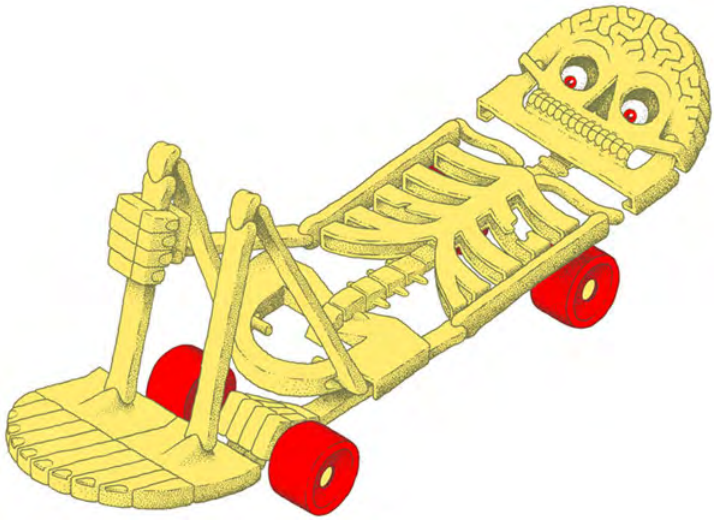
Delft University of Technology

BONUS BOOKLET

ANALYSIS OF BROKEN / DISCARDED SKATEBOARD DECKS AND POSSIBLE ARCHITECTURAL IMPLEMENTATION



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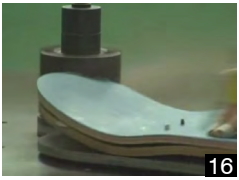

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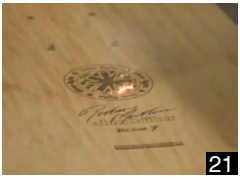


hatching logo

applying graphic

packaging

shipping

Fig. B.1

The images explains in sequence the industrial steps required for the realization of a skateboard deck. snapshots taken from the YouTube video: "How almost skateboards are made" < https://www.youtube.com/watch?v=FOtbEfdfk9o >

B.2 Wood species implemented

• Acer Saccharum, also known as sugar maple and hard rock maple, is the preferred species for the constructions of skateboard decks because of its hardness, resistance to shock and pop or rebound among other things.

The wood grows in south east Canada and north east United States in the surrounding of the great lakes regions.

Canadian winters, more rigid than those in the U.S, are able to generate a wood that is 10% stronger.[1]

• Bamboo have also been used in the construction of skateboards and may arguably work well. In the past they could not take the abuse Sugar Maple could, nor did they have the same feel. We find bamboo mainly used for longboard deck, since it's a cheap material, light and widely available.

• Birch plywood is sometimes used in skateboard decks too. Due to its relatively high cost compared to other woods with similar but not overtaking characteristics, it is a great alternative since it is a little bit lighter than maple and it adds flexibility to the board.[2]

B.3 Deck composition: veneers

Today's skateboard deck is an engineered, sculpted work of art.[3]

As explained in Chapter B.1, the steps to be followed in order to achieve a perfect skateboard deck are numerous and delicate; the level of precision and accuracy is critical in the process.

Similarly a normal plywood which is used as building material follows also a similar path but the quality of the plywood used is inferior to that used in skateboards.[4]

Decks are for the great majority manufactured entirely in wood although in the last decade some companies started to introduce layers of Kevlar or other stiffeners in between the plies

Traditionally a skateboard deck is made out of 7 plies of Canadian maple glued together with specific glues (read chapter B.4)

Every manufacturer has its own 'recipe' when it comes to produce the best skateboard deck so that there are many subtle variables that varies from deck to deck

Wood veneers are sheets of thinly sliced wood about 1/16" thick.[5]

It is important to clarify now that veneers are obtained by rotary cut, which means that the log is positioned on a rotating machine and a blade peels a long, unique sheet of veneer. (Fig. B.3.1) This technique, in comparison to others such as flat slicing, quarter slicing, rift cutting, generate veneers that only slightly crosses the annual growth rings and have very different grain patterns.[6] (Fig. B.3.2)

The advantage of rotary cut over other cutting methods is that it is generally the least expensive one. The disadvantage is that rotary cut veneers can have a bland appearance and may vary widely in color[7] but this is not a concern at all since the main purpose is not aesthetic in a skateboard deck, but mechanical.

Out of the long peeled single sheet, veneers are cut in a variety of shapes, for the skateboard manufactures it is normally used a rectangular shape of 9.5" x 34".

Very important is also the direction of the grain which the sheet of veneer is oriented. Hence, they are cut in 2 directions, along the grain or cross-grain. (Fig. B.3.3)

Afterwards they are inspected and grade, according to possible blemishes, knots, or general imperfections. (Fig. B.3.4)

Some of the best looking veneers gets coloured in order to be used as top and bottom layers of the skate deck.(Fig. B.3.5)

To ensure the maximum strength and at the same time flexibility of the skateboard deck it is of paramount importance to alternate the grain direction of the 7 plies by inserting two cross-grain sheets in between. (Fig. B.3.6) This will add torsional strength to the deck and prevent splitting.[8]

A good skateboard deck can not be produced without the use of a proper glue and a molding press.

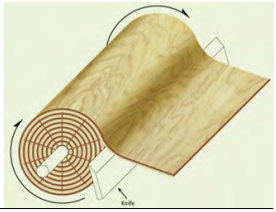


Fig. B.3.1

Rotary cut technique

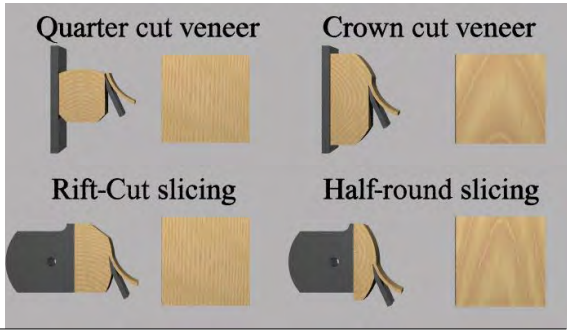


Fig. B.3.2

Other techniques used to get veneer with more interesting patterns

Fig. B.3.3

Canadian maple veneers used in the construction of skateboard decks:

The TOP image represents a veneer cut along the grain (long grain)

DOWN it represents a cross-grain veneer

Fig. B.3.4

Imperfections in veneers, that do not affect mechanical properties of the deck. Veneers that present this issues will be used inside the skate deck (core veneers).

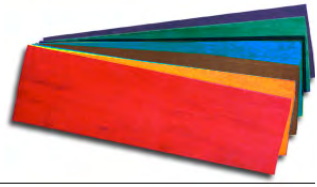


Fig. B.3.5

Good quality veneers without imperfections gets stained and used at the top or bottom layer (face veneers)

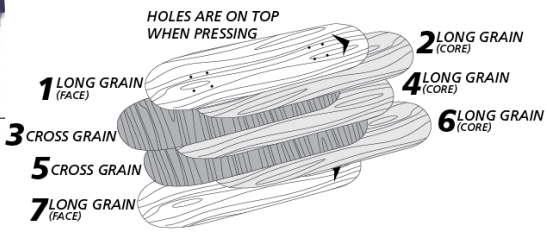


Fig. B.3.6

Veneers assembly to increase strength and flexibility in a skate deck.

B.4 Glues

Recently, in the last 2 decades, many are the technical innovations or new products tailored specifically for skateboarding and glues have met new engineering level.

Almost skateboarding believed in the use of epoxy glue type, re-engineered under the name of Resin glue.[9] Other glue factories, foreseeing a commercial profit adapted their formulas releasing specific skateboard glues, like in the case of *Franklin*, that released a glue called 'Multibond sk8'(Fig. B.4.1), manufactured specifically for an artisan way of producing decks in a cold-press.[10]

Nonetheless all skateboard-glues must meet certain criteria such as strength, drying time and the ability to hold its shape when removed from the skateboard mold.

PVAs

Skateboard glues used by major manufacturers are non-toxic water-based glues called PVA (Poly Vinyl Acrylic) that are premixed with a catalyst which is an additive with the function to speed up the drying time.

In the past, some of these catalyst were highly toxic and made recycling an impossibility.[11] Recent glues have non-toxic catalyst premixed, saving both time and effort involved in getting the mixture right and allowing the skateboard decks to be recycled.[12]

However, the choice on which many small-medium manufactures of skateboard decks rely on is *TiteBond III* (Fig. B.4.2), a high solid PVA glue which has a 'longer' wet time of around 9 minutes[13] which is good when it comes to hand-brush glue on every single veneer without the risk of drying up too fast. Its high solid content of 52% also provide a good gap-filling ability[14] in case the veneers have scratches or knots.

EPOXY

Some independent small manufactures believe that epoxy glue is the most suited in the skateboard industry since the advantages are manifold as follows.

First of all epoxy is not only water resistant but also water-proof which makes it ideal for the marine industry. Secondly it has a very high ability to fill gaps and a supreme creep resistance (ability to withstand lateral pressure without allowing the joint to stretch, preventing delamination). Thirdly it can bond dissimilar materials with ease, making composited board a reality.[15]

The disadvantages are the higher cost in respect to PVA glues, the fact that it releases dangerous fumes by chemical reaction of the mixture of 2 separate parts (glue and catalyst) and not by evaporation as in the PVA glue, and the fact that clamping under pressure all the 7 plies would create a weak bound since epoxy is effective with a glue-line thickness of at least 0.003", which is actually too much in a skateboard deck.

Nonetheless, as mentioned before, Epoxy has been re-engineered for the skateboard industry by *Almost skateboards* with success, so that we can conclude that it can be a very good choice for an industrial production, but for small or independent producers, being epoxy such an aggressive bonding agent, hosts problems and expenses that are just too much of an hassle.

Fig. B.4.1

Multibond sk8, a glue specifically developed for the construction of skateboard decks

Fig. B.4.2

TiteBond III, the most used glue among independent constructors or small factories

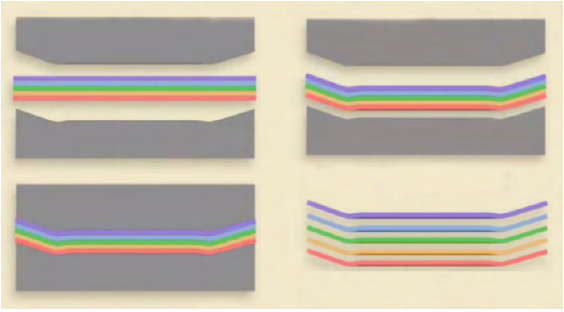


Fig. B.5.1

This industrial molding method was highly effective in producing more with a less effort (less energy, less equipment)

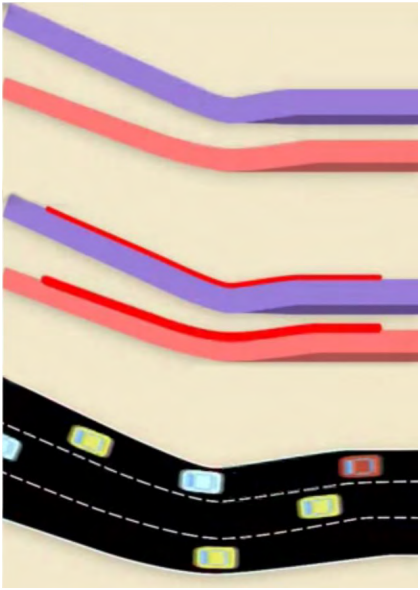


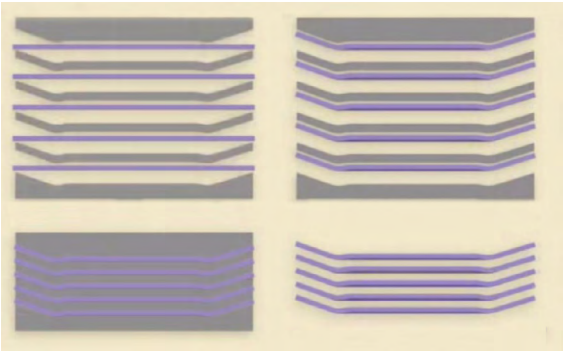
Fig. B.5.2

The two decks at the top and bottom of the mold are hereby compared. The TOP one has a more pronounced tail/ concave. The BOTTOM one is much more mellow.

This situation can be compared to what happen in a curve: the car in the inner lane will have to steer more than one driving on he most external lane.

Fig. B.5.3

New pressing method



B.5 Molding

Pressing the maple veneers into a mold is the most delicate stage of the whole production process of a skateboard deck: wrong pressure or blemished molds can jeopardize the structural properties of the deck, discarding them during the next quality check.

Geometrically speaking it is possible to state that a deck is a double curved surface and molding under pressure is the most conventional technique to obtain such a complex surface.

On the other hand a simple flat deck is not desirable for street skateboarding. Although skate decks were actually flat in the past, they firstly evolved by lifting the tail up and lately also the nose. Longitudinal concave was also introduced in the meanwhile in order to let skateboarders to have more feeling and control of the board while performing tricks.

Obviously, pressing requires time so that there have been invented smart techniques to speed up the process and to increase the production at an industrial level with the use of 'hydraulic presses'.

INDUSTRIAL METHODs:

Decades ago the fastest production method was to put into a single mold 35 layers of maple in order to produce 5 skateboard decks with 7 plies each. (Fig. B.5.1) This method was highly effective in producing more boards but the board at the top of the mold had the steepest nose and tail whereas the one at the bottom were the most mellow.[16] (Fig. B.5.2) This situation created 5 different skateboard decks that could possibly fit the needs of more skateboarders but unfortunately the supply of similar decks was decreased by 80%. Furthermore, steepest boards were preferred on mellow ones, leaving the most mellow unsold.

Nowadays it is preferred to press only 7 plies into one mold but the idea is that

molds can be stacked on top of each other (Fig B.5.3). The advantage is that the boards will all have the same exact shape and can be sold as one single product. Easily, different molds can be installed to create another type of board but all the instances will be exactly the same.

ARTISANAL METHODs:

For small factories of independent manufactures buying and operating Hydraulic presses is prohibitive but there are many other slower possibilities that simply need more hand-labor.

Typically, most independent producers custom-build their single mold press. Molds can be made from CNC-milled aluminum or concrete cast, which is the preferred method since it is much cheaper.

The press requires the purchase of a single or double hydraulic ram.[17] (Fig. B.5.4)

Other solutions are the ribbed press (Fig. B.5.5) that uses wooden hand-shaped layers for the mold and a traditional clumping system, or the dimm press (Fig. B.5.6) which uses molds made by foam.

The thin air press (Fig. B.5.7) method developed by roarockit is a revolutionary D.I.Y. olution.

It consists of a one-sided mold on which are placed the 7 maple plies that will be pressed into a vacuum bag to form the final skate deck.

More specifically this method uses a manual, electric or venturi vacuum pump as a vacuum source to evacuate air from a sealed bag forcing atmospheric pressure to act as a clamp to press multiple layers veneer together into a skateboard shape. The Styrofoam mold can be customized allowing amateurs to build complex shaped skateboards.

Fig. B.5.4

On the left an artisan molding machine that will work together the hydraulic ram , represented here on the right

Fig. B.5.5

Ribbed press

Fig. B.5.6

Dimm press

Fig. B.5.7

Thin air press developed by roarockit

<www.roarockit.eu>

B.6 Reuse of skateboard decks

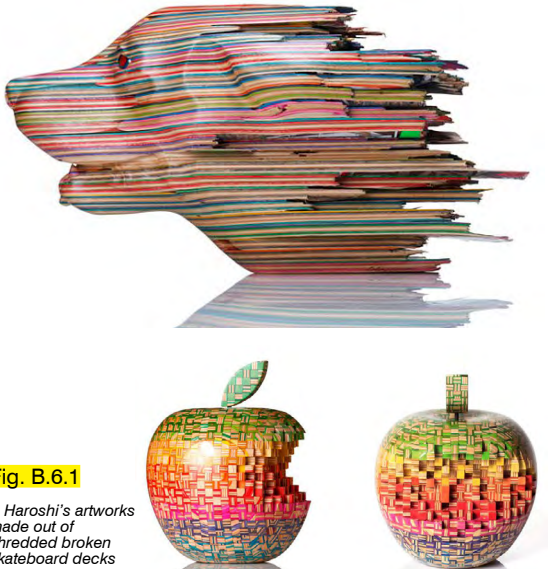


Fig. B.6.1

Haroshi's artworks made out of shredded broken skateboard decks

Giving a second shot to skateboard deck is a relatively new tendency of no more than a decade ago.

It can be affirmed that the Japanese artist Haroshi can be considered one of the first pioneers on the reuse of skateboard decks for artistic purposes. His collection counts dozens of art-pieces as of 2014. (Fig. B.6.1)

He follows a meticulous process for the their realization:

> *In order to make a sculpture out of a thin skateboard deck, one must stack many layers. But skate decks are already processed products, and not flat like a piece of wood freshly cut out from a tree. Moreover, skateboards may seem like they're all in the same shape, but actually, their structure varies according to the factory, brand, and popular skaters' signature models. With his experience and almost crazy knowledge of skateboards, Haroshi is able to differentiate from thousands of used deck stocks, which deck fits with which when stacked. After the decks are chosen and stacked, they are cut, shaven, and polished with his favorite tools.*[18]

Hundreds of other artists, interior designer, fashion designer, took inspiration from Haroshi.

JEWELRY

Most of the time skateboard decks have colored veneers sheets at their top and bottom layer, sometimes also in the inner layers. Dying veneers does not strengthen the deck, it is a simple and not critical process that some veneers undergo in order to be tagged for their future purpose, while adding just an aesthetic property to the skateboarder deck.

In jewelry this aesthetic property is exploited to the top; with amazing handcrafting skills and precision it is possible to create beautiful patterns in the watch dial, or to create full-body ear-rings (Fig. B.6.2)

Fig. B.6.2

Implementation of the colored veneers in skateboard deck as an added value to be exploited in jewelery design for the creation of patterns

FASHION DESIGN

Broken decks are re-evaluated in fashion apparel gadgets: I-Phone cases, sunglasses. (Fig. B.6.3)

Fig. B.6.3

Other implementation in fashion-related apparel gadgets

INTERIOR DESIGN

Discarded but not broken skateboard decks are used to create staircases or they are handcrafted as a piece of art to make chairs, lamps, urban furniture... even guitars body, fan-blades and much more. (Fig. B.6.4)

Broken decks did not find any use in architecture as we know yet.

Only “shy” interior projects (Fig. B.6.5) using decks as tiles have been attempted, the potential in this regard is enormous due to the amount of decks discarded by both pro and amateur skateboarders.

Fig. B.6.4

A series of interior design objects

ARCHITECTURAL DESIGN

Years ago, an architectural project involved the use of skateboard decks offcuts in the facade of a pavilion at the Museum of Modern art in New York. (Fig. B.6.6)

The main objective was to provide a shaded refuge for the crowds with refreshing cooling stations and detachable wooden seats. With a porous skin made of woven skateboard scraps, the experimental structure has successfully met the challenge and has been awarded the “young architects program award”.

Fig. B.6.5

Skate decks cut in rectangular shape to be used for covering a office counter.

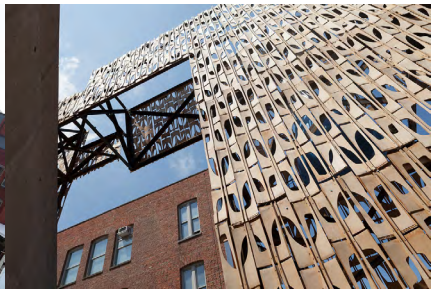


Fig. B.6.6

CODA’s “Party wall”. selected as winning proposal of the 14th annual Young Architects Program.

Built in the courtyard of the PS1 Contemporary Art Centre in New York. The facade is made of cut-offs of skate-decks.

B.7 Research by design

The possibilities in implementing broken or discarded skateboard decks in an architectural design are manifold.

As seen in the previous chapter, skate decks are often shredded in order to recompose the pieces with intriguing patterns into an every-day's use object.

This technique requires a consistent supply of energy and effort which may not be suitable/sustainable for architectural bigger scale projects that utilizes discarded/free material.

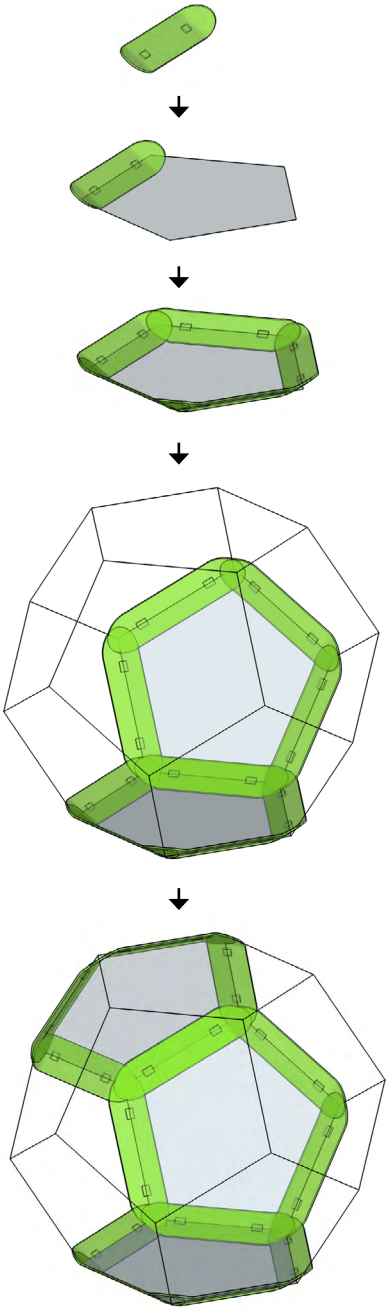
The exploration has been conducted by research by design considering, at this stage, only discarded but still integer decks (which are not structurally compromised).

Skateboard decks, being all of the same length and width of 80x20cm (little variations are negligible) are considered as a repeatable architectural element, in the same way a brick is considered exactly the same as another one although it may slightly differs (if handmade this difference is more evident).

The main points addressed in the exploration were:

- Possible connections between the decks.
- Geometrical patterns
- Possibility of aggregation in composing a facade of a building
- Tensegrity implementation

The following images with related captions will describe all the results coming from the research by design exploration.



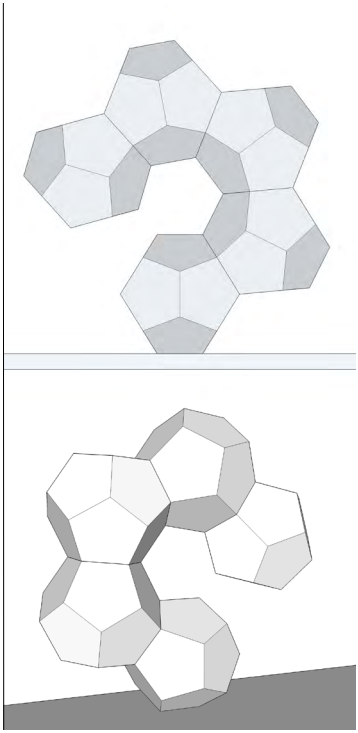


Fig. B.7.2

First exploration about matching faces of dodecahedron together.
This attempt failed to create a structurally feasible geometry.

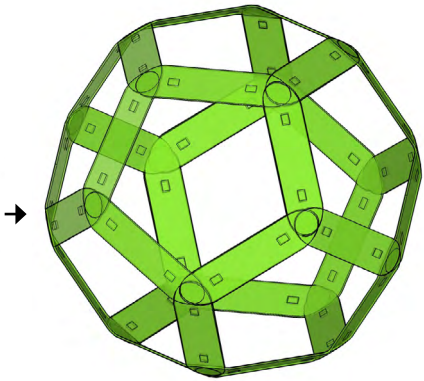


Fig. B.7.1

Given the fact that the dodecahedron has all the edges equals it has been tried a replacement of an edge with a skateboard deck.

The angle of the nose and tail of a skateboard (around 18- 19°) deck seems to be perfectly matching the angle that the edges of the dodecahedron creates between each other.

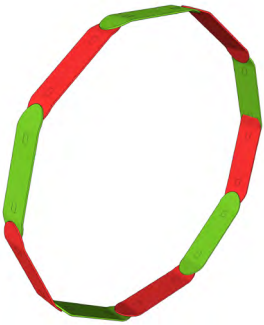


Fig. B.7.3

No more/ no less than 9 decks can be nailed together to create such a geometrical pattern

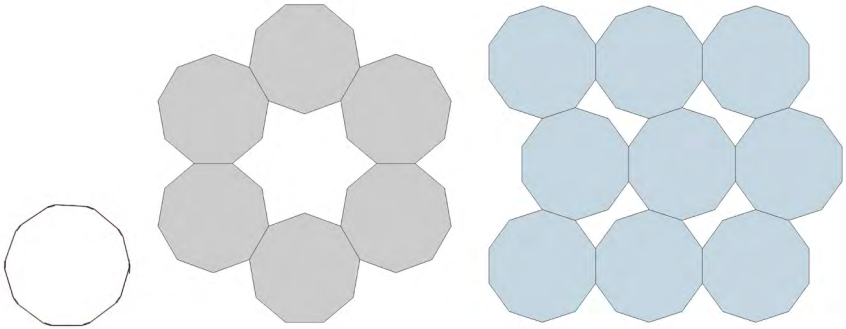
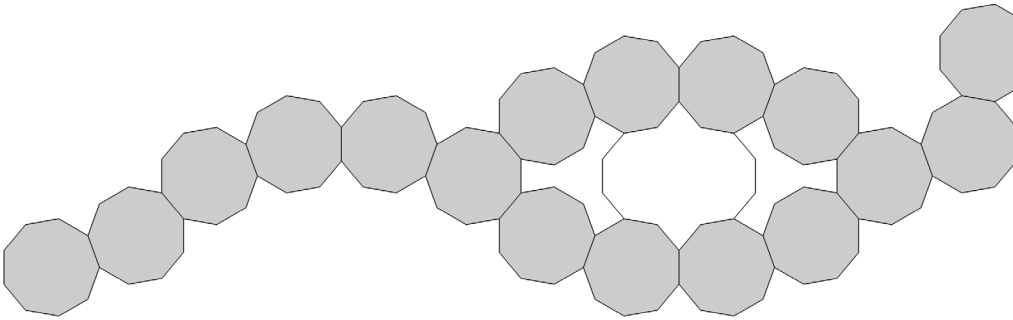


Fig. B.7.4

9 decks can create a 'wheel element' and this exploration aims to find other geometrical patterns.



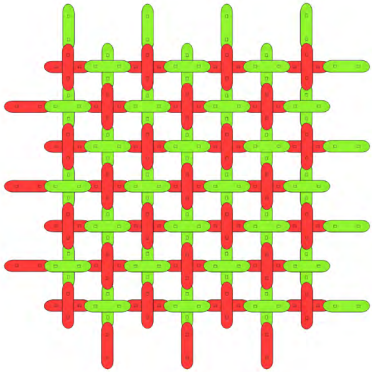


Fig. B.7.5

Decks can also nailed in a linear pattern, the repetition on linear arrangements can create an interesting interwoven pattern

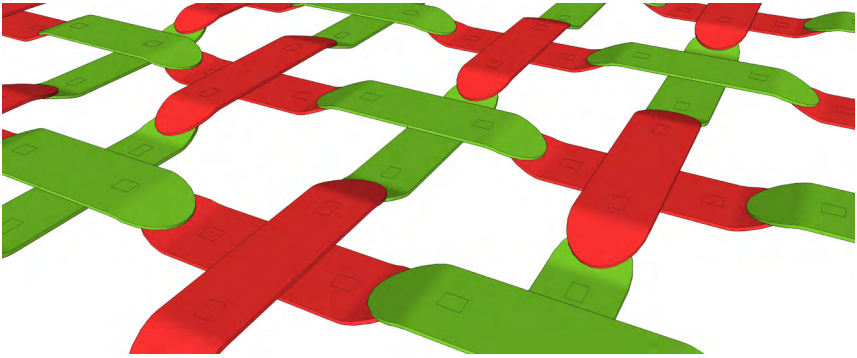
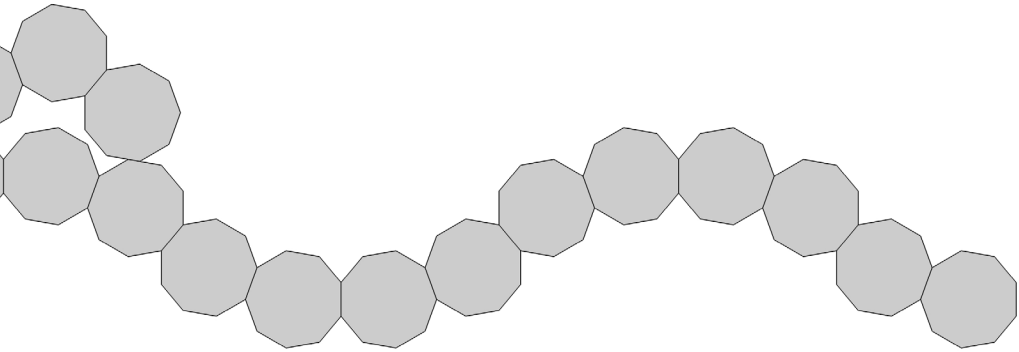
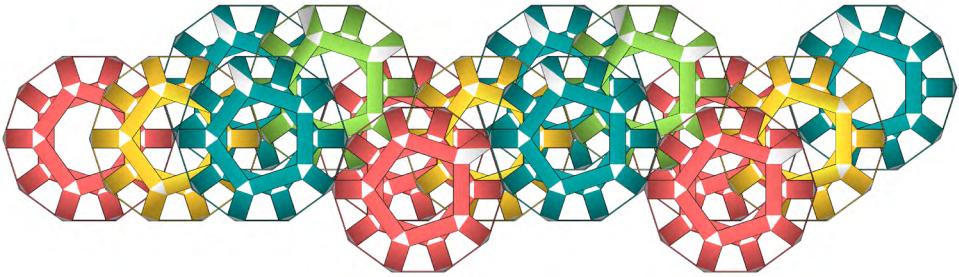


Fig. B.7.6

Focus on the interwoven pattern





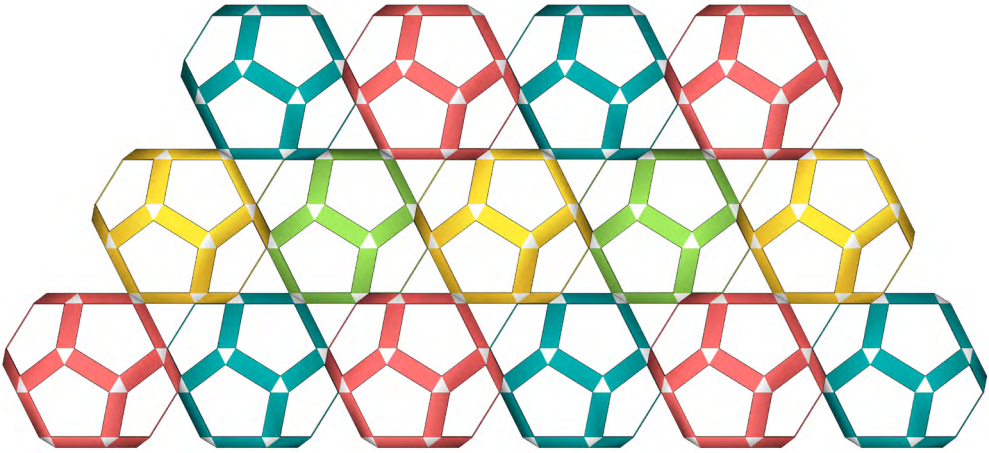
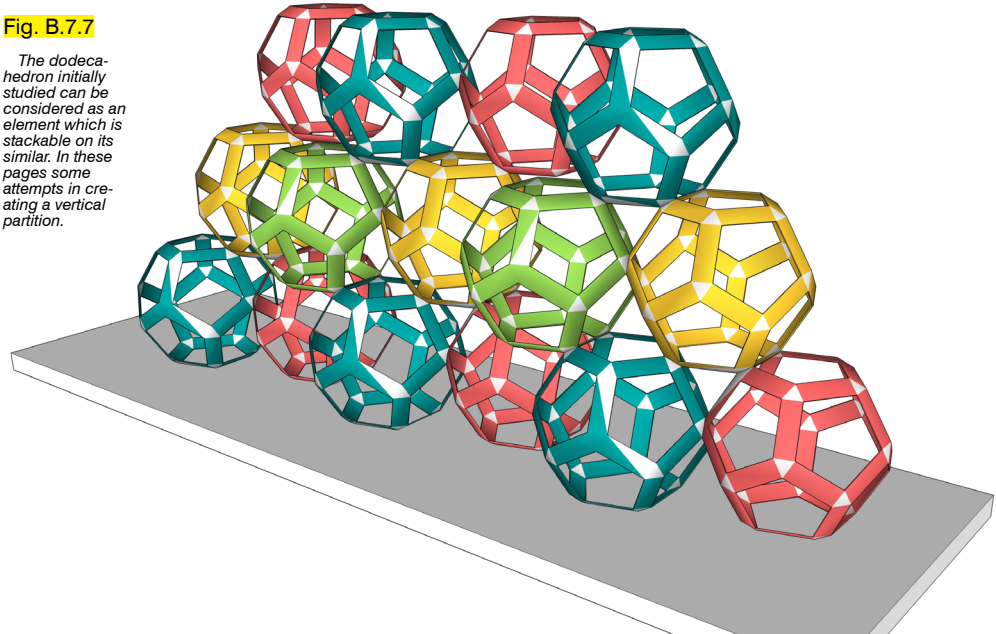
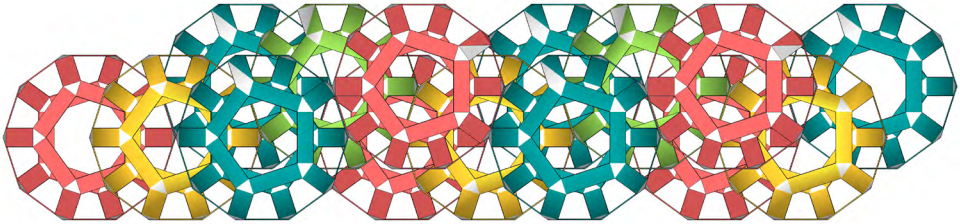


Fig. B.7.7

The dodecahedron initially studied can be considered as an element which is stackable on its similar. In these pages some attempts in creating a vertical partition.





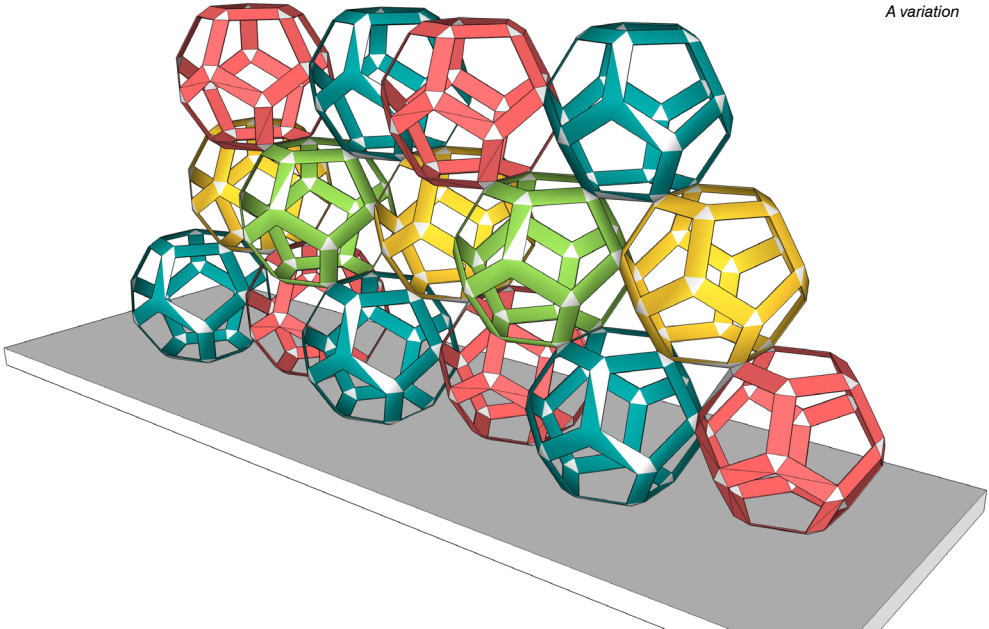


Fig. B.7.8

A variation

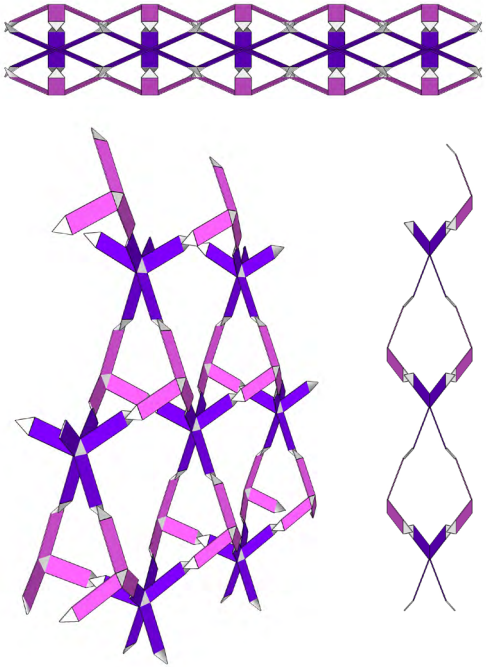
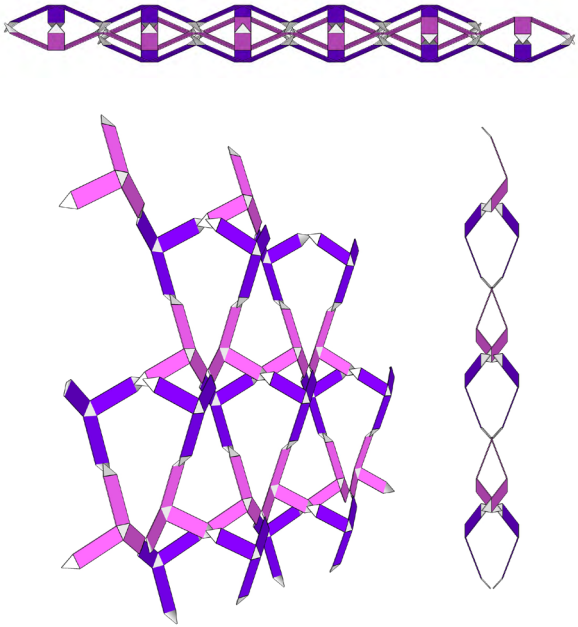
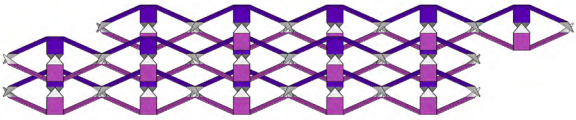
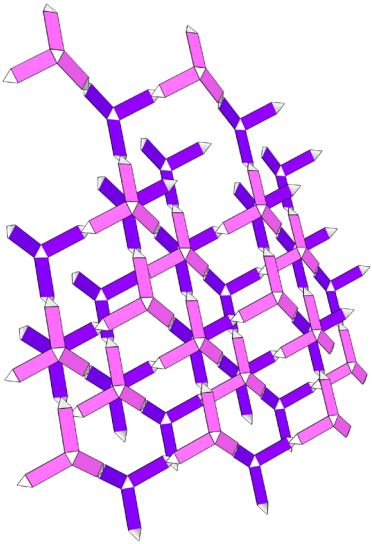


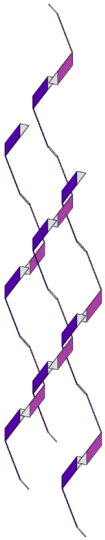
Fig. B.7.9

Tryouts researching possible patterns for a facade.









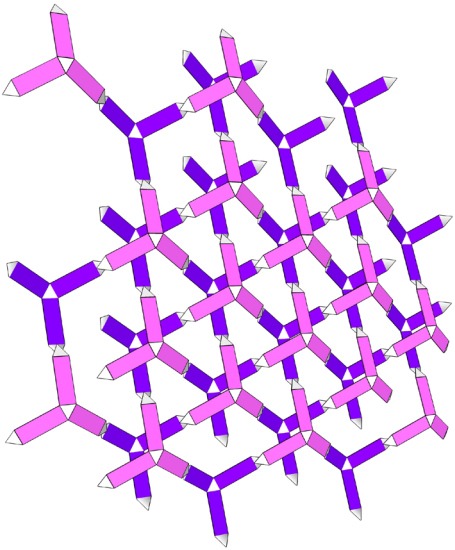


Fig. B.7.10

Tensegrity definition:

"it is a structural principle based on the use of isolated components in compression inside a net of continuous tension, in such a way that the compressed members (usually bars or struts) do not touch each other and the prestressed tensioned members (usually cables or tendons) delineate the system spatially

from: Gómez-Jáuregui, V (2010). Tensegrity Structures and their Application to Architecture. Servicio de Publicaciones Universidad de Cantabria, p.19

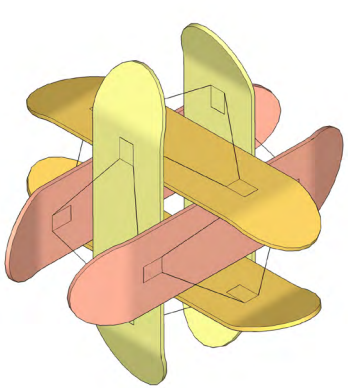
Every deck is connected with other 2 through a closed loop (a tension cable)

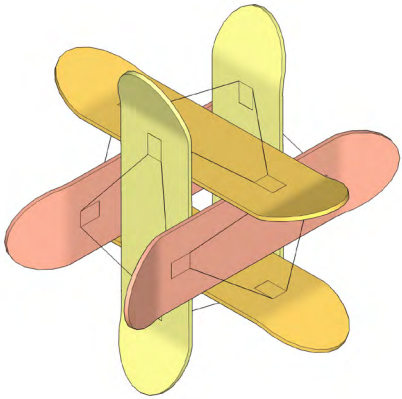
The loop, in case of a tensegrity structure with 6 skateboard decks, follows the red dashed line as shown in the B/W image,

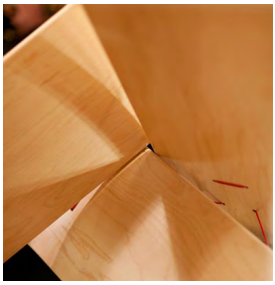
A 1:1 model of the same tensegrity structure hereby studied has been successfully attempted utilizing old discarded decks from the Skateland skatepark in Rotterdam.

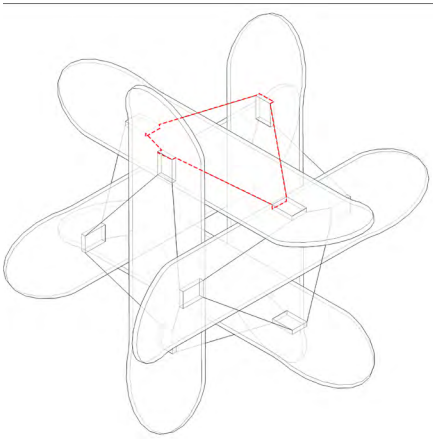
Tensegrity seems to be a very nice implementation of discarded decks for possible architectural purposes because:

• It does not require sawn/ drilling since it exploits the already existing 8 holes on which to mount the trucks with wheels









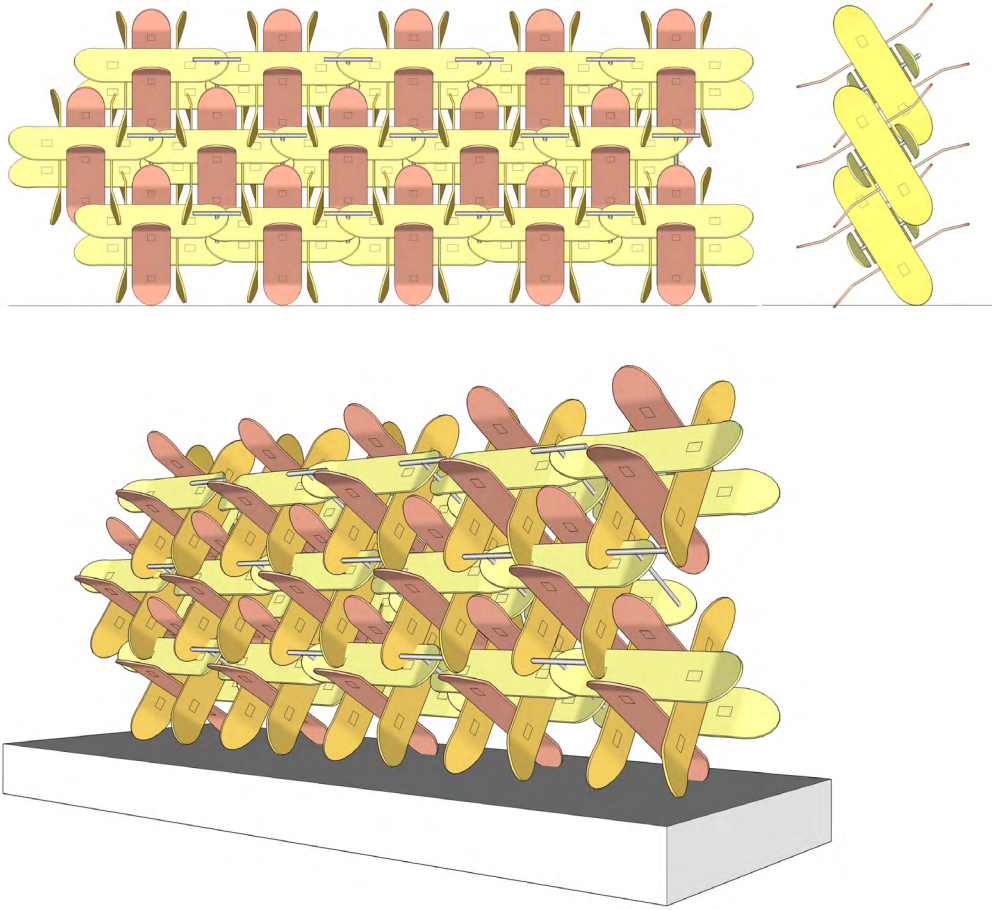


Fig. B.7.11

Exploration on how to combine tensegrity elements of 6 decks each into a wall or a canopy/ ceiling

Endnotes

Bonus Booklet Endnotes

1. < www.ministriofwood.com >
2. < http://www.youtube.com/watch?v=Eq-krgOdKAY >
3 Tom Miesmer quote, from: < www.wizzley.com >
4 Ibid. 3
5 Ibid. 3
6 How wood veneer is made, from Youtube: < http://www.youtube.com/watch?v=AdYDsIhy2VU >
7 < http://www.statesind.com/veneer_cutting.php >
8 < www.roarockit.eu >
9 < www.DIYskate.com >
10 < www.Franklinadhesivesandpolymers.com >
11 Ibid. 9
12 Ibid. 9
13 Ibid. 10
14 < www. canadianwoodworking.com >
15 Ibid. 14
16 Rodney Mullen, How almost skateboard are made, from youtube: < https://www.youtube.com/watch?v=-FOtbEfdfk9o >
17 Ibid. 1
18 < http://haroshi.com/artworks/ >