

Component Analysis: Wooden Skateboard Deck

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BREAKDOWN OF EXISTING PRODUCT

A Brief History;

The first skateboard was created in the 1950s - a rudimentary design that involved attaching a set of roller skates to a wooden board (Siljeg and Starr, n.d.). Then, the 1980's saw the advent of 'street skating,' where skaters "made the whole world into their skatepark" (Cave, 2017). The physical demands and complexity of the sport began to increase - and with it, so did the technology behind the board. It is through these advancements that we have what is now considered to be the modern-day skateboard.

The Wooden Skateboard Deck;

The deck is the riding surface of the skateboard. Its upper surface is typically covered in self-adhered sandpaper to aid grip, whilst the bottom surface usually features a graphic design, and/or the manufacturers branding. Decks have varied greatly in both size and shape since the 1950's, but it wasn't until the early 90's that the deck style commonly seen today came into existence (Borden, 2002).

Materials Used;

The majority of professional grade decks consist simply of wood and glue, where 7 or 8 thin slices of wood are layered together and bonded. The wood of choice is typically Canadian Maple. The colder the climate, the shorter the growing season. This produces tighter growth rings and, as a result, a harder wood - meaning the premium maple harvested for deck construction comes from Northern Canada (Miesmer, 2013). The properties of Canadian Maple can be tabled as follows;

Canadian Maple (<i>Acer Saccharum</i>)	
Average Weight	Heavy - 720kg/m ³
Bending Strength	High - 120 to 175 N/mm ²
Stiffness	Medium - 12 to 15 kN/mm ³
Maximum Crushing Strength	High - 55 to 85 N/mm ²
Shock Resistance (impact)	High - 1.2 to 1.6 m
Bending Properties	Very Good
Durability (resistance to preservative)	Heartwood is resistant; Sapwood is permeable
Seasoning (drying rate)	Slow - 3 ½ to 4 weeks

(Lincoln, 1986)

There are a number of types of glues used in the production of skateboard decks, with the most common being water-based Polyvinyl Acetate (PVA) - both in two-part form and a one-part solution with pre-mixed catalyst. Epoxy glues are also used and offer some benefits over PVA - particularly in decks of a composite make-up - but due to cost and concern over health risks relating to poor safety practices, these are less commonly adopted (Ministry of Wood, 2012).

Manufacturing Process;

Harvested trees are cut to the required length before being soaked in hot water to loosen the bark prior to peeling. Once the bark is removed, the logs are dried before the rotary cutting process begins (Fig.1), producing one continuous length of veneer (Fig.2&3). This is then guillotined into shorter lengths ready for shipment to client (Lefteri, 2007).



Fig.1

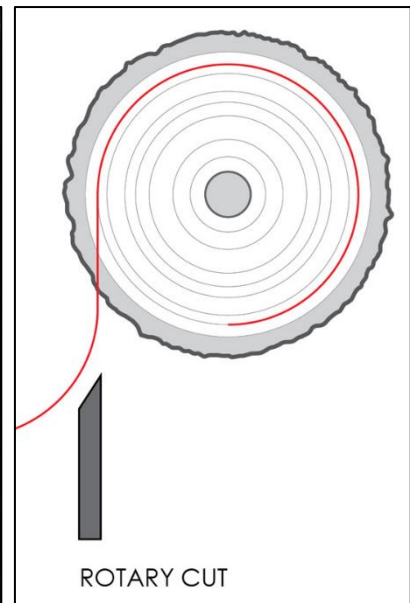


Fig.2



Fig.3

Once the maple veneers arrive at the deck factory, the manufacturing process begins;

- **Step 1:** The veneers, typically $\frac{1}{16}$ " thick, are coated with a thin and even layer of glue. Dependant on the size of the manufacturing operation, this may be applied manually or through dedicated machinery
- **Step 2:** The veneers are then stacked according to the direction of their grain. The grain in the "crossband" sections go sideways across the deck, while the grain in the "face" and "core" layers travel end to end (Fig.4). By alternating the grain direction in each layer, considerable strength is gained - a process utilised in the manufacture of plywood
- **Step 3:** The resulting stack of veneers are then placed into a two-part mould (Fig.5). On smaller scale production lines, the mould is typically bolted together. However, a hydraulic press is often utilised on larger scale productions - where, depending on the size of the machinery, as many as five to 15 decks may be pressed at one time

- **Step 4:** The sheets are then left in the mould until dry - which can take anywhere from minutes to hours, depending on the adhesive used
- **Step 5:** Once removed, a worker drills eight holes for the truck mounts. The location of the holes is paramount to the correct function of the skateboard, so a drilling rig is used to ensure accuracy
- **Step 6:** The worker will then rough cut the deck to size with a band saw (Fig.6), before sanding to a precise finish
- **Step 7:** The deck is then treated with a sealant, before the final design is screen printed onto its underside
- **Step 8:** Once dry, and dependent on the customer's order, self-adhesive grip tape may be applied to the topside of the deck prior to shipment (Fig.7)

(Petruso, n.d.; Miesmer, 2013)

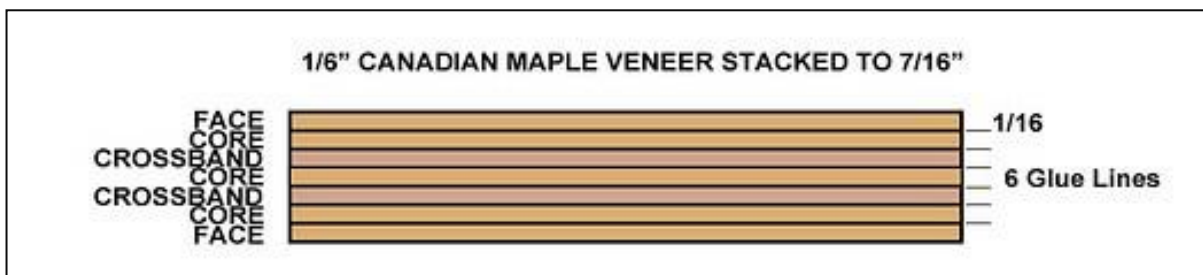


Fig.4

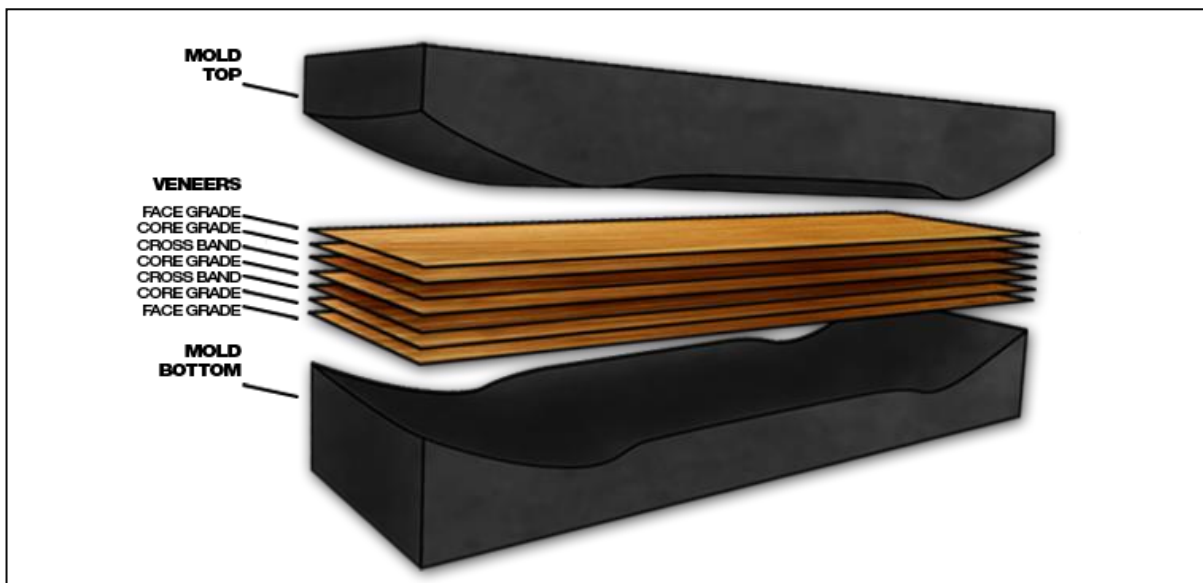


Fig.5



Fig.6



Fig.7

Design Considerations;

To strike the fine balance between comfort, control and performance, most decks follow a very specific shape that has been honed over three decades. This design includes;

- Pronounced kicks at each end (Fig.8)
- An oblong, 'popsicle' shape (Fig.9)
- Concave in shape across their width (Fig.10)
- Most commonly 7 $\frac{3}{4}$ " to 8 $\frac{1}{4}$ " wide and 1 to 1.5kg in weight

Another important design consideration relates to the image on the underside of the deck. In a heavily competitive market, it's often the graphic design and brand image (Fig.11) that attracts the customer. As Borden (2002:81) explained;

Essentially, all skateboard manufacturers now use the same overall shapes, materials and construction standards, and use graphics to differentiate products, accelerate turnover and, to some extent, direct them at regional markets.

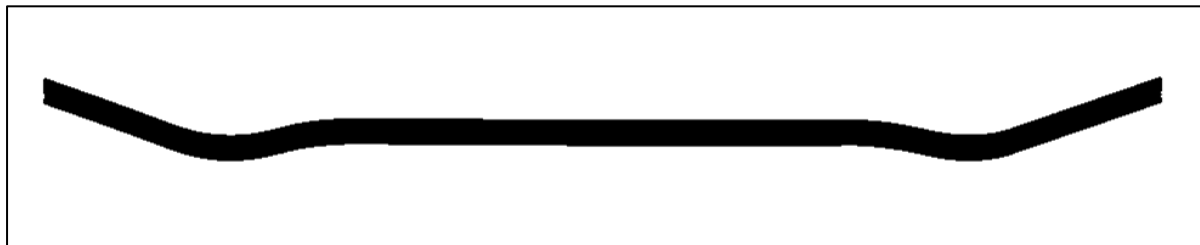


Fig.8

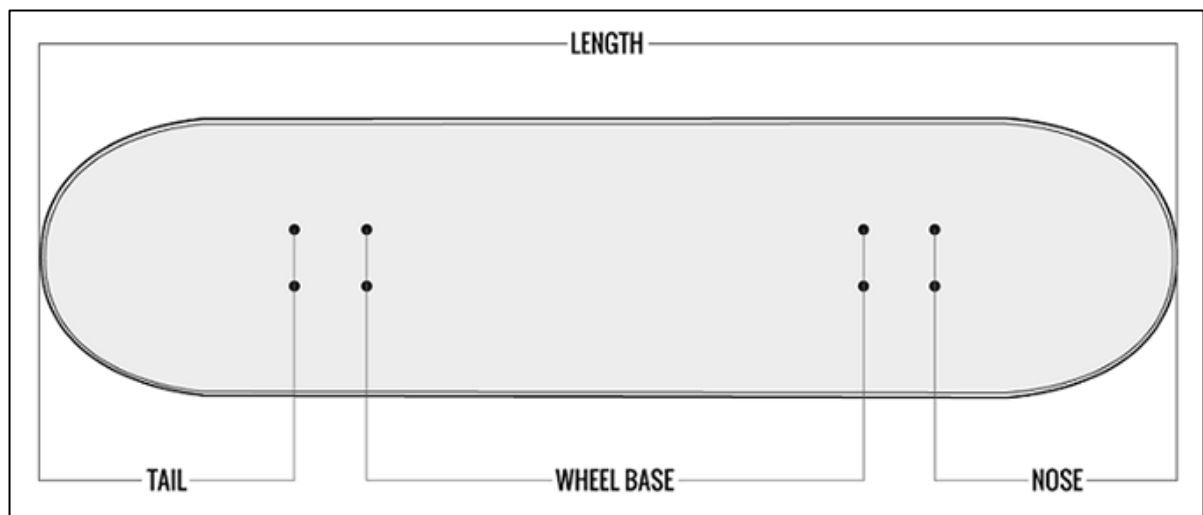


Fig.9

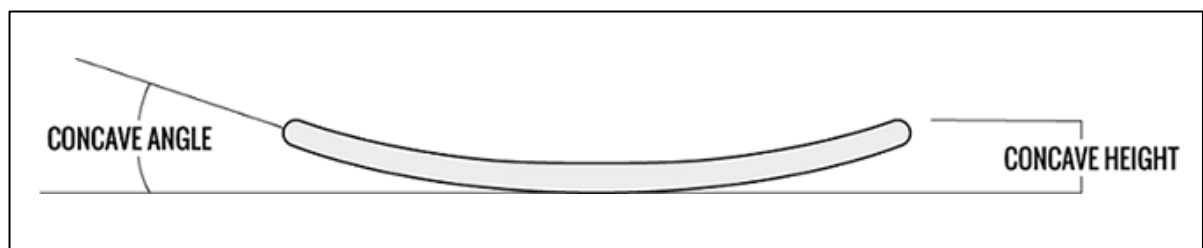


Fig.10



Fig.11

Connected Components;

A deck is directly connected to the following components;

- Grip Tape - Provides the traction needed to perform tricks
- Hardware - The bolts and locknuts used to connect the trucks to the deck
- Trucks - Connect the wheels and bearings to the deck
- Risers (optional) - Absorb shock from the trucks, and helps prevent wheel bite

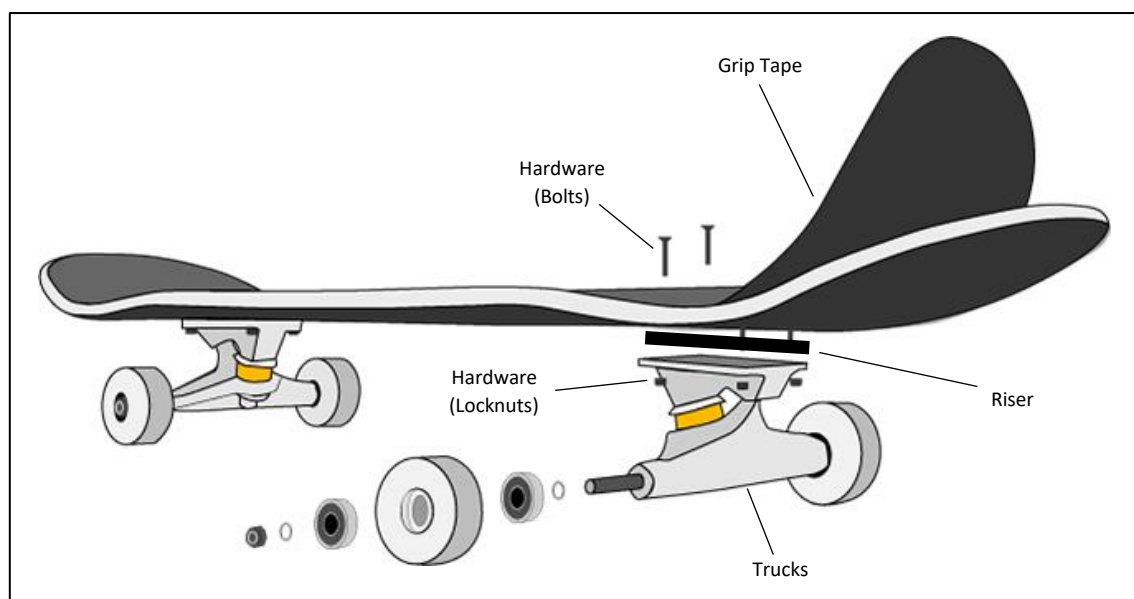


Fig.12

ALTERNATIVE SOLUTION

Maple Wood and Fibre-Reinforced Polymer Composite

I propose a maple wood and fibre-reinforced polymer (fibreglass) composite as an alternate solution to the current wood only deck. During a recent project I was tasked with creating wooden L-shaped stool legs from layered strips of flexible plywood and Gorilla Glue. Once the glue had set and the legs were removed from the mould, 100kg of weight was applied to one of the legs and it snapped instantly. I then started again, this time adding a strip of woven roving fibreglass in between each sheet of flexible plywood. Once removed from the mould, the composite leg was now able to withstand well over 100kg. without failure. From this experience I believe Type E fibreglass, in woven roving form, sandwiched between each layer of maple veneer and bonded with an epoxy resin will add a level of strength to the deck, without adding much weight or indeed cost (Thompson, 2007). Unlike carbon fibre, which is considerably more expensive, fibreglass also has a greater level of flex (GW Composites, n.d.) which is essential for the required 'pop' of a skateboard (Surf Dome, n.d.). Fig.13 displays the structural make-up of my solution;

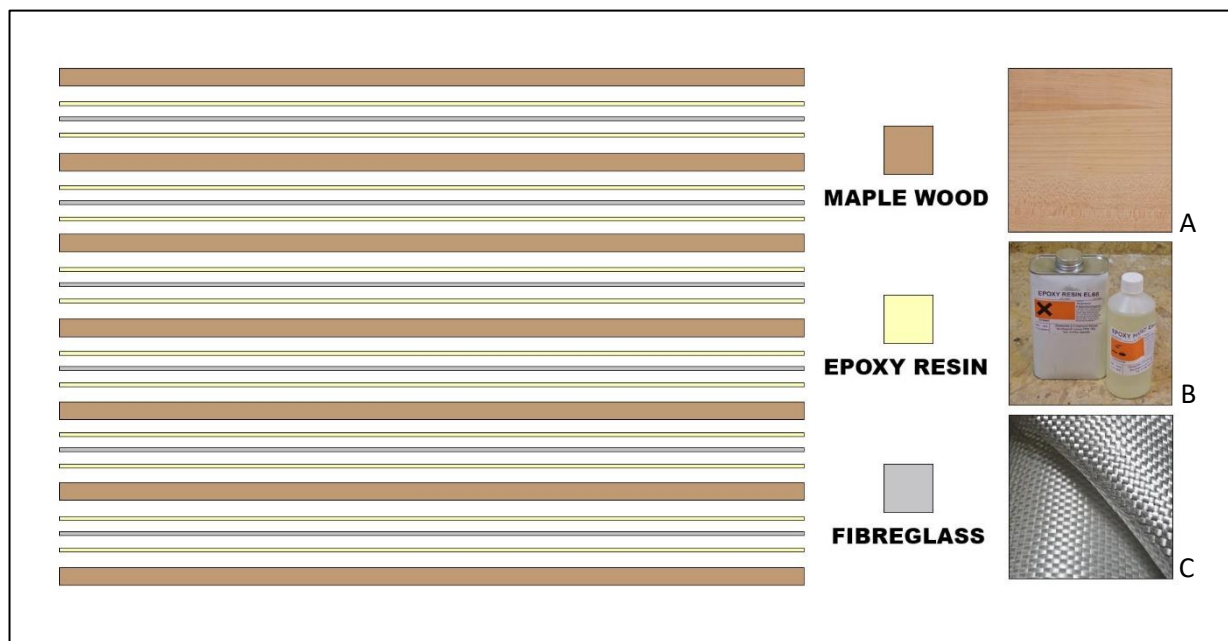


Fig.13

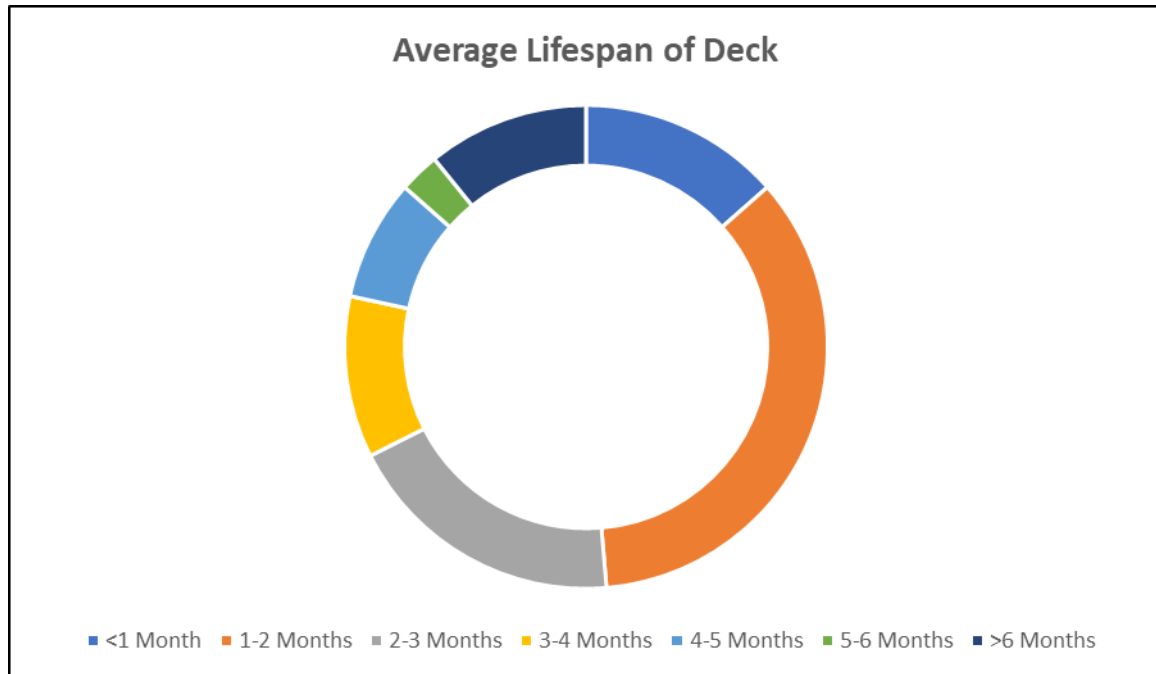
Type E fibreglass is the most commonly used and is characterised by its water resistance and high softening point (Pfaender, 1996). The below table details the properties of Type E fibreglass in comparison to other fibres;

Typical Fiber Properties				
Fiber Type	Density (g/cc)	Young's Modulus (MSI)	Tensile Strength (KSI)	Approximate Strain of Failure
E-Glass	2.55	10	500	5.00%
S-2 Glass®	2.49	12	665	5.30%
Kevlar®	1.44	16.4	430	2.60%
Intermediate Carbon (IM)	1.76	33	530	1.60%
High Strength Carbon (HS)	1.78	42	770	1.80%

Fig.14

Justification

Snapped decks are a common occurrence in skateboarding. Typically, the more experienced the skater, the more frequently they break decks as extended and more adventurous use takes a toll. The following data has been harvested from a popular skateboarding message board, where users discussed the frequency in which they need to replace their deck;



(Anti-Hero., 2008)

As can be seen from the graph, roughly 70% of decks are broken after just 3 months of use. The following image demonstrates the type of skateboarding that can lead to broken decks, and the areas of the deck most vulnerable to breakage;

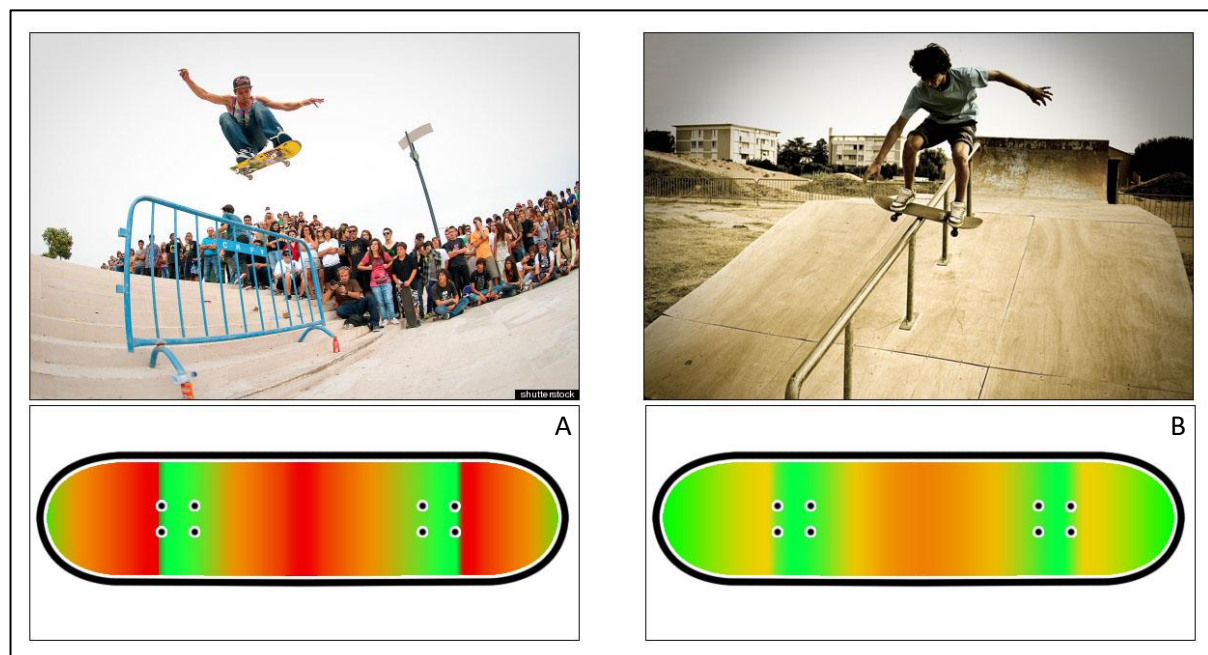


Fig.15

Manufacturing Process

The manufacturing process would remain largely unchanged over the process detailed above. A step would be added prior to the stacking of the glued veneers, where a worker would manually place sheets of woven roving fibreglass atop each veneer and apply a new top coat of glue, before the sheets of maple wood and fibreglass would be stacked for insertion into the mould. Cycle time remains unchanged, dependent largely on the drying time of the epoxy resin.

Design Considerations

With my design, the complex shape of the deck would remain unchanged. These features have been sculpted over many years of redesign and improvement; keeping them does not only retain those benefits but would feel natural and comfortable to existing skateboard clientele, which would aid its adoption. Also, as previously detailed, the graphic design on the underside of the deck is a massive deciding factor at point of sale. This proposed design would allow the current screen printing process to take place unencumbered.

Connected Components

A key to this design is that existing skateboard technology would require no redesign or modification to work with the deck. Compatibility with existing products would act as a convincing selling point to potential customers and would aid adoption by manufacturers within the skateboard industry.

CONCLUSION

There's a range of benefits to the proposed design. It adds strength with only a small increase in weight. It utilises the existing manufacturing process and tooling, with minimal increase in manufacturing workload and cost. There is definite room for improvement with the lifespan of current wooden decks, but the solution needs to be affordable and most importantly - performance needs to remain undiminished. I believe my suggestion would meet the affordability requirement, but further research and prototyping would be required to confirm the latter. Also, the fact my design would harmoniously interact with existing components is a massive benefit. That said, the design is not without drawback. The addition of fibreglass would make the deck more difficult to recycle - however, I feel this is somewhat offset by an extended lifespan over existing products.

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