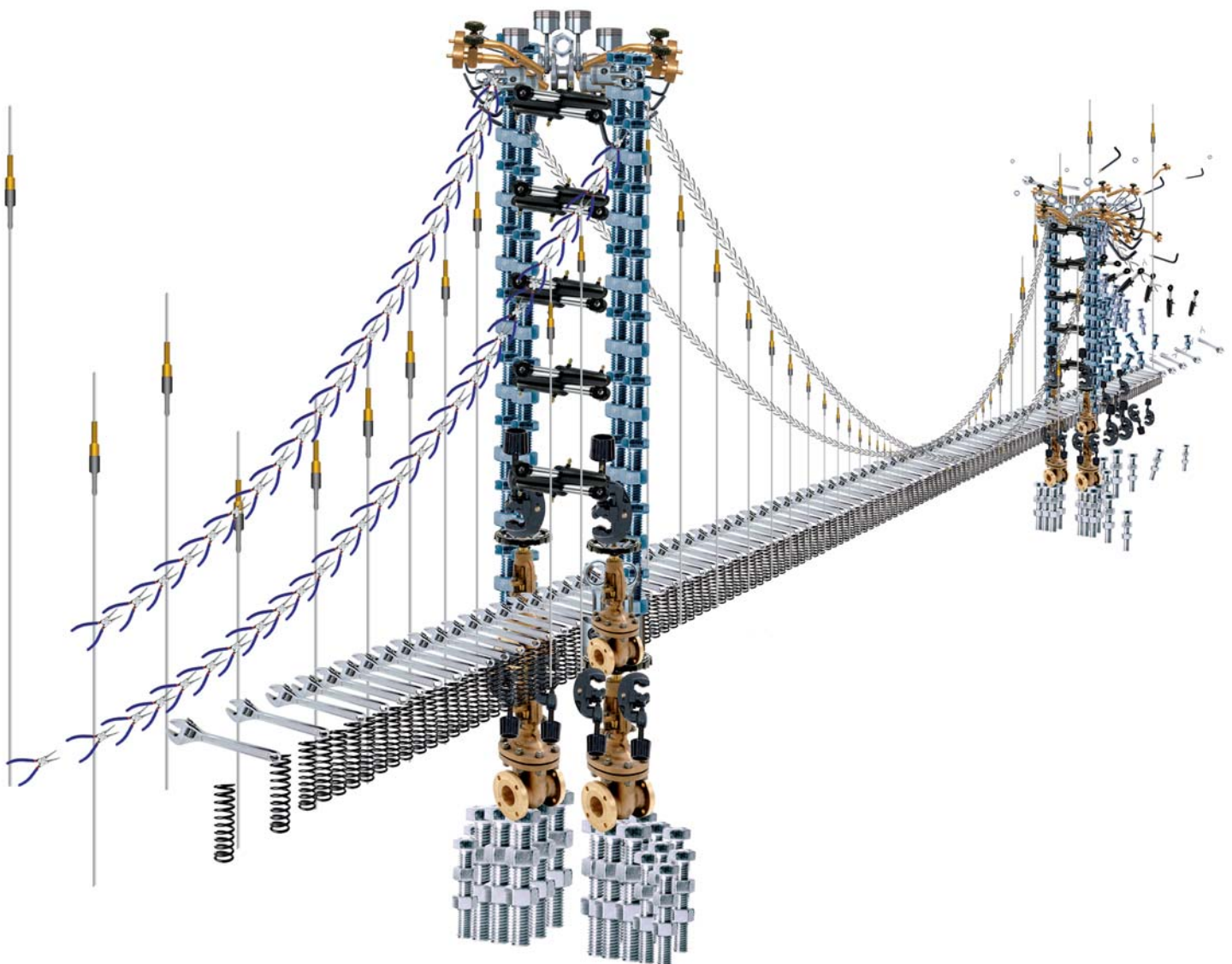


SAMPLE INTERNALLY ASSESSED UNIT

UNIT 7 - ENGINEERING THE FUTURE





**Diploma – Principal Learning
Engineering**

**Level 1 / Unit 7
Engineering the future (ENG1U7)**

Sample Internally Assessed Unit

CANDIDATE'S WORK

Level 1 Unit 7 Engineering the Future

Task 1

Report

I have looked at the following materials:

- Kevlar
- UHMWPE
- Composite armour from Carbon fibre and UHMWPE
- Composite armour from ceramic plates and carbon fibre
- Nanomaterials (Tungsten Di Sulphide)
- Steel
- Titanium
- Shape memory alloy

For every material I have found the important properties, the advantages and disadvantages, how it could be made into armour, how it is disposed of when you finish with it and the source of information.

Here are the results - of the investigation (see pages 2 to 9).

2.

Material Name: Kevlar

Important Properties:

Great tensile strength (3000 MPa) and a relative density less than 25% of steel.

Advantages And Disadvantages Of Using This To Make The Armour:

Used in armour so we know it works.

Very difficult to cut the chains so good against stabbing.

Quite expensive.

Can't be repaired so would have to make new.

How It Could Be Made Into Armour:

Made by polymerisation. Can buy as fibres or sheets or injection moulding which is used for helmets. So could make clothes from Kevlar material and put on plates of Kevlar made by moulds from the contestants' bodies.

How It Is Disposed Of When You Have Finished With It:

It can be recycled which would save materials for use on later shows.

Where I Found Out About This Material:

'What is Kevlar' pdf on Dupont website.

3.

Material Name: Ultra High Molecular Weight Polyethylene (UHMWPE)

Important Properties:

Highest impact strength of any plastic, very difficult to break.
15 x more resistant to scratching than steel

Light weight

Can be either fibres like cloth or sheets.

Advantages And Disadvantages Of Using This To Make The Armour:

Already used in armour so we know it works.

Difficult to damage so it would look good on camera.

Very expensive to buy

Can't be repaired so would have to make new.

How It Could Be Made Into Armour:

Fibres are used as stuffing in body armour, called Dyneema.

Plates can be made by forcing the material into a mould, using sheets. This uses heat to soften the plastic then squeezes it between a mould with 2 halves.

How It Is Disposed Of When You Have Finished With It:

It can be melted down and used again.

Where I Found Out About This Material:

Wikipedia entry for UHMWPE

4.

Material Name: Composite Armour made from Carbon fibre

Important Properties: and UHMWPE

Very stiff plates that have high strength. Won't let a rifle bullet through.

Advantages And Disadvantages Of Using This To Make The Armour:

Used in US marine interceptor body armour so we know it works.

Easy to make the armour. (doesn't need much power)
When it breaks you have to make a new one.

How It Could Be Made Into Armour:

You would make a mould of the shape you need like a competitors arm and arrange layers of UHMWPE and carbon fibre in it. These are soaked in epoxy resin. They dry overnight and can be spray painted.

How It Is Disposed Of When You Have Finished With It:

This is thrown away. It cannot be recycled which is not good.

Where I Found Out About This Material:

Wikipedia entry on body armour.

Material Name: Composite armour from Ceramic Plates and Carbon fibre.

Important Properties:

The plates take a lot of energy to break. The carbon fibre helps to stop them breaking from small impacts.

Advantages And Disadvantages Of Using This To Make The Armour:

The plates break when they are hit to soak up the energy so you need to replace them often.

There might be gaps between plates where you could get hurt through.

When it breaks you have to make a new one.

How It Could Be Made Into Armour:

The plates are made by sintering.

The composite is made by putting carbon fibre material between layers of plates and soaking it in epoxy resin to hold it together.

How It Is Disposed Of When You Have Finished With It:

Composites can't be recycled so you have to throw them away.

Where I Found Out About This Material:

Howstuffworks.com section on body armour

6.

Material Name: Nano material (~~It~~ Tungsten Disulphide)

Important Properties:

Very expensive.

Very, very strong - can stop bullets and any damage up to 250 tons per centimeter

Advantages And Disadvantages Of Using This To Make The Armour:

Very strong so no one could get hurt.

Very new so may not be able to buy the equipment to make it.

Probably have to make a new one when it breaks.

How It Could Be Made Into Armour:

You soak them into fabric and they harden. You would use a mould in the shape you want.

How It Is Disposed Of When You Have Finished With It:

They don't know what happens when you try to recycle it.

Where I Found Out About This Material:

Ap nano website

Material Name: Steel

Important Properties:

Strong, easy to repair.

Cheap material.

Heavy - density of $6-7 \text{ g cm}^{-3}$

Advantages And Disadvantages Of Using This To Make The Armour:

Used in medieval armour so proved to work.
 Might be too heavy to wear all day.
 People drown if they fall into water wearing heavy steel armour.

Damaged armour can be hammered back into shape.

How It Could Be Made Into Armour:

Shape it when it is red hot by hammering using an anvil in a blacksmith's shop.

How It Is Disposed Of When You Have Finished With It:

Can be recycled to make cars, radiators, I-beams.

Where I Found Out About This Material:

Howstuffworks.com website

8.

Material Name: Titanium

Important Properties:

Light weight but strong
Can be dented without breaking.
Shiny appearance.

Advantages And Disadvantages Of Using This To Make The Armour:

Used in airplanes so know it's strong.
Light weight so easier to wear.
Can be joined by riveting or nuts and bolts.
Easier to shape than steel but also easier to damage. Damaged armour can be bent or hammered back into shape.

How It Could Be Made Into Armour:

Would need a big press to stamp it out to the right size and shape.

How It Is Disposed Of When You Have Finished With It:

Can be melted down and recycled.

Where I Found Out About This Material:

Wikipedia entry on titanium.

Material Name: Nickel Shape Memory Alloy.

Important Properties:

Made from Nickel metal. Once it has been shaped, if it is damaged and heated it pops back into shape. Quite strong. Can be dented without breaking.

Advantages And Disadvantages Of Using This To Make The Armour:

If it was damaged it would be very quick to repair by heating it up.

Heavier than plastics but lighter than steel.

Can be cheaper than plastics.

How It Could Be Made Into Armour:

By using sheets of metal, hammering them into shape and heat treating them so they will go back to that shape. Workshop would look a bit like a blacksmith's shop.

How It Is Disposed Of When You Have Finished With It:

Can be melted down and recycled.

Where I Found Out About This Material:

I did a google search on "shape memory alloy"

Summary.

Steel used to be used for armour but it is not used any more because it is too heavy. Some people can't get up when they fall down wearing it, so even if the contestants were very fit it would be too much to wear it all day.

Composite armour and nanomaterials both (all three) have good properties but they can't be recycled. If there were a lot of different contestants this would mean having to wear their own armour which couldn't be recycled which would mean lots of materials to throw away which is very wasteful.

UHMWPE is stronger than Kevlar and very difficult to scratch or damage, so would look better on camera.

Titanium and Shape Memory alloy are both lighter than steel. However Shape Memory alloy could be made to repair itself so would need quicker repairs than Titanium.

This means the choice is between UHMWPE and Shape Memory Alloy. Both can be recycled, saving waste if there are lots of contestants. Shape memory alloy is cheaper and could be easier to repair. UHMWPE is a bit lighter and would need to be replaced not repaired, but is more harder to damage. Shape memory alloy could be repaired in a blacksmith's shop but UHMWPE would need a big heat press. Shape memory alloy could be shaped by hammering but UHMWPE would need moulds of the contestant.

to be made, which would take a lot of time.

So overall I think that the armour should be made from sheets of shape memory alloy as this is the cheapest option and easy to repair.

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Task 2

Information Chart: Power Sources that could be used to provide Electricity to the Armour Workshop

Energy Source	How it Works	Advantages and Disadvantages
Solar Power	Uses boards made of photovoltaic cells. When the sun hits these it makes electricity. This needs to be stored in batteries. This would need a lot of boards to be able to power the workshop.	<ul style="list-style-type: none">- Only 6% of light becomes elec- Doesn't work at night or when it's cloudy- Needs a lot of boards to make enough power+ could be sold afterwards+ environmentally friendly+ maintenance free
Wind Power	When the wind blows it turns a propeller. This turns a motor and makes electricity. The propeller has to be 30 feet up in the air so that the windmill is high enough to get enough wind. The electricity would need to be stored in batteries. One wind turbine can make enough electricity for over 50 houses so it would be enough for one workshop.	<ul style="list-style-type: none">- doesn't work when it isn't windy- makes a lot of noise- can be seen from a long way away- only makes electricity 6-13% of the time- motors can break down and be difficult to fix if they are up in the air so you would need a crane- electricity costs 15% more than nuclear power+ turbines cost about £50,000

		<p>which is cheaper than most other ways of making electricity + it doesn't make greenhouse gases so it's environmentally friendly.</p>
Nuclear Power	<p>It uses uranium to heat water to steam which turns a turbine which is a motor that makes electricity. One nuclear power station can power a whole country so it is probably too much for just one island.</p>	<ul style="list-style-type: none"> - Nuclear power stations are very expensive and can cost £1 billion to make - They make nuclear waste - They need a lot of people to run them and keep them working + the electricity they make is very cheap + they don't make global warming
Tidal Power	<p>These use the waves to move a paddle up and down. This is connected to a motor which makes electricity. Some tidal power units have a central tower and there are long lines of paddles stretching 100 ft or more either side. One of these can power a small village so would be enough for the workshop.</p>	<ul style="list-style-type: none"> - It needs to be built in the water at sea. - It costs more to build than solar power or wind power but less than nuclear power. + it works all the time unlike solar power or a windmill. + environmentally friendly
Geothermal Power	<p>This uses the energy under the ground to heat up water to steam, which turns a motor to make</p>	<ul style="list-style-type: none"> - needs lots of equipment to drill the hole which might not be on the island - won't work everywhere,

electricity Just like a nuclear reactor. The water is heated by sending it down deep holes that can be a mile or two miles deep. Sometimes the water can come from geysers or can be heated up by magma or lava like that in volcanos. One geothermal station can power a lot of houses so would be needed to power the workshop.

you have to have good geology.
 - needs a few people keep it working.
 + environmentally friend
 + works all of the time making power

Recommendation

I think that nuclear power would cost too much to build. We don't know if we could use geothermal power on that island. Tidal power would be really good for an island and is environmentally friendly, but it would cost a lot to build which wouldn't be good if the series is not on long. Solar power and wind power are both environmentally friendly and could be taken away after and sold if they didn't work or if the series didn't last long. Wind power might be easier as there is only 1 generator to put up which would be easier than lots of solar power boards to get the same power.

Choosing the energy source for the Armour Workshop

Level 1 Unit 7 Engineering the Future

Task 3

The team split up the energy sources...

Who	Energy Source
John	Nuclear power
Shantideva	Geothermal power
Phillip	Tidal energy
Kiesha	Solar power
Emily	Wind power

We all worked well and agreed the recommendation,
which is the best choice.

Solar power

Good points:

- Environmentally friendly
- Could be sold afterwards
- Maintenance free



Bad points:

- Only 6% becomes electricity
- Doesn't work when its not sunny
- Needs a lot of boards to make enough power

Geothermal power

Good points:

- Environmentally friendly
- Works all of the time



Bad points:

- Difficult to build
- Needs good geology
- Expensive to build

Nuclear power

Good points:

- Does not do global warming
- Makes cheap electricity



Bad points:

- Very expensive to build
- Needs lots of people to run it
- Makes nuclear waste

Tidal power

Good points:

- Environmentally friendly
- Works all the time



Bad points:

- It needs to be built in the water at sea
- Costs more to build than solar power or a windmill

Wind power

Good points:

- Environmentally friendly
- Could be sold afterwards
- Equipment cheaper than most other ways of making electricity



Bad points:

- Only makes electricity 6-13% of the time
- Doesn't work when its not windy
- Motors can break down and be difficult to fix if they are up in the air

Recommendation

- Nuclear power, geothermal power and tidal power cost too much to build
- Solar power and the windmill could both be taken apart and sold if the programme didn't work
- Would need lots of solar power boards but only 1 windmill

So... we recommend a windmill