like format, in this design they appear as a contrast to the sheets. The armrest is formed also by a pole, fixing the front and back legs, and holding the sheets.

After the analysis, I briefly reflect. By using the structural properties of the material in different formats, the idea that the functional elements fulfil the structural role was realised. The result is sturdy and comfortable, and the visual message is coherent. However, the experimental approach is clear: structural purity and conceptual ideas in the design were prioritised at the expense of armrest comfort. Another unpleasant property is its material. Metal makes the chair cold, heavy, and noisy.

This chair, called FOLD CHAIR No1, gave the proof of further investigation of the concept. It became the predecessor of the wooden version No2. The metal armchair is a success of the idea, but due to the brittleness of the material, it called for a wooden version. [fig. 12-14]
In the No2 wooden armchair, there are two formats of the birch: the solid birch frames are forming the legs and armrests, and the two frames are connected by three moulded birch plywood profiles providing the surfaces of the seat and backrest. [Fig. 15] The way the three moulded plywood pieces connect to the legs serves the structural demands so that no additional brace is needed. The most important feature of the design is the joints where the veneers are bending to the solid wood legs. [Fig. 19] This organic connection is the essence of the design.

When loading the structure by sitting on the chair, there is a perfect harmony between the stresses arising in the structure and the natural behaviour of the materials. In addition, the bent and flexible profiles give a comfortable and playful sitting experience, however, the inflexible centre, thanks to the solid frames, provides stability and security. [Fig. 16]

The wooden pieces of the armchair are fixed to each other by bolts, so they can be flat-packed. FOLD CHAIR No2 can be used as a dining chair or as any other domestic chair owing to the friendly wooden appearance, the elegant proportions and its comfort.

Though the backrest follows the spin line and makes the seat comfortable, I found the visual language of the whole not coherent because of the curve of the backrest. The simple, well-recognizable, more geometrical shapes fit better with my idea. I decided to keep the backrest straight in further development.

In FOLD CHAIR No1 and No2 structure and function are carefully harmonized; each element works both ways: structurally and functionally, there is no useless piece in any of the compositions. Both armchairs represent the design of using materials of their own nature and the design of the pure structure.
I was motivated to apply the same concept to new shapes and functions. I was curious how this strict rule system I determined could work out with other compositions. First of all, I wanted to design a chair without armrests. I assumed that would be the first step to extend the concept for various functions, and I was right, but there was a slight issue with this.

As I described detailed above, in the two armchairs each piece has a structural role, because of the conceptual rule. Since my hobbyhorse was that there is no useless piece in the composition, removing an element is not that simple. Besides, armrests have a very important structural role in my previous designs, the functional role is almost secondary.

If the armrest is just simply removed [fig. 20-21], the front and back legs are connected only by the middle component. Consequently, when loading the structure by sitting down and standing up, the legs slightly open and close flexibly. The movement alone would not be a problem, but its extent is too much, and also, the direction of the loads is forcing the middle component to open, whose structural strength is better when forced to close, loaded from the opposite direction. I found this not in line with my idea, so I started to search for a better solution for the version without armrests.

For a long time, I was holding this hypothesis too theoretically and too convulsively. My creative attitude got into the groin of this theoretical and strict rule system, therefore, I started to think more analytically. I listed the possible solutions as variants for the same problem, and I set up an evaluating system to analyse the results. I was not able to decide by a subjective intuition by being flexible, I wanted to convince myself by finding the “only, single and perfect” answer to my question.

At this point I let myself dig deep and I let myself be analytic instead of intuitive. As an analytic person, I was focused on the problem, i.e. the concept I had. I handled it as an unalterable and valid task to solve. My illusion was that I only need to work hard enough to come up with a perfect answer. I found the question challenging enough to be worth tackling.

Because the problem I had was solid, I got into a loop, in which I was coming up with more and more ideas. I wanted to try all of them, and I wanted to prove and understand why they cannot be a good answer to the question. Below, I am going to present the results of this recurring trap situation in a linear format.
I will now introduce the design aspects I used for evaluating the ideas. Also, I wanted to fulfil these aspects in a maximalist way, as perfectly as it was possible.

The first aspect, of course, was to keep the original concept, that is, use everything structurally and functionally at the same time. The next is strongly related to the first aspect, structural reasonability, meaning the manner of using components based on the materials’ structural nature. One more aspect related to structural considerations is the sturdiness in all ways; wobbling back and front, right and left, torsion and all other occurring transformations when the structure is loaded. The next important aspect was thinking in collection so that the components composed differently can provide various functions. This is in line with the next aspect, which is the potential for mass production.

User experience is crucial. I divided it into the aspects of ergonomics, comfort, and sitting experience according to expectations. The practical usage, such as storing or moving, could have been added. However, those aspects were not on my list, and those were not the determining aspects of this study.

Last but not least, I was also evaluating them by the subjective term of beauty and my personal preference, finding the favourite. In a less subjective way, it can be also called visual coherence.
I made almost every idea on a one-to-one scale so that I can test them and see them as functioning chairs. I have also tried seemingly bad ideas, aiming for finding new, unexpected results. My simple aim was to remove the armrest and come up with an alternative way of fixing the legs.

After simply removing the upper part of the legs and armrest [fig. 20-21], it seemed to be a handy solution to somehow connect the legs. The first idea for connecting them was to use a slice of the middle component by placing it just below, in-between the legs. [fig. 23] Similarly, another concept was to make the middle component double-decker. [fig. 24] These mock-ups were not satisfying enough structurally; they made the structure only a little bit stronger at the expense of ruining the concept and the visual coherence. The attraction of these ideas was to use an already existing element in the composition instead of adding something new. In line with this idea, I also had an experiment with moulded plywood legs [fig. 25, 28], replacing the solid wood ones. Visually, it was too much; the message of the action was unclear, and structurally and compositionally, it could not work out.

As a next step, I connected them by a beam. [fig. 26-27] I tried to put it in lower and higher levels. It made the structure sturdy enough but ruined the concept, and more importantly, the composition visually was not coherent, and I did not like it at all. When the beam was placed at a higher level, the legs had to be placed inside of the middle component, therefore, the two more moulded components can be only attached directly to the middle part, and not to the legs. This did not make any sense, neither visually, nor practically because the created shape collects and keeps the dirt and dust. Additionally, it also made me rethink the importance of the two components of the seats. [fig. 30-31] Anyway, when I looked at the design without armrests [fig. 21], the divided parts of the seat looked unnecessarily complex, making the appearance and also the production complicated. So, from this point, I also started to think of a solution for a one-piece seat component. [fig. 31] The middle element with the four legs automatically started to work as a core of the compositions.
For the seat surface, I had several options. One idea was to gain it also from a mould, but from a totally different shape compared with the original front element. This piece bend to the back legs, instead of the front legs, so it laid on top of the middle component but run further to the front. [fig. 32] This new composition inspired the idea of fixing the two front legs at two more points: from the top to the seat element. I hoped, that the created, small triangle, and the doubled connection between the legs [fig. 36] can fix the structure strong enough. The mock-ups could not prove the prediction, most probably because I did not glue them, to keep all the pieces variable. Without glue, the connection was not tight enough. If it was convinced in other aspects, I could have accepted the use of glue, but there were more problems. The middle and the seat components were supposed to follow the same curve, turning paralleled. But the moulded plywood elements’ radius cannot be provided precise enough, there is always unpredictable flexibility around the planned angle and radius [fig. 36], and in addition, it changes according to the moisture in the air. It seemed, that these paralleled components never can be precise enough to turn tight without small gaps, especially if we think in production. To avoid this problem, I also variated the order of the leg, the seat and the backrest element, so that the gap at the turning is obvious [fig. 37], but as a consequence, the gap disappeared between the backrest and seat, creating again a collecting shape for dirt and dust. Also, it bothered me, that for this composition, I needed still three moulds [fig. 32, 36], contrary to the concept of simpler production. On the other hand, this composition was one of my favourites. [fig. 32] Its proportion and general visual look were satisfying for me, and I wanted to achieve something similar. For the three-mould-problem, I had an idea and by this, I was able to reduce the number of moulds to two. From the same mould, it is possible to get both the pieces of backrest and seat. [fig. 38-39] This idea became my favourite, and the one I was mostly interested in. Although in the final pieces I did not use this development, it inspired more possibilities and compositions, which I will briefly refer to at the end of this study.

Next, I thought, what if the seat is just a simple plain piece [fig. 33, 34] or coming from the same mould with the backrest [fig. 40, 34] and connects to all the four legs? It seemed good enough, especially with glued connection, but the composition was somehow unreasonable, the middle component’s shape did not make sense anymore. By hiding the middle component from above, the beauty
of the turning action disappeared, which turned out to be important for the look and the coherent composition. But anyway, this was the first mock-up containing the final elements, and by playing and assembling them in different ways, new compositions can be created. [fig. 34]

If the seat is not the one which can fix the legs beyond the middle component, then what else can be a connection? Since I was using bolts for fixing the elements, the idea came, that the metal threads could be extended and connected to the legs. [fig. 29, 35] I had big expectations from this version, since the metal rod is organically originating from the bolt joint, it is just an extended version of the bolts. For this version, a new middle component was needed with differently directed holes for the rod. (For the other experiments I used always the same middle component.) Therefore, only for curiosity, I made a thinner middle component. This time, instead of 9 veneer layers I used only 7, assuming, the metal connection makes the structure anyway strong enough. From this point of view, the result was disappointing. The structure happened to be extremely weak, and not because the legs were opening, but because the torsion was significant. The big and important conclusion was that the thickness of the middle component is significantly important for structural sturdiness. Even though I liked the composition with the metal rod, in this format the structure was weak. If I thickened up the middle component again, the question was raised, what if even more than 9 layers are making up the middle component? Maybe an additional brace is not even necessary? Seemingly, the extra connection does not help for the torsional movements. After this experiment, I was repeating to myself this fact consciously.

The last experiment I made is connected to the latter conclusion. I decided to make a thicker component for the seating, but instead of using it as a middle component, I extended it so that it can provide the whole seat surface. For this chair, I needed a different shaped mould, but only two moulds were enough for the whole chair. [fig. 41] The composition was rather convincing. The original concept worked out perfectly, all the pieces were functional and structural at the same time. The chair is set up only from 6 elements: seat, backrest and the four legs. I liked this purity. The visual aspects were ambivalent, though. I found it strange but I also liked it. The obvious disadvantage was the collection-wise aspect, it would have been hard to extend for more functions, using only these two moulds, both of them being specific. And also, when standing up, the deep surface at the front was uncomfortable. However, the most important proof of this piece was, that the thick component structurally was perfectly enough to fix the legs, no additional connection was needed!

The direction of the research got far from the design of the FOLD Chair No2, a wooden armchair, mainly because of the one-piece seat, which made the look clean and simple. Though at this point I focused only on making a chair without an armrest, in the background I was considering the aspects for designing the other pieces of the collection. I knew that I will change the seat as one piece, and I knew that a new armchair was going be to born naturally from the design of the simple chair, meaning, the FOLD Chair No2 is not going to be a member of the collection.
No matter how strongly I wanted to solve the problem, specifically expressed, removing the armrest but still providing a stable connection between the front and back legs, my rule system was too strict to let any solution become valid. I found always something “unacceptable” in all the results.

To proceed further from the situation in which I got stuck, I had to redefine my original goal and evaluate the whole process so far. The question that helped me was: what is the essence of the design I was doing if I ignore the conceptual theory for a moment? I realised, apart from the conceptual theory, many valuable design features were worth noticing.

The material pick is one of the best parts of the design. The moulded plywood surfaces and the solid wood legs have been always in good harmony with structure and function in all of the previously presented variations. The usage of material also includes the way of implementing the components. The presence of a mould throughout the manufacturing process encourages repetition, which predestines production-like thinking. Another important feature is the joint detail of how the veneers are bending to the legs from the side view. [fig. 48] This meaningful detail tells a lot about the essence of the design because it comes from the idea of sheets are not only providing the functions but by the bent shape, they are also able to work as braces for the legs. Maybe it is a minor detail, and only a consequence, but it can still be on this list, is the flexibility of the backrest, and the way it bends when leaning back. At last, the strength coming from the conceptual theory has to be mentioned, too, because it resulted in minimalistic structural solutions, giving always a clear and straightforward outlook. The design was saved on the details, prevailing its identity.

After acknowledging the advantages, I let the conceptual theory go, and I based my decisions on the strengths of the design, intending to apply it to diverse functions.
At the beginning of the chapter, I was writing about the analytic approach, focusing on the problem, that is, on the conceptual theory. During the analytic process, I have deepened my knowledge of the nature of the problem to be solved, meaning, what kind of requirements a structure has in a chair if these certain materials are used with these certain joints. I have mapped the possibilities and tried to find the recipe for the solution. However, this kind of approach is not typical and efficient for solving design problems, this is more akin to how science works. Lawson, who investigated the design process deferring from other ways of thinking, described designers as having a solution-focused strategy, instead of a problem-focused. This statement fits my process. From this point forward, instead of focusing on the problem, I started to focus on the solution actively. Specifically, I chose a more pragmatic and less theoretical approach, following intuitions and subjective taste, making decisions proved by my judgement and not waiting for scientific permission.

Now we can move on to the next chapter about the application of the design.
I prioritised the strengths, and the joint detail came first in the ranking. The appearance of this detail is not accidental but comes directly from the metal armchair, based on the idea of sheet material folded to the legs, working as a brace, beyond providing a seat or backrest [fig. 49]. Later, sheet metal became moulded plywood, showing the action of bending more didactically; this is because of the contrast between the straight solid wood with its homogeneous texture and the bending veneers with their identical layered texture. As earlier expressed, this joint gives the essence of the design, suitable for being the determining property of the furniture. In order to prevail on this feature, the other details had to be calmed down. This led to the decision to thicken up the middle module so that no additional brace is needed in any format, not even as armrests. [fig. 50]

Once I realised and accepted, that the solution is to leave the brace and thicken up the middle component, a new chapter began in the design. It gave the possibility to construct different compositions more freely. Since the making procedure, the material, and the joints were already decided, the focus shifted to the different functions the compositions could provide. The question, since then, was more about how unity appears in diversity, specifically, how the pieces are going to show the identical feature, that makes them a collection.

The next important consideration, to which I subordinated other aspects comes from the moulded way of creating the components. Since I was aiming to design for several functions, the production-like approach led to a new way of thinking: how can the fewer moulds provide all the forms that the various compositions need? Finding an answer to this question also helped in thinking in terms of a collection rather than individual pieces.

Two moulds are the absolute minimum needed while keeping the essential joint. One for the backrest and one for the middle component. That is because the angle formed by the backrest with the chair’s back leg differs from the angle the seat and the legs are forming, meaning, that only one mould would not be able to provide all the different angles needed. Two moulds are anyway better for giving more possibilities for diverse compositions.

The symmetricity of the middle component was also a conscious decision so that it can be switched and connected from both sides by the same angles. And also, besides chair-kind of asymmetric compositions, the symmetric middle component can be used in symmetric compositions as well, i.e. table.

While combining the components to get different variations, a system was shaped more and more clearly. The components so far were the backrest component, the middle component, and the four legs. To achieve the most compositions, one more additional component was needed, which is the simplest, straight plywood board. With those 7 standardised elements, it was possible to set up all the functions, which can form a 5-piece-collection.

In summary, the application of the concept meant first, the change of the thickness of the middle component, so that it is thick enough to work as an only brace between the front and back legs. The second is the optimisation of the two final moulds for the backrest and the middle component. And last, one more component was added to the system to provide all the functions. With these changes, the 5 final pieces of the collection can be constructed.
The Armrest of the Armchair

For the armrest of the armchair I had to face some difficulties again. Depending on the way of fixing the armrest to the backlegs, I had several options. All of them were working so I could not base my decision on the “best working one”. [fig. 54-56]

I decided to make the same joint between armrest and backleg which I used for other joints in the compositions. Using the same mould as for the middle component, I got the two little moulded pieces for the armrests. I was hesitant for the shape and direction of the armrests, it was really difficult for me to find a shape for something which is not anymore a structural issue. [fig. 51-52]

For the armchair prototype I made a decision but it can be later still varied. [fig. 53, 57]
OUTCOME

/ DESCRIPTION

/ USAGE

/ FURTHER IMPLICATION
**Middle component** The middle element is coming from mould, so its angels and sizes from the side-view are determined, however, the width of the component is variable. This parameter can be adjusted for specific functions. The middle element works as a core element in all pieces of the collections, not only compositionally but structurally as well. For fulfilling the latter role, it must be thick enough, I used 11 layers of 1 mm thick birch veneers. For the armchair I made a thicker middle component with 13 layers.

**Backrest component** The other element coming from the second mould has only one angle, so even though the angle is constant, beyond the width, the length is variable as well. This element can serve the backrest role and only the two chairs in the collection need it. In addition to its own function, structurally, it provides an additional brace between back legs. According to thickness, the flexibility can be fine-tuned. During the process I was also experimenting to reducing the layers inside one piece, meaning that at the brace part where it is the most loaded by forces it has the most layers, and coming to the top part of the piece, the veneers are gradually reduced by 5 or even 3 layers. The reduction gives a great value to the flexibility, however, in the prototypes of the chair and armchair I used 7 layers without reduction.

**Plain component** The next element is a piece of plain plywood, meaning, that all the parameters are variable, the length, width and shape. Its flexibility and simplicity can provide many different functions in the collection. This is a piece which can be easily upholstered or finished with various qualities, such as linoleum, fibre-glass, painting, or simple wax. This piece can be considered as the compromise of the initial concept since function and structure are split by its presence, not being the same anymore. This plain plywood piece has mostly functional purposes in all the pieces of the collection, and that is its great benefit, meaning the variability of its shape, and the surface is perfect to fine-tune the pieces according to the function. In that sense, it is the “jolly joker” among the components.
Leg components

The four legs are four more components, more precisely, we can talk about two pairs of components, because two-two are the same in all the pieces. The variability of the legs is first of all the length, but according to the functions of the pieces, they join in different ways to the plywood components.
Materials

The main material of this design is birch [fig. 61], however, it is used in two different formats, in solid wood [fig. 62] and layered veneers [fig. 63] formats. These two qualities have significantly different properties structurally, functionally and sensually. Solid wood is paired with the main holding roles such as the legs. The functional roles, meaning the seating, backrest and armrests are fulfilled by the surface-like layered veneers. The homogeneity of the birch allows emphasising the play of the compositions, by not being too textured.

During the design process, it became obvious that the most efficient way to connect the pieces is to fix them with bolts since it is fast and lets the pieces be changed. However, after the experimental phase, since the compositions have been formed, the decision had to be evaluated again. The metal thread in the wooden hole makes the hole bigger and bigger over time, so it can be only a short-term solution. Another option instead of bolts could be the glued, wooden pins, but the bolt connection has many other advantages contra glued wooden pins. The bolt connections allow flat-packing, and its industrial nature fits with the whole production-based design concept better. The disassembly was not important anymore, for the other reasons mentioned above, the bolt connection has been chosen, at the expense of alleviating the metal thread problem.

structures

All the furniture compositions are built on the core, which works also as a structural core. The middle component due to its thickness is strong enough to keep the legs fixed. The two chairs have one more brace, formed by the backrest element. In the table function, there are two horizontal layers, which make the structure stronger.

The original concept has been transformed, not every element has structural and functional roles at the same time, since the plain plywood elements are used for functionality, however, they make the structures sturdier in all compositions.
Joints

There are three combinations of how the legs can connect to the middle component, forming the core.

In the bench, stool and side-table functions all four legs are fixed from the inner side of the core element. The solid wood pieces end at the point where the veneers start to bend. The bent curve frames the edgy ending, contrasting with the edge and curve. From the side view, it appears as a symmetric composition, which makes sense, since these functions typically call for symmetric structures because of the horizontal surface they have.

In the two chair compositions, the pair of front legs are fixed from the inner side, but the pair of back legs are placed outside of the middle component. Meaning, that there is an asymmetric scenario, well harmonized with the function of the composition. The legs are fixed outside to provide a place for the backrest component to connect. So, the joints at the back legs hold two bent components, those bending in two directions, and the appearance of this joint is the origin of the whole project.

The third way how the legs connect to the middle component is symmetric again and suits for a table-like function. Both pairs of legs are fixed from the outside of the bent plywood and run up way. This type of joint shows a new composition with the curvy bending and the straight solid wood.

The three types of joints play all the combinations possible, making a nice trio of joints. These differences in the connections allow different compositions, however, since all of them are only different combinations of the same elements, they show a strong unity, and they refer to the same idea.

[fig. 64]
The middle component with four legs naturally became a core for all functions. The role of being a core was earlier detected, but at this point it became purposeful. Adding the standardised components in different ways to the same core creates various compositions, and more importantly, they can provide various proportions for specific functions.

The core itself can be an individual prototype. Depending on its proportion, it can be a stool or a bench. In this thesis, there is a bench presented as the first piece of the collection.

If the plain plywood element is fixed to the top of the core providing a bigger surface, the function can be a stool, side-table or small table. So, the second piece of the collection is a side table.

Adjusting the size of the plain plywood and adding the other component coming from the second mould to the two back legs, we get the simple chair of the collection.

The armchair has longer back legs and two more cut pieces from the middle component as armrests.

If all four legs are longer, running over the surface of the middle component, and on the top of the legs a big plain plywood piece is fixed, we have a table with a small under-shelf, forming the fifth piece of the collection.
Surfaces

For the prototypes’ upholstery I used a dark woolen fabric from the company Kvadrat, product Hallingdal 65. For the hard surfaces I used black linoleum.

For the finishing of the birch surfaces I used woodwax from Osmo in 2 layers. For the solid wood legs I applied transparent colour, and for the moulded modules I put one layer transparent and another layer “birch” colour, which means a small amount of white pigment to avoid the yellowish effect of the oil. That is the reason of the slightly different colours on the two birch surfaces.

The chosen colours and surfaces intend to express the materials own beauty, by emphasising eachother to make a nice composition.
All the pieces are safe and useful. The two chairs have some flexibility in their backrest, which make the sitting experience comfortable and playful. This is because of the property of the material and structure. The table has a shelf-like surface under the desk, which can provide newspaper storage. The stool and the side-table are fulfilling their function in the simplest way.

Customisation

The plain plywood elements provide to apply various surface qualities, such as upholstery, linoleum or painting. With upholstered surfaces, the chair’s comfort level can be higher. [fig. 74-77]
Application

The BENT Collection concept can be applied for standard use, in domestic, public or commercial situations.
The main outcome of this thesis is the prototypes of the furniture collection. Being a prototype means a representation of a concept and refers to further development. They are ready for testing, evaluating and developing accordingly. The collection intentionally has the potential to become a product, nevertheless, the concept is made — among many others — for mass production. All the pieces are made of final material, the look of the design has its final character, but the details have to be designed to the final functional application and for mass productional technologies.

The pieces of the collection currently presented have certain sizes and proportions, aiming to represent all the compositional possibilities which can serve a function. However, with the same materials and with the same compositional and structural principles, but different dimensions and proportions more functions can be designed. Meaning, different kind of tables and stools, such as dining table, writing desk, small desk, stand for plans, benches and stools of various heights.

During the process, it was a challenge to narrow down the scope and find a sharp focus, meaning the simple pieces of the collection. The concept I had from the beginning inspired more ideas than I could handle on a thesis research scale. That is because a concept can be applied in so many different ways, and in the thesis scope I had to choose only one way. Some of the ideas I tested led me far from the original design and they would have ended up in a totally new story. I was compelled to put them on one side in order to create a complete and compact furniture collection. However, all of them were worth doing for experiences and learning about various design problems raised, and some of them are worth saving for future development.

I was calling the cantilever chair idea [fig. 79] the cousin of the furniture family because the relationship was much looser among the pieces. I am planning to develop further in the future maybe for an extension of this collection.
Summarising the design result, an initial idea of structure in furniture was developed and transformed, and in the end, successfully applied to the pieces of a furniture collection. All the pieces have the same structural core, and adding different elements in different ways to the same core creates the various pieces of the collection. They all refer to the same concept but serve different functions.

All in all, I am very happy with both the outcomes, the prototypes and the design itself. During the experimental process, I thought this concept is too strict to work out successfully, but I got many positive feedbacks on the partial results, which made me think more intuitive about the whole project. The most criticism I received was for the time management. I started to deal with this topic at the beginning of my Aalto University master’s studies in 2019; the metal chair was born for the first furniture course there. The idea of developing this concept was early decided, however, I picked the topic again only a year later. To transform the metal chair into a wooden version was again a long process, meanwhile, I got the intention to extend the concept for a collection. Due to several reasons, such as other projects, pandemics and my analytic and experimental attitude stretched out this process over one additional year. Regarding the thesis guidelines, the process obviously exceeded the required time consumption and workload. Looking back, it is easy to tell, which steps could have been skipped in order to finish sooner. Interesting to mention, that before I started to experiment with the various ideas for removing the armrest, – introduced detailed in the chapter called “Extending the concept” – the advisor of this study, an experienced designer, who has a long carrier behind, tried to lead me towards the solution I ended up finally. At that point, I could have not been convinced by any suggestion, unless I see the possibilities by myself. Me, as a young designer I needed to go through the experimental process to design the pieces. In this sense, the long period was needed not only for the project but for a thorough exploration of the designing process, which I believe the most beneficial for me in the future. I am very grateful for the school environment which made it possible to dig deep into the topic. Later probably it will be very rare to devote this amount of time and energy to a project of this scale. Besides my own experience in designing furniture and developing a concept, I also gathered practical knowledge. I have learned a lot about woodwork, basic carpentry methods, metal work, different kind of technologies and generally about efficient ways to test design ideas.

During the process I had the opportunity to experience the analytic and problem-focused work style, however, I realised the efficiency of intuitive and solution-focused thinking in design, which led this study to the current prototypes. I got the conclusion that making subjective decisions, doing mistakes and pragmatic solutions are more valuable in a design process than theoretical identification. I achieved the set goals I had, not necessarily in the same idealistic way as I imagined at the beginning, but much more realistic and hence identic. I am satisfied with the prototypes as the representatives of the design, and I can even see further potential for the design. Though many times I got stacked during this project, I was enjoying working and monitoring the slow shaping process with an observing eye. I wish in the future I can have similar possibilities to work on.
TECHNICAL DRAWINGS

Dimensions:

- 100°
- 5°
- 420
- 350
- 450
- 818
- 200
- 107°
- 120
- 432
- 380
REFERENCES

/ BIBLIOGRAPHY


/ LIST OF FIGURES

fig. 1-13, 15-81. BALOGH, Imola (2019-2022) photos and sketches