Designing A Machine to Make Skateboard Decks From Recycled Plastic

Jason Knight 1303034

Preface

Experimentation with recycling plastics began two years ago, in my kitchen, as part of an Industrial Design and Technology Undergraduate project entitled IKB or Integrated Knowledge Brief. The project required us to pick one aspect of a product we had been designing and explore it in further detail. My product was a plastic safety knife. Concerned by the environmental impact of the material I had chosen I began to research more sustainable alternatives. I began researching how to recycle common types of plastics and discovered that the process can be done at home in a domestic environment with no specialist equipment. My first swatches were produced.

Since then the concept, that was originally part of a smaller project, has grown and branched in several directions. The tube pictured to the left shows my portfolio case, cast in a steel tube from used shopping bags. The process has been researched in detail and up-scaled. In the summer leading up to the beginning of this current projects I have exhibited the work as part of a science convention and ran recycling workshops at several music and arts events.

This current project aims to tie in all the research and experimentation I have conducted over the past few years in to a final polished and tested product suitable for market.

My research so far has mainly been focussed on HDPE. HDPE was chosen because it has the lowest melting temperature (130 °C), of the common domestic plastics, and a high burning temperature. When plastic burns it emits carcinogenic fumes, having a large range between melting and burning makes HDPE ideal for experimentation.

HDPE can be found in a wide range of domestic products, primarily plastic shopping bags, bottle caps and milk cartons. In order to ensure the plastic melts evenly and forms a consistent grain; it must be broken down in to smaller particles, using a blade or shredder, before melting. Having an even grain maximises the strength of the material.

Heat is then applied to the plastic. Depending on the outcome you are looking for this can be done through a variety of methods (e.g. extrusion machines, injection moulding, compression machines). In this case the plastic is being moulded so it is placed on a baking tray lined with greaseproof paper in an oven set between 130 °C-175°C.

Once the plastic has been sufficiently heated, in this case 10-15 mins , it becomes soft and malleable. Its consistency resembles sticky clay. During this process the material significantly reduces in size as the particle merge together. It is possible to re heat the plastic to this state once it has cooled but it loses roughly 40% of its strength each time.

The plastic can now be formed in to a solid object. This process requires a large amount of sustained pressure to remove all air pockets from the material and hold it in place long enough for it to cool. The molten plastic can be extruded in to usable material using specialist machinery or, like in the example above, be cast in a mould.

The outcome is an incredibly strong solid material with a surface finish that resembles marble. The colour scheme of the can be varied by what raw material is fed in to the process. The material can be CNC cut, turned on a lathe and used as 3D printing filament as well as numerous other applications.

During my placement year I worked at FabLab RUC a public maker space specialising in rapid prototyping and technology driven design and manufacture methods. FabLabs are non-profit organisations which provide incubation for stat-up projects and research initiatives. In return any work conducted at the FabLab must be photographed, documented and is encouraged to be made open source so that any future projects can learn from and incorporate the knowledge developed at the facility.

My role at the FabLab was split in to three main tasks:

Learning how to operate and de-bug new machinery such as 3D printers, Laser Cutters, Plasma Cutters and CNC machines as well as many others.

Teaching users of the lab how to use software, machinery and giving general design.

Part of my role at the FabLab was to conduct a self-led project, and document the process to contribute to the body of knowledge that the FabLab network is building.

My self-led project consisted of developing an open source plastic shredding machine that could be replicated at any FabLab around the world, to enable people to begin efficiently shredding plastic in preparation for recycling. A shredder was chosen as the most time consuming part of the recycling process was breaking down the material by hand. A full tutorial and source files can be found at:

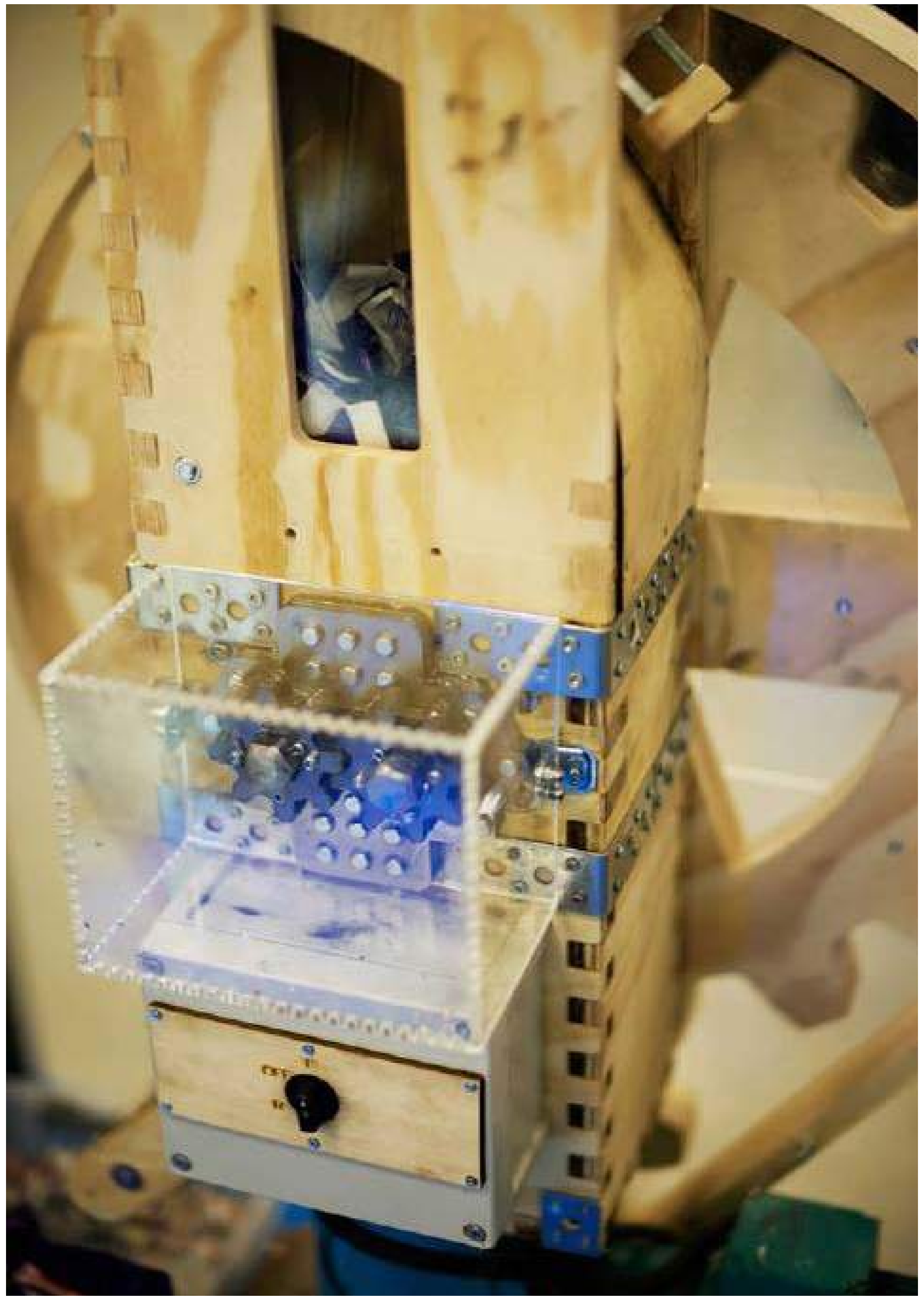
fablab.ruc.dk/plastic-recycling-shredder/

The shredder was also featured on the online maker community, Hackaday. The article can be found here:

hackaday.com/2016/06/01/sWcratch-fabricated-plastic-gobbling-shredder-brings-recycling-home/

The shredder was exhibited with a selection of plastic samples at science I forum (science in forum) an event aimed to inspire young children to pursue scientific aspirations. It was also exhibited during several music and arts festivals as part of a recycling workshop.

The project is open source and protected by creative commons to ensure that the information remains open source for anybody to benefit from and cannot be privatised for private or financial gain.



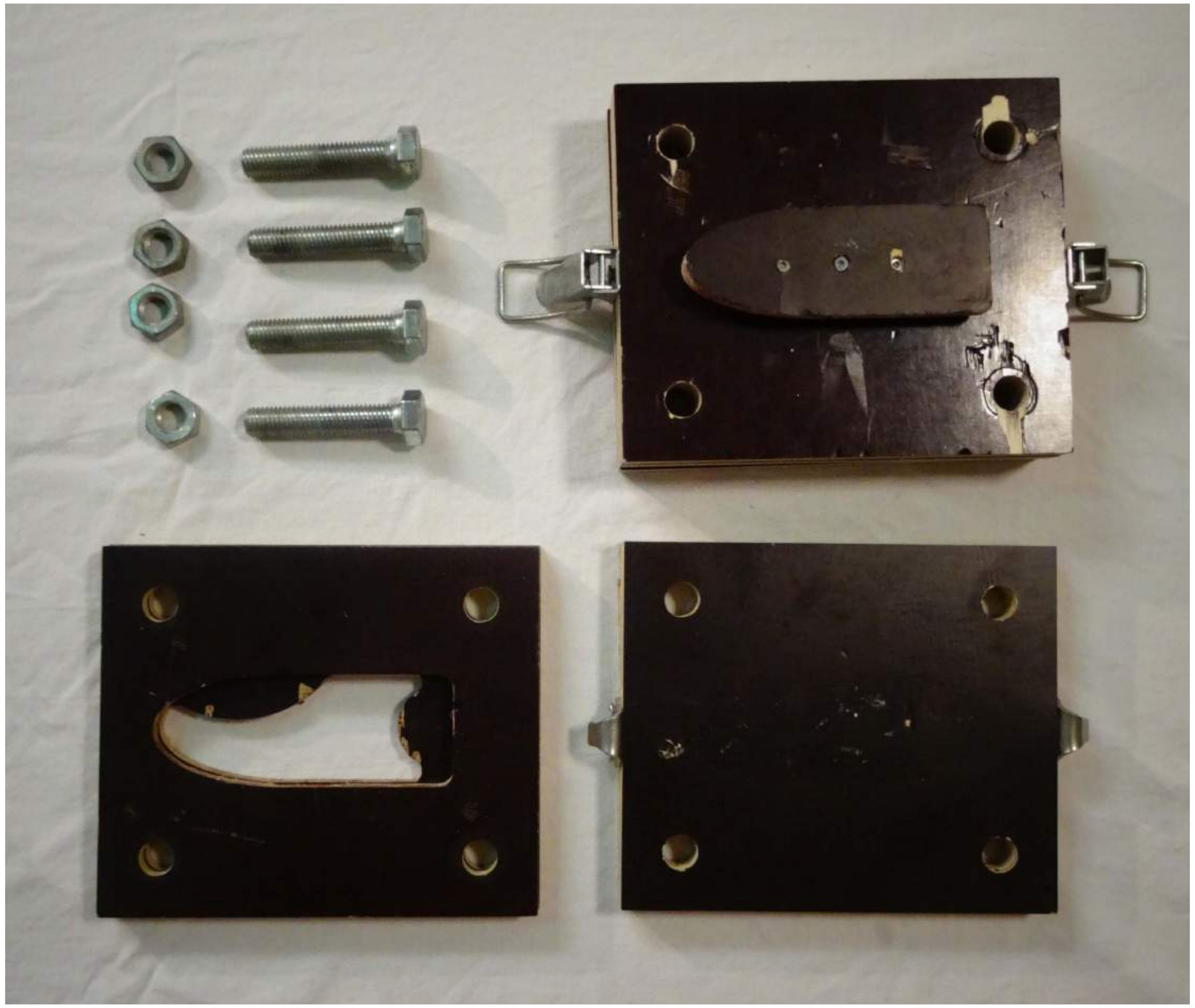
Following the completion of the shredder I was asked to organise and run plastic recycling workshops at several events around Denmark. The workshop taught users about the plastic recycling process by instructing them on how to make a bottle opener using pre-made moulds.
A message was posted on each events webpage letting attendees know about the workshop and that they should bring any used bags which they would be able to turn in to something they could keep for free.

The workshop was structured like a typical production line, broken down in to simple stages.

- Heating; the plastic was placed on a baking tray and heated using a small portable camping oven.
- Pressing; the plastic was pressed in to the mould and pressure was applied using G-Clamps and two latches. The moulds were modular so there was a choice of left and right handed openers.
- Cooling; once the plastic had cooled enough to be ejected from the mould it was dropped in to a bucket of cold water to thoroughly cool.
- Adding Functional Parts; a washer was attached the opener to act as part of the opening mechanism.
- Finishing; sandpaper was provided so attendees could finish their bottle openers to their own standard.

The workshop was run at three events across the summer period:

- Guldminen Upcycling Festival; A free festival held at Guldminen, a community project set up in collaboration with the municipal waste management to encourage Upcycling and Recycling projects. The Guldminen centre holds 12 individual ventures all with their own unique approach to recycling. The workshop was run in collaboration with the FabLab hosted there.
- Roskilde Festival; the second largest music festival in Europe with 160,000 attendees. The workshop was run as part of the area known as Makerspace, located in the festivals campsite. A shipping container with everything needed to run the recycling workshop was delivered to the site. On arrival began to spread word of the workshop using the shredder to catch people's eyes. Over the weekend there we're 40-50 participants of the workshop and thousands of spectators.
- The Borderlands art festival is an event organised by the Burning Man community and the social principles which make it unique to any other kind of event. The workshop was structured and delivered the same way as Rosklide Festival, using the shipping container to both transport and host. Due to the festivals unique social dynamics the workshop was delivered to far fewer people but over a longer period of time to give a more in-depth understanding of the process.



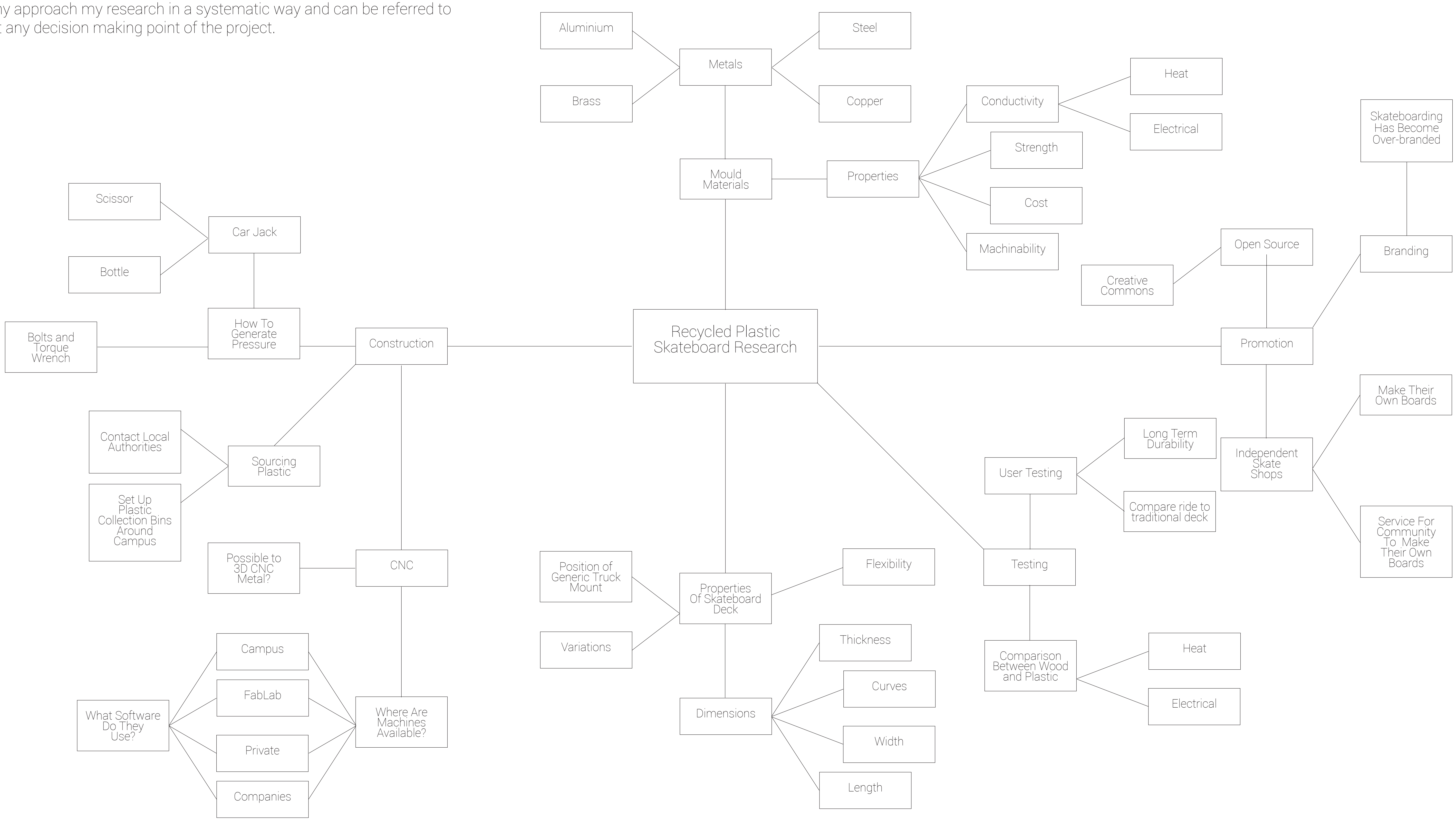
Brief

The goal of the project is to design a press to that allows communities to locally produce skateboard decks made from recycled plastic. Through primary research I discovered that an average skater goes through one deck every two months and that they are available in a variety of sizes. (Hyains, 2016) Decks are made from plywood, predominantly taken from Canadian maple trees and skateboarding is the biggest contributor to their deforestation. (Nay, 2016) Over 300 million tonnes of plastic is produced each year, the majority of which can be recycled. (McKie, 2016) Designing a press would enable skate shops or other small community organizations to set up local recycling schemes where they either charge people to use the machine, buy waste plastic and produce their own decks to sell or simply allow people to use the machine. The aim is to challenge the stigmas attached to used plastic, from seeing it as waste to viewing it as a valuable resource, as well as change the current attitude towards recycling as being an inconvenience to an activity which is fun and constructive, which can be done as groups of friends and something that has direct tangible rewards. Through primary research I have discovered decks typically cost between £40-£60. (Hyains, 2016) This means skateboarding is not a feasible hobby for people with less financial resources available. The design of the press will remain open source. Keeping the press open source will mean that people would have access to boards for a much lower cost or even for free whilst simultaneously tacking the growing issues regarding global resource management.

Research

Areas To Research

Before conducting any research I produced a quick mind map of know-unknowns to help me decide which areas I should prioritise and which areas needed more in-depth research. Developing this mind map helps my approach my research in a systematic way and can be referred to at any decision making point of the project.



Every single piece of plastic humans have ever made still exists...

...Somewhere.

We still produce over 300 million tonnes of new plastic each year. This consumes 2143 million barres of oil. The majority of plastic that is used domestically and industrially is recyclable. Despite this, globally on average, less than 5% is actually recycled world wide. The other 90% finds its way in to landfills, the oceans, animals stomachs and our water supply. If society's perspective of used plastic made a transition from viewing it as waste to viewing it as a valuable resource the benefits would be staggering. It would mean less raw energy being used to produce new plastic, less pollution by extracting plastic from the biosphere and a decrease in finite resource consumption.

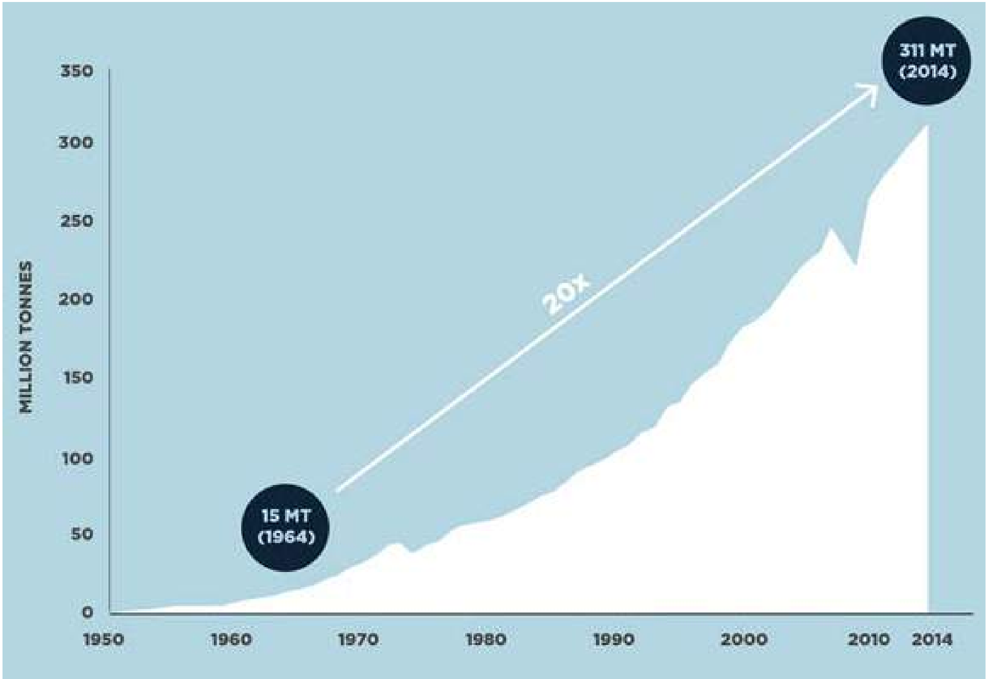
Bioplastics are an example of a progressive step so resolve these problems but they do not come without disadvantages as they require a large amount of land, which could otherwise be used for food production, and special end-of-lifecycle processing to compost which consumers are not usually aware of. It is often mistaken for normal plastic waste and rarely makes it to the composting process, contributing to the problems caused by oil-based plastics.
Bioplastics are a step in the right direction but their integration into society does not solve the problem of the billions of tonnes that have already been produced and discarded.

In order to completely reverse the impact that plastic production has had on the planet we need to look both in to the past as well as the future. Bioplastics are a step in the right direction, for future plastic production, but their integration into society does not solve the problem of the billions of tonnes that have already been produced and discarded. These are two completely different sub problems.
The objective of this project is to reverse the damage that non-biodegradable plastic has caused in the past, and continues to caused, whilst simultaneously reducing the demand to produce new plastic from raw material in the future.

The most common recyclable plastics are marked with a symbol to identify what type they are and hence how they can be recycled:

Polyethylene Terephthalate	Hight-Density Polyethylene	Polyvinyl Chloride	Low Density Polyethylene	Polypropylene	Polystyrene	Other

Global production of plastic made from raw materials



Production is increasing but the recycling effort is lagging. The Images below show some of the most devastating ecological consequences of poor resource and waste management.

Disturbing facts:

- A plastic bag has an average life of 12 minutes but has a life. expectancy of 1000 years.
- 1 trillion Plastic bags are used each year world wide.
- 50% of plastic is only used once before disposal.
- Many types of plastics do not biodegradable completely like other materials do; they only break down in to smaller and smaller and smaller microplastic particles.
- 1 million birds die each year from plastic ingestion.
- 50% of plastic is only used once before disposal.
- If the amount of plastic in the ocean continues to increase at the rate that it is now it will out-weight the amount of fish before 2050.
- More than a quarter of all fish now contain microplastic particles.
- In the last decade we have produced more plastic that the entire previous century.
- On average one tonne of plastic requires 5774 kwh to produce.
- Phthalates, softening agents added to many types of plastic to make them more flexible, have been proven to share a positive correlation with abnormal male sexual development, male infertility, premature breast development, cancer, miscarriage, premature birth and asthma.
- It requires up to 75% less energy to make plastic from recycled material as opposed to raw material.

As seen previously a large amount of research in to the properties of the recycled plastic has already been done. The area of the project that needs most research attention is the physical properties of skateboards and information about riding them. To gather this data I plan to approach several skateboarding organisations in central London. The potential research locations I found after an online search are as follows:

Shops

London Skate Centre
Slam City Skates West London
Slam City Skates East London
Slam City Skates North London
Skate Attack
Slick Willies

I approached the organisations via email or social media with a brief message introducing myself, the project and stating my intentions:

Dear _________

I am an Industrial Design student studying at Brunel University in West London. For my final year project I am designing a machine to make skate decks from recycled plastic.
I was wondering if you guys would be able to help me with a few things;

1. I am really interested in skate culture but don't have much experience riding, would it be okay to come down and ask you guys some questions about skating and skateboards, e.g. physical properties, what types of variations are available etc.?

2. Do you have any old broken decks that I could have so that I can conduct some laboratory tests on them to find out their yield strength and strain?

I have attached some pictures of some smaller samples of the plastic I have made as part of my research.

Looking forward to hearing back from you!

Thanks for your time,

Jason Knight

During this stage of research I am also going to begin collecting old decks so that I can compare them mechanical properties of HDPE and an actual deck. I will also need a board to identify the contours when it comes to making a model for my moulds. I also posted on the recycling forum "Freecycle" to try and find a board:

Freecycle

WANTED: Skateboards (can be broken)

Location: Brunel University
Date: Fri Sep 30 14:41:24 2016
Posted by: +fb2bb40b52
Description:
Skateboards any size, condition or age, (broken/snapped ones too!) for an Industrial Design Project

I was met with an immediate interest from several organisations that were interested in being involved with the project. The responses include:

Hi Jason,

Sounds good. Come by anytime, we usually less busy on weekdays and we are only closed on Mondays. xx

Hi Jason,

Sounds interesting and yeah please pop in anytime and there will be someone to talk too, weekends can be busy so a weekday may be better!

I think we have a spare deck up there so you can grab that… will be keen to hear how all this goes.

Cheers

Sure pop down to any of our stores on any day other then sat and the staff will be happy to answer any questions

Jason

Please feel free to come and talk to us.
We don't have old boards though, only new ones.

All The Best

Hi,
I've got a broken skateboard deck, you want it? and may I ask what the project is about?
Thanks, All The Best

Jason Knight 1303034

Brunel University London

Recycled Plastic Skate Deck: Initial Research

Name:____

Location:____

Date:____

I understand there are variations of thickness, size and curvature of a deck. Could you give a little detail about these variations and what affect they have on the deck?

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I understand flexibility is an important factor, how flexible should a deck be?

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Is there any terminology specific to these properties?

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What is the most common type of deck?

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Are there any recurring weak points or points of failure? e.g points that the board always breaks or points that wear a lot faster than others?

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Are there any other physical properties of the deck that I have not mentioned that affect its performance?

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How often do regular skaters buy decks?

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What is the price range for a deck alone? (No trucks, wheels or grip tape etc.)

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That's pretty much it, are there any other factors we have not discussed that you think I should consider?

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Thanks for your time!

Participant Information Sheet
Jason Knight 1303034 Brunel University

Participant Information Sheet: Recycled Plastic Skateboard Deck Initial Research Survey

My name is Jason Knight; I am an industrial design student studying at Brunel University London. For my final year major project I am designing a machine to make skateboard decks from recycled plastic, your participation would be very much appreciated if you are happy to.

What is the Purpose of this survey? The purpose of this study is to collect information about skating and skateboards, e.g. physical properties, what types of variations are available etc.

Why have I been invited to take part? You have been invited because despite heavy interest in skating culture I have little experience actually riding and need to know more to ensure the project best suits actual skaters.

Do I have to take part? You are not in any way obligated to take part

What do I have to do if I take part? If you do chose to take part I will ask you a few questions. The answers will be recorded on paper and, given your consent; a video with audio will be recorded.

The survey will take between 15-30 mins depending on the level of detail you feel is relevant to share.

Can I complete a paper questionnaire? Yes, if you would prefer to fill in a paper questionnaire rather than a video being recorded.

What are the possible benefits of taking part? There is not direct benefit of taking part apart from helping ensure that the final product that is developed will best suit the need of skaters.

What are the possible disadvantages and risks of taking part? Despite all the questions being strictly skateboard related and none ask for any personal information, there is a risk that answering the questionnaire may cause you distress if the topic is sensitive or regarding personal information. At any time during the survey you feel uncomfortable with continuing you are free to withdraw without giving reason.

What If something goes wrong? Details of who to contact if a complaint needs to be made can be found at the bottom of this document.

What will happen to the results of the research study? The results of this study will be analysed only by myself and kept confidential unless specified otherwise in the consent form. Any direct quotes taken will be non-attributed unless otherwise specified in consent form.

Who is organising and funding the research? Their research is organised and funded privately by myself as part of my Industrial Design and Technology undergraduate degree.

What are the indemnity arrangements? This study is covered by standard institutional indemnity insurance. Nothing in this document restricts or curtails your rights.

Participant Information Sheet
Jason Knight 1303034 Brunel University

Who has reviewed the study? This study has been approved by the Research Ethics Committee of the Department of Clinical Sciences in the College of Health and Life Sciences, Brunel University London.

Who has reviewed the study?

College of Engineering, Design and Physical Science Ethics Committee

What if I have a complaint? If you have any concerns or complaints about the conduct of the researchers or the study please contact:

John Park
Research Ethics, College of Engineering, Design and Physical Sciences
Brunel University London
Tel. +44 (0)1895 266057
Email: CEDPS-Research@brunel.ac.uk

'Brunel University is committed to compliance with the Universities UK Research Integrity Concordat. You are entitled to expect the highest level of integrity from our researchers during the course of their research'

Contact for further information: You can get more information or answers to your questions about the study, your participation in the study, and your rights by contacting the study team via:

Jason Knight
Email: 1303034@mt.brunel.ac.uk

Consent Form
Jason Knight 1303034 Brunel University

Recycled Plastic Skateboard Deck Initial Research Survey Consent Form

	Yes	No
Have you read the Participant Information Sheet?		
Have you had an opportunity to ask questions and discuss this study?		
Have you received satisfactory answers to all your questions?		
Who have you spoken to?		
Do you understand you will not be referred to by name in any report concerning the study?		
Do you understand that you are free to withdraw from the study:		
At any time?		
Without having to give a reason for withdrawing?		
Where relevant I agree to the interview being recorded.		
I agree to the use of non-attributed direct quotes when the study is written up or published.		
Do you give consent for a video with audio to be recorded during the study?		
Do you give consent for the video and audio recorded during the study to be published as part of my project?		
Do you agree to partake in this study?		

Signature of research participant:	Date:
Name In block capitals	

I am satisfied that the above named has given informed consent	
Witnessed by:	Date:
Name In block capitals	

Researcher Name: Jason Knight	Signature
Supervisor: David Harrison	Signature

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London
Kingston Lane
Uxbridge
UB8 3PH
United Kingdom

www.brunel.ac.uk

7 October 2016

LETTER OF CONDITIONAL APPROVAL

Applicant: Mr Jason Knight

Project Title: Recycled Skateboard Press

Reference: 3816-LR-Oct/2016- 4138-1

Dear Mr Jason Knight

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.
- No research data collected prior to this ethical approval should be included in your research.
- Please do not include any personal telephone numbers or email address in the Participant Information sheet, please amend this to just your Brunel Email address.
- You should agree with your supervisor how you will mitigate the risk to yourself by recruiting people via social media and then interviewing them. Perhaps a fellow student could accompany you in these situations.
- The Committee recommends that you complete the Ethics Training module via Blackboard Learn prior to commencing your research project. Please click on the link below and complete the course online. https://blackboard.brunel.ac.uk/webapps/blackboard/content/listContent.jsp?course_id=_8579_1&content_id=_322757_1

Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.
- Approval to proceed with the study is granted subject to receipt by the Committee of satisfactory responses to any conditions that may appear above, in addition to any subsequent changes to the protocol.
- The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.
- You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.

Professor Hua Zhao

Chair

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London

Page 1 of 2

Interview

I understand there are variations of thickness, size and curvature of a deck. Could you give a little detail about these variations and what affect they have on the deck?

Thickness should be the same as ideally a skateboard deck is composed of 7-ply layers of Canadian maple. The width it's the most important bit as it determines how easy is to elevate your deck from the ground (pop) and flip it around itself. The smallest the width the easiest to flip around, if the deck is wide then it is more stable. A small width deck varies from 7.4 to 8.375 inches. Anything above that is considered wide. Small decks are more ideal for street skating whilst wider decks are better for ramp skating.
Curvature varies from deck to deck and its about personal preference really.

I understand flexibility is an important factor, how flexible should a deck be?

They are a tiny bit flexible. They only reason for that is to be able to pop and elevate from the ground.

Is there any terminology specific to these properties?

Not really. There are several manufacturer websites that provide exact designs of decks but they are not very specific about flexibility.

What is the most common type of deck?

8.25 to 8.5" popsicle shaped decks is probably one of the most common ones.

Are there any recurring weak points or points of failure? E.g. points that the board always breaks or points that wear a lot faster than others?

Anywhere except the truck is a good breaking point. The middle is the most sensitive. It depends on how you land a trick and the impact that your body absorbs compared to the impact your deck absorbs.

Are there any other physical properties of the deck that I have not mentioned that affect its performance?

Shape that is different than curvature or concave. Most decks are popsicle shape but they can come with pointy noses or fishtails etc.

How often do regular skaters buy decks?

It really varies. A pro skater can change deck every week. A very good amateur skater who spends most of their time skating every 3 weeks to a month. A normal skater who just skates regularly every month to every 3 months.
Except for breaking, the main reason to replace a deck is cause it has lost its 'pop'. That happens faster if the deck gets wet.

What is the price range for a deck alone? (No trucks, wheels or grip tape etc.)

£40 to £60

That's pretty much it, are there any other factors we have not discussed that you think I should consider?

Not really. Good luck with your project!

Consent Form
Jason Knight 1303034 Brunel University

Brunel University London

Recycled Plastic Skateboard Deck Initial Research Survey Consent Form

	Yes	No
Have you read the Participant Information Sheet?	✓	
Have you had an opportunity to ask questions and discuss this study?	✓	
Have you received satisfactory answers to all your questions?	✓	
Who have you spoken to?	Jason Knight	
Do you understand you will not be referred to by name in any report concerning the study?	✓	
Do you understand that you are free to withdraw from the study:		
At any time?	✓	
Without having to give a reason for withdrawing?	✓	
Where relevant I agree to the interview being recorded.	✓	
I agree to the use of non-attributed direct quotes when the study is written up or published.	✓	
Do you give consent for a video with audio to be recorded during the study?	✓	
Do you give consent for the video and audio recorded during the study to be published as part of my project?	✓	
Do you agree to partake in this study?	✓	

Signature of research participant:	Date: 5 . 10 . 2016.
Name In block capitals Harry Edwards-Wood	

I am satisfied that the above named has given informed consent	
Witnessed by:	Date: 5 . 10 . 2016.
Name In block capitals ALICE WALSH	

Researcher Name: Jason Knight	Signature
Supervisor: David Harrison	Signature

Interview

I understand there are variations of thickness, size and curvature of a deck. Could you give a little detail about these variations and what affect they have on the deck?

Yeah sure, between each one, the plastic decks, are you talking more about the plastic decks or traditional wooden? [Interviewer: wooden] You've got all sorts of different types. Basically the deeper the concave in them, it easier it tends to be to flick the board when you are doing tricks. As well, when you have a deeper concave, on either side, on the nose and on the tail, you tend to get a better thing that we call "pop" which is when the board kind of makes that popping noise, [the board] comes up higher than a board with a flatter concave. You've got different widths of boards to suit different needs, for example, I would use an 8.1inch wide board and that is because I am about size eight foot, about 5'7"-5'8" in height. I don't necessarily need a very wide board where as a bigger guy, who's maybe like 6'-something and has like size 10 feet; he might use an 8.25-8.5. size board. So depending on how big the actual person is depends how wide the board can kind a go for. Length wise they all tend to be roughly the same, between 31" to 32" at the very maximum. Again it kind of depends on the person; it's more of a preference. The ones that tend to have a longer, towards the 32", have longer tails which some people prefer because it gives you more space on the back of the board to do their thing but it tends to be less steep. That's all I can really think of off the top of my head; the curvature, the width and length and how they all change.

I understand flexibility is an important factor, how flexible should a deck be?

When board are new they tend to be very rigid, they tend to have to take a bit of a beating and some heavy drops until they kind of start to loosen up. It's kind of like when you are breaking in a new pair of shoes, so really stiff at the beginning, you break them in and they get more comfortable. It's the same kind of thing with skateboards. They always start off really stiff but they get a little bit softer through time. I think its because the Canadian maple, that is what they are all made out of, what that does is give you a lot of strength but it's also quite forgiving in the terms that it has got that tiny bit of flex. It has got that tiny bit of flex. You don't want it to be too flexible. You don't want it to be made out of bamboo if you're doing this style of skateboarding. Longboards, bamboo all day because it gives you like a suspension while you are cruising. But with these kinds of boards [traditional] you want them to be more stiff that super flexible.

Is there any terminology specific to these properties?

Concave is the curvature where it [the board] dips down there at the sides. You can see it more from on top of the board; there is a line which runs down the middle, along each side.

Pop is the kind of hard to explain, it's only used in skateboard terminology. The board kind of flicks up [from horizontal to vertical] that there is the pop. If a board is rubbish it will kind of just lift up and won't feel too good. So when it flicks up [slightly jumps of off ground when vertical] like that is the pop. It has good pop when it does that.

What is the most common type of deck?

The average type of concave, you've got like a shallow concave; mid concave, deep concave, and upper deep concave, most of them are a medium concave; that's everyone preferred. Personally I find it easier, the deeper the concave the better. Again it's a massive preference kind of thing.

Are there any recurring weak points or points of failure? E.g. points that the board always breaks or points that wear a lot faster than others?

What tends to be an issue, on a lot of wooden ones, around the sides starts to chip away [and] becomes loose. It's basically because the glue doesn't tend to hold really well, the glue that they are using isn't really great. Constantly taking knocks, it's going to start to shave away. Another problem that happened is "de-lamming". Basically what this is, the top couple of plys are coming apart. Especially down here there is no glue to hold it, that's just common age problems. It will happen with all boards.

Another one is, obviously, if you land too heavy in the middle, then it can just snap. That's why you want to have a tiny bit of flexibility in the board. If it's super rigid it's just going to snap straight away. Snapping in the middle tends to be a big issue.

You can't really get around that unless you, there are technologies called Pop-Secret and P2, which are basically like a fibreglass ply along the centre of the board which make it super strong, the same kind of weight, it doesn't really and any weight. It supposedly gives you more of that thing called pop. It gives you a bit more of a spring in it. That's the only way they have been able to tackle it still happened. They also had another one called impact support. Which is again, the same kind of thing as P2 and Pop-Secret that we we're talking about. The only issue is they all tend to do that de-lamming thing pretty quickly, where the glue separates, it doesn't tend to kind of stay as well as a normal ply of Canadian maple. They also use carbon foam. They drill out like Popsicle shape in the middle of it and pump it full of carbon foam. Not necessarily to make it strong but to make it lighter. That works pretty well, but it's so expensive doing it that it costs like £120 just for the deck. An average board costs about £50-£65. By doing that you're paying double the price.

Are there any other physical properties of the deck that I have not mentioned that affect its performance?

Lightness is very important. It will depend on what type of skateboarding you are doing, if you are doing more bowl skateboarding then you are not too worried about the weight because you're getting air but you're [also] getting a lot of speed from going up and down all the time so you sort of fly out of it anyway. By having a heavy board you feel it on your feet more. When a board tends to be heavier it will tend to be stronger. Again, like those kinds of boards tend to constantly be sliding on the copings, slamming the middle of the deck, coping being the metal part that goes around the half-pipe or the bowl. The heavier boards go through a much harder beating, and the reason why they are heavier is because they are stronger. The lighter boards, which is what I use, is for more technical style skateboarding. They are more for doing what you see on TV, more of the tricks, down stair sets, down rails, that kind of thing. Only problem is by going with a light board it tends to be much weaker. What they do with the trucks is they hollow them out, which makes them lighter but it also makes them weaker. It's the same thing with boards. If you are going to try and use a lighter form of Canadian maple with thinner plys its going to make it weaker. That's the kind of things you have to sacrifice weight and strength or lightness and weakness basically.

How often do regular skaters buy decks?

Its really down to the type of skater; kids can have a deck that will last them a year. They weight nothing, 30-50kg, just cruising about doing little Ollies off stairs or whatever. When you get to slightly later on in life and you're really going out skateboarding on big stairs, people can snap boards in 15 minutes. My friend, he bought one, went round the corner, jumped off the stairs, landed in the wrong place, it snapped straight away. They won't carry warranty issues with that kind of thing, it's your fault, it's probably a perfect board but you landed on it the wrong way so that's your own fault. So yeah boards can last any when from a year for younger kids but can last anywhere, realistically though, on average like 2 months. I've had mine since the beginning of august and I need to change it as soon as I can. So yeah about 2 months on average and I'm not a super-heavy skater, I'm sort of an average [time spent] skater. For the higher end skaters they probably go through two a month.

What is the price range for a deck alone? (No trucks, wheels or grip tape etc.)

An average skateboard is, UK brands, about £40. Simply became its not imported from America. It may be made in Mexico or China, and you have to pay import tax. They don't have to buy it from a brand, who gives it to a distributor, etc. American boards are going to start around £55. Simply because they are made in America or made in Mexico and then shipped over to the UK, sold to a distributor, then sold to a shop then we have to sell it on so it goes through multiple hands. It probably costs them like $10 to make, or less, but going through hands it goes up massively in price.

That's pretty much it, are there any other factors we have not discussed that you think I should consider?

You wouldn't want to make one of these boards from plastic [Traditional Popsicle] it wouldn't feel the right way. Obviously you can manipulate plastic pretty well but there is something about wood. You can feel that it vibrates a certain way against the floor, it channels the vibrations against the floor in a way that plastic doesn't do. So plastic a lot of the time, are great for the cruiser boards, like the Penny's; [boards] Amazing, super super strong, pretty light. That's one thing you should worry about because plastic can be quite heavy. That's [Penny Board] heavier than a normal skateboard so you've got to be careful about weight. They are super strong, pretty affordable for what they are considering they don't break. But yeah they are just heavy. You've also got Nickle boards as well which are like the bigger version of the Pennys. They are the same [style] as the penny boards, they are just longer. They tend to be flat. I think that's the massive downfall of this kind of brand, because they're flat. When you're on it just doesn't feel right. You don't have the right control over it where when it's concave it's much easier to feel where you are on the board. You have a rough idea when you're on the nose. For me this feels complexly alien after being on a normal wooden board. It would feel much nicer if it had a normal width on the tail and if it wasn't quite so flexible as well. When you're standing on these you can see they flex quite a but I suppose you really need that on a plastic board or a cruiser but suppose you were wanting to make plastic in to that sort of style, the popsicle shape we were looking at, you would have to have a wider tail, slight concave, a little bit longer and I think you'd be ok. Also consider the grip tape as well, these don't come with grip tape, these have a thing called waffle grip, which is kind of take from the vans shoes and they have kind of embedded it in to the plastic. It's kind of like a natural grip. It works ok but what tends to work better is anything that is like that:
That is the ultimate grip. Anything like that kind of thing, tiny little lines up and down, will just old on so much better than that, just because of the way it is.
I don't think anyone has tried to do plastic boards of this shape so give it a try, you could catch on to something but check out the metal boards they tried in the 90s, the trek-craft, something like that, try and read up a little bit about that because again it's trying something that nobody has ever done before. They did it, they got it actual production, they we're selling them but they just didn't catch on. They we're heavy, a bit clunky, you got kind of messed up on them, if you fell off, and land on them, or it land on you, you tend to feel it, a lot more than the wooden boards, so yeah check them out. If you just search 90s metal skateboard I'm sure there will be some old reviews, opinions from proper skateboarders on that kind of thing. That's probably the best thing for you to do,

Brunel University London

Consent Form
Jason Knight 1303034 Brunel University

Recycled Plastic Skateboard Deck Initial Research Survey Consent Form

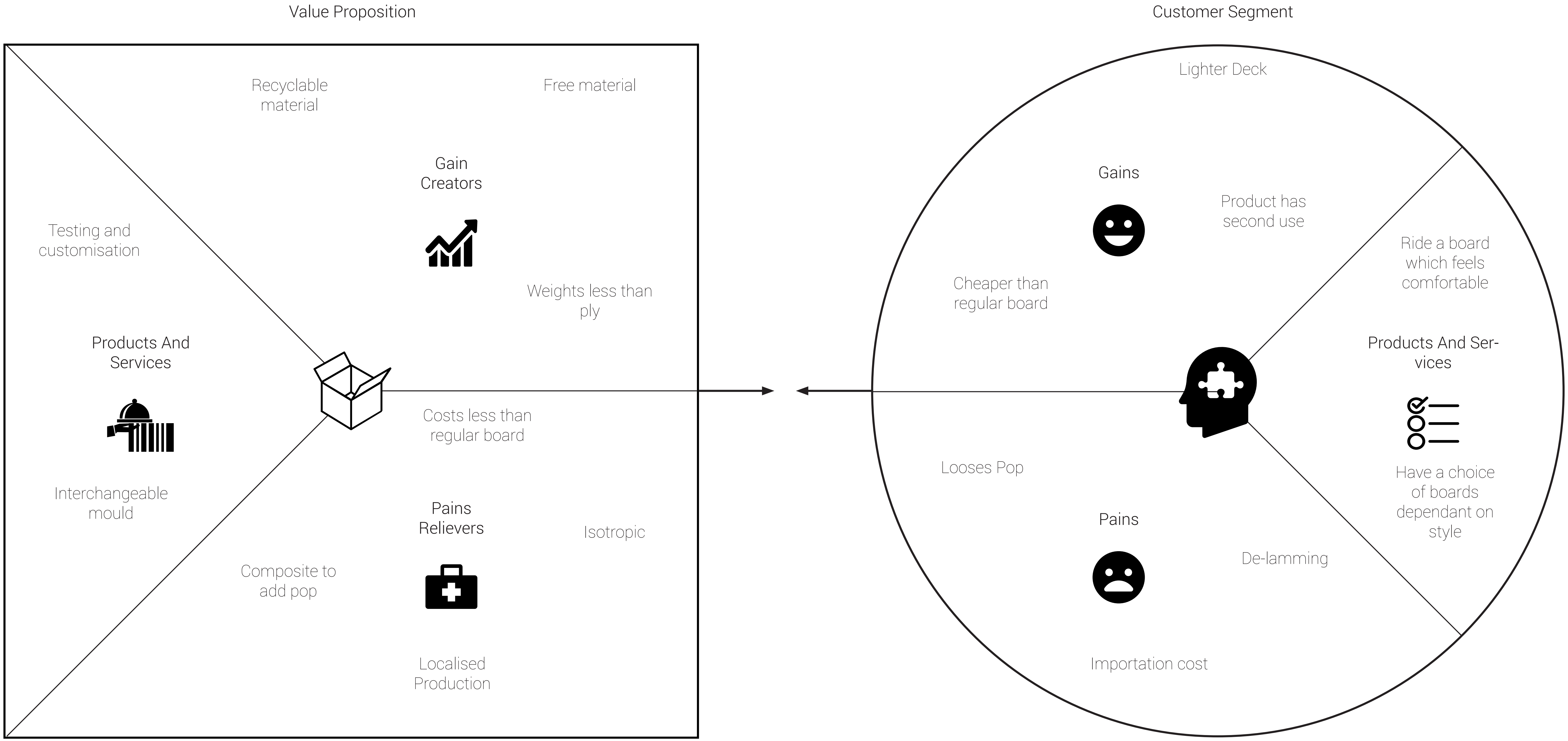
	Yes	No
Have you read the Participant Information Sheet?	✓	
Have you had an opportunity to ask questions and discuss this study?	✓	
Have you received satisfactory answers to all your questions?	✓	
Who have you spoken to? JASON	✓	
Do you understand you will not be referred to by name in any report concerning the study?	✓	
Do you understand that you are free to withdraw from the study:		
At any time?	✓	
Without having to give a reason for withdrawing?	✓	
Where relevant I agree to the interview being recorded.	✓	
I agree to the use of non-attributed direct quotes when the study is written up or published.	✓	
Do you give consent for a video with audio to be recorded during the study?	✓	
Do you give consent for the video and audio recorded during the study to be published as part of my project?	✓	
Do you agree to partake in this study?	✓	

Signature of research participant: L. Hyams	Date: 5/10/2016
Name In block capitals: LOUIS HYAMS	

I am satisfied that the above named has given informed consent	
Witnessed by:	Date: 5/10/2016
Name In block capitals: ALICE WALSH.	

Researcher Name: Jason Knight	Signature
Supervisor: David Harrison	Signature

The purpose of a Value Proposition Canvas is to ensure that product you design provides a solution to the customer's problems. By identifying what the customer wants from a product you are able to deliver something that addresses each of these needs and that is a valued improvement of the current situation.



Strengths	Weaknesses
Localised Production, reduced transportation costs. Free Material. Each board is unique and customizable. Overlap of users interests, skating and sustainability. Longer life than current products. Cheaper than current products. Pre-existing distribution network. Strong moral obligation to recycle. After initial set up cost, little maintenance cost. Increasing demand for cradle to cradle products. Aesthetically pleasing. Higher breaking point then wood. Plastic is hydrophobic. Supports a sporting culture which promotes better health. Skate Boarding is increasing in popularity. Increasing trend of personalisable products. In contact with network of experienced skaters Workshop and CAD experience. Skateboard community is very open and willing to help.	Expensive set up cost. Requires training to operate machine. Lots of factors to explore during scope of project. Will feel different to a wooden deck. Large amount of material to make mould. Lots of moulds required. Machinery is cumbersome. Difficult to regulate manufacture quality. Lack of personal experience with skateboarding. Poor welding skills and little metalwork experience. Developing on tight budget. Steep learning curve. Time management of all aspects of the project. Having to rely on technicians often causes unanticipated delays whilst they are dealing with other students. Other plastic boards on market have poor reputation. Short time frame for size of project. Limited availability of workshop time and machine access.

Opportunities	Threats
Increasing demand for recycled products. Competitor plastic boards are not as popular as traditional boards. Global market and established community. Autonomous product promotion and encouragement to recycle through use of machine. Machine gives organisations the freedom to create a scheme which best suits their local community. Currently no good plastic based boards on the market. Current wood boards have a short lifespan as average life is usually 1-2 months before replacing. Wooden boards are built in layers and are vulnerable to 'de-laming'. Product is recyclable. Average amount of plastic being produced each year is increasing. Help improve local economy and local environment through waste collection. Challenge the stigma of the skating from being rebellious to supportive of local community and waste management. Demand for lots of variations in board size and shape.	Transition from well established material. Owner of machine must trust that he will get a return on their investment. Skaters may be reluctant to adopt a new type of board. Strong human error factor, could reflect on as bad product. Users are only comfortable with specific physical properties. Although Skateboarding is becoming more mainstream there is a decline is skateboarding interest. Sports equipment legislation. Each prototype takes several months to complete. Skateboarding industry is heavily branded and privatised. Recycled plastic is a rapidly expanding market area and other boards are being released made from diffident types of plastic waste. Sustainability motivated sales may be a passing trend and may decrease in popularity over time. Ethics approval of testing sports equipment may be a lengthy process.

Name: Penny Board
Style: Cursing, Technical Tricks
Size: S
Avg Length: 560
Avg Width: 150
Cost: £30+
Material: Polymer Composite

Name: Cruiser
Style: Cursing, Technical Tricks
Size: M
Avg Length: 700
Avg Width: 180
Cost: £30+
Material: Canadian Maple

Name: Traditional (Popsicle)
Style: Street, Technical Tricks, Pools, Ramps, Parks, Vert
Size: L
Avg Length: 840
Avg Width: 180-250
Cost: £40+
Material: Canadian Maple

Name: Longboard
Style: Cruising, Downhill
Size: XL
Avg Length: 840-1500
Avg Width: 230-255
Cost: £100-£200
Material: Canadian Maple, Bamboo, Fibreglass, Carbon Fibre

Name: Nickel
Style: Cruising, Technical Tricks
Size: M
Avg Length: 170
Avg Width: 230-255
Cost: £40+
Material: Polymer Composite

Name: Mini Board
Style: Technical Tricks
Size: S
Avg Length: 460
Avg Width: 127
Cost: £15+
Material: Canadian Maple

Name: Old School
Style: Pools, Ramps, Parks, Vert, Freestyle
Size: L
Avg Length: 840
Avg Width: 250+
Cost: £60-£100
Material: Canadian Maple

Name: Mountainboard
Style: Cruising, Downhill
Size: XL
Avg Length: 900–1100
Avg Width: 400
Cost: £150-£300
Material: Composite carbon,glass reinforced plastics, wooden core

Physical Attributes

Axle A metal rod, which the wheels are mounted too, with threaded ends running through the trucks.

Bearing The part of the wheel which bears the load and friction generated by riding. There are typically two in each wheel.

Concave Two curves which run along each side of the deck which are noticeable steeper than the curvature of the rest of the board.

Cushion/Bushing A rubber or plastic disc which sits in the trucks and allows the axle to pivot.

Deck The large flat part of a skateboard which all other components are mounted to. The deck comes in to contact with the feet of the rider and on traditional wooden boards is coated in grip tape.

De-Lamming When the glue between the layers of ply comes unstuck, as a result of hard knocks or age, causing the layers to separate.

Flick Controlling the board whilst it and the rider are in mid air using subtle foot gestures.

Grind To slide along an edge using part of the board other than the wheels.

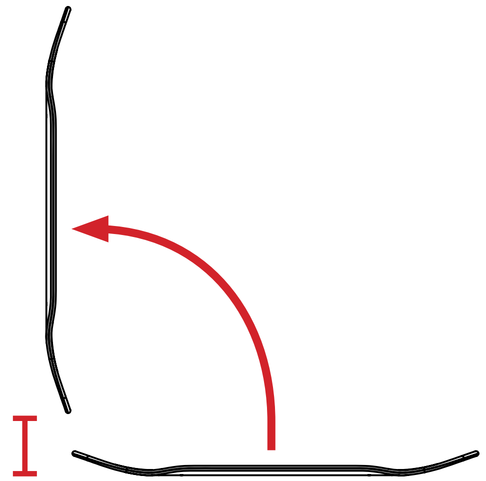
Grip Tape Adhesive backed sandpaper attached to the top surface of the deck to increase friction between the rider and the board

Kingpin The bolt which holds the individual parts of the truck assembly together

Nose The section of the deck which protrudes in front of the front truck mounts.

Ply The unit used to measure the thickness of the board. E.g. A "7-Ply' is made of a seven layer piece of plywood.

Pop The springy quality of the board which allows it jump off the ground or a surface when a force is applied.



Elevation

Possible The term given to the traditional style of wooden board, named after the shape of a wooden popsicle stick, wide and the ends and narrow in the middle.

Tail The section of the deck which protrudes behind the rear truck mounts.

Trucks Two bracket assemblies that mount the front and back axles to the deck. The brackets contain a steering washer called a bushing

Wheelbase The distance between the diameters of the inner two pairs of truck mounts

Styles:

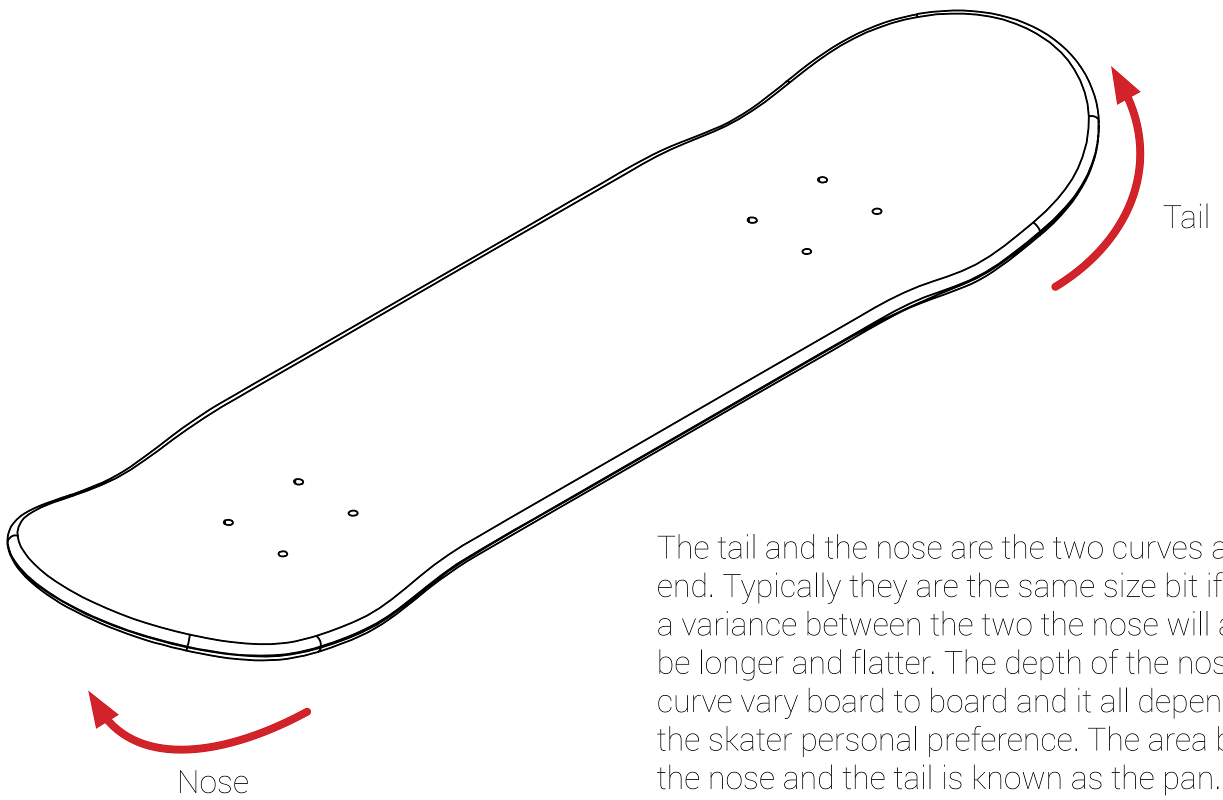
Cruising/Downhill Cruising is the least technical style of skating, and means to simply ride the board, without tricks, through parks, urban areas or downhill. The aim is to achieve and sustain the fastest speed possible with minimal ground contact.

Freestyle Freestyle skateboarding involves incorporating as many tricks as possible in to a sequence, is mostly conducted on flat ground and usually involves choreography and music. It was the first style of skateboarding and can be traced back to the early 60s.

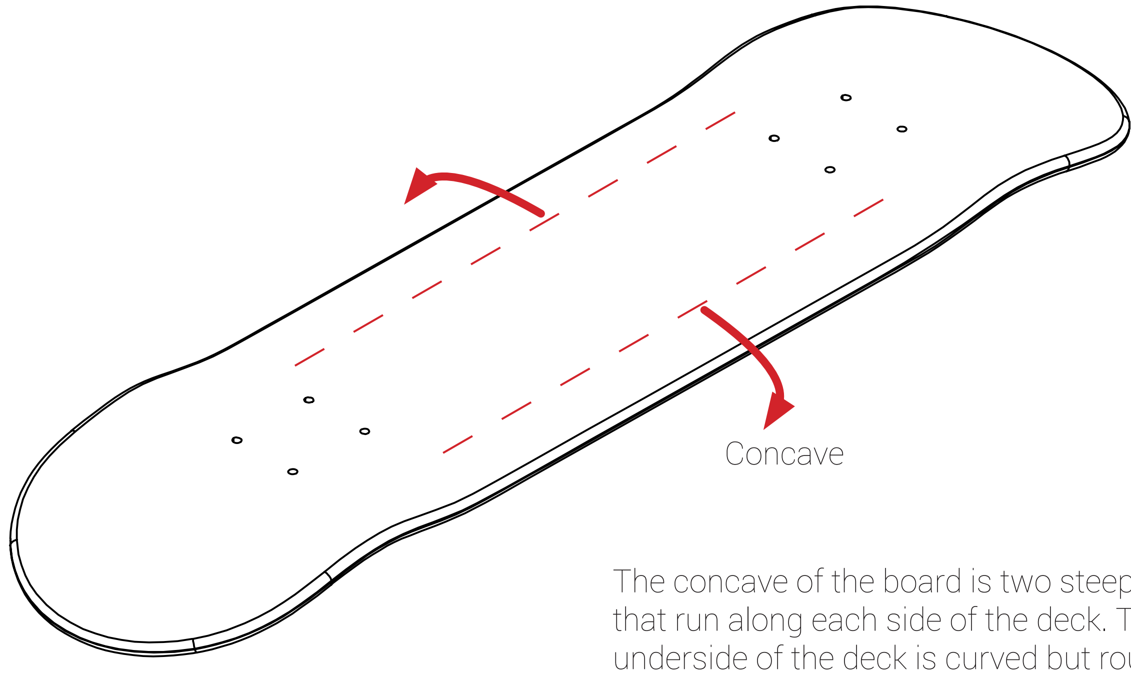
Ramp Or *MegaRamps* are large ramps, often 150ft+, which consist of a larger drop followed by a steep incline at the bottom with the aim of achieving the maximum amount of airtime. The skater drops in to the large ramp and then performs freestyle tricks whilst in the air.

Street Street skating is a trick-oriented style of skating where riders make use of pre existing public furniture such as hand rails, benches and walls etc. The aim is to transition between different parts of street furniture and infrastructure whilst incorporating tricks in to the route you take. Common environments for street skating are plaza, industrial areas or any other public space

Vert Skating on enclosed vertical faces such as bowls and pools. The style originated when skaters began to preform tricks in drained swimming pools.



The tail and the nose are the two curves at each end. Typically they are the same size bit if there is a variance between the two the nose will always be longer and flatter. The depth of the nose and curve vary board to board and it all depends on the skater personal preference. The area between the nose and the tail is known as the pan. The distance between the inner centre points of two sets of truck mounts is known as the wheel base.



The concave of the board is two steep dips that run along each side of the deck. The entire underside of the deck is curved but roughly 40mm from each edge there is a steeper dip (when looking at from underneath) that allows the skater to control the board whilst he is in the air. The concave varies between board to board and depends on the style of skating and personal preference of the skater.

Thickness

The thickness of the board is dependent on the type of skating and measured in ply. The most common thickness is 7 ply. Bowl skateboarders typically require a stronger board so opt for the thicker end of the scale but street and cruise skaters value weight more so tend to go for thinner and lighter boards.
The term ply is used because of the construction of the board. Like any plywood they are made from thin lamented layers of wood with alternating grain directions to add strength.
The most commonly used material for skateboards Canadian Maple.

Ply	MM
3	3
5	6.35
7	9.525
9	12.7
11	15.875
13	19.05

Width & Length

The width and length of the board are dependent on the size of the skater. The majority of decks are the roughly length but can be anywhere between 787mm and 812mm. The width varies a lot between riders and is dependent on their weight, height, shoe size and personal preference. It typically varies between 165mm and 210mm.

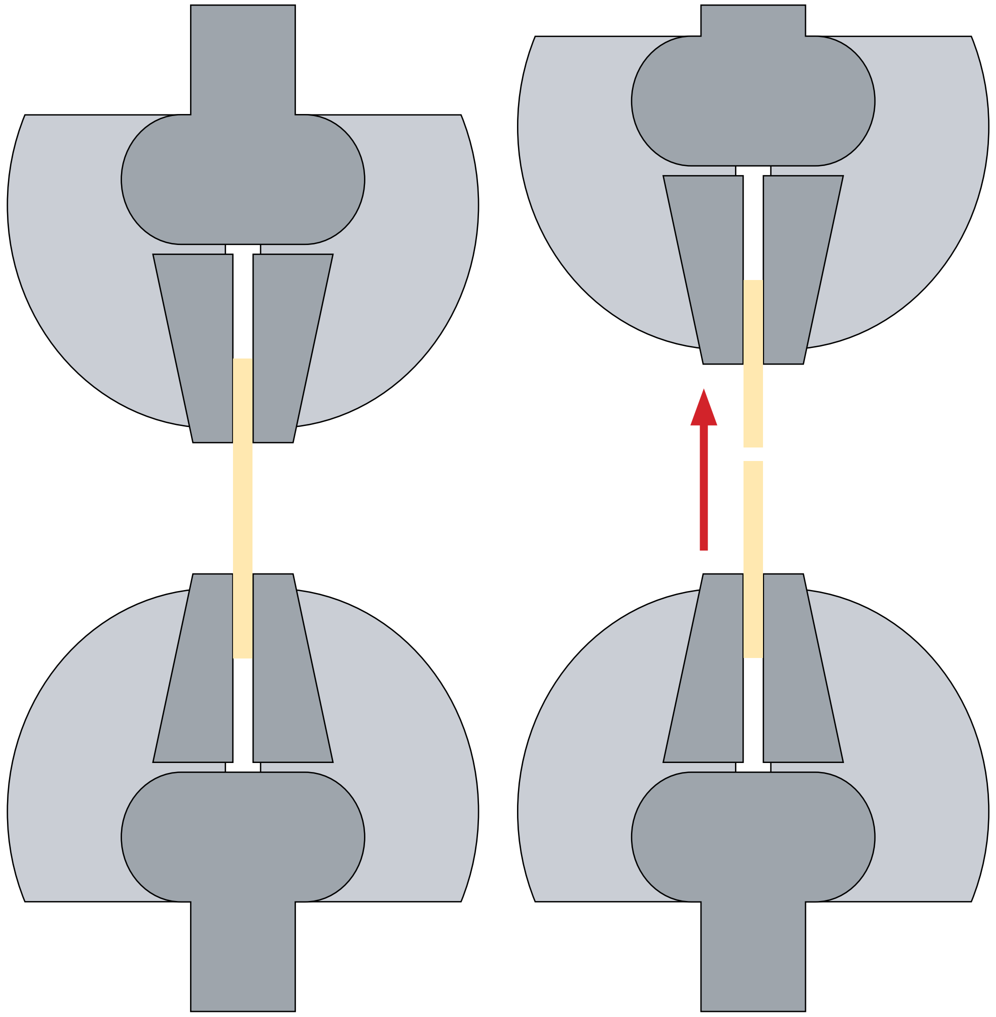
Height	Age	Shoe	Board Size
<3'5"	<5	<3	165.1-171.45
3'5" -4'5"	6-8	4-6	171.45-177.8
4'5"- 5"3	9-12	7-8	177.8-185.42
5'3"<	13<	9<	185.42-190.5+

Adult (5'3"<) Skate Style	Board Size
Street, Technical Tricks	190.5-203.2
Pools, Ramps, Parks	203.2-209.55
Vert, Pool, Cruising	209.55<

Material Testing

To compare the mechanical properties of recycled plastic in comparison to Canadian maple, the material used to make traditional skateboards, a series of materials tests must be conducted. Following a conversation with a materials technician, we concluded that three tests would be relevant for the materials intention. We also defined the dimension restrictions for the test samples to ensure that they fit in to the testing jigs.

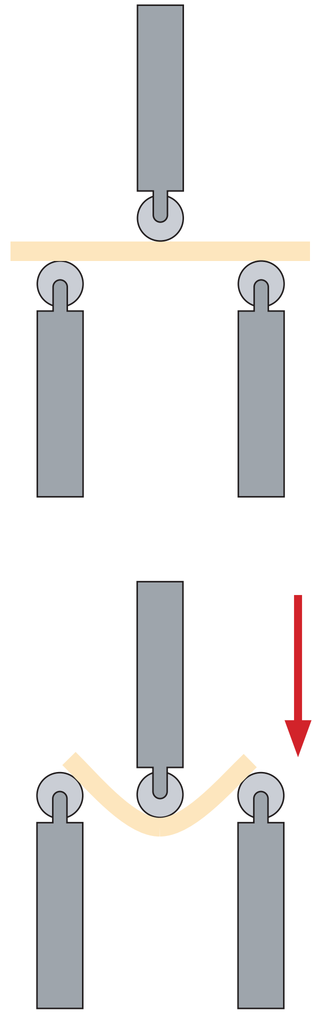
Tensile strength



A sample is clamped at each end and a gradually increasing force is applied to each clamp, pulling them apart until breaking point. The tensile strength test gives us a graph of deformation against tension and the ultimate tensile strength. The ultimate tensile strength is the maximum amount of load applied before breaking. The tensile strength tests require a specific shape sample, wide at the ends and narrow in the middle.

This ensures that when the material breaks it is in the middle, not the part of the sample being clamped. The maximum dimensions are 10x10mm in depth and width and should be roughly 150mm in length.

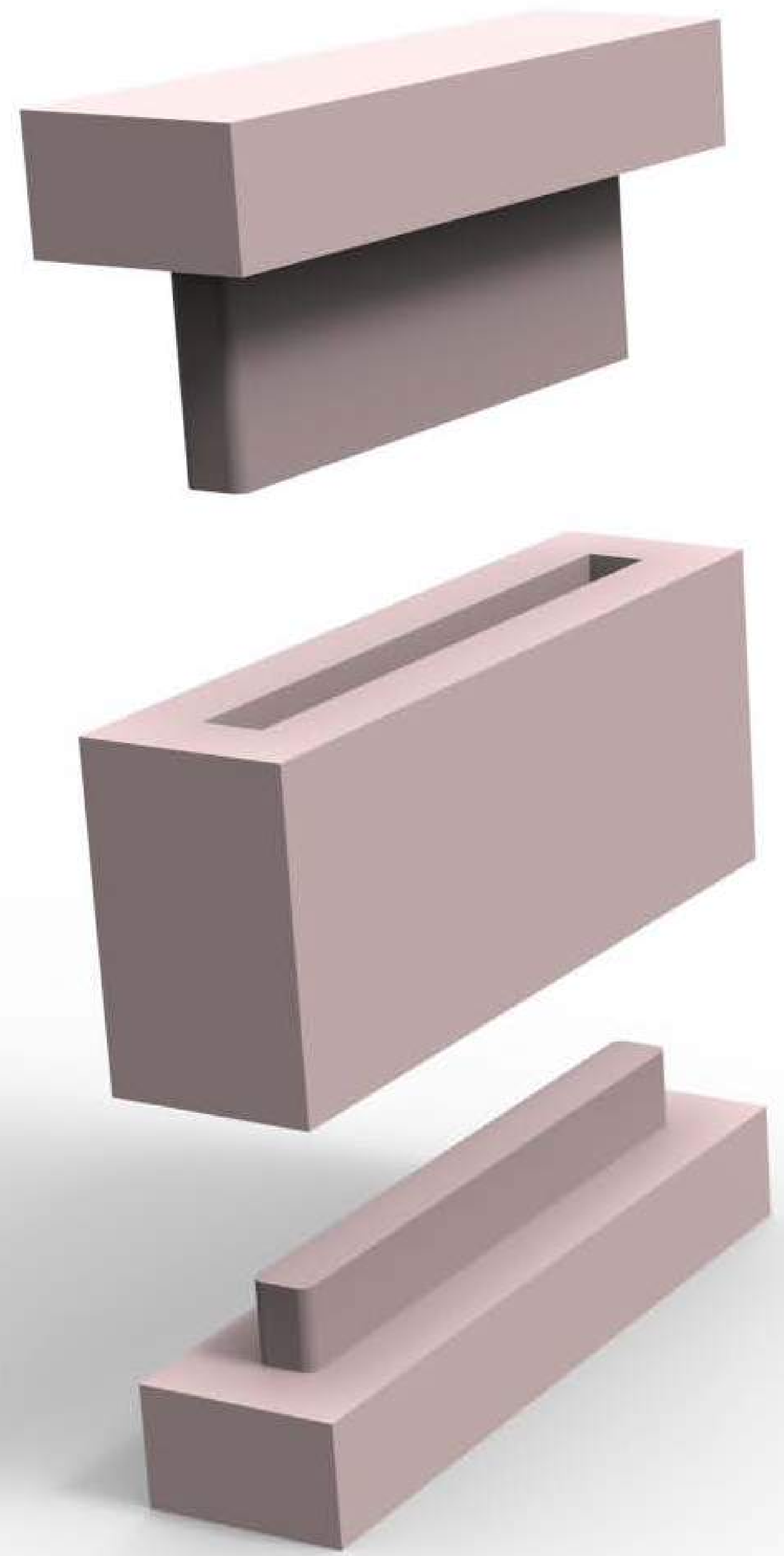
Flexural Strength

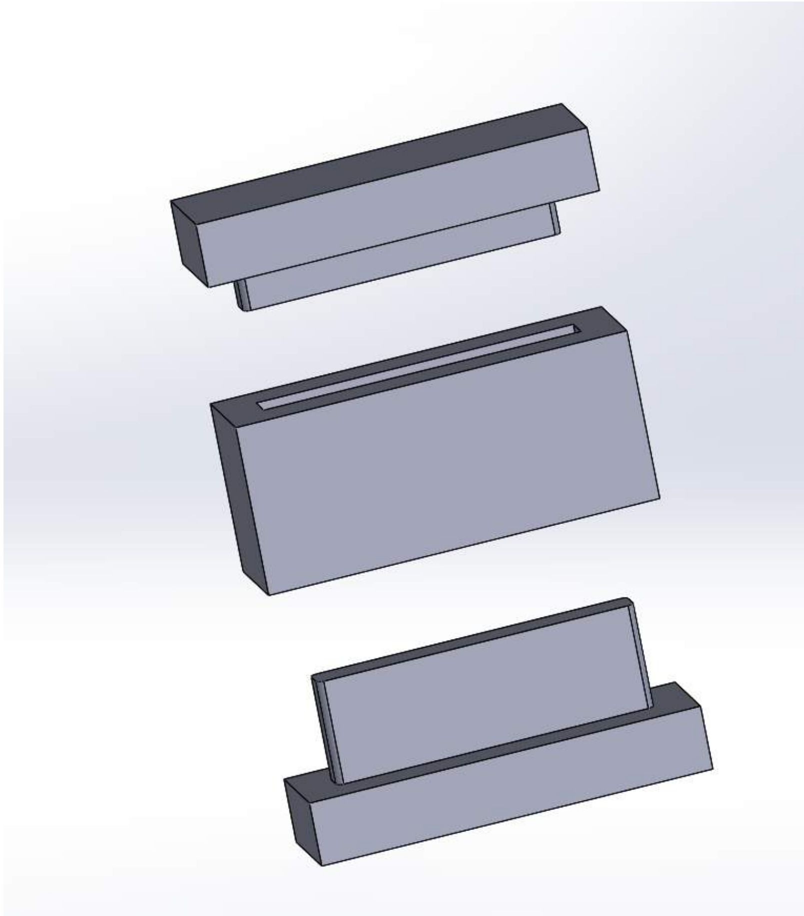


A sample is placed horizontally above two rollers with a void between them. A 3rd roller applies a gradually increasing force to the middle of the sample until it permanently deforms. The flexural strength test gives us a graph of deformation against force applied and the flexural modulus. The results can be used to identify flexural modulus, the point that the material will not return to its original form, and the elastic modulus, the resistance to flexibility.

The width and thinness should be roughly the same as the strength test but can be wider. It should be between 100-200mm in length.

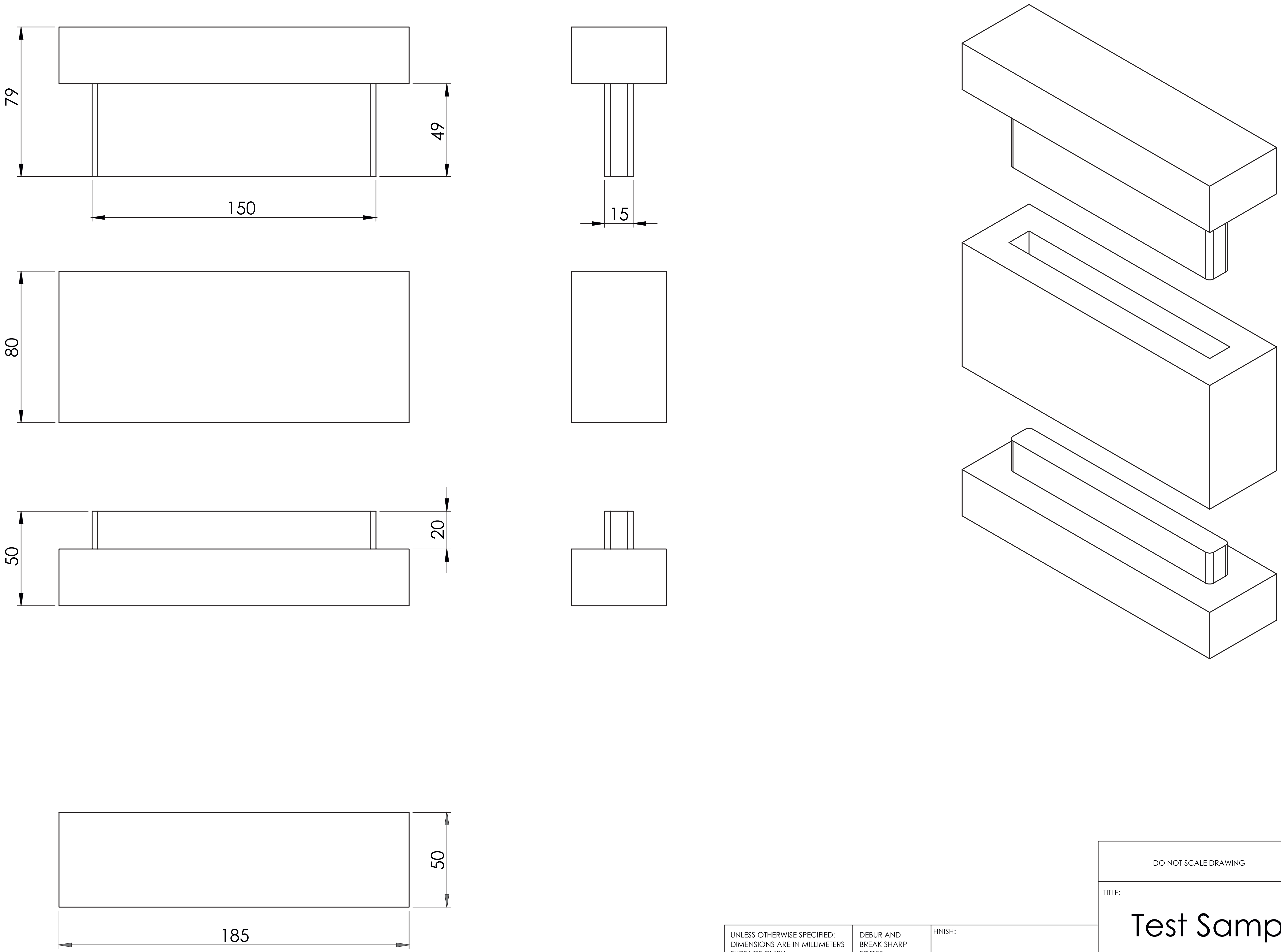
One thing I should consider is the curvature of a the board and if the curve adds flexural strength to the cross section.





To replicate the wooden test samples, made from a skateboard deck, from mould was created so that HDPE could be shaped. A 3D model was made Solidworks the CNC cut from Uriel by a technician. Uriel was chosen because of its ease of machinability and its resistivity to heat.

The 3 part mould consist of a middle section with an extruded cut all the way through, a cap to stop the material escaping out of the bottom and a cap with a long plunger to both press the material as it compresses and stop it escaping from the top of the mould. The rounded corners have been added to allow for the radius of the cutting tool. One mould can be used for all samples as will be cut and sanded down to size.



DO NOT SCALE DRAWING	REVISION

TITLE:

Test Sample Mould

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

DEBUR AND BREAK SHARP EDGES

FINISH:

MATERIAL: Uriel

DWG NO. DM3701-01

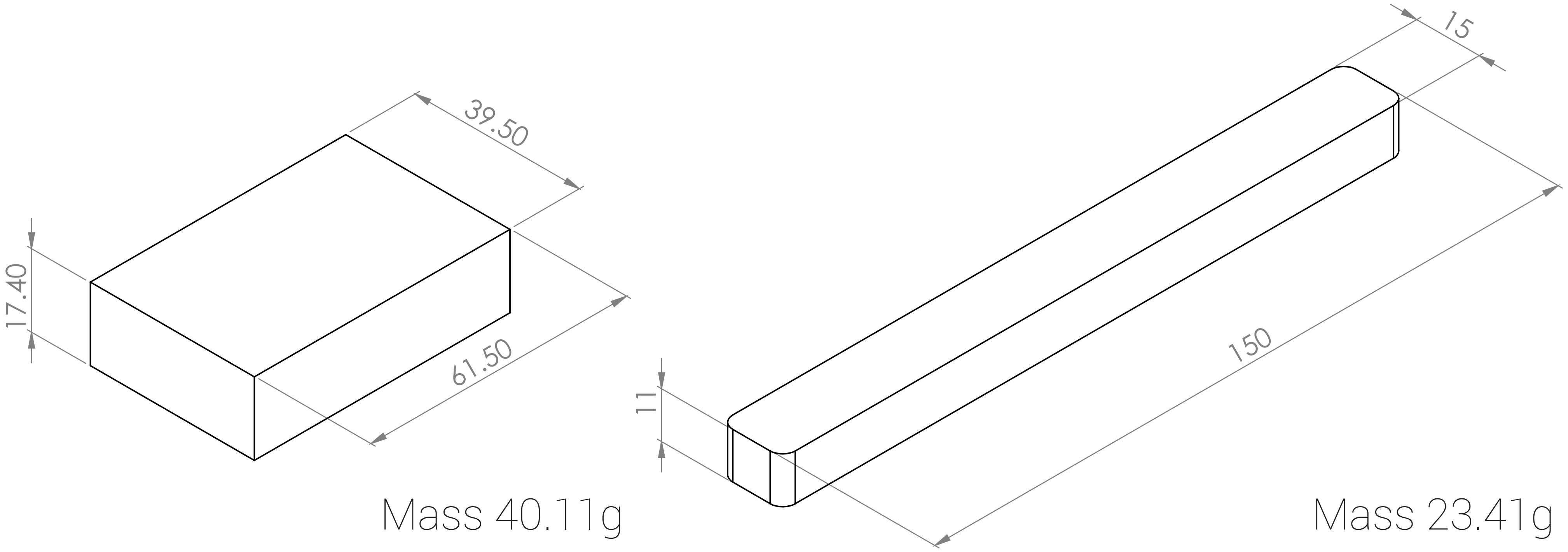
A3

	NAME	SIGNATURE	DATE
	Jason Knight		23/11/16

WEIGHT:

SCALE:1:2

SHEET 1 OF 1



Before moulding the test samples I was required to calculate the mass of plastic to place in to the moulds before placing it in the oven to ensure it fully fills the mould and allows it to close properly. To do this I took a test sample and machined it to a perfect square using a band saw and belt sander. I then measured and weighed it to work out how the mass of the material per 0.01mm3. Using the "Mass Properties" tool in Solidworks I could then work out the volume of my test sample and hence calculate is mass using the value acquired from the test swatch. My calculations can bee seen below.

Swatch
40.11g 17.4mm x 39.5mm x 61.5mm

Volume of Swatch	=Height x Width x Depth	=17.4mm x 39.5mm x 61.5mm	=42268.95 mm3
Mass per 0.01 mm3	Mass of Swatch Volume of Swatch	40.11 g 42268.95 mm3	=0.0009489235
Mass of Test Sample	=Weight per 0.01 mm3 x Volume of Test Sample	=0.0009489235 x 24665.02 mm3	=23.41 (2 d.p)

Raw Material For Test Sample
23.41g

Before assembling the mould I coated the inner faces with coconut oil to ensure that it could be disassembled easily. The shorter cap is inserted first to the bottom of the middle section.

Using kitchen scales I weighed out the right amount of material in a greaseproof paper glass dish then placed it in to the oven at 170 °C for roughly 20 minutes until the plastic was molten and bonded together.

The molten plastic was then placed in to the mould and the top cap was placed on to the mould. A large arbour press was used to apply pressure to the mould, forming the HDPE test sample.

First using a belt sander the flash (excess material) was removed from the test sample. The Wet and dry paper was used to finish the surface and remove any smaller imperfections.

The plywood samples were cut using a band saw and sanded down to size using a belt sander. The image above shows the outcome of both the HDPE and plywood samples.

Comparing the flexural modulus of HDPE with a traditional wooden skate deck

The flexural modulus, or bending modulus is the ratio of stress to strain In flexural deformation e.g. the materials resistance to bending. To identify the flexural modulus of a material the slope of its stress strain curve is in putted in to a formula:

$$\frac{L^3}{4 \times w \times t^3} \times m$$

Where:

L= Length (mm)
W=Width (mm)
T=Thickness (mm)

M=Slope of load deflection curve

$$\frac{y^2 - y}{x^2 - x} = m$$

Taken from Milestone Video

Two tests were conducted. One of a sample taken from an actual wooden skateboard deck and one from a section of HDPE. The unit of the results is in mega-pascals (Mpa).

Wood:

Calculating m:

$$M= \frac{600.53821 - 201.19893}{1.31723 - 0.57758} = 538.903 \text{ (3 d.p)}$$

m= 538.9030352

Calculating Flexural Modulus (Mpa)

L= 192
W= 10.2
T= 15.5

$$Mpa= \frac{192^3}{4 \times 15.5 \times 10.2^3} \times 538.9030352$$

$$=58080.08594$$

HDPE:

Calculating m:

$$M= \frac{350.00244 - 100.27256}{8.29235 - 1.62746} = 37.468 \text{ (3 d.p)}$$

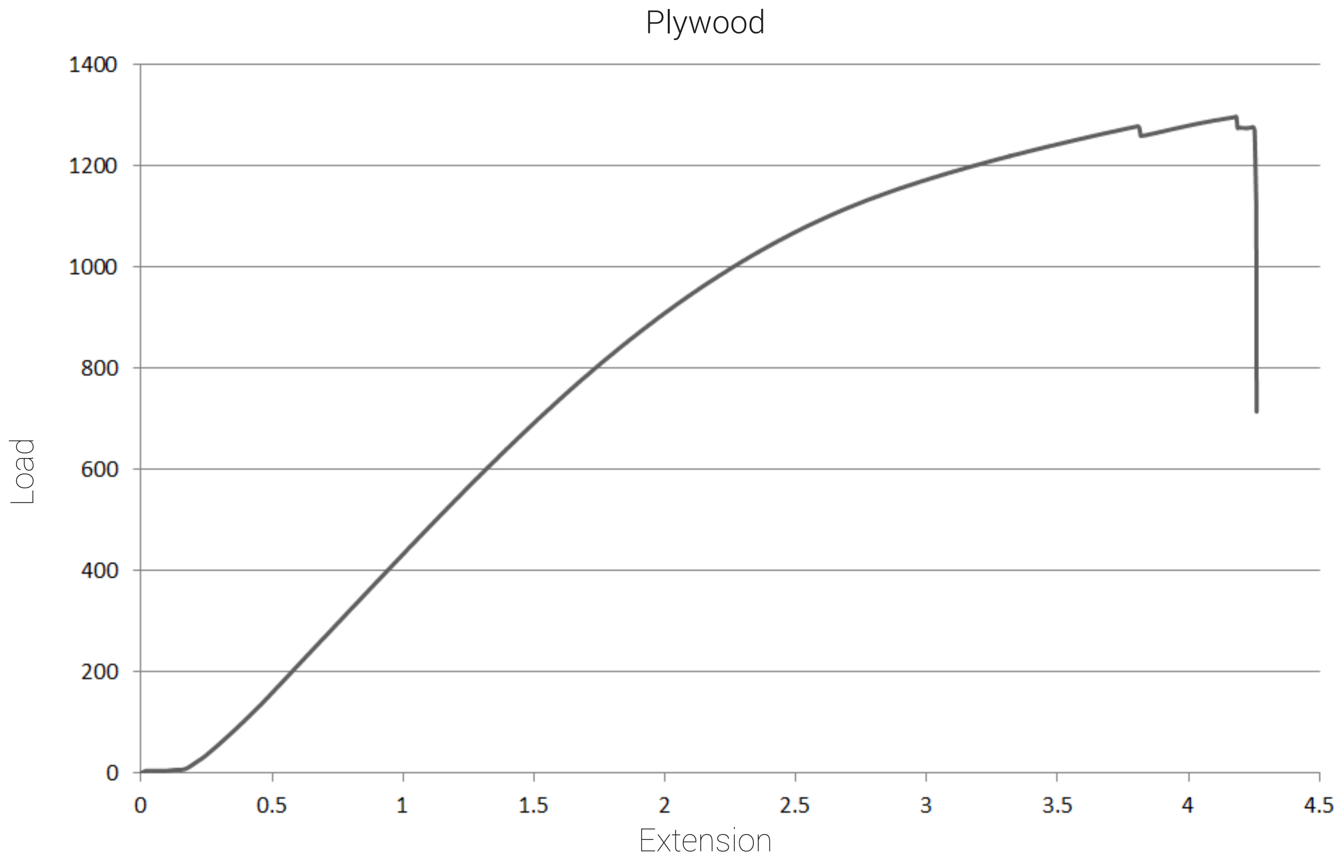
m=

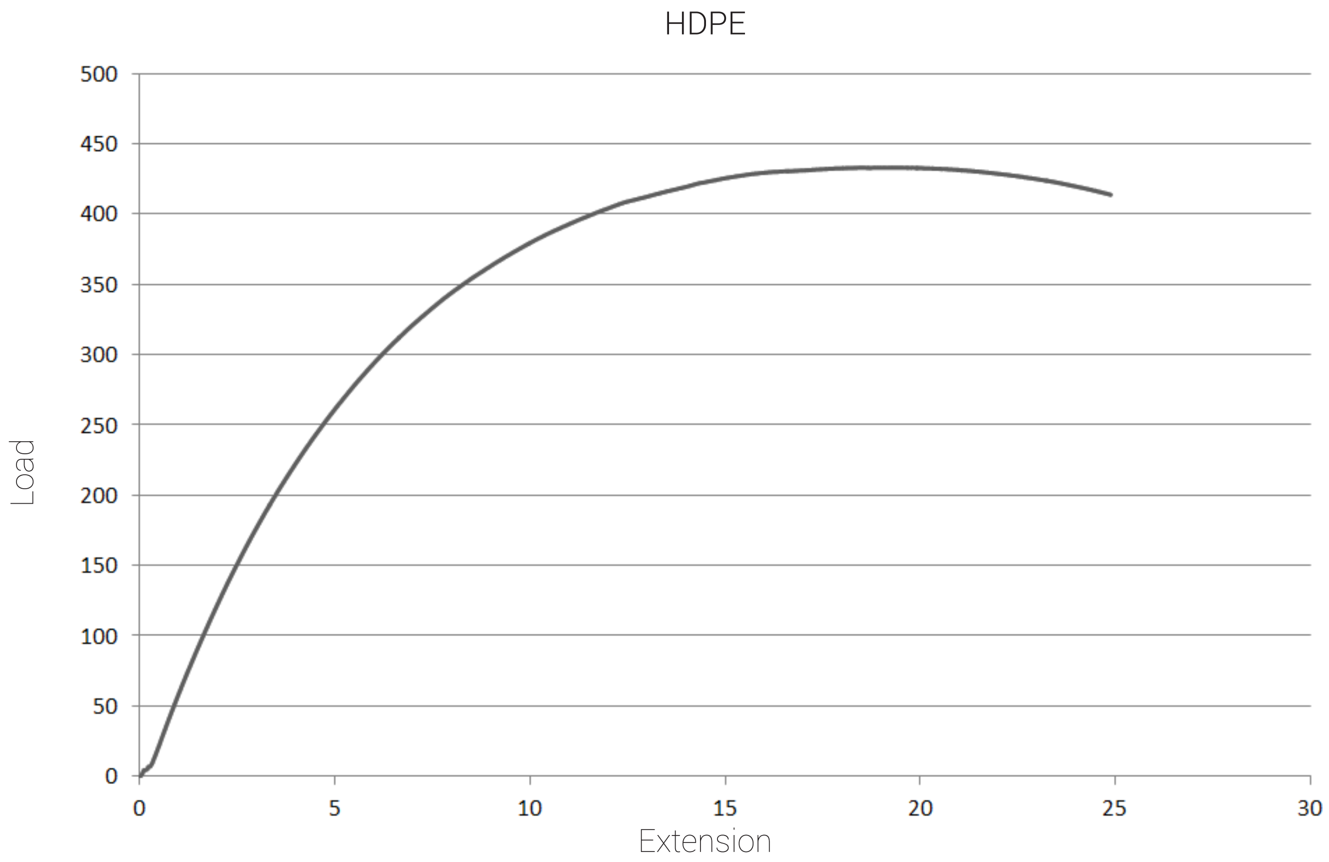
L= 148
W= 12.5
T= 18

Calculating Flexural Modulus (Mpa)

$$Mpa= \frac{148^3}{4 \times 12.5 \times 18^3} \times 37.4684557$$

$$=416.546332$$





Conclusion

As we can see from the results the wood has a much higher flexural modulus than the HDPE. This means that it is much more resistant to bending. This could be either beneficial or problematic when making deck from HDPE.

What we observed from testing the plywood specimen is that it is very resistive to bending up to a certain point. Then after a certain load is applied it suddenly breaks. This is represented by the sharp drops in the load-displacement graph to the left This is typically expected as skateboards often snap along their central point. Making a deck from a material with these physical properties gives it pop but means it is prone to snapping.

What we observed from testing the HDPE specimen is that it can be bent much more significantly than plywood before breaking and will return to its original form from a much greater deformation. Despite this it does not require much force to bend the material in comparison to plywood. This means that it far less likely to break but may lack the pop which characterises a good deck.

The only way to find for certain if the physical properties are suitable is through user testing. If the board is to flexible it will be unsuitable but it must have a certain amount of flex to accommodate for the riders weight. If the board does not have enough pop a composite material may have to be used.

Comparing the tensile strength of HDPE with a traditional wooden skate deck

The yield strength is the measure of stress to strain in elongation e.g. how much the material can be stretched before it permanently deforms. A stress strain curve is then plotted from the results. Specific points on the graph can be used to identify different key points in the materials deformation. The data recorded is specific to the dimensions of specimens I have chosen. To convert the data in to dimensionless values the following formulas were used:

To identify the strain of a material:

$$\varepsilon = \frac{\Delta L}{Lo} = \frac{L - Lo}{Lo}$$

Where:

L= Final Length (mm)
ΔL=Change In Length (mm)
Lo=Initial Length (mm)

ε=Strain

To identify the engineering stress of a material:

$$\sigma = \frac{Fn}{A}$$

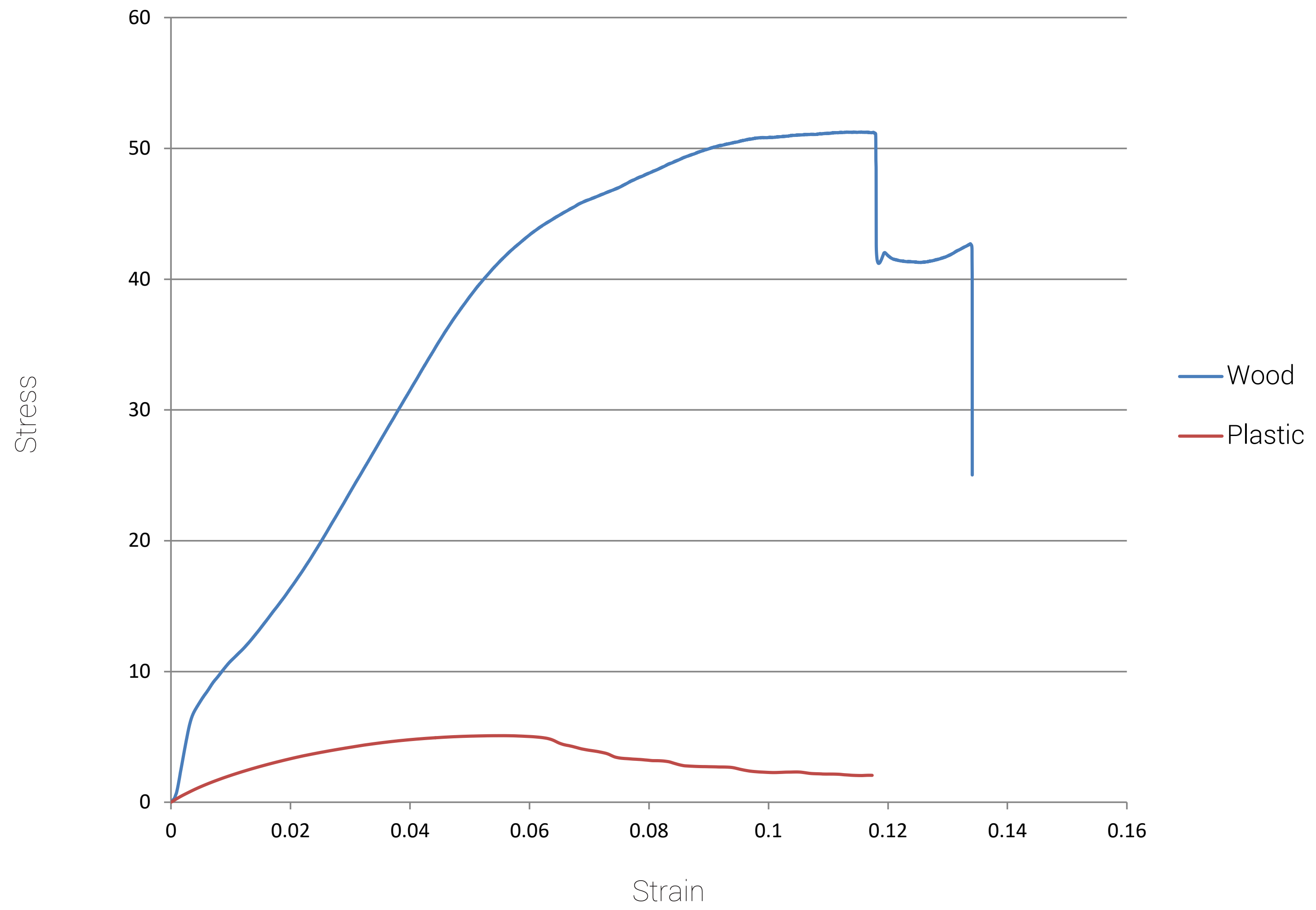
Where:

F= Tensile Force (N)
L=Cross-Section Area (mm)

σ=Initial Length (mm)

Using excel to process the data and apply the formulas on mass to all of the data collected, the stress strain curve could now be plotted.

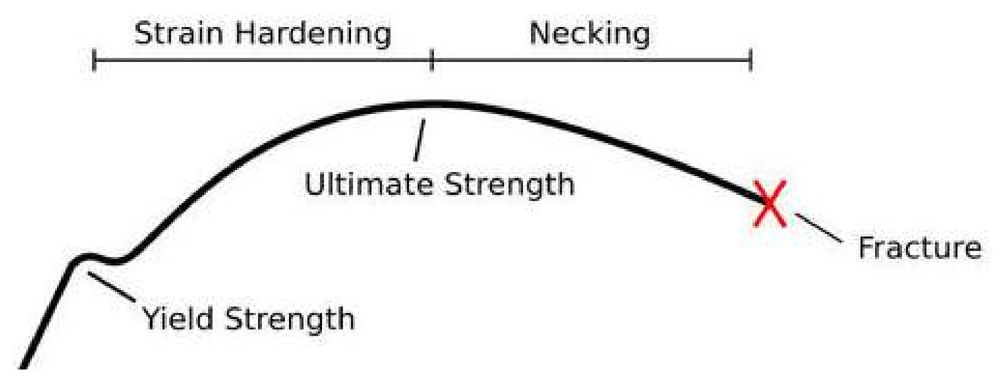
	A	B	C	D	E	F	G	H
1	Yield (Offset 0.2	1783.976	N					
2	Yield (Offset 0.2	0.9035	mm				Area	159.6
3	Strain : Tensile st	75	mm					
4								
5	Time	Extension	Load	Length	Stress	Strain		
6	(s)	(mm)	(N)					
7	0	0	0.24431	75	0.001530764	0		
8	0.1	0.00113	6.00617	75.00113	0.037632644	1.50664E-05		
9	0.2	0.0064	13.48193	75.0064	0.084473246	=(D9-B3)/D9		
10	0.3	0.01209	17.72455	75.01209	0.111056078	0.000161174		
11	0.4	0.01702	21.36893	75.01702	0.133890539	0.000226882		
12	0.5	0.02217	25.20788	75.02217	0.15794411	0.000295513		
13	0.6	0.02708	29.74726	75.02708	0.186386341	0.000360936		
14	0.7	0.03206	34.16705	75.03206	0.214079261	0.000427284		



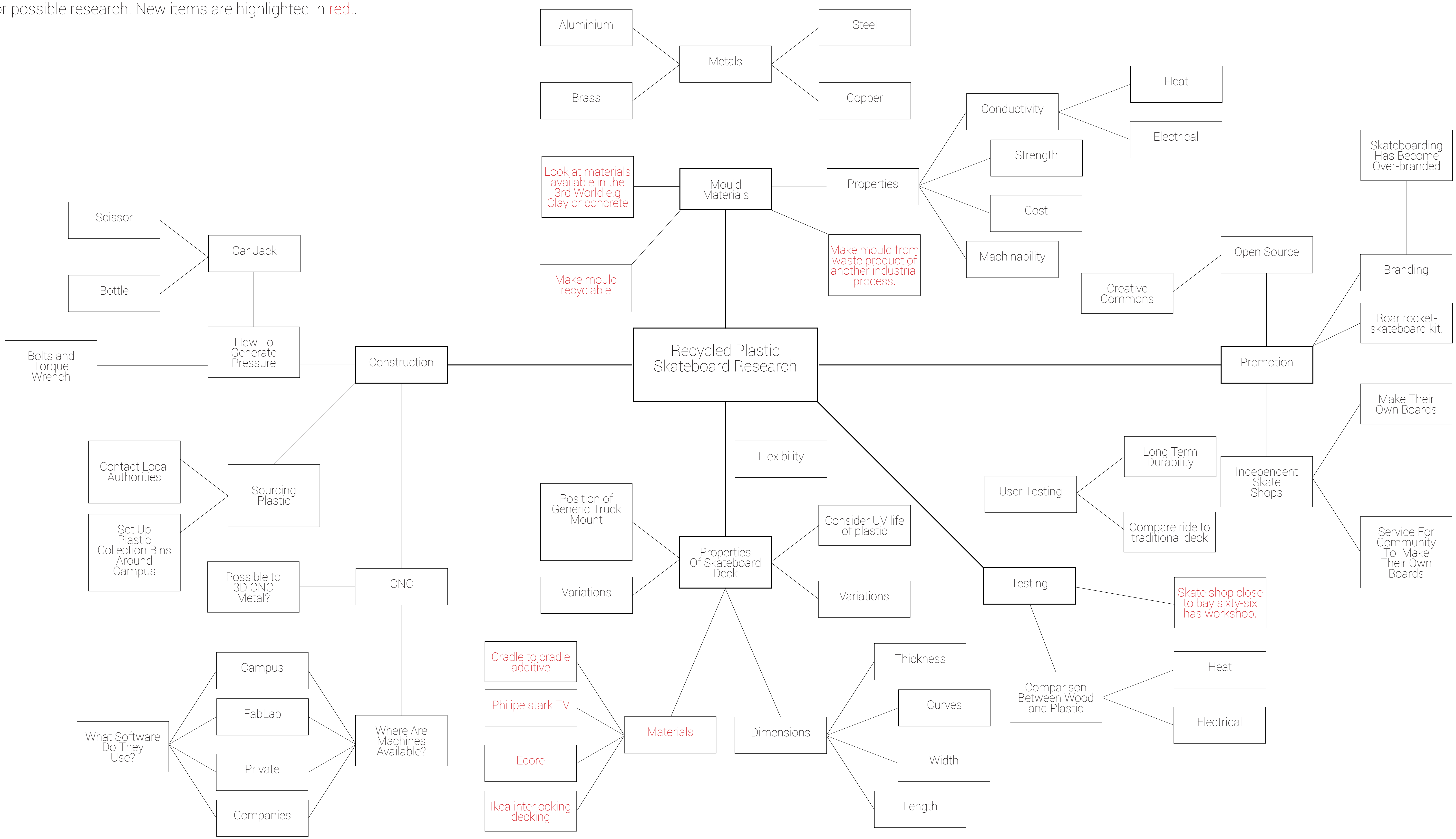
Conclusion

As we can see from comparing the stress strain curves of two materials wood can withstand slightly higher stress before reaching its yield strength. Despite this it does not necessarily mean that HDPE is not a suitable material. The plasticity (amount of deformation where the board will return to the its original shape) of both materials is very similar. The direction of force applied during this test is not usually a breaking point of the board whereas flexibility and compression are. What we observed during the test is that when wood fractures it breaks a lot more violently and splinters which may cause harm to the rider. When the HDPE breaks it gradually tears in to fibrous soft strands.

Key:



Following my initial user research and the feedback I received at the IRE (Industrial Review Evening) the mind map was update with new areas for possible research. New items are highlighted in red..



CES EDUPack and CES Selector are material selections software packages released by Granta Design that contain extensive information about materials.

The software packages are broken down in to levels, each with increasing complexity of data for each material.

Level 1, 69 materials
Level 2, 100 materials
Level 3, 4000 materials

Level 1 +2 Basic database containing:
Mechanical
Architectural
Bioengineering

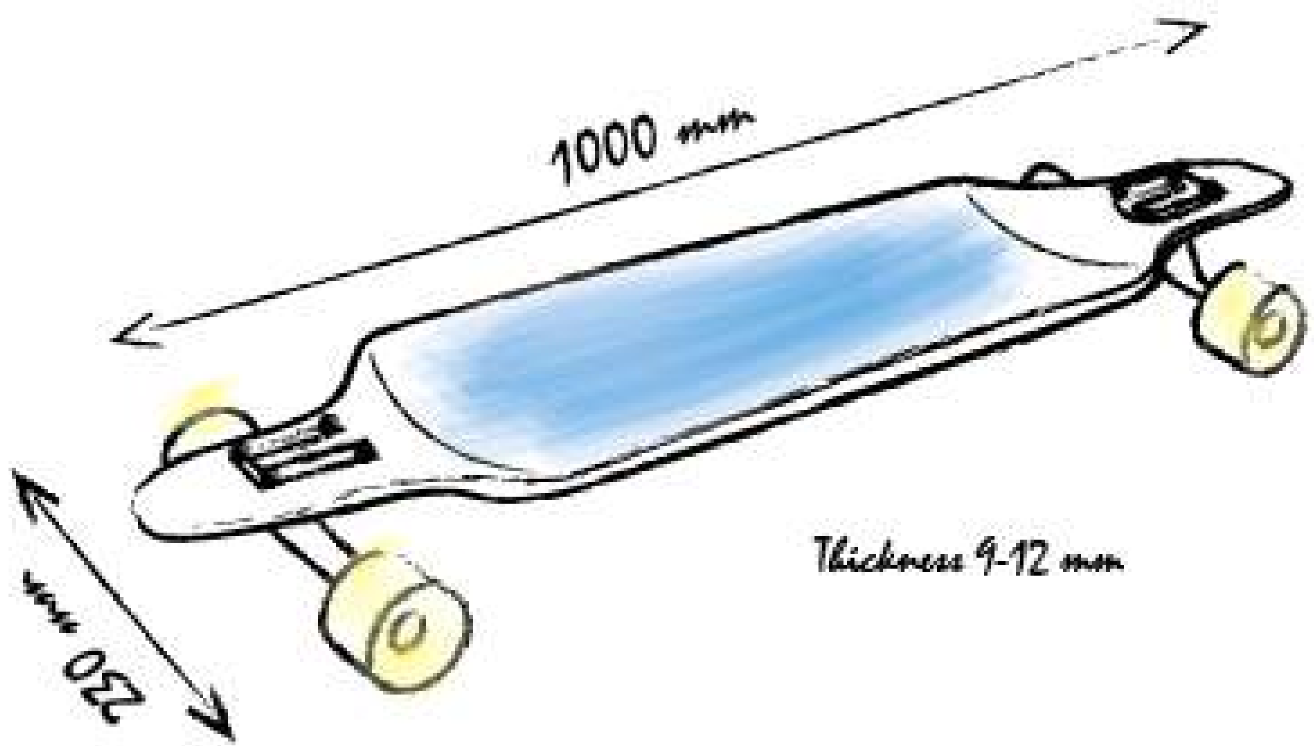
Level 3 Advanced databases also containing:
Aerospace
Energy
Sustainability
Eco Design
Polymers

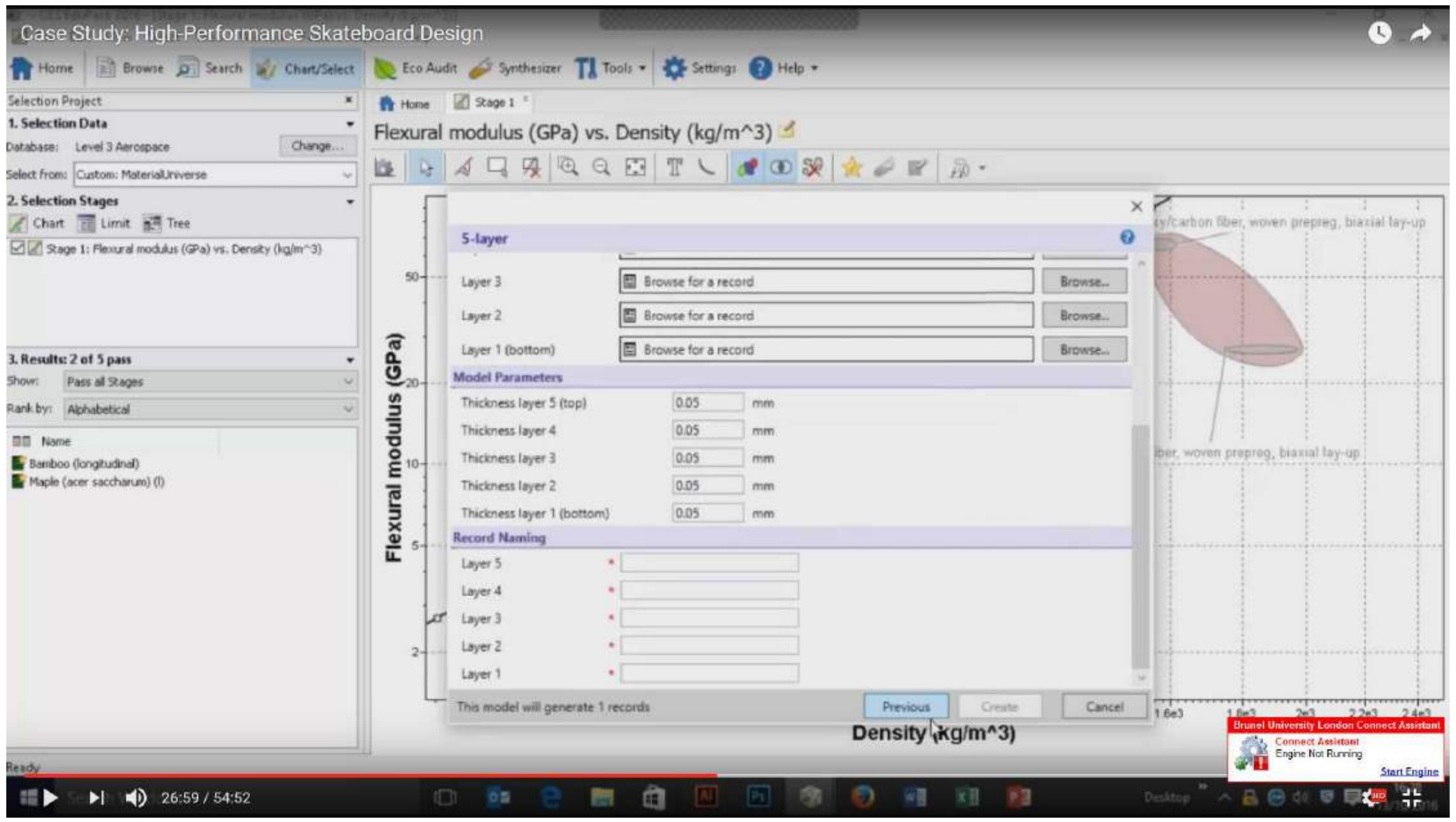
Once software is open, data about a material can be seen by selecting it from the list on on the left titled “browse.” You can create a chart from your section and plot relevant properties against each other.

Design requirements of Skateboard:
Function- Panel In bed (performance index pEf1/3)
Constraints- Geometry (Length, width, wheels spacing),Same bending stiffness as reference board, weatherproof.
Variables- Thickness, Combination of Materials
Objectives-Minimizes weight

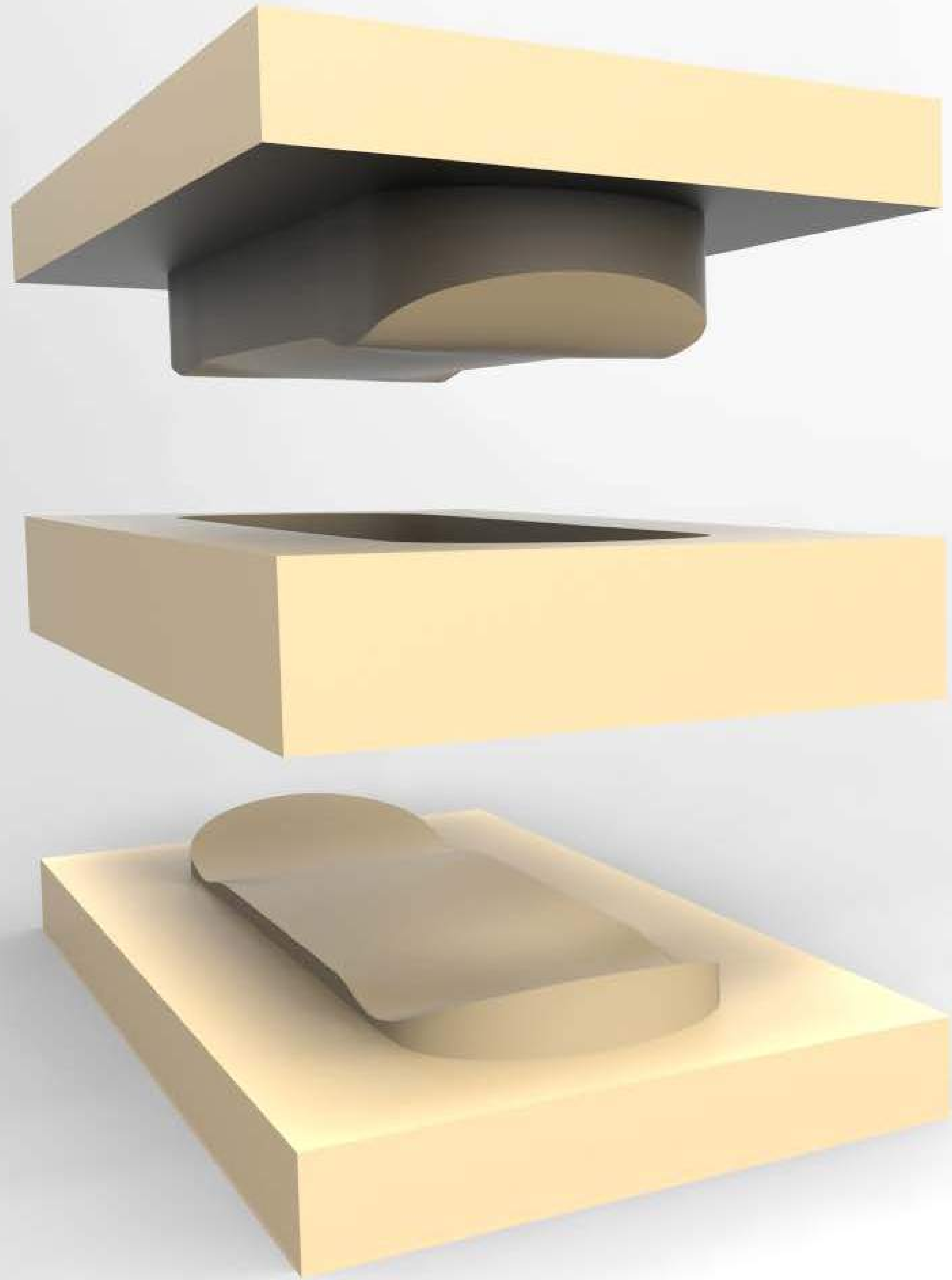
To plot go to:
>HELP
>Quick Start
>Table of indices
>Stiffness Limited Design
>Mass
>Panel In Bending
You will find the equation to minimise flexibility here.
>Double click chart axis
>Input formula
>Flexural modulus (Ef) can be found under the “Mechanical Properties” dropdown.
>Density (P) can be found under the “physical Properties” dropdown.

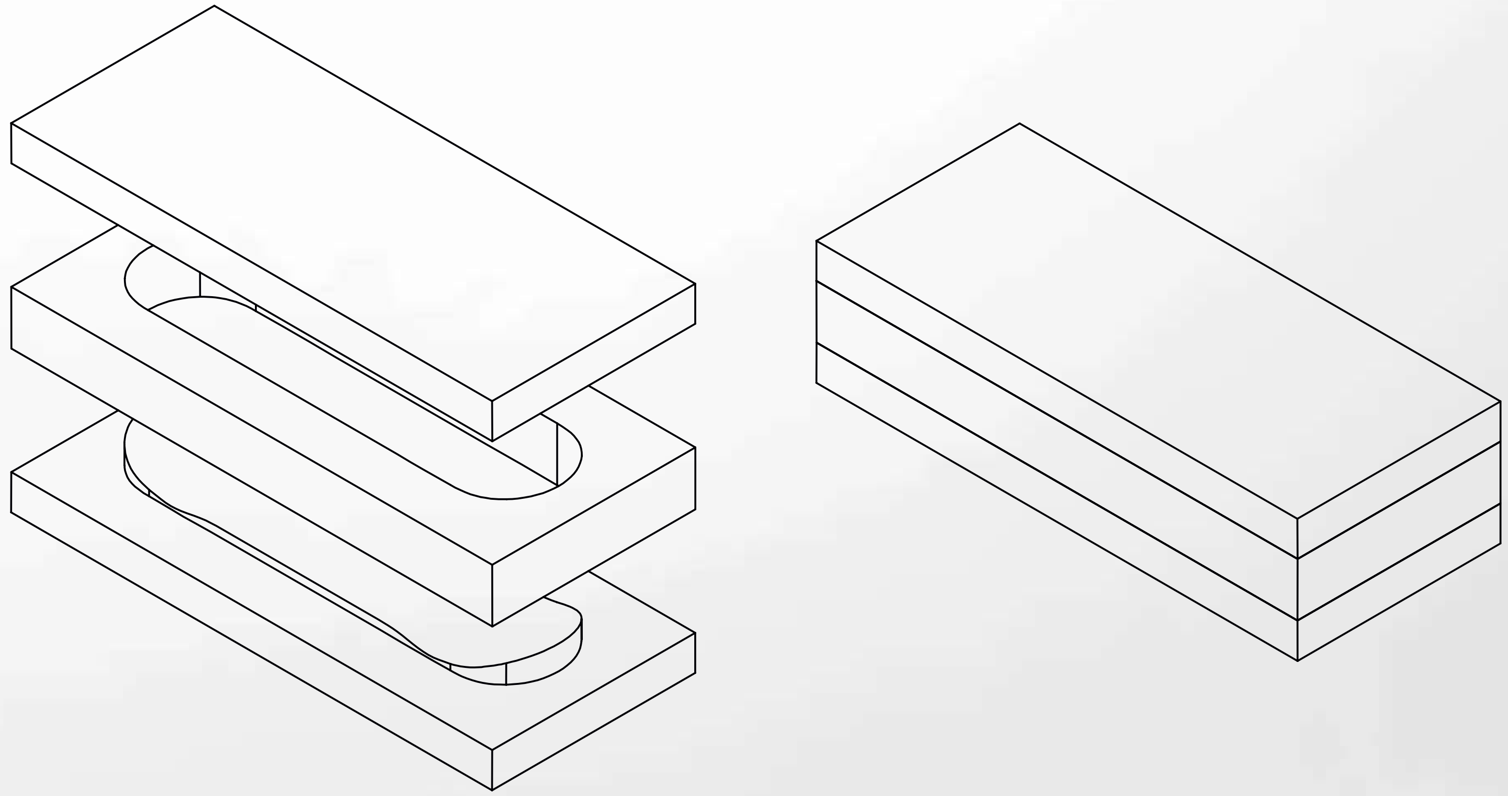
Add potential materials to the chart using the browse menu to the left. New composites can be made using the “Synthesise” menu at the top of the page.

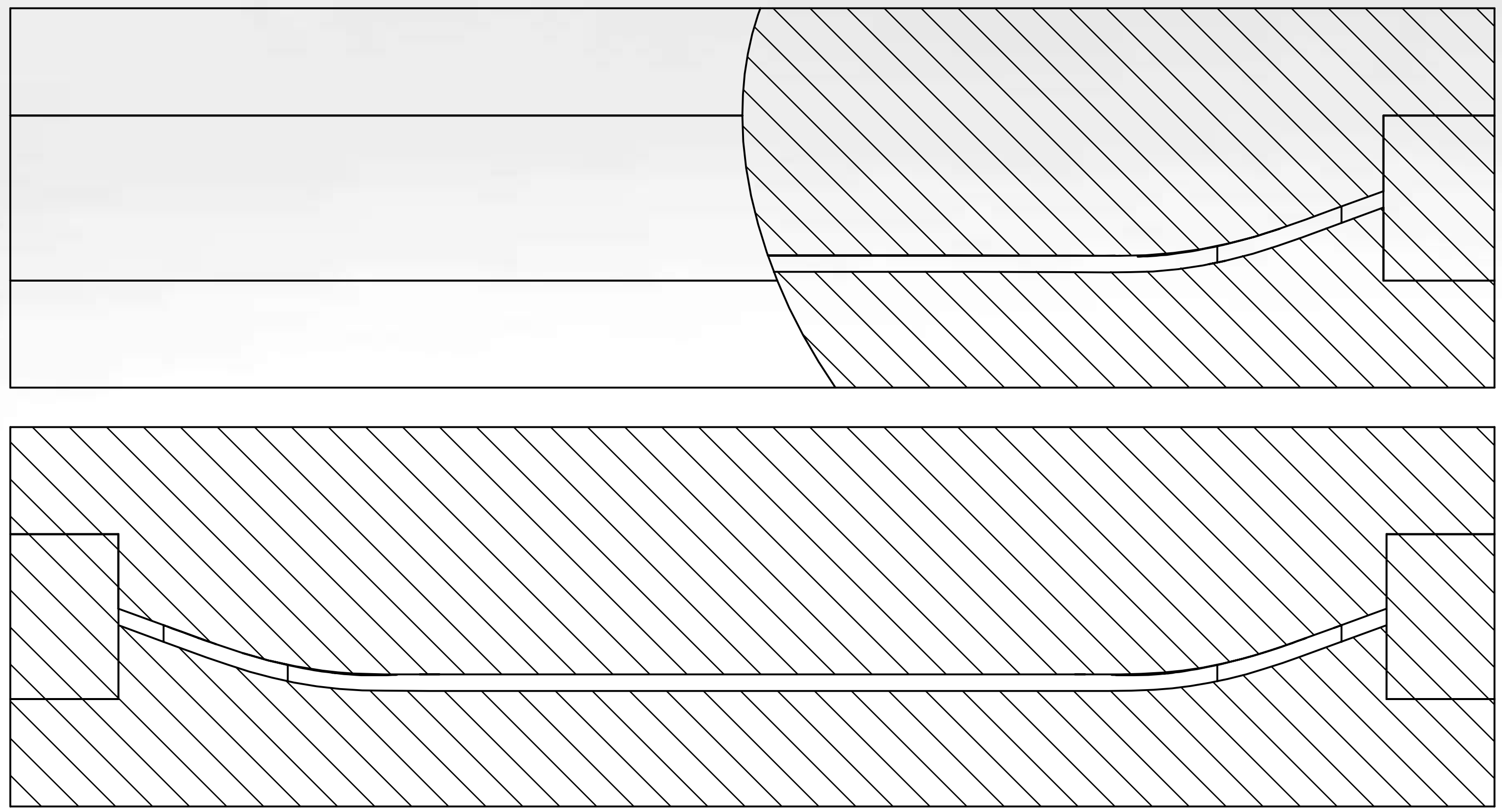




Prototyping Phase 1

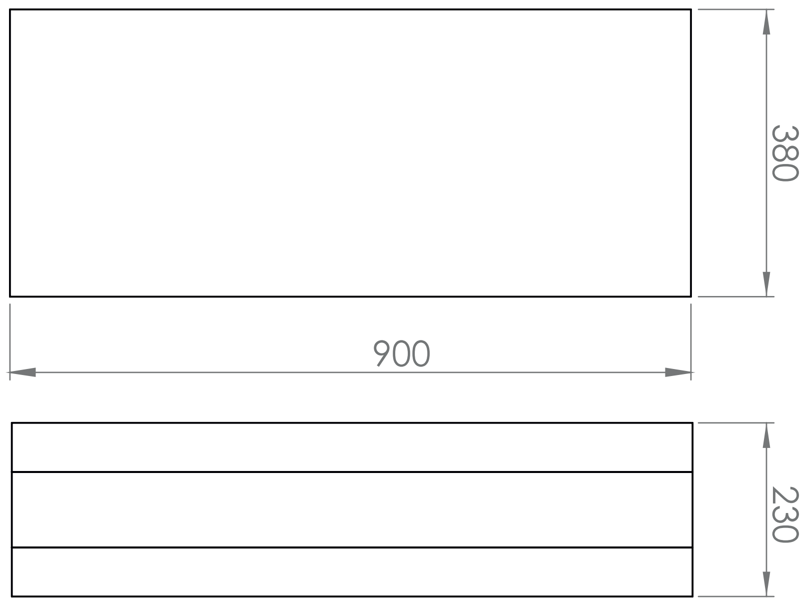






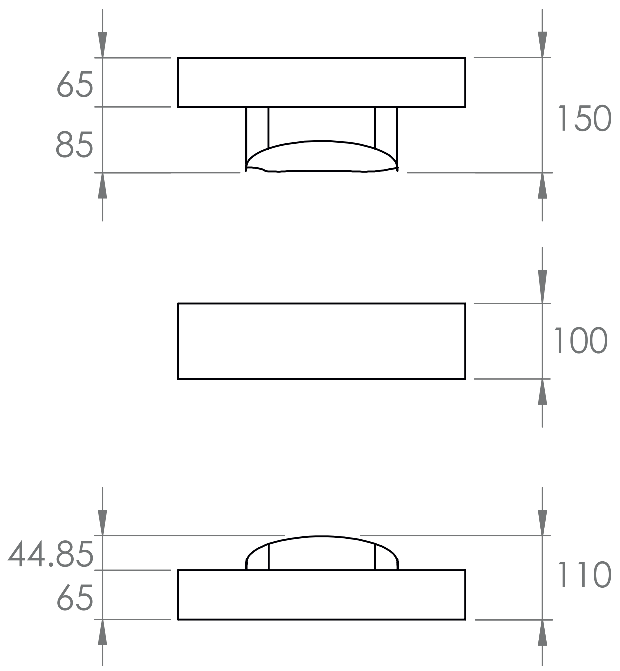
I began to develop a prototype mould to experiment with both the shape and the factors involved with machining a full size deck. I used Rhinoceros CAD software to create a 3D model of the mould.

Total Dimensions



The moulds basic form is based on the geometry of the test sample mould. There are three plates, a central body with a one dimensional extruded cavity, a cap to plug its bottom and a cap for the top with longer plunger on to compress the material. The main development from the test mould is that the two caps will have a 3D face to create the curvature of the board. To do this a large-format 3D CNC machine will be used.

Section Dimensions



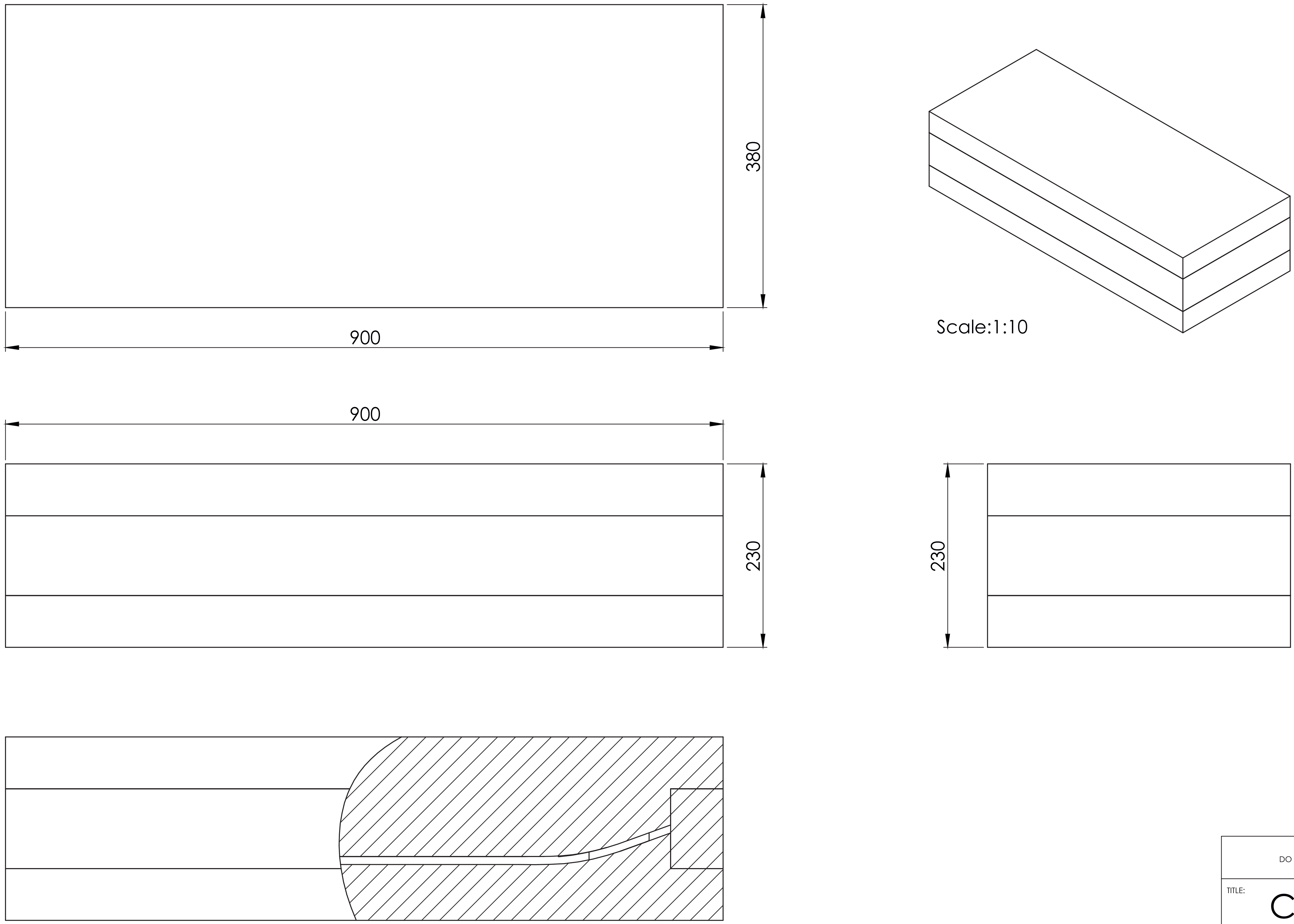
Making The Mould

As this mould is just to prototype the shape it does not need to be as heat resistant as the final. My original choice was to use Jelutong as it is a strong hardwood that has a fine grain. When calculating the size of the blocks needed to machine the mould I realised that it was going to use a considerable amount material. As Jelutong is a very valuable I concluded that was only really a necessity for the two flat faces that contacted the plastic to be made from it, the rest of the body could be made from a less valuable material such as MDF. The table to the right shows how I broke down each section of the material in to Layers so that the minimal amount of Jelutong could be used. They Layers will be glued and clamped. A 30mm border has been left around each sheet so that they can be machined down to the right size.

Layer	Cutting List	
	No. Of Sheets	Dimension
Part 1 CNC Dimension: 153x390x910		
110mm MDF	2	15x410x930
	5	18x410x930
50mm Jelutong	2	50x200x930
Part 2 CNC Dimension: 103x390x910		
110mm MDF	2	15x410x930
	5	18x410x930
Part 3 CNC Dimension: 113x390x910		
50mm Jelutong	2	50x200x930
60mm MDF	4	18x410x930

The full size mould was cut using a Bridgeport Interact 1000 1150x490x250 large format CNC machine using a 20mm diameter milling bit. Before cutting each section it was mounted to a base plate then the top surface was flattened. Next a cutting profile was generated using the Delcam PowerMILL software package with the assistance a technician. The software allows specific controls over the cutting order. The profile was imported in to the software then we configured it so that he larger sections were removed using a flat-end milling bit then the detail and smooth finish was achieved using a rounded milling bit. The entire process of milling took roughly four days including clean up time.

The milling process leaves the curved surface of the mould with a 0.2mm steps between each layer. To remove this first course sandpaper is used gradually working towards a finer grade. The edges of the middle section were given a slight radius with a file to allow the cap sections to easily be inserted. To ensure that the molten plastic does not stick to the faces of the mould they were treated with a mixture of Tung oil and white spirit. This makes them water resistant and ensures the plastic will not bond with them. Only the two large faces needed to be treated so the sides were covered using masking tape. Five coats were applied with 24 hours between each one then the mould was left for two weeks before it was used.



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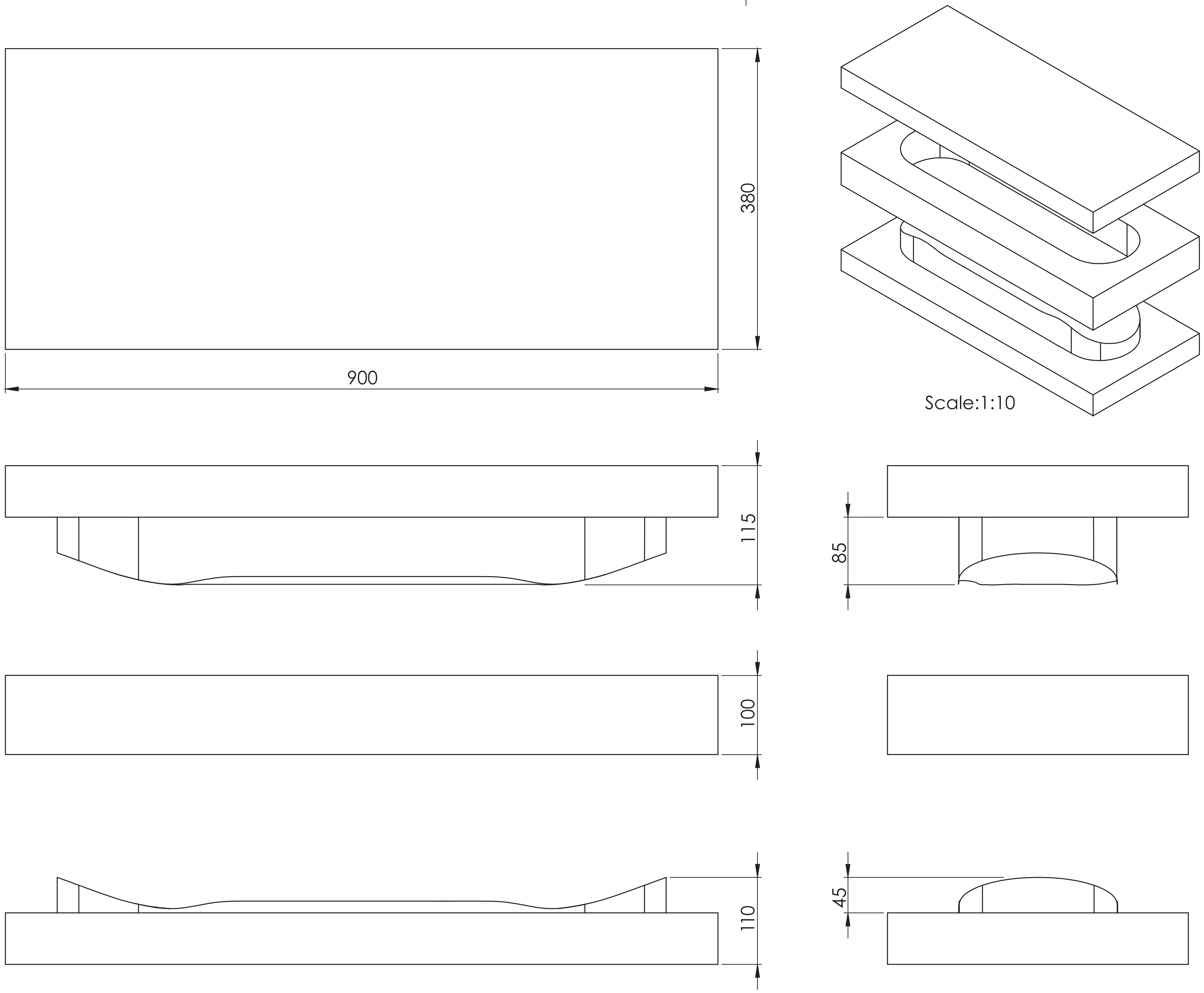
		MATERIAL:	DWG NO. DM3701-02 — A3
NAME	SIGNATURE	DATE	
Jason Knight		23/11/16	WEIGHT:
SCALE:1:5	SHEET 1 OF 1		



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REVISION: 2.0

TITLE:

Complete Mould Exploded

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	DEBUR AND BREAK SHARP EDGES

FINISH:

MATERIAL: Jelutong

	NAME	SIGNATURE	DATE
	Jason Knight		23/11/16

WEIGHT:

DWG NO. DM3701-03

A3

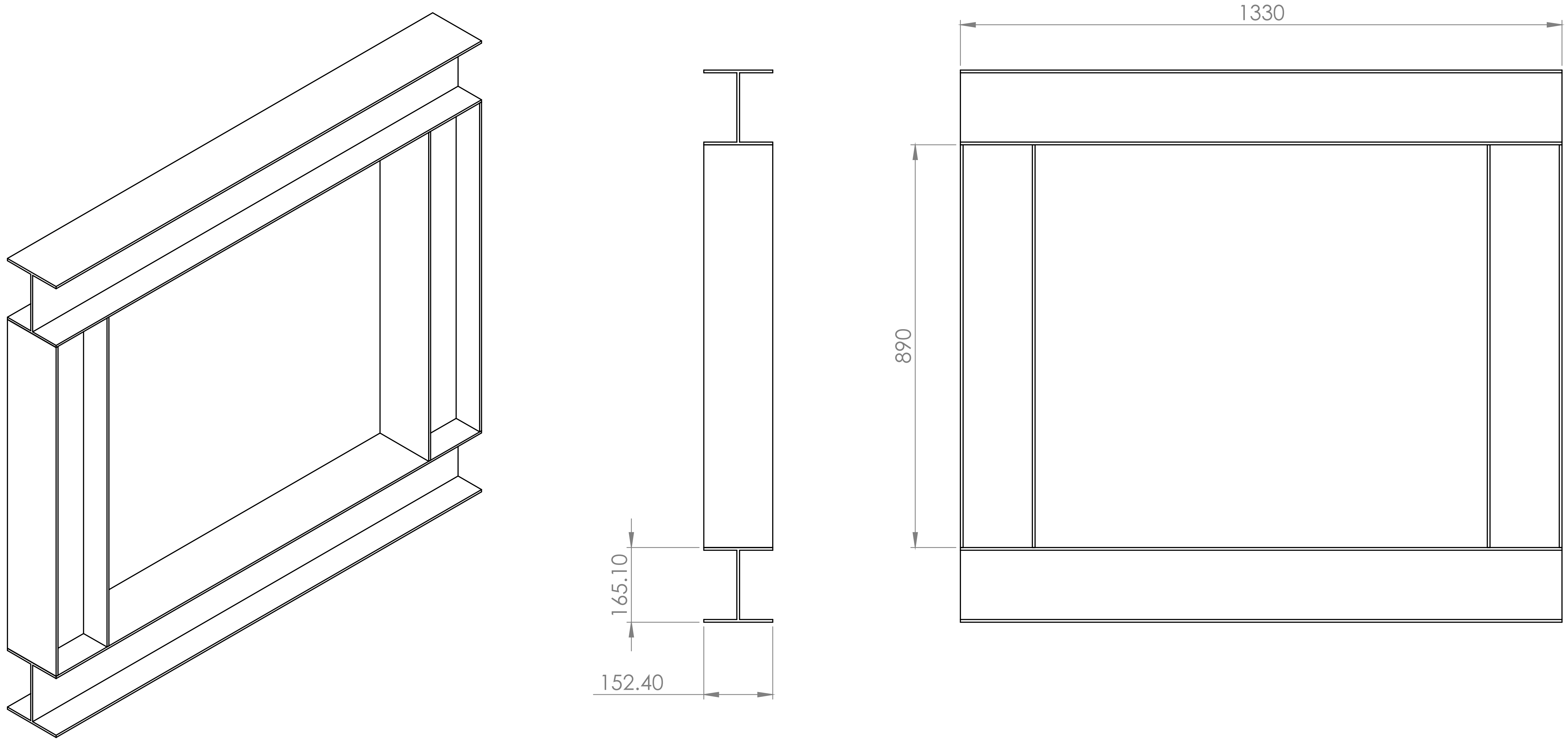
SCALE:1:5

SHEET 1 OF 1

The first press prototype was made from 6"x6.5" steel girders recovered from a local scrap yard. The girders were cut to size and welded together. A base was made from railway sleepers and four wheels were attached to the bottom so the press could easily be moved. The material was chosen with the anticipation that it was far more heavy duty than required but it would allow me to experiment with how much force was required to press a deck with the confidence that the frame would not be the point of failure. The outcomes I am hoping to discover from this prototype are a greater insight in to how users interact with the press, identify what criteria it must satisfy, potential weaknesses and produce decks suitable for user testing.

The Image above shows the model made in Solidworks to help visualise the press before it was constructed. The same model was used to generate engineering drawings which were used to communicate how the frame should be welded to the fabrication technician. The engineering drawing can be seen to the right.

The chosen pressing mechanism was a scissor jack. The scissor jack was also sourced from a local scrap yard. Its maximum load is 3-tonens. The dimensions of the frame were calculated so that when the arms of the jack was at 45° to parallel the distance between the two faces was exactly the same as the thickness of the mould when it is fully closed. This was done because when the arms of the jack are at 45° they are at their strongest, ensuring that the maximum amount of force could be applied to the mould.



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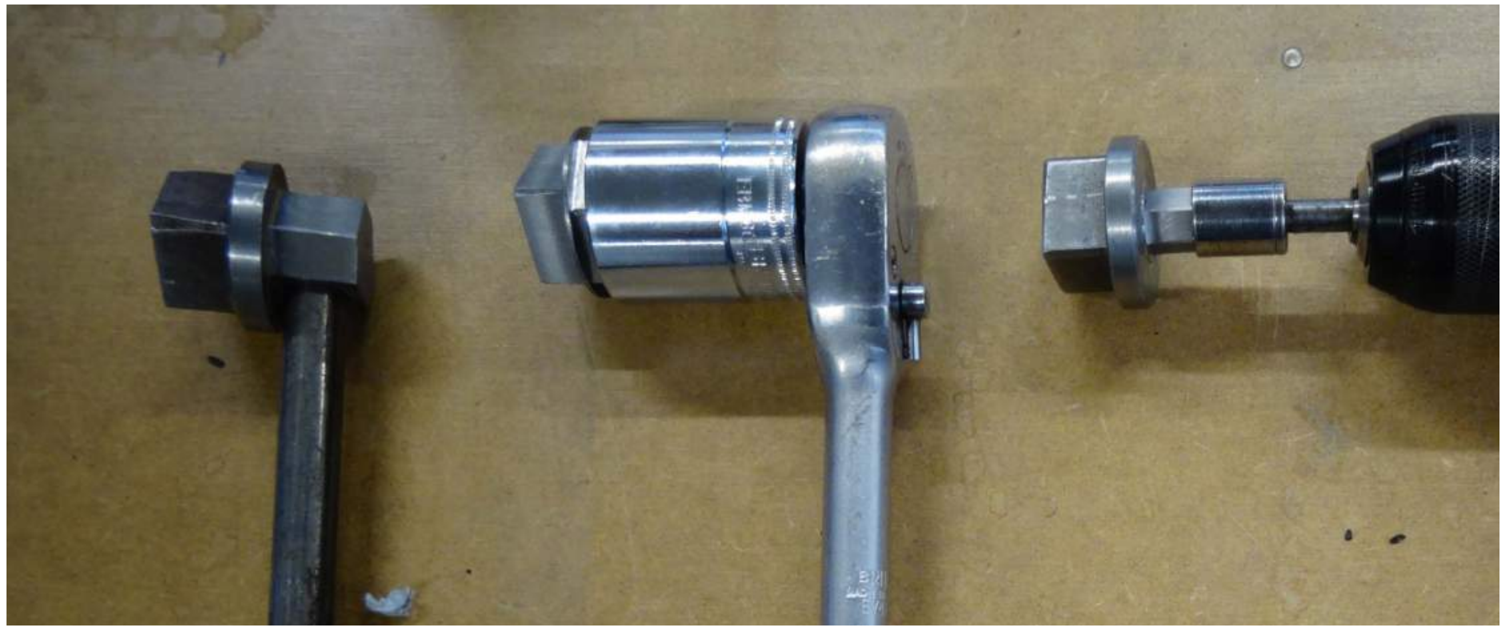
		MATERIAL: Steel	DWG NO. DM3701-04 A3
NAME	SIGNATURE	DATE	
Jason Knight			WEIGHT:
SCALE:1:20	SHEET 1 OF 1		

To control the scissor jack a bespoke four headed bit was needed. Three bits were made from steel primarily using a milling machine. A small bit that fitted in to a socket which could be driven using a drill was made. This could be used to control the press when it needed to me moved quickly but was not capable of applying much pressure. A second bit was made that fitted in to a socket that could be driven using a torque wrench. This would allow the jack to be tightened when high pressure was needed but speed was not important. A third bit with a simple handle attached was made. This was to act as a backup in case neither a drill or torque wrench were not available.



The base plates of the press were bolted to the bottom of the frame and the wheels were bolted to the bottom of them. Both the base plates were sourced from a local scrap yard and the wheels were left over from a previous university project. Holes were drilled in the base of the frame and they we're screwed in place. The scissor jack was bolted to the inside of the frame.

Before pressing a deck the inner faces of the mould are coated with coconut oil. This both acts as a lubricant so the molten plastic spreads with as little effort as possible. The oil is only applied to the two jelutong faces, not the MDF middle section, as they have been treated with a waterproofing agent.

The weight of plastic required is calculated using a Solidworks model. It is then packaged in an envelope made from Baking Paper and heated in the oven. The material took roughly one hour turn completely to a molten state. At several points in the heating process the material was taken out an needed to ensure it was heated evenly.

Before loading the material the mould was positioned exactly in the middle of the pressing plate. Once I was confident the material was molten it was taken out of the oven, the envelope was removed and it was stretched and pressed in to the mould, trying to distribute it is evenly as possible inside the mould.

The top section of the mould was inserted in to the middle section. A steel bar was paced on top to help distribute the pressure along the board. First the drill attachment was used to move the jack in to position then the torque wrench attachment was used to tighten the jack fully.

The mould was left overnight to allow it to cool. Placing a foot on the bottom sections handle and pulling up on the top section allowed the mould to be separated easily. As the board cools it shrinks slightly so it simply dropped out of the mould as the sections were separated. Any excess release agent is wiped from inside of the mould to preserve it.

To finish the deck a 5mm radius is added around the edge using a router. An oscillating sander is then used to smooth the rough surface left by the router, gradually working towards a finer grain. To drill the truck holes the actual board that the mould was modelled off was used as a template.

Buckled Scissor Jack

12 Tonne Bottle Jack

Jack Centralising bracket.

Base widening modification.

General Comments

The first jack used was a 3.5 tonnes scissor jack, this proved to be too weak and bucked under pressure. The jack also did not extend at exactly 90 degrees meaning that pressure was not distributed evenly across the mould. The scissor jack was the substituted with a 12 tonne bottle jack. The jack done a much better job at distributing the plastic but still was not quite strong enough so clamps were added to each side of the mould to add extra pressure.

The frame is far too big; the area between the top and bottom of the pressing surfaces is too wide so I had to add blocks of metal on top so that the jack had enough reach to fully compress the mould. The base of the mould is also far too narrow; the mould wobbles from side to side when force is applied is applied meaning you do not get an evenly distributed pressure. This prevented the mould from fully closing and the thickness of the board produced was not consistent. At an attempt to solve this issue a bracket was made to centralise the jack. The base was also widened using two pieces of lumber and topped with an aluminium plate. An aluminium plate was also added to the top of the mould to distribute the pressure evenly.

The process of heating the plastic also resulted in it being weakened. The plastic as taken out of the mould to be needed several times I the heating process at an attempt to stop it sticking to the inside of the baking paper parcel it was contained within. At an attempt to stop this Teflon was used make the parcel instead of baking paper. The final mould should render this problem obsolete as it will heat the material itself.

After several uses the mould began to deteriorate. Small splinters and splits began to appear after several uses. In an attempt to maintain the shape they we're filled with wood filler. The final mould will be made from a stronger material so this problem should not reoccur.

General Comments

The board was given to several people with previous skating experience to test and general feedback was given.

The following notable comments were made:

Flexibility: The board is too flexible, much more flexible than a traditional wooden board. It is close but not quite ridged enough. Despite this it does have pop, the pop is different to a traditional board but when you get the hang of it the elasticity of the board means you can ollie (jump) much higher than a wooden board. This could open up new possibilities for tricks.

Thickness: The board is slightly thicker than average but not noticeably. Thickens is not a major issue for most riders as long as the weight is not too high. If possible it would be a good idea to make the board slightly thinner.

Curvature: The board feels pretty flat, which suits some riders but increasing the concave would still feel natural to the majority of riders and would also add strength. As long as the board is not too curved otherwise it would feel weird to ride.

Appearance: Aesthetically the board looks incredible, the fact that each board is unique is so cool, riders will be able to customise their decks with whatever colours the like.
Ride: When riding on flat ground the board feels almost identical to a normal board, you can't really notice that it is more flexible until it comes to doing tricks.

If you look at the nose of the first deck produced you can see that it has not formed correctly. This is a result of the mould not fully closing because of the car jack bucking. There is also a visually noticeable weak point in the centre of the board where the material was placed in the mould. To tackle this the material should be distributed before pressing.

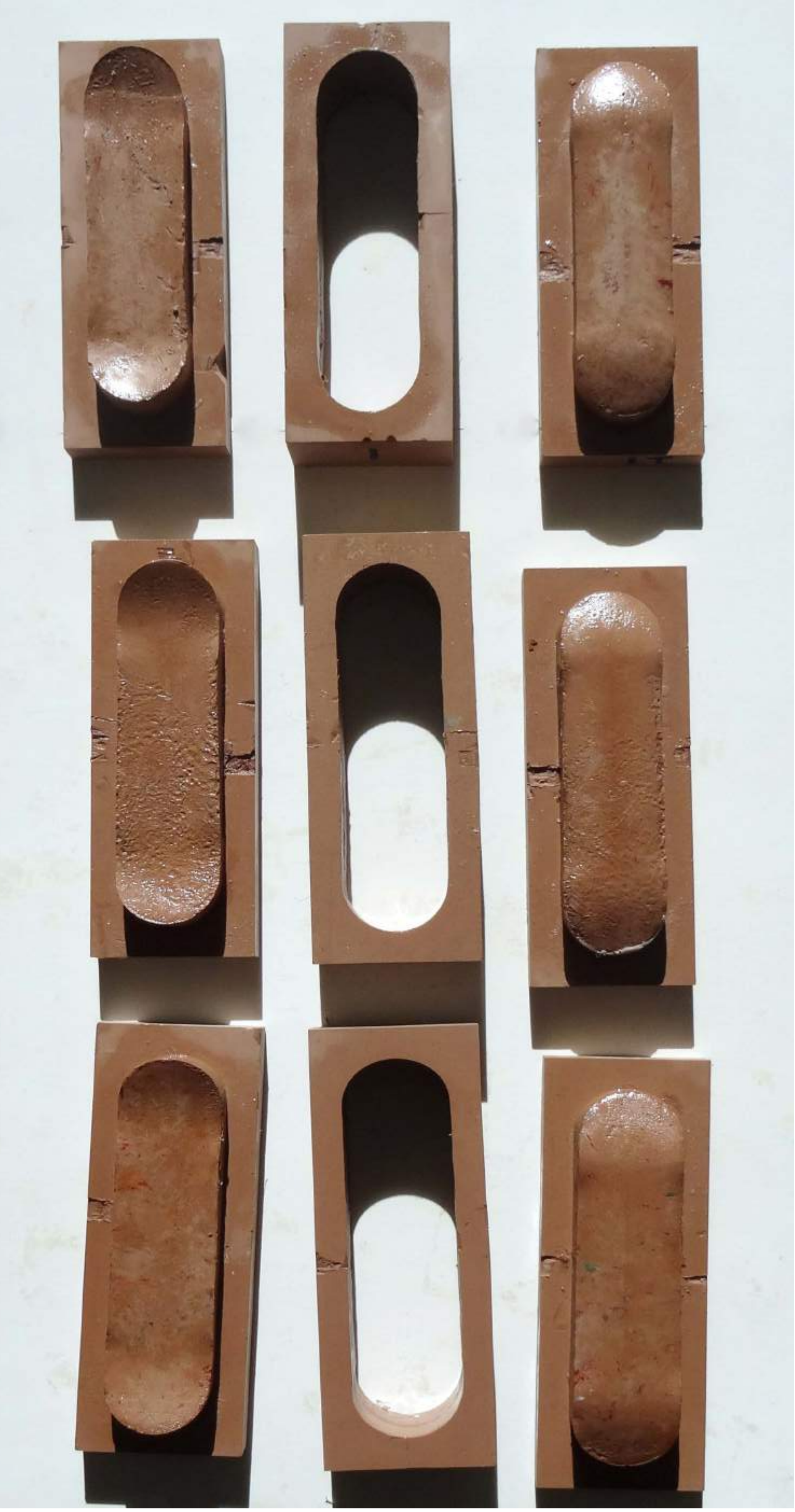
The second deck formed evenly but too much material was placed inside the mould so it was unable to close completely. Despite this the added material meant that the surface finish was a not smoother than the first board. Before being placed in the mould the material was spread by hand along the centre of the mould so that it would fill it more evenly.

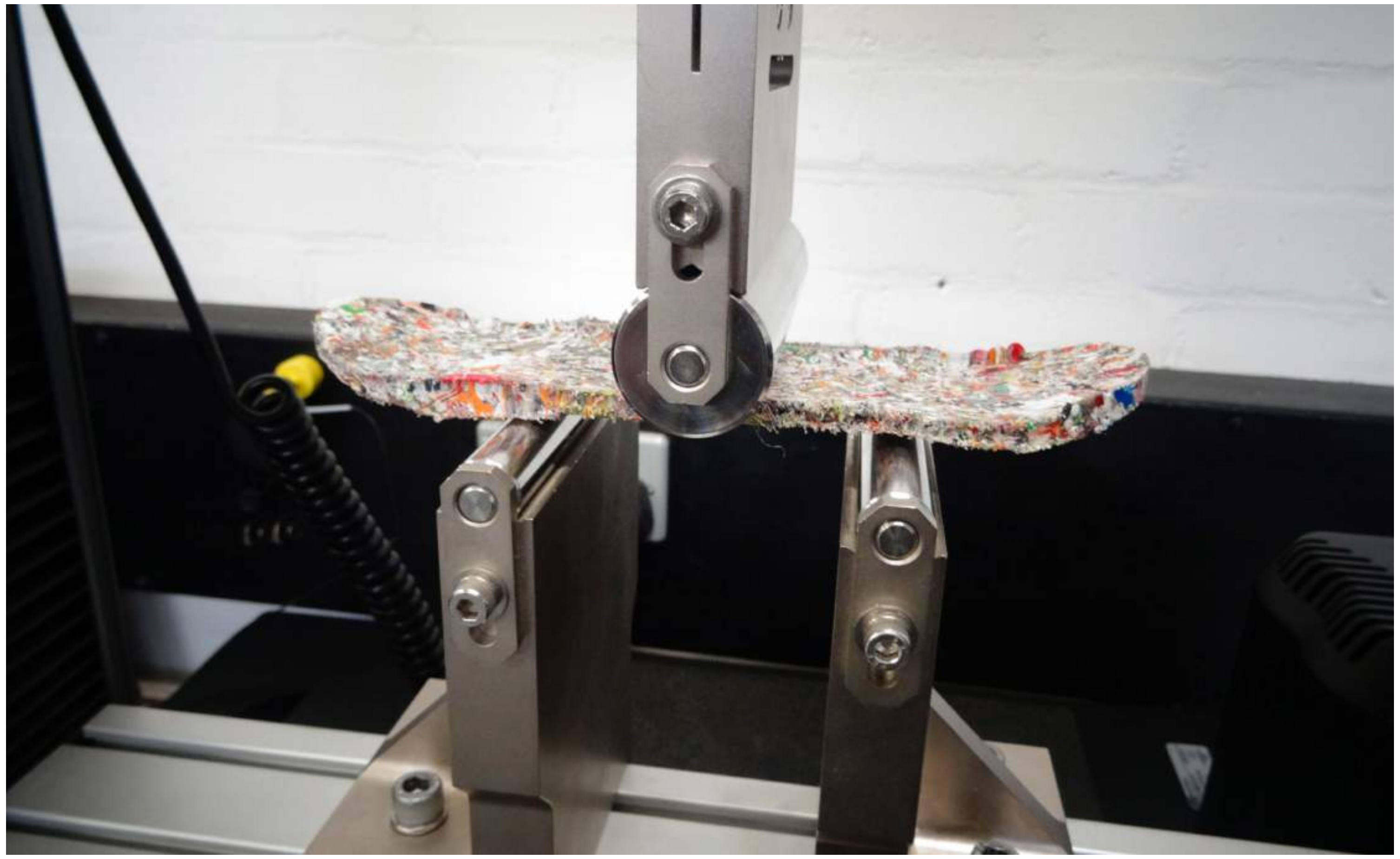
The third deck formed perfectly, the mould closed and the material distributed evenly. Up until this deck grease proof paper had been used to line the decks. I began to notice that small sections of the paper had got mixed in to the deck, potentially reducing its structural integrity. At this point the change was made to using Teflon sheet.

Following a discussion with the Institute of Materials and Manufacturing regarding the flexibility issues that had been identified in the first three decks a mix of polypropylene, HDPE and LDPE was used to make a deck. The first did not compress properly as it took longer to transfer the material from the oven due to its viscosity.

A second deck was made from the same composite. This time precautions were taken so that the material could be transferred to the mould as quickly as possible. The deck moulded perfectly and was visually much stronger than the deck made from HDPE alone. Trucks were attached and the board was used to get user feedback.

Prototyping Phase 2





As well as an alteration to the material a change in curvature was also explored to address the issue of flexibility. Increasing the concave also increases the rigidity of the deck. Think of trying to bend half of a tube as opposed to bending a sheet. The tube will naturally have higher resistance to bending. Increasing the concave would also have ergonomic implications. If the board is too curved it may feel unnatural to ride. An exploration in to which degree of curvature was the optimum shape for both rigidity and ergonomics was conducted.

Three 1/5th size moulds were CNC cut from Uriel and One the exact same curvature as the full size mould, one an estimated best fit size and one extreme. The same technique as making the previous test samples was used: calculating the weight using Solidworks, melting the material and pressing it in a vice. A reference deck made from HDPE was made then five variations with different combinations of the top and bottom profiles were made from the PP and HDPE composite. Three point testing was conducted to measure the flexural modulus of each profile. The results of all six tests were plotted on the same axis so they could be compared.

The profiles were also shown to several skaters who commented on which would be most suitable. Their responses concluded that the extreme curvature would probably be too much but a slight increase would not be an issue; in fact it would improve the controllability of the deck.

Cross Sections

HDPE Reference

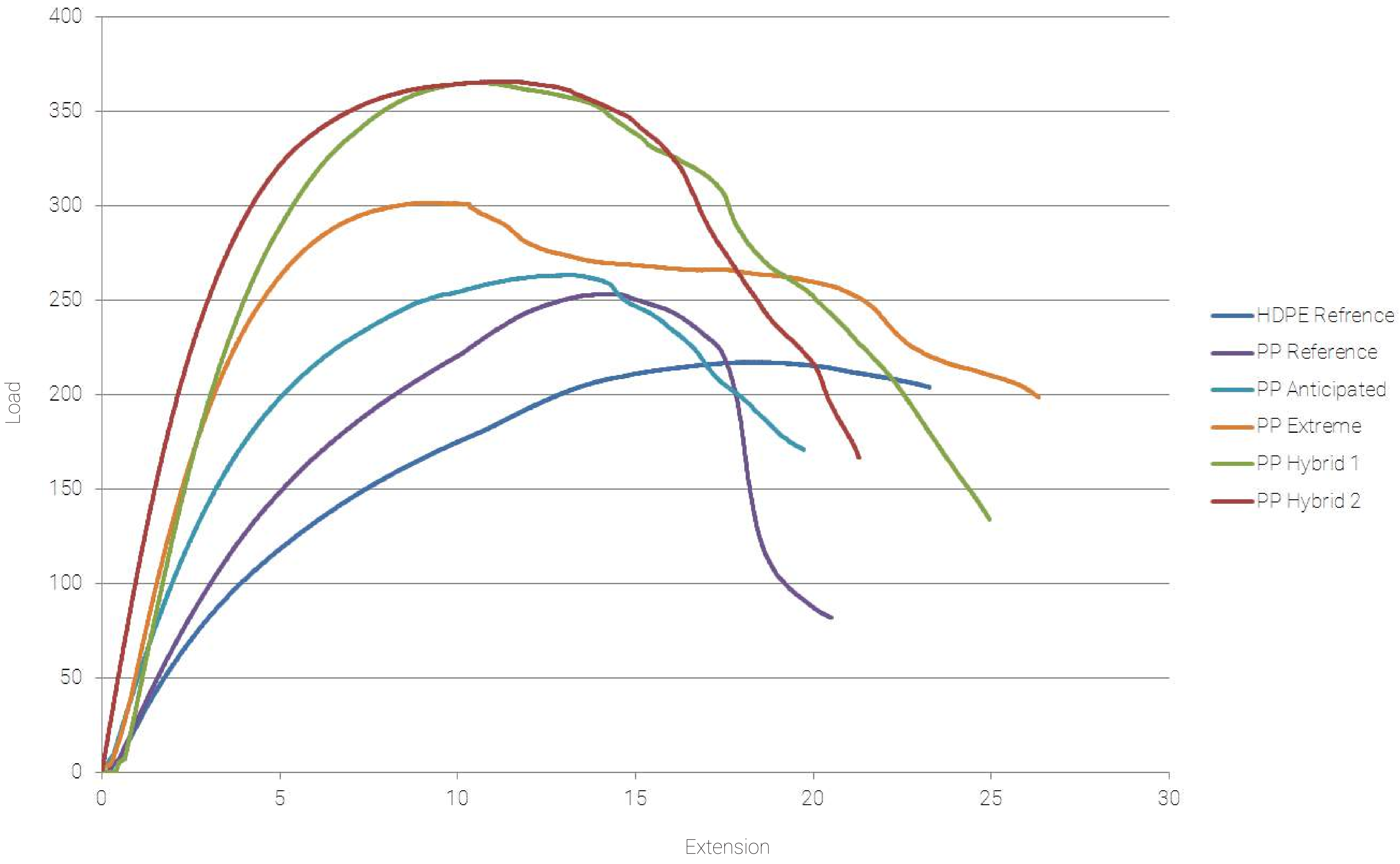
Composite Reference

Anticipated Curvature

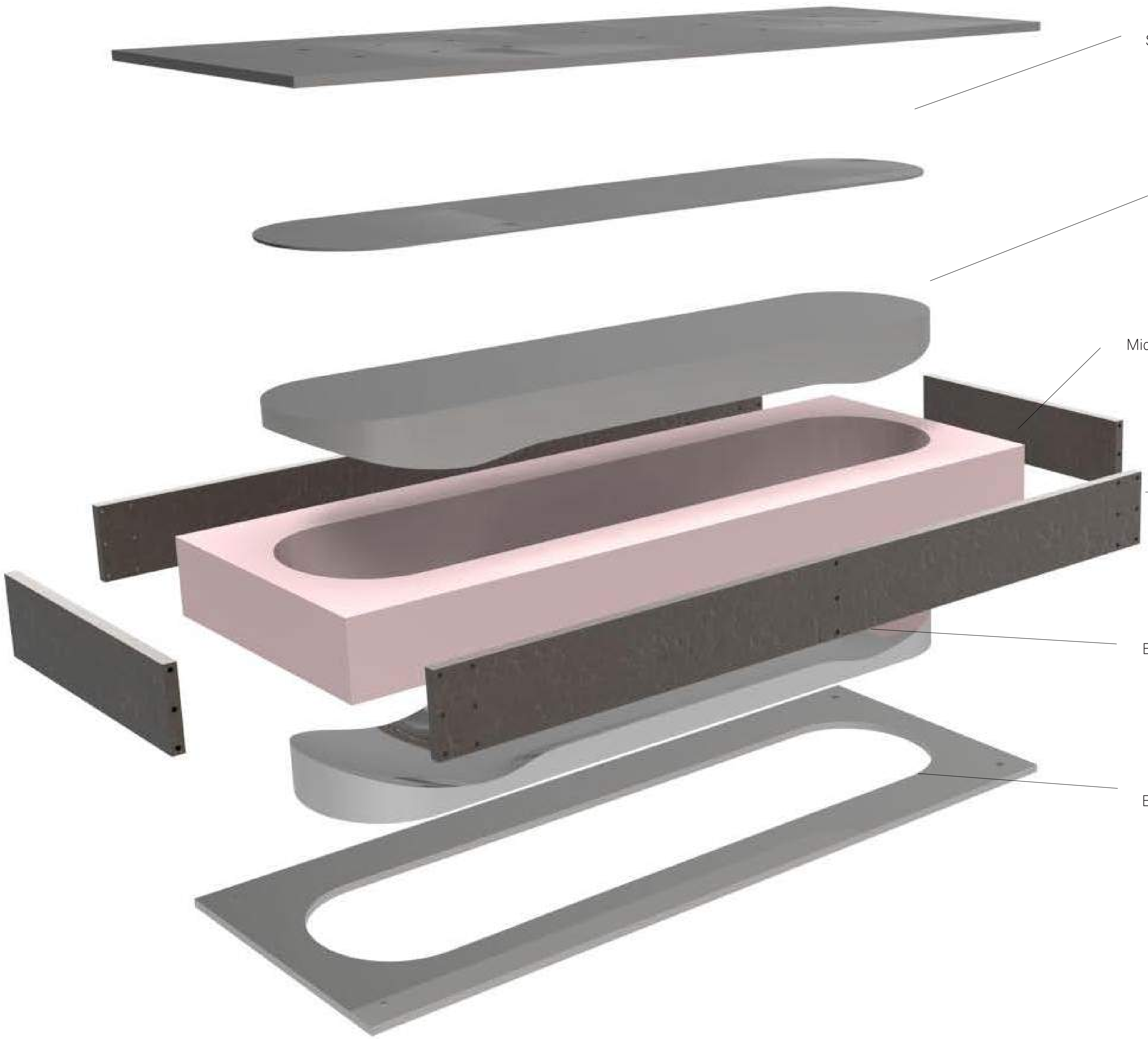
Extreme Curvature

Hybrid: Top-Refrence Bottom- Anticipated

Hybrid: Top-Anticpiared Bottom- Extreme



As we can see from the graph the switch to a polypropylene composite significantly increases the resistance to bending. The initial three variations increase equally incrementally whereas the two hybrid boards are both significantly stronger and have the same flexural modulus, despite the difference in shape. The final design for the mould will be based on the second hybrid which features the same top profile as the first mould but a more exaggerated bottom face. As the thickness along the edge is narrow and the board gets thicker as it gets towards the middle it will be strong but appear to be as thin as a regular deck, similar to the technique used in MacBook Air laptops.



Top Plate

The top plate provides a mount for the top face of the mould. The plate was CNC cut from 10mm Aluminium sheet. The material was chosen for its weight and strength. A thin plate was chosen as so that it can be easily gripped and lifted in to position. The strength is required to distribute the pressure when pressed.

Spacer Plate

The spacer plates act as washers and allow the thickness of the board to be adjusted. They were plasma cut from 2 and 3mm aluminium so that the thickness can be experimented with. The plate was cut 5mm smaller than the top face to allow for a the tool when the top face is being CNC but.

Top Face

The top face was made a CNC cut aluminium block. Aluminium was used because of its strength, lightness and heat conductivity. The face-will be mounted to the top plate so that it can be lifted on and off easily. The plate will be mounted using bolts so that it can changed if a different type face is desired.

Middle Section

The middles section provides an outer wall and is not subject to a significant amount of pressure. The plate has been cut from Uriel, as it is cost effective and acts well as an insulator. It is not subject to much pressure so strength is not an pressure. Despite its simple shape the piece was also CNC cut to ensure accuracy.

Frame

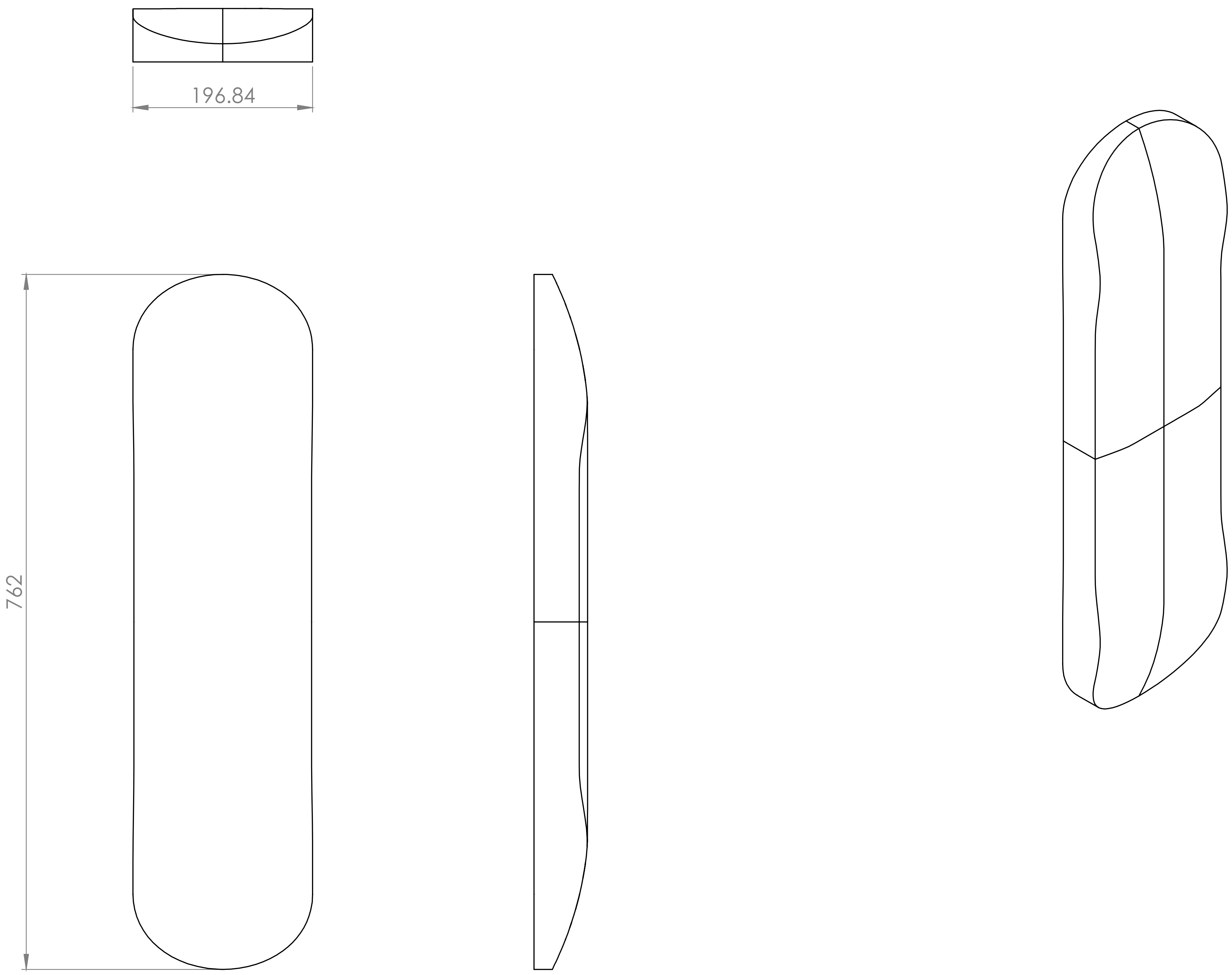
The uriel middle section was cladded in steel for several reasons. To stop the Uriel from bowing along its longest edge . To provide protection from knocks and bumps and to provide a surface that is graspable when separating the mould sections. 80mm extruded was used to construct the box/

Bottom Face

The bottom face will be used to melt the plastic. The face was made from a CNC cut aluminium block. Aluminium was used because of its strength, lightness and heat conductivity. The face will sit in the bottom plate and directly contact the heating elements,

Bottom Plate

A base plate to hold the bottom face in position was plasma cut from stainless steel. Stainless steel was chosen because the plate needs to be very thin yet very strong. The decision to use steel not aluminium was made so that it did not act as a heat sync and draw heat away from the aluminium faces.



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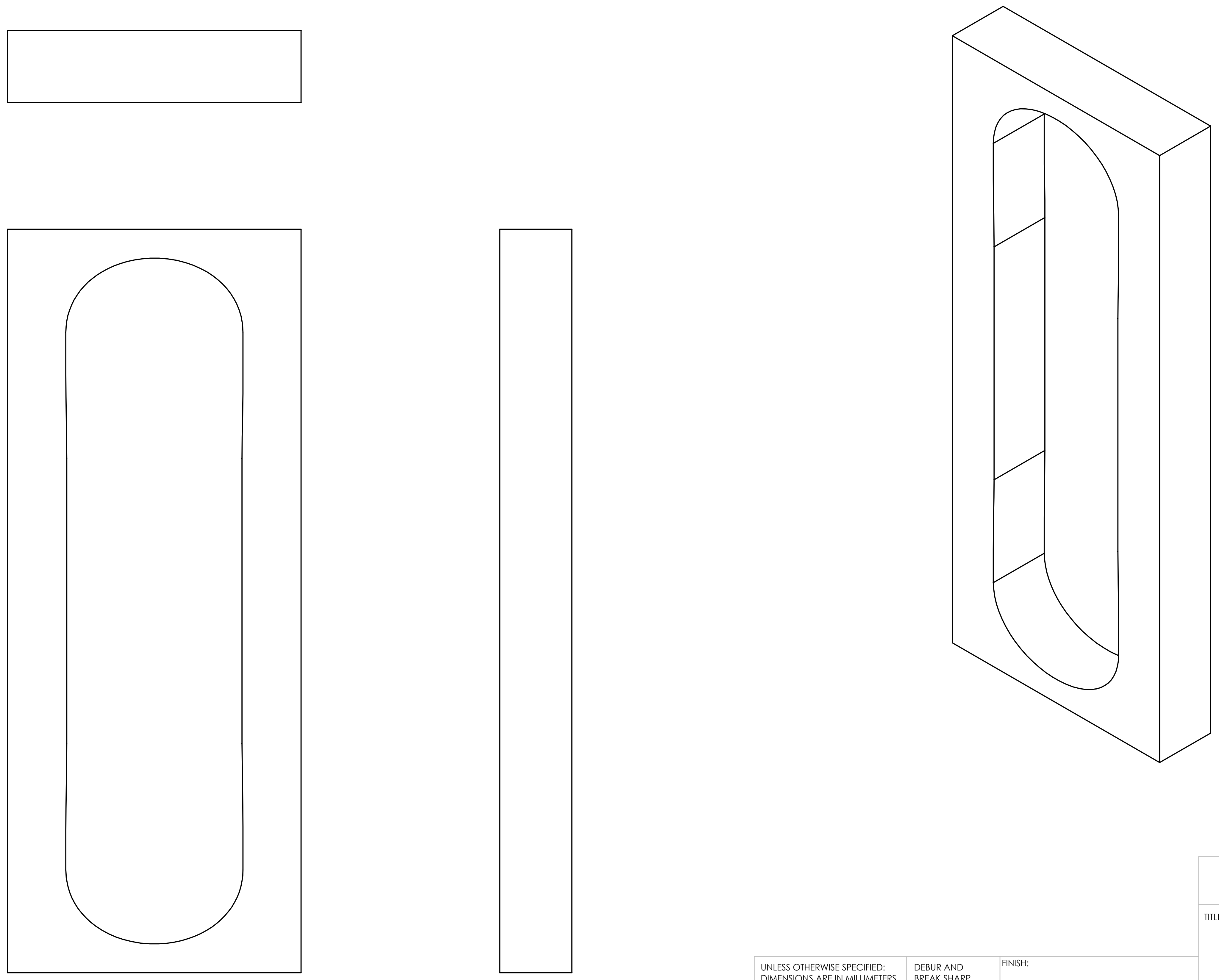
NAME	SIGNATURE	DATE	
Jason Knight			
		MATERIAL: Aluminium	DWG NO. DM3701-07
			A3
		WEIGHT:	SCALE 1:5
			SHEET 1 OF 1



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REVISION 1.0

TITLE:

Middle

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SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

DEBUR AND BREAK SHARP EDGES

FINISH:

MATERIAL: Aluminium

DWG NO. DM3701-09

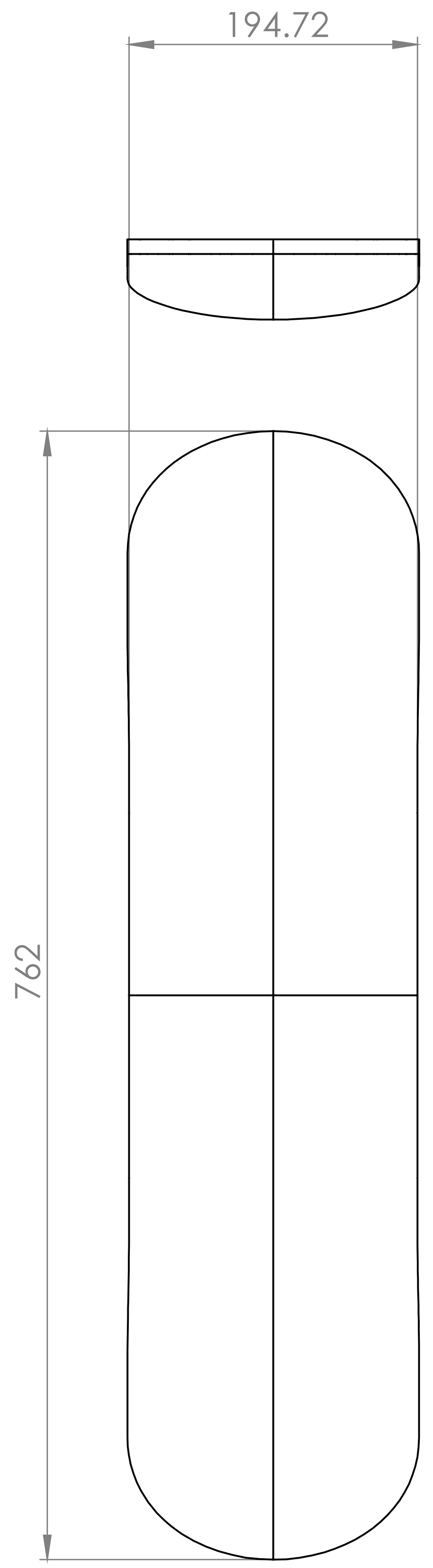
A3

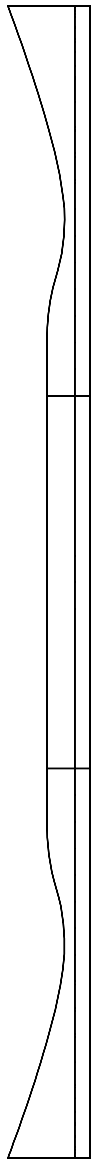
NAME	SIGNATURE	DATE
Jason Knight		

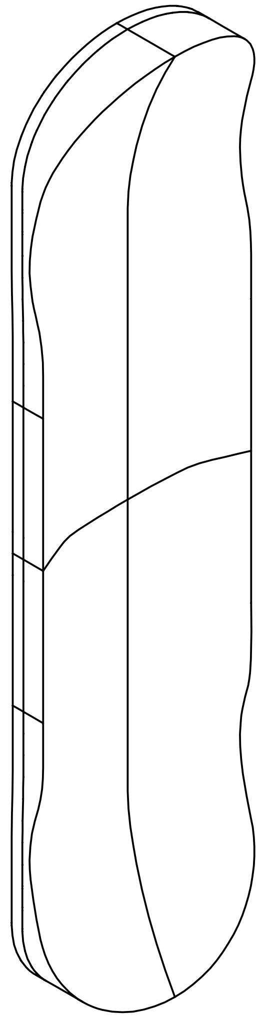
WEIGHT:

SCALE 1:5

SHEET 1 OF 1







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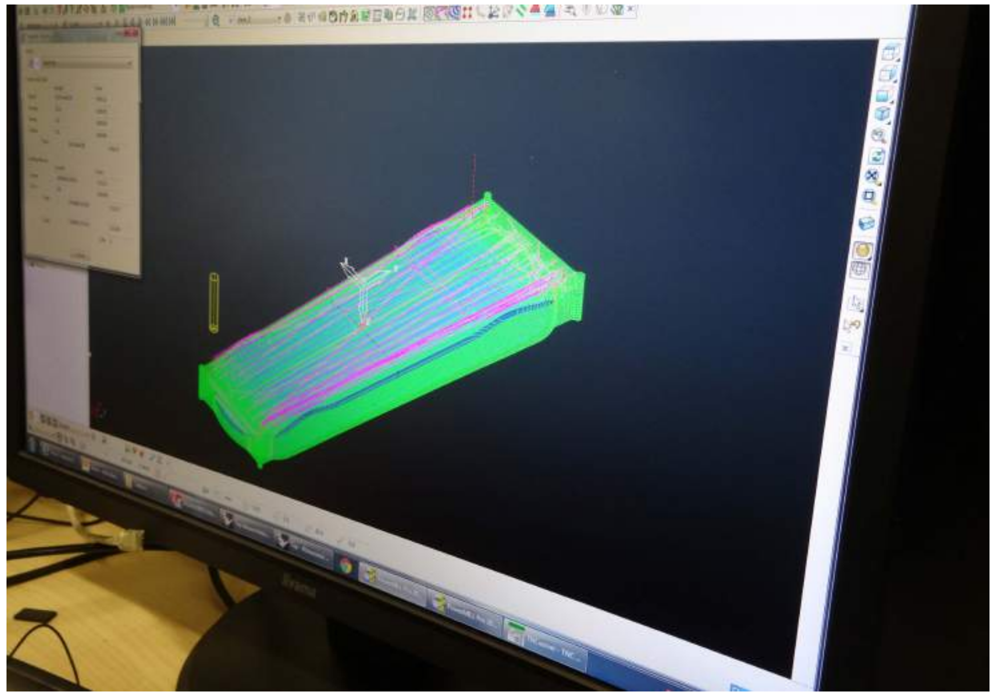
NAME	SIGNATURE	DATE		
Jason Knight				
		WEIGHT:	SCALE 1:5	SHEET 1 OF 1

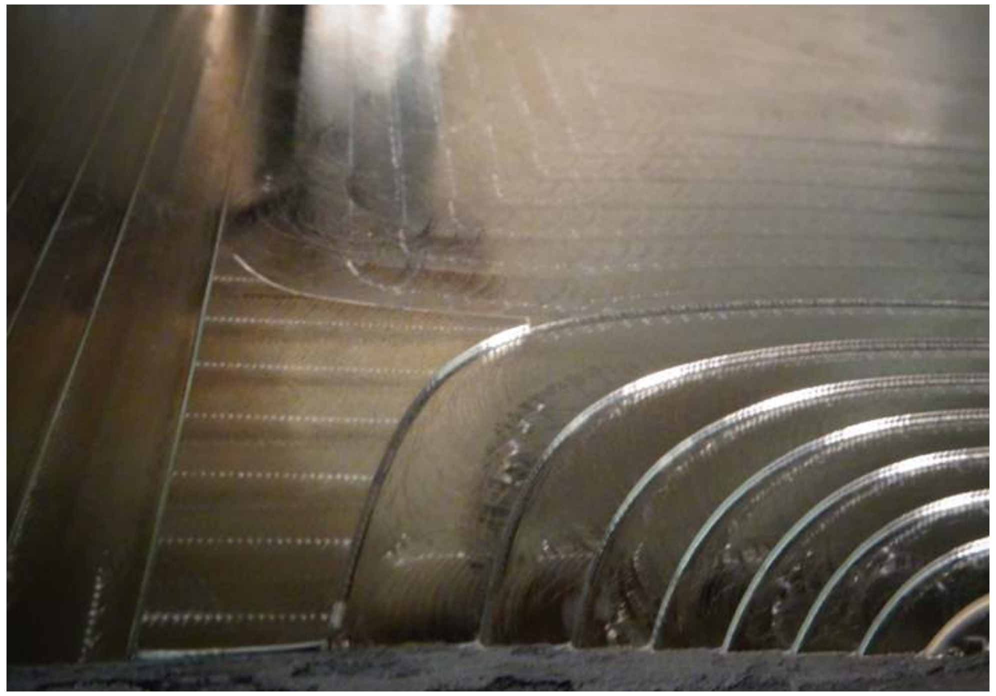


The files for each section of the mould we're loaded in to PowerMill, a software package used to generate machine code which could then be sent to the CNC machine. The software has extensive features including virtual path simulation to ensure that the tool path cuts the most efficient way possible.

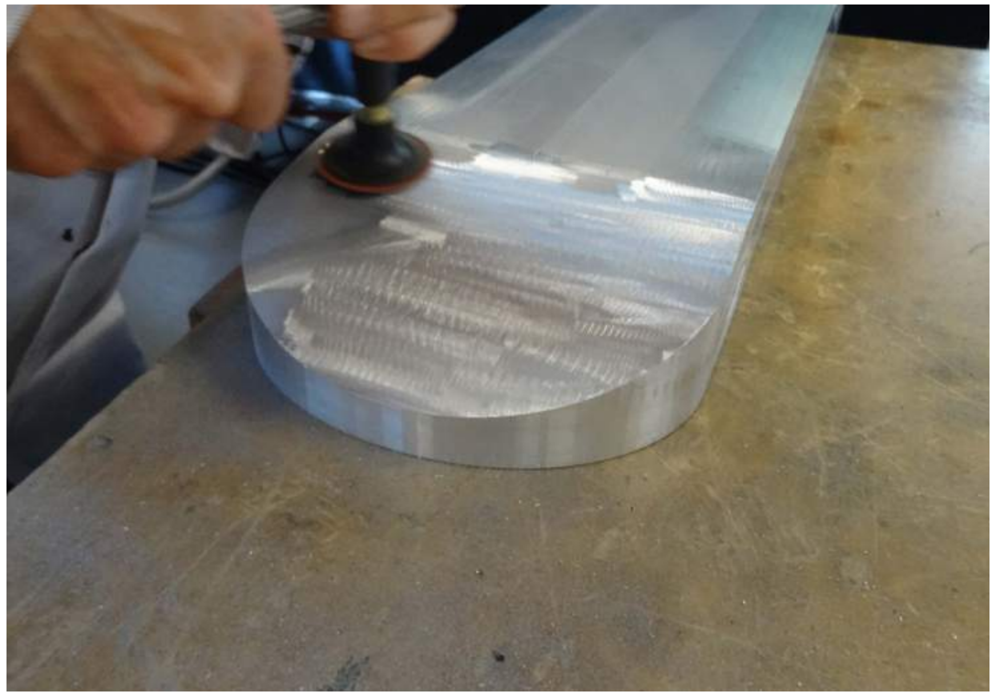
Mount holes were drilled in to the base plate, the holes we're then countersunk so that the screws fitted in to them flush. This allows the base plate to be mounted flat on the cutting bed once the aluminium block has been mounted to them. Four additional holes we're made for dowels to stop the block shifting sideways.

The aluminium block was mounted to the base plate using clamps. Corresponding holes were then drilled and a tap was used to thread them. The depth of the holes was carefully calculate to ensure that the bolts did not protrude through the face of the mould once the next cut was made.

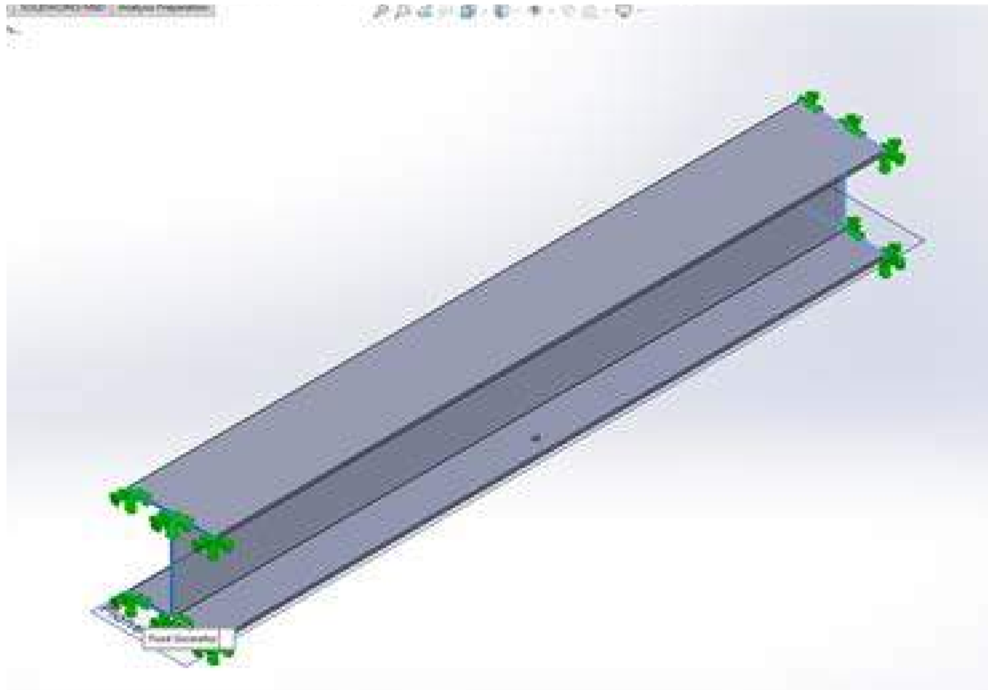
The aluminium block was mounted to the base plate and clamped to the bed with the spacer plates in place to allow for the tool to pass past the material without damaging the base plate. The first rough cut was taken using a 20mm flat head bit to take away the majority of the material.



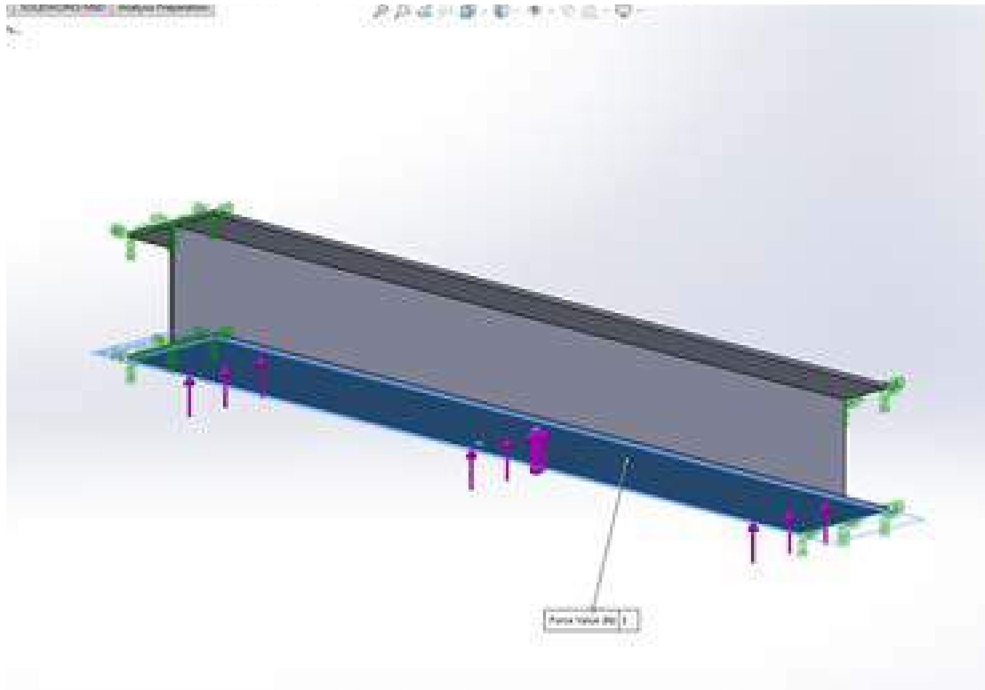
The first cut took just under three hours to complete. Following the rough cut the tool was changed to a ball nose bit so that the finer detail could be added. The ball nose passed over at 0.1mm intervals to ensure that the final surface was as smooth as possible. This stage to roughly 5 hours to complete so was left overnight.



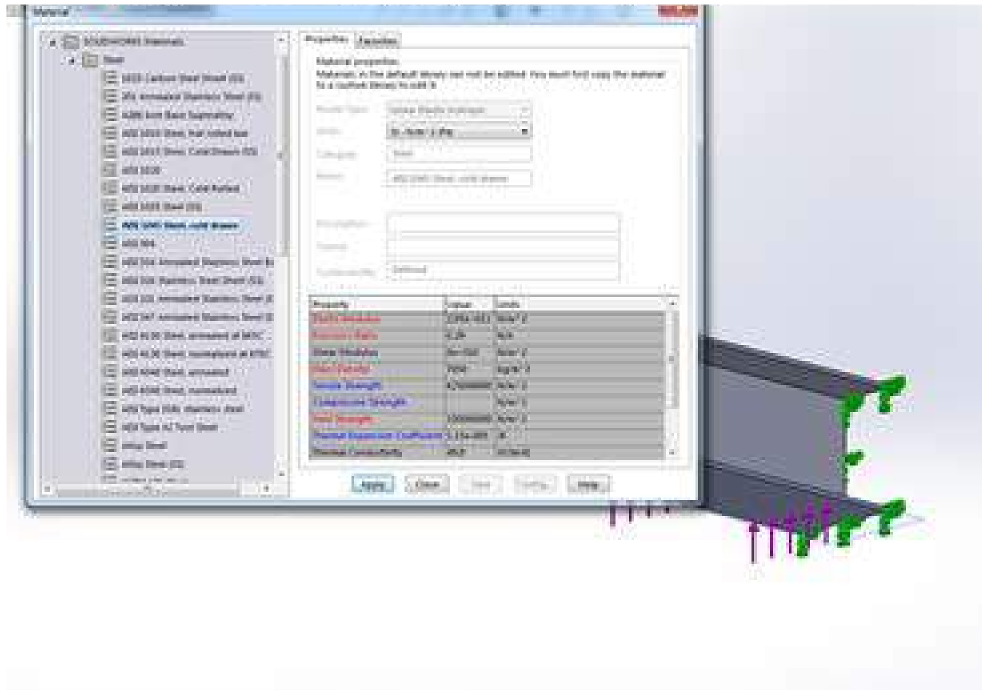
Finally the edges were trimmed and the middle section, which had been cut previously, was used as a template to ensure that the two pieces fitted together correctly. The surface was then finished using incrementing grades of sandpaper. The second section was cut using the same technique and the same baseplate.



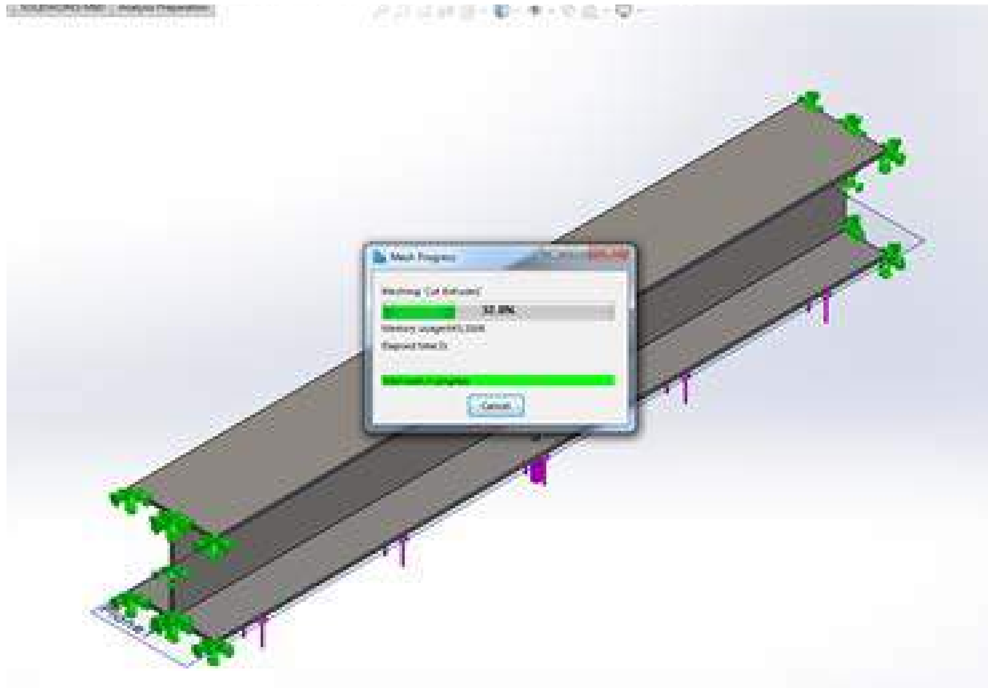
Before construction began on the final press virtual analysis was conducted using Solidworks SimulationXpress to test if the steel sections were strong enough to withstand the pressure they would be subject to. The model was imported. The first stage was to select which points it would be fixed, in this case, the two ends were selected.



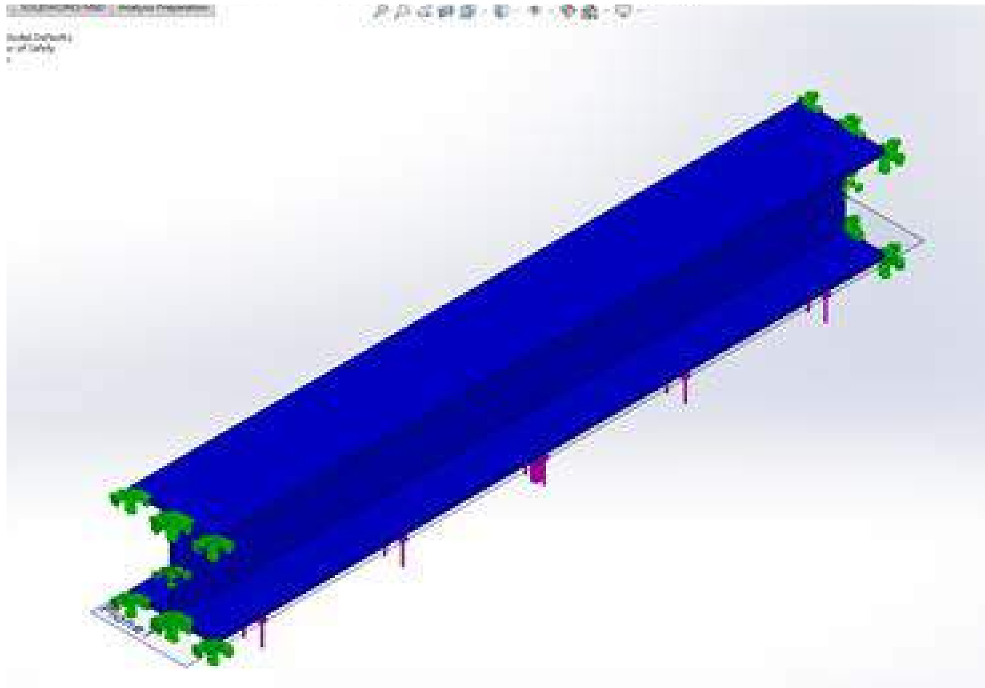
The next stage was to configure the force acting on the beam. The bottom face was selected as this where top of the jack will be pushing up on to. The magnitude was set to 196133 N, the equivalent of 20 tonnes, the maximum force that can be applied by the chosen bottle jack.



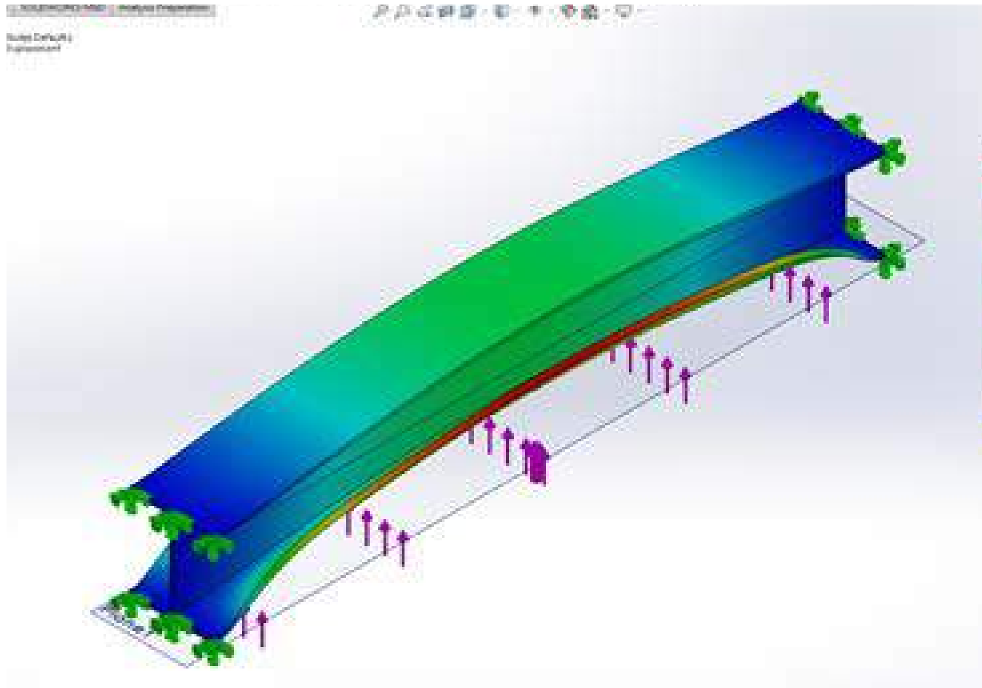
The next stage was to configure the materials properties. Solidworks includes an extensive library of materials. Cold pressed mild steel was selected as it is the most common process used to manufacture structural RSJs. The library automatically configures properties such as the flexural modulus and tensile strength.



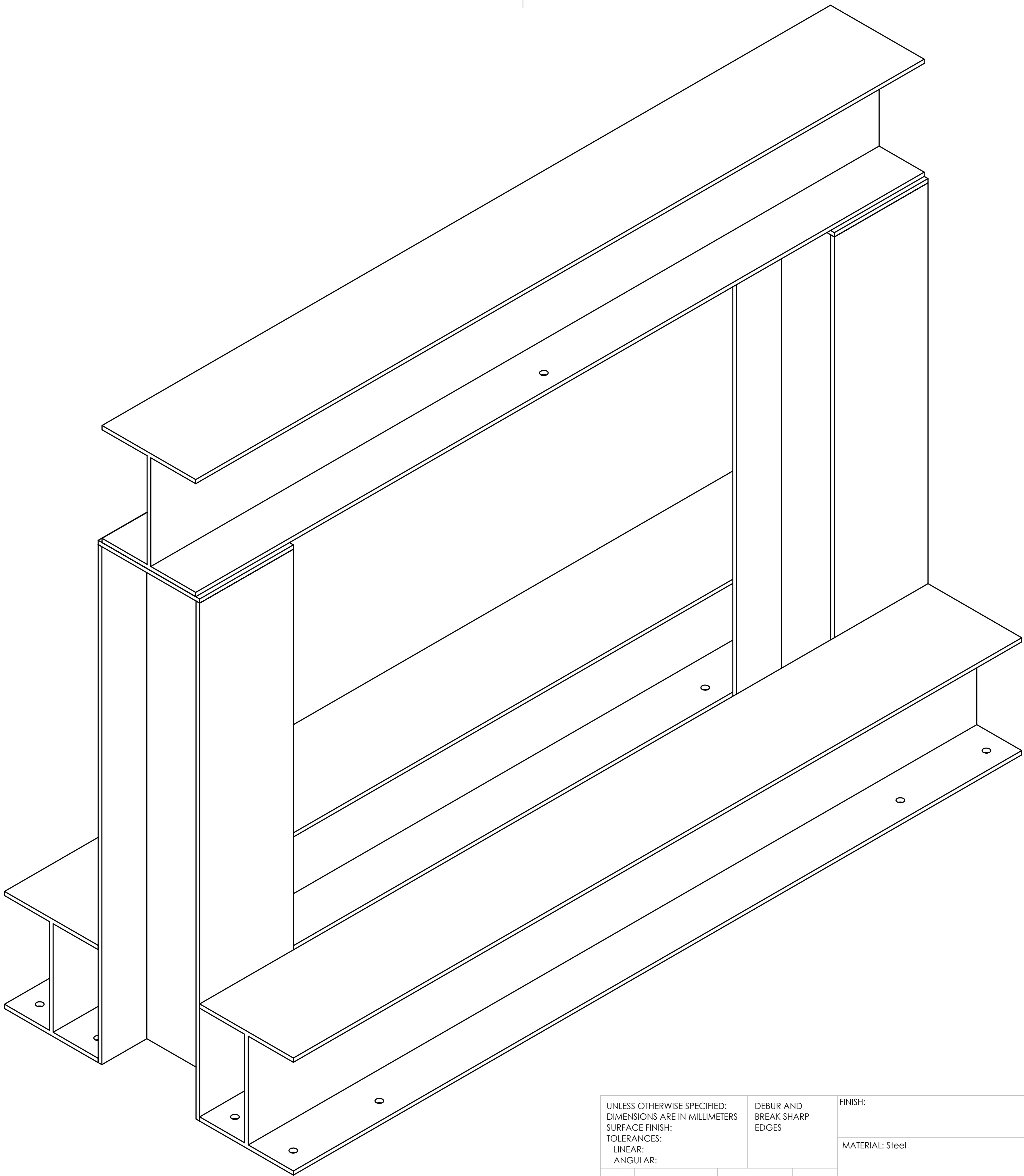
Next a solution was produced. Clicking run simulation initiates solidworks to generate a mesh of the file then run through the simulation. The solution is generate the model animates the deformation that occurs as an incrementing magnitude of force is applied, up to the maximum.



Finally a solution is produced. A results report can generated in the format of a word document. The factor of safety unit is given at 1.55 (1 beings the minimum safe) meaning that the bean is strong enough to withstand 50% more force than the maximum that it may be subject to during operation.



Finally a graphic visualisation was generated to show the displacement. A spectrum is projected on to the shape which helps identify the weakest points and points of likely failure. The visualisation shows the extreme conditions to exaggerate the visual effect generated by the tool so that the results could be easily interpreted.



DO NOT SCALE DRAWING

REVISION 1.0

TITLE:

Final Press

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

DEBUR AND BREAK SHARP EDGES

FINISH:

MATERIAL: Steel

WEIGHT:

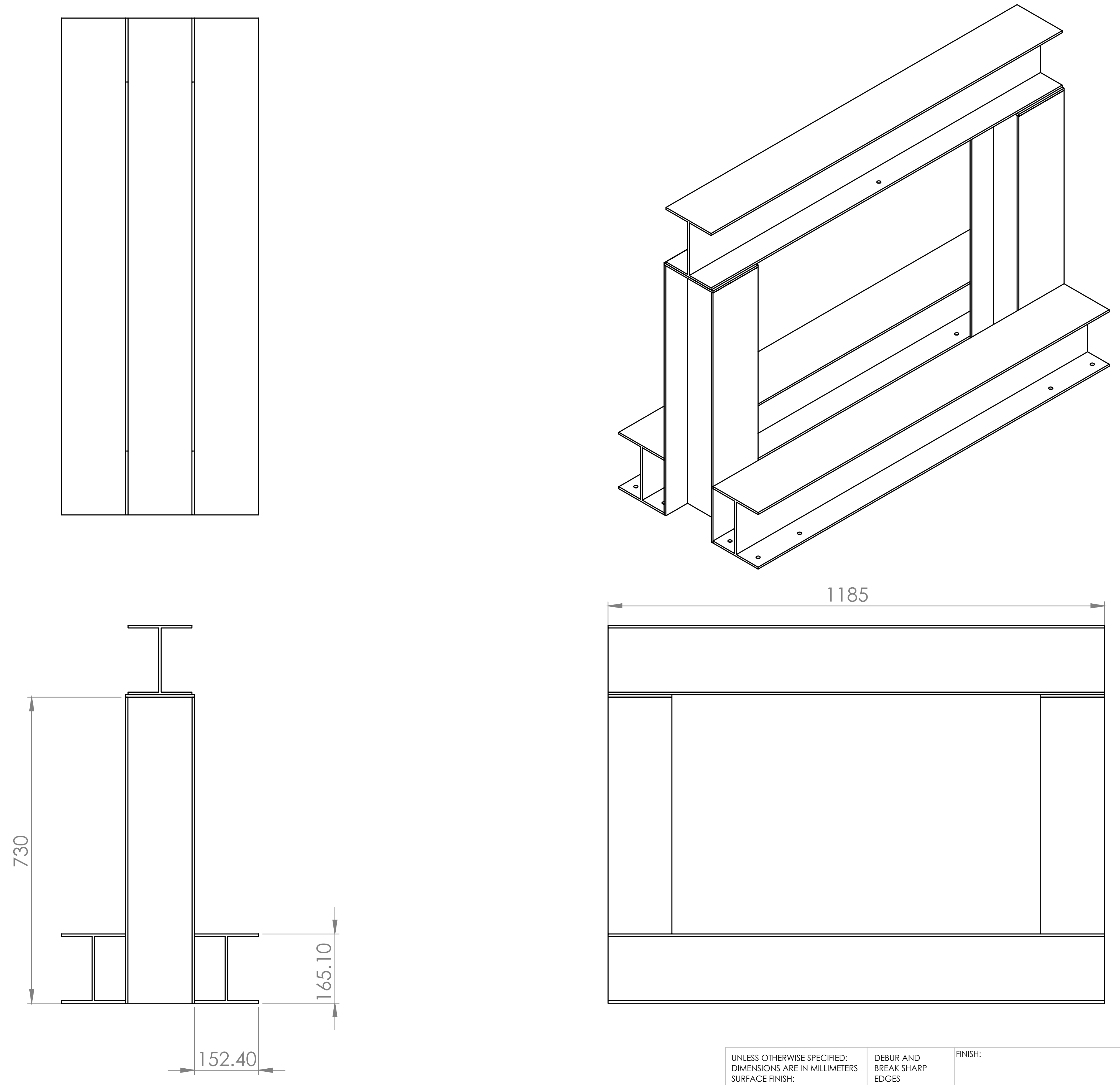
	NAME	SIGNATURE	DATE
	Jason Knight		

DWG NO. DM3701-05

A3

SCALE:1:20

SHEET 1 OF 1



DO NOT SCALE DRAWING

REVISION 1.0

TITLE:

Final Press Four View

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

DEBUR AND BREAK SHARP EDGES

FINISH:

MATERIAL: Steel

DWG NO. DM3701-06

A3

	NAME	SIGNATURE	DATE
	Jason Knight		

WEIGHT:

SCALE:1:20

SHEET 1 OF 1

To prevent users of the press from burning themselves safety lights have been added around the base. The lights are automatically activated when the heating elements are turned on. Strips of 5050 Red LEDs encased in pre made PVC extrusions were chosen as they are simple to mount and power.

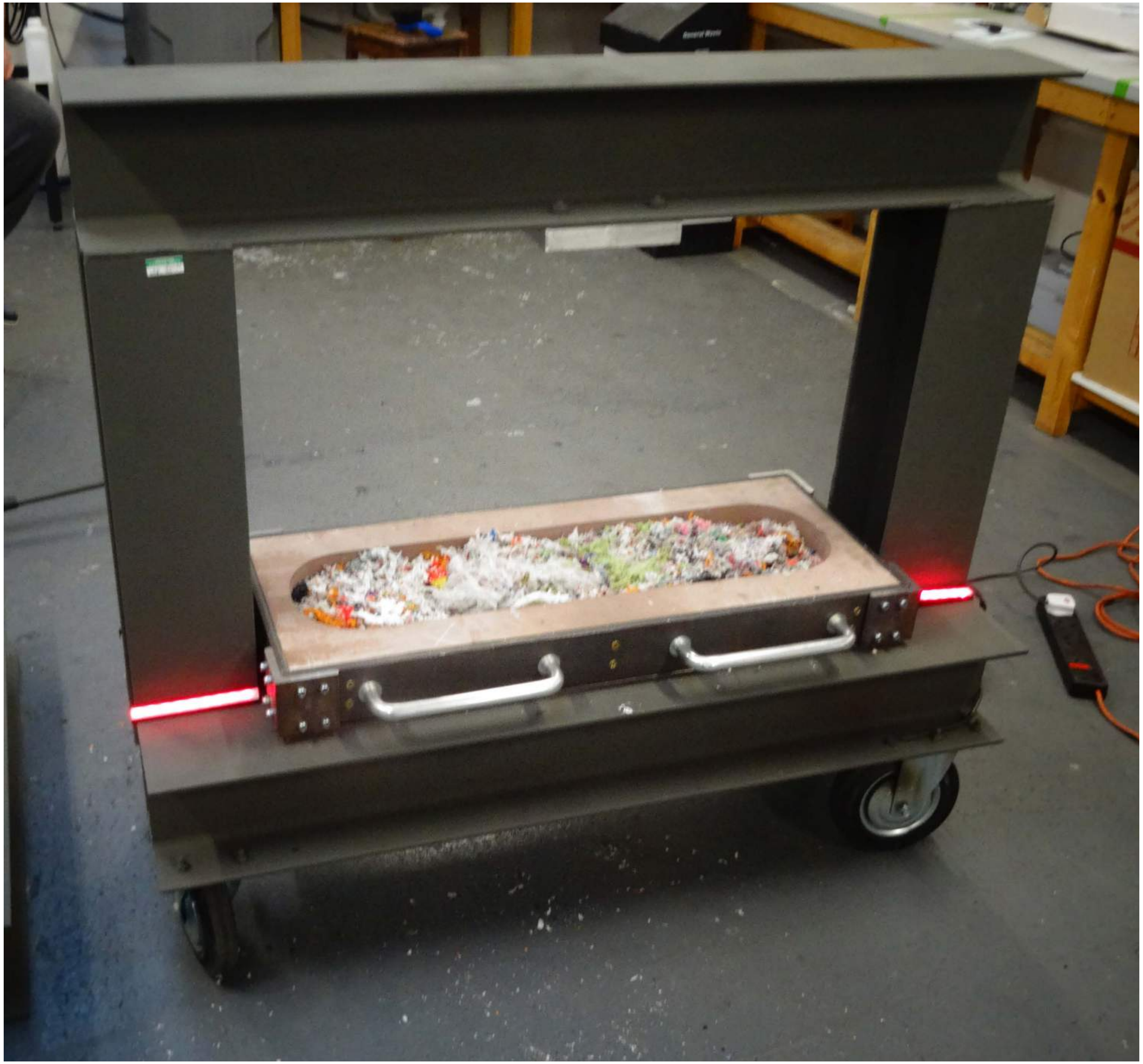
The heating element is controlled by a simple twisting thermostat. The thermostat measures the temperature of the heating element and regulates itself autocratically. The temperature control is required as it allows different types of plastics with different melting temperatures to be used in the press.

A bespoke tool was made specifically to operate the bottle jack. One end of the tool features a groove which allows the pressure release of the jack to be tightened. The other end of the tool features a grip so that when the tool is used to lever the jack it can be held comfortably without damaging the users hands.

The final press weights just over 120kg without the mould inserted, which is hazardous to lift with less than four people. Four 200mm Diameter rubber caster wheels were attached to the base of the press so that it can be transported easily. The wheels were bolted to the base sections.

Handles were attached to the frame that encases the middle section of the mould so that when it needs to be separated it can be easily gripped. Standard 225 mm aluminium door handles were used to save manufacturing time and keep the cost of the press low. The top plate also features handles plasma cut in to it.

A centring bracket was attached to the top face so that the bottle jack does not have to be centred by eye, this mitigates any human error when pressing and ensures that the pressure is distributed evenly. This ensures that the final board has a constant thickness and no additional clamps are needed to close the mould.



Iterative Changes

The final press varies from the prototype in several ways.
The distance between the top and bottom is much smaller to ensure that the frame does not bend under pressure and to accommodate for the narrower mould. The base of the final press is wider than the mould to stop it tipping as pressure is applied. The gap allows the heating element to be mounted directly beneath the bottom face of the mould so that the unit does not require an external oven to heat the plastic.

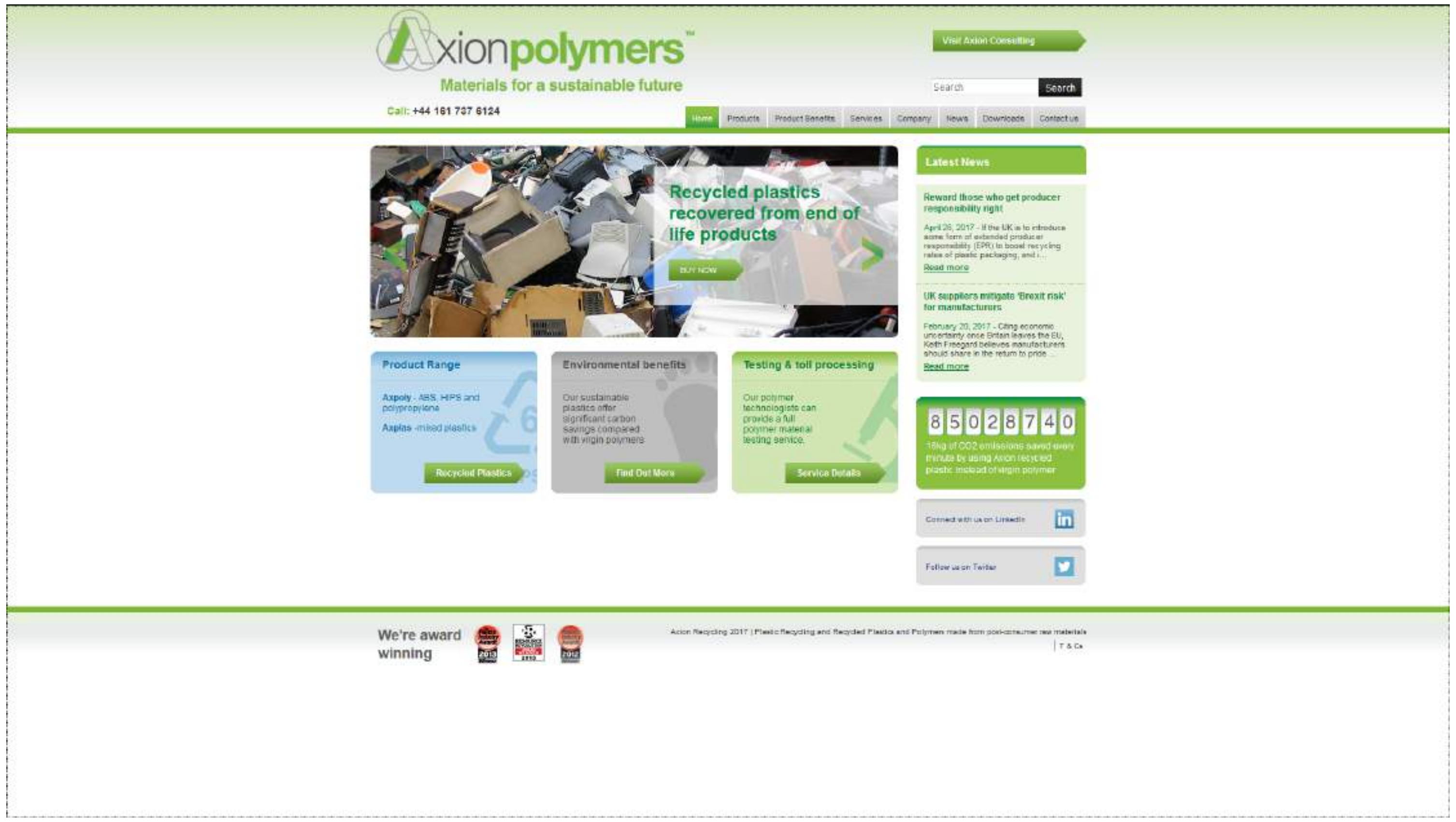
Following the completion of the second prototype including these refinements a second the process was ran through to help identify any problems. The reduction in distance between top of the mould and top beam of press meant that it did not bend. The heating elements lined up flush with the bottom of the mould.

Complications

Despite the heating element contacting the mould, and heating up to significalty over the required temperature it still took an significantly longer time than using an oven to heat the plastic. The block of aluminium took just over two hours to heat up and the same amount of time to melt the plastic. This is most lightly due to the fact that there was no insulation under the element and the fact that it came in to contact with the mould at several points mean that the heat was dissipated away from the mould face.

Unfortunately due to time restrictions it was not possible to make a further iteration within the scope of this project. The next step of development would be to thermally isolate the heating elements so that all the heat they produced transferred directly in to the mould. This could be achieved by placing non conductive spacers between the frame and the heating elements, and my covering the bottom face of the mould with insulation.

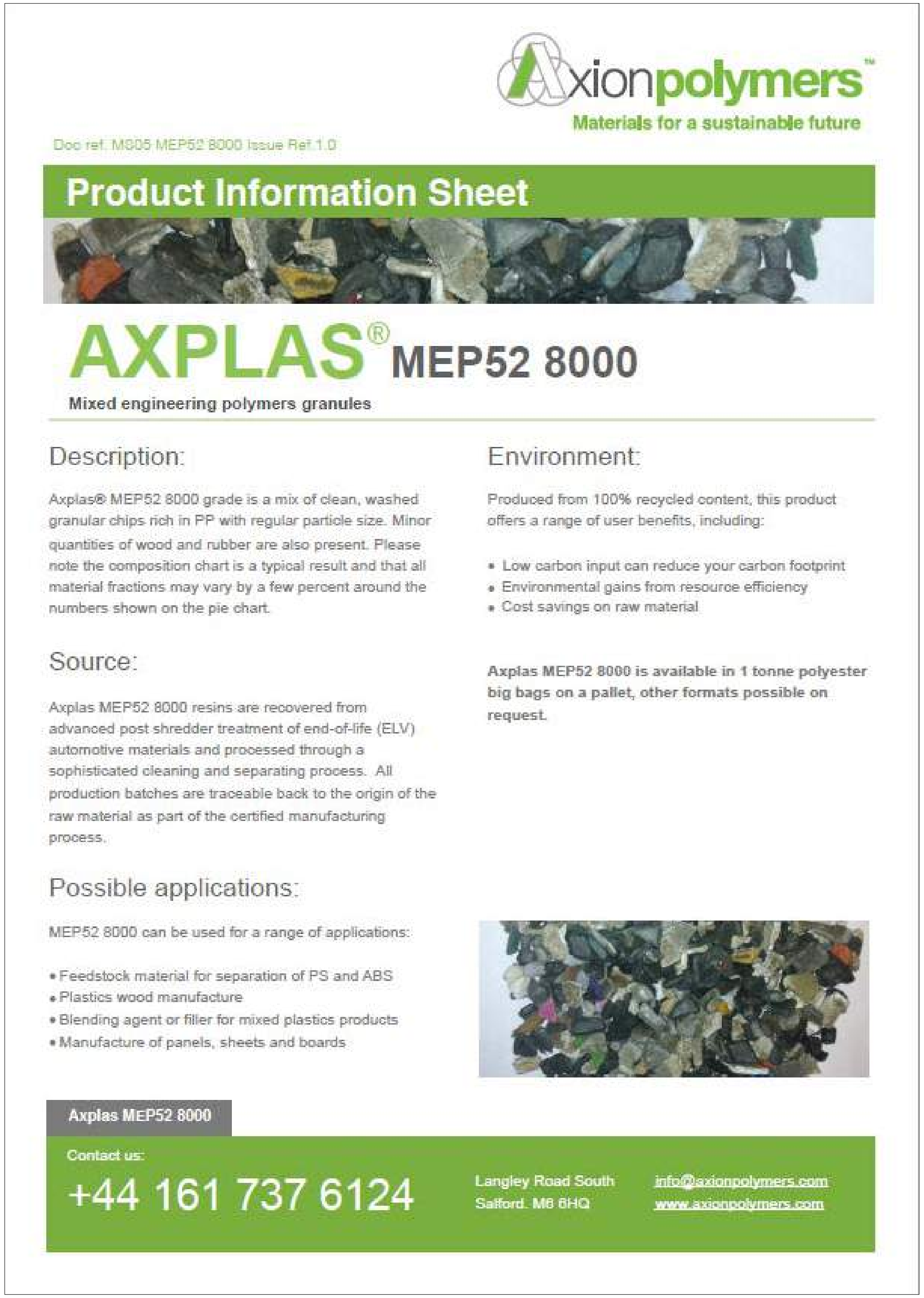
Feasibility



Axion Polymers Home Page

Following a discussion with the institute of materials I contacted Axion polymers, a Manchester based polymer recycling company which sell specifically formulated mixes of shredded and washed recycled polymers sourced from waste electronics and automotive parts. After a series of emails discussing what physical properties I required from the board the conclusion to use AXPLAS®MEP52 8000 was made. The mix has been specially engineered to for its strength hence the reason why it was chosen; to increase the decks rigidity. The mixture consists of even sized granules. Primarily PP but with several other smaller percentages added to it to give it strength. A test sample of 6kg (enough to make 3 boards) was sent for prototyping. Typically the material would be delivered in one tonne quantities costing between £200-£300 depending on availability.

Material	Percentage range
PP	15-55%
PE	0-5%
ABS	15–60%
PS	15-45%
Rubber	0-2%
Wood	0-2%


xionpolymers

Materials for a sustainable future

Doc ref. MS05 MEP52 8000 Issue Ref.1.0

Product Information Sheet

AXPLAS® MEP52 8000

Mixed engineering polymers granules

Description:

Axplas® MEP52 8000 grade is a mix of clean, washed granular chips rich in PP with regular particle size. Minor quantities of wood and rubber are also present. Please note the composition chart is a typical result and that all material fractions may vary by a few percent around the numbers shown on the pie chart.

Source:

Axplas MEP52 8000 resins are recovered from advanced post shredder treatment of end-of-life (ELV) automotive materials and processed through a sophisticated cleaning and separating process. All production batches are traceable back to the origin of the raw material as part of the certified manufacturing process.

Possible applications:

MEP52 8000 can be used for a range of applications:

- Feedstock material for separation of PS and ABS
- Plastics wood manufacture
- Blending agent or filler for mixed plastics products
- Manufacture of panels, sheets and boards

Environment:

Produced from 100% recycled content, this product offers a range of user benefits, including:

- Low carbon input can reduce your carbon footprint
- Environmental gains from resource efficiency
- Cost savings on raw material

Axplas MEP52 8000 is available in 1 tonne polyester big bags on a pallet, other formats possible on request.

Axplas MEP52 8000

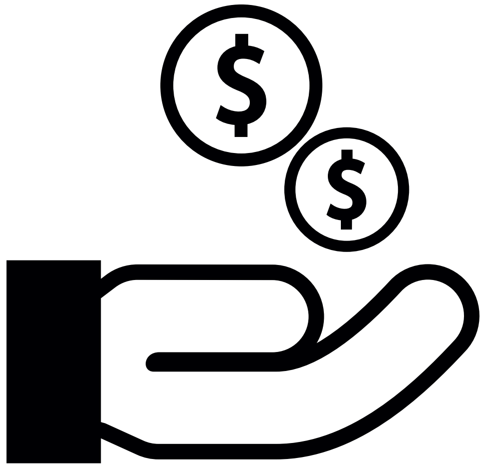
Contact us:

+44 161 737 6124

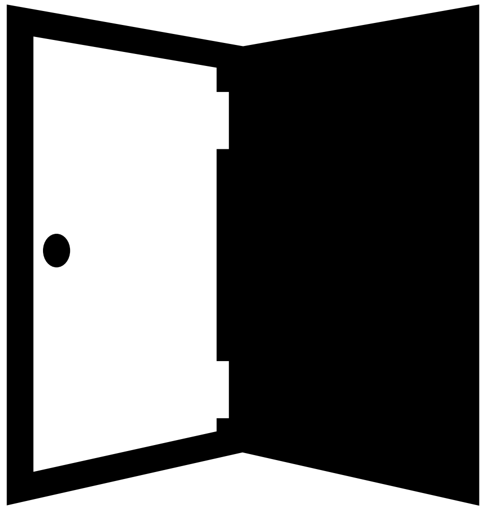
Langley Road South
Salford. M6 6HQ

info@axionpolymers.com
www.axionpolymers.com

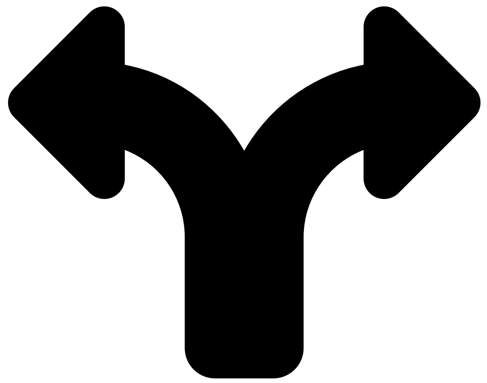
A community could simply allow unrestricted access to the press to incentivise people to collect waste plastic with the intention of making and keeping their own board. Or operate the press for them for free.



A host organisation could set up a scheme where they pay-per-weight for waste plastic for those who want to make an effort but not necessarily want their own deck. Either buy using its own employees or public contribution.

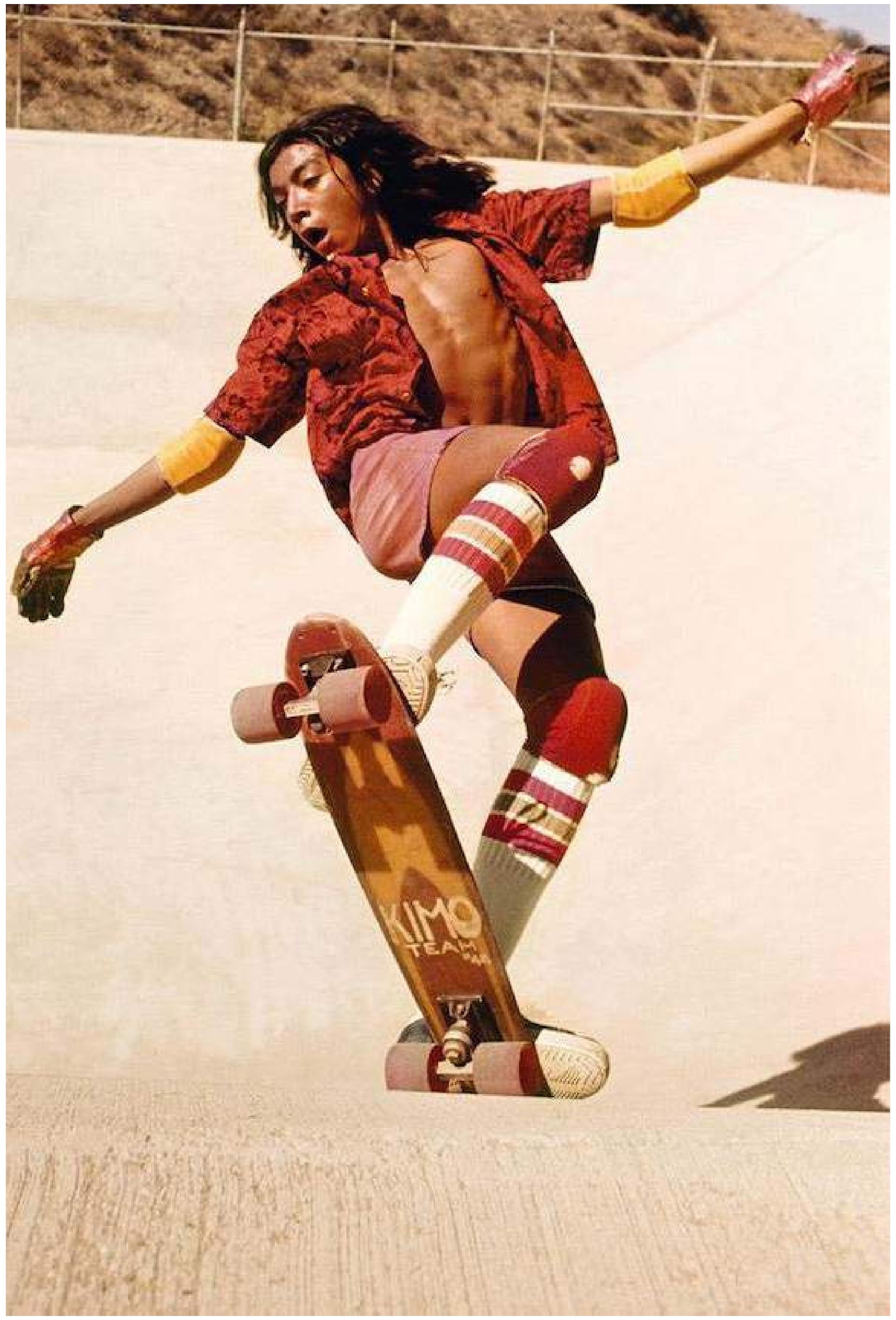


The community could charge a small fee to use the press, or for the host organisation to make a deck for them and people provide their own material. As long as the cost significantly less than buying a new deck.



People are allowed to use the deck for free, or get a deck made for them for free but in return they must hand over the same amount of plastic to the host organisation so that they can make their own deck as well.

A host organisation could run workshops teaching people how to use the press and let them keep the decks, proving material to do so. In return the host organisation received good publicity and improves its reputation



“Things began to change. It started with skateparks and contests - suddenly all the skaters were dressed up in t-shirts with company logos on them”

Hugh Holland,
Skateboard Photographer who rose to fame in the early 70’s,
Interview i-d Magazine, 12 August, 2015

It is my belief that skateboarding, as an industry has became over branded. The decision not to brand the deck was made. To identify the boards as my own a small “=” symbol has been de-bossed beneath the rear trucks. This is a subtle nod to one of the first stylisations associated with skate culture, the iconic tube sock. It also has a double meaning and represents the products effort to restore the equilibrium man kind has with nature.

The objectives I set myself for the project at the beginning were mostly completed, at least the most significant. The outcome was to produce a working press and ridable board both of which were achieved by the first prototype stage. The iterations I made were satisfactory but in hindsight I would have like to have more time to experiment with optimising the process, something that I will do after the project.
Aside from technical and design related skills that were developed during the process, the most important lesson I learned is that everything takes twice as long as planned. Unforeseen delays such as staff shortages meant that some of the objectives I set myself were not achieved during the scope of the project. I would have liked to have had time to do more thorough user testing to get quantifiable data on how my deck compares to a traditional wooden deck but it was not possible, and will have to happen when the project continues after the submission.

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