

Stage 2
Furniture Construction
Material testing

-ve ; Student to use the correct name of task; **Resource Study** that comprises of two sections, a **resource investigation** and an **issues exploration**.

Introduction

+ve ; The student has made a clear link to the product in introduction.

For my major project, I plan to make a bookshelf constructed out of either Veneer Particleboard or Pinewood. During my schooling, I have made projects both out of veneer particleboard and solid Pinewood but I still feel I need to investigate which material is stronger, more durable, easier to use and does not negatively affect the environment. In this report, I will research, test and compare the two different materials to decide which material is the best option to use for my major project.

Pinewood

-ve ; Where possible avoid the use of Wikipedia as a reliable reference.

Pinewood also is known, as *Pinus Radiata* is native to California USA (**Wikipedia. 2020**). Pinewood was introduced to Australia following testing of many different imported timbers during the 1870s. The Australian conditions enabled Pinewood to thrive, therefore, leading to many plantations to be established in Australia. Because of these plantations, native forests in Australia have been able to flourish, as native timbers are seen as less resourceful and take longer to grow. Pinewood is the most common coniferous tree worldwide and there are around 100 different types of Pinewood trees. They tend to grow in large forests in wide-open areas and requires lots of available sunlight, and growth is slow under shady conditions. Pinewood can also be used in high-value carpentry items. Including, roofing, floors, furniture, and panelling. Despite this when Pine is harvested it has a negative carbon footprint. *“Timber, when managed correctly has a negative carbon footprint. It actually uses up more carbon than it puts into the environment. ... Timber that is harvested at the correct age from a forest or plantation that is immediately replanted is certified as being ethically sourced.”* (**The Fremantle Door & Window company. 2020**). The shortcomings with Pinewood are the size and length of available logs due to the branches that grow and therefore creates knots. Pinewood is mainly used in housing construction as it is easy to work with and because it is a softwood, Pinewood can be cut, sawn and nailed using simple hand tools. In summary, Pinewood is environmentally sustainable, its use reduces pressure on native forests, is economical compared to other timbers and has many applications, making it a versatile material.

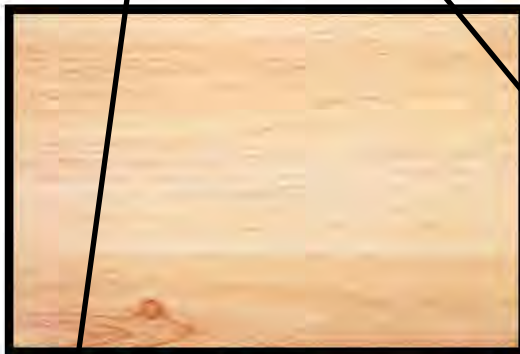
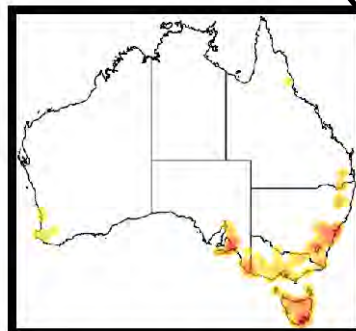


Image of Pine



Image of Pine tree

+ve ; additional statement for issue exploration



Map of where Pine is grown in Australia

+ve ; evidence and referencing to environmental and sustainability issues

+ve ; summarises findings relating to solution requirements

Veneered Particleboard

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+ve ; link to product

+ve ; supporting references

Particleboard is a factory-made board that is usually used in furniture (**Simplicity Sofas. 2018**). It is primarily preferred in furniture manufacturing as it is cheaper and a lot more cost-effective than solid timbers. This creates an advantage of Particleboard over solid timbers. Particleboard is a composite material which means it is created from two or more different materials with different physical properties and therefore when combined creates a material with different characteristics from the original individual materials. Particleboard is an engineered wood product made from waste such as sawdust, wood shaving and wood chip. A heat pressing procedure is applied in the formation of large Particleboard sheets and a thin piece of veneer wood is glued at high temperature to the outside of the Particleboard sheet to create the final product (**Science Direct. 2017**). Particleboard is usually found in furniture that is required to use a large, wide timber rather than using a thinner solid timber, which is more time consuming and is not as strong. Particleboard is capable of creating a similar look to traditional solid timbers, which is why it is so popular. Additionally, Particleboard is environmentally friendly, as it has no wastage (**Sfgate. 2020**). In summary, Particleboard is environmentally sustainable as it is created using other timber waste, it is economical compared to most solid timbers, looks like solid timber and has some better properties than solid timber, for example, can be used in replace of where large and wide solid timbers are needed.

+ve ; support information for issues investigation



Image of Particleboard



Image of Particleboard angled view

+ve ; use of supporting graphics

-ve ; The section above provides a rather generic overview of the two timbers (material composition and the use of some references to environmental impact) but lacks depth of discussion into an issue.

The ticks below show the rating of the material in relation to furniture construction.

Good: ✓✓✓

Average: ✓✓

Poor: ✓

+ve ; material comparison completed but criteria for ratings were required

Property	Pinewood	Particleboard
Environment	✓✓✓	✓✓✓
Sustainability	✓✓✓	✓✓✓
Flexible application	✓✓	✓✓✓
Easily sourced	✓✓	✓✓✓
Cost	✓✓ (Less expensive)	✓✓✓ (More expensive)
Appearance	✓✓✓	✓✓

-ve ; error in classifications / understanding of results evident...
Pine wood is more expensive than particleboard.

Test Planning

The reason why I am comparing Pinewood and Particleboard is that they are both widely available, economical, fit for purpose and ethically sourced compared to other timbers. I have chosen the tests below to determine which material is better for my major project. To ensure that the comparison is equivalent between the two

-ve ; at this point the actual product has not been specified so tests appear rather generic

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=ve ; Product specified

materials, the testing will be the executed same for each material in a controlled environment. The same tools, sanding grit, stains, glue, machines and testing process (for example weights used in strength test) will be on both materials.

+ve ; clear intentions of testing and reasons for this

The properties of the materials I need to understand and compare, to be fully informed of which material is better for my project are:

- **Surface Durability** (Dent test, Scratch test and Shock Press test) – this will give an understanding of how durable the bookshelf will be during construction and when used at home.

-ve ; are all surface durability tests required? Were they prescribe by teacher or choice given to student?

- **Moisture Resistance** (Soak test) – this will show which material is less prone to moisture damage and deterioration.
- **Strength** (Weight test) – this will inform me which material is the strongest and can better support books or vases.
- **Surface Finishing** (Sanding test, Glue and Stain Test) – this will inform me which material provides the better surface finish and produces a more appealing looking product.

Testing

Test 1: Dent test

The Dent test was performed by dropping a thick metal rod 300mm to dent the material. To make sure the drop would be the same every time, a plastic pipe was cut at 300mm and the metal rod dropped through the pipe, ensuring the rod was placed at the top of the 300mm plastic pipe. When dropped this would create a dent in the wood. When doing the drop test I did three drops per timber sample to ensure the tests were consistent.

Results

When I visually reviewed the test results I saw that the Pinewood had deeper dents, whereas the dents in the Particleboard were smaller and looked to be insignificant compared to the Pinewood. This was a qualitative observation. The Particleboard is denser material compared to Pinewood and will be taken into consideration when I choose which material to use.

Pinewood



Particleboard



Additional testing options- Students in the higher grade bracket would have indicated how to resolve this if a dent or scratch occurred. A dent in solid pine can be removed by steaming but its less possible in veneered particle board. Particle board has a thin pine veneer layer which if sanded will go through to the pressed engineered wood below.

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? ; excellent link to product (previous page)- how water could affect the timber through washing/ mopping of the floor. However, with the use of a finishing coat on the product, this may eliminate possible moisture uptake by both materials investigated.

Test 2: Soak Test

The soak test was conducted by wetting a towel and placing a piece of Particleboard and a piece of Pinewood that are the same size on top of the wet towel. The timbers would soak up the moisture from the towel.

Results

After one minute, the water had been soaked up by samples of timber. The water had risen 75mm on the piece of Pinewood, whereas on the Particleboard the water had risen 160mm. After ten minutes, the water on the Pinewood had risen to 110mm, whereas on the Particleboard the water had risen to 530mm. This demonstrates the Particleboard soaks up more water compared to the Pinewood. This is a quantitative result. This will be taken into consideration, as when the floors around this area are mopped water will be soaked up by the timbers meaning the timber will expand and, once dried, contract. After the timber has expanded and contracted multiple times this will damage my major project.



Test 3: Weight Test

The weight test was conducted by using the Radial Arm Saw and cutting two pieces of timber that were the same size, one of Pinewood and one of Particleboard. A channel was cut on the Radial Arm Saw in the same place on both timbers so that it would weaken the timber at that point, and I would not need to use as much weight to see which timber is stronger.

Results

I started with a 20kg weight to measure the strength of both timbers. First, I put the 20kg weight on the Pinewood and as seen in the image on the right, there was a significant bend. I then put the same 20kg weight on the Particleboard and the timber snapped instantly after I had released the weight gently. This is a quantitative test.

Pinewood



Particleboard



+ve ; strength test is very relevant to the solution as weight of articles on the bookshelf can cause the shelves to bow.

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Test 4: Scratch Test

The scratch test was conducted by getting a 30cm metal ruler and scratching diagonally across the timber samples with the same strength both times.

Results

With the Particleboard, I noticed it was not deeply scratched, whereas the Pinewood was scratched deeply. The result was similar to the dent test in that the Pinewood was affected more than the Particleboard. This is a qualitative test and will be taken into consideration, as I will need to use a timber that is not easily scratched so I can spend less time sanding out scratches in the timber and spend more time constructing the major project.

Pinewood



Particleboard



Test 5: Sanding Test

The sanding test was conducted using the Orbital Sander, 180 grit sandpaper and sanding both pieces of timber for 30 seconds the samples were removed to see which material was looking better.

Results

The Pinewood was smooth and look relatively similar to before it had been sanded, whereas on the Particleboard after 30 seconds on the Orbital Sander had sanded through the veneer exposing the woodchips of the Particleboard. This is a qualitative test. This will be taken into consideration as if there is a deep scratch or dent that needs in-depth sanding, I will need a timber that can be moderately sanded for my final project.

Pinewood



Particleboard



-ve; placing all the testing in order as prescribed in introduction would have made the work flow better for the reader E.g. placing all the Surface durability test together—dent test, scratch test and shock test.

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Test 6: Shock Press Test

The Shock Press test was conducted by individually placing both pieces of timber underneath the Shock Press and pressing down on the timber until the Shock Press gauge read 3.5 metric tons.

Results

I started with the Particleboard, after 2 metric tons, I saw some slight damage to the timber. After it had reached 3.5 metric tons I saw that the Particleboard was slightly more damaged. During the shock press test on the Pinewood, I noticed that after 2 metric tons the timber was severely more damaged than the Particleboard. After 3.5 metric tons, I removed the Particleboard from the Shock Press and there was a hole that was 5mm deep. This is a quantitative result. This will be taken into consideration when I choose my material, as I need to work with the strongest timber to minimise dents, scratches or the risk of it braking in the storeroom.

Pinewood



Particleboard



Test 7: Glue and Stain Test

The glue and stain test was conducted by using PVA glue and a paintbrush, and simply painting the PVA glue onto both timbers, leaving the PVA glue to dry, then applying a stain to the timber.

Results

When I examined the Pinewood, the glue was visible however, on the Particleboard the glue was much easier to see. This is a qualitative test. This will be taken into consideration as when I am whipping off the glue on my major project and if I miss a spot and then stain over the top of the glue it will not as easily be seen on the Pinewood compared to Particleboard.

Pinewood



Particleboard



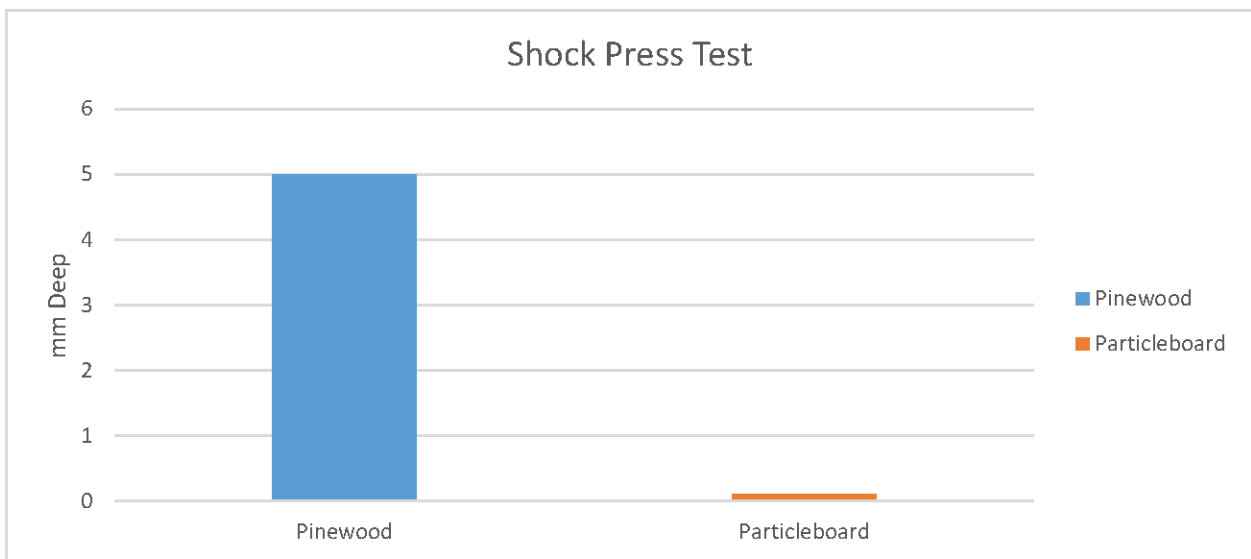
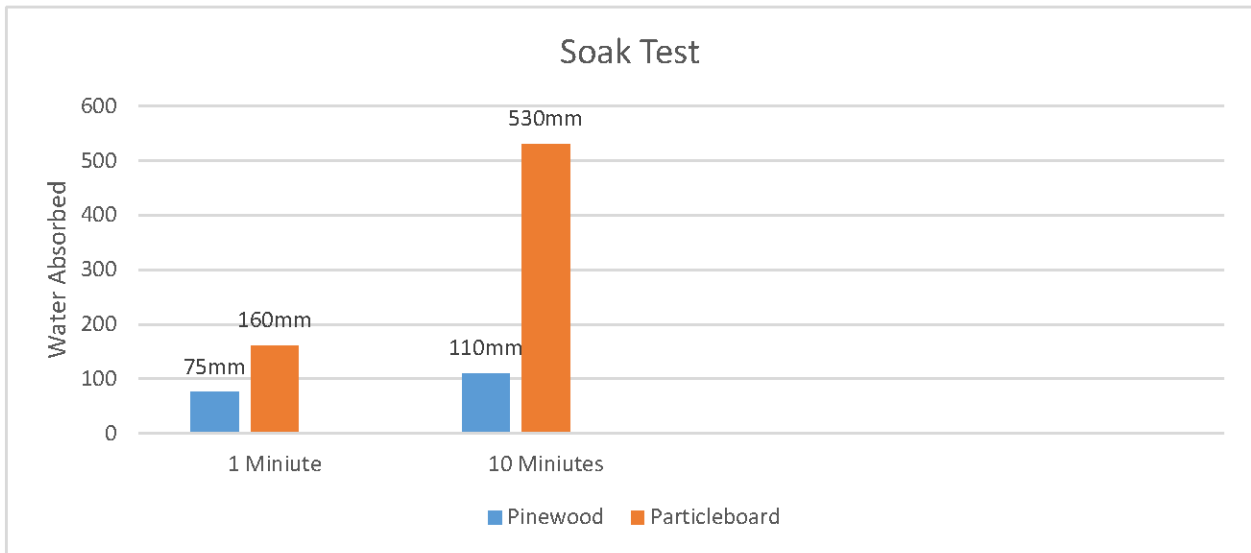
+ve ; Tests provide good analysis and links to product with excellent use of supporting images

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+ve ; Qualitative and Quantified data has been presented

Test Results Summary

Test	Results	Value of Property	Recommendation
Dent Test	Particleboard is more dense.	High	Particleboard
Soak Test	Particleboard soaks up more water than Pinewood.	Low	Pinewood
Weight Test	Pinewood is stronger than Particleboard.	Medium	Pinewood
Scratch Test	The surface of Particleboard is more resilient than Pinewood.	High	Particleboard
Sanding Test	After 30 second on the Orbital Sander, the veneer on the Particleboard was damaged.	High	Pinewood
Shock Press Test	Particleboard is more dense.	High	Particleboard
Glue and Stain Test	The glue on the Particleboard shows more than the Pinewood.	Medium	Pinewood



Ethical considerations

Due to the pine plantation, that Australia has it is not considered unethical to cut down a pine tree unless it is not replaced with another pine tree once it has been cut down. However, the time to grow a Pine tree takes a lot

-ve ; this seems out of place here. Better suited in issues investigation section

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longer than if you were to make the same amount of timber and make Particleboard. Additionally, due to the recent bush fires the Australian Oak and the Pine plantations have burnt down this has lead me to mainly using Particleboard for the majority of my design.

+ve ; A good conclusion that sums up resource investigation (testing) and provides links to product being developed.

Conclusion

In conclusion, for my major project, I will be using Particleboard for the following reasons based on the material comparison and test results. Particleboard is cheaper than Pinewood, making it more economical, especially if I were to make a mistake and needed to use more material. Particleboard is more ethically sourced than Pinewood as it reuses wood waste products, and therefore is an environmentally better option than Pinewood. The test results determined that Pinewood is easier to dent, scratch and damage, which may affect the time efficiency of the creation of my project if damaged during construction, and make the bookshelf less durable when it is in use. Finally, if I were to make an error with my screws, it would not make a big difference to my work, as it will be easily recoverable compared to Pinewood, which would split and create many problems. Although Pinewood performed better in the Weight test, Particleboard is still appropriate to use in this case. The Glue and Stain test results and Sanding test results were better for Pinewood, but now that I am aware of the limitation of Particleboard in these areas I will ensure that during construction, I will take the necessary precautions to avoid glue stains and over sanding on my final project. The cost compared to Pinewood is a lot cheaper, Pinewood costs \$39.56 per square meter whereas Particleboard costs \$21.02 per square meter this is almost half the cost of Pinewood per square meter. Although, Pinewood does look better than particle especially on the end grains that can be easily fixed as I can use a thin piece of pine similar to the particleboard and edge strip where the end grain of the Particleboard, is and creating the same effect as natural Pinewood.

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Overall ; the **resource investigation** was stronger than the **issues exploration**, however , a good **Resource Study** at a **B grade**