

# ***YR 9 MONEYBOX PROJECT***

# HELPFUL INFORMATION

(THIS MIGHT BE USEFUL FOR SOME OF THE QUESTIONS YOU HAVE TO ANSWER DURING THE PROJECT)

## TOOLS & EQUIPMENT



Strip Heater



Hegner Saw



Laser Cutter



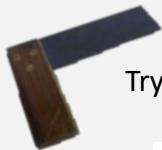
Acrylic Jig



P240 sandpaper (grey)  
P80 sandpaper (yellow)



Vinyl Cutter



Try-Square



Heat resistant gloves



Belt Sander

## KEYWORDS AND DEFINITIONS

- **Adjustment**- slight changes to something. In this project you might have to **adjust** your roof so that it fits neatly.
- **Brittle**- A way to describe a material that might crack or snap when you cut or drill it. Glass or acrylic are brittle.
- **CAD**- stands for **Computer Aided Design**. 2D design and SketchUp are examples of CAD programmes
- **CAM**- stands for **Computer Aided Manufacture**. This is the name for the machines that cut out your work once you have designed them on the computer. Examples for this project are the vinyl cutter (stickers) and the laser cutter (acrylic)
- **Gable End**- The ends of the house that have the triangle points. Used a lot in the building industry.
- **GSM**- grams per square metre- the way of describing different thicknesses of paper, card and board.
- **Industry**- Used to describe the **real world** version of Design & technology where people and companies design and make things to sell.
- **Jig**- A tool that helps to create the same shape over and over again. For this project the jig is used to help make the accurate folds in the roof.
- **Modelling**- a way of coming up with designs without having to draw. Often used to check **quickly** if a design will work without having to waste expensive materials.
- **Non-renewable**- something that cannot be grown or made again. Once it is gone it is gone. Plastic and metal are examples of non-renewable materials.
- **Porous**- something that allows liquid or air to pass through it.
- **Thermoplastic**- A plastic that can be heated and moulded into shape over and over again.
- **Trial & Error**- A saying that means you have to try lots of different ways of doing something and to be prepared to fail before you get it right.

# HELPFUL INFORMATION

## MATERIALS

Name	Description	Why it's used in our project
<b>MDF</b>	Medium Density Fibreboard. Made from sawdust and glue pressed together.	Easy to cut and sand, comes in different thicknesses, looks nice painted
<b>Acrylic</b>	Type of plastic. Comes from Oil. Non-renewable material. Not good for the environment.	Pre-coloured so we don't need to paint it, easy to heat up and bend into shape, cuts easily on the laser cutter
<b>Vinyl roll</b>	Colourful roll of thin plastic that is sticky. Has a white paper backing that is peeled off when you want to use the sticker.	It goes into the vinyl cutter and cuts really easily making high quality stickers
<b>Paper (80 gsm)</b>	Very thin, made from pressing fibres from trees, comes in a variety of colours	Quick, easy to fold, cheap, can be cut with scissors, recyclable
<b>Card (160gsm)</b>	Can range in thickness (gsm) but we use 160gms	More rigid than paper, good for modelling with your phone, still easy to cut and fold.
<b>Low-tack film</b>	See-through roll of slightly sticky film used for placing stickers onto the house. It's just sticky enough to hold the stickers when transferring from the paper, but not too sticky so it is easy to take off once on the side of the house.	It's great at keeping all the stickers together when taking them off the white backing paper and putting them onto your house. The fact that it's see-through means its easy to see where to put the stickers.
<b>PVA Glue</b>	Polyvinyl acetate- used for sticking two bits of wood together. Will work on any porous materials (not acrylic or metal)	Safe, easy to use and strong. Dries clear and can be sanded afterwards so you won't see it. Can't be used on painted surfaces.
<b>Emulsion Paint</b>	Often used for wall and ceilings. It's water-based and can be shiny (gloss) or dull (matt)	Easy to apply, safe, dries quickly, brushes only need water to clean

## QUALITY CHECKS

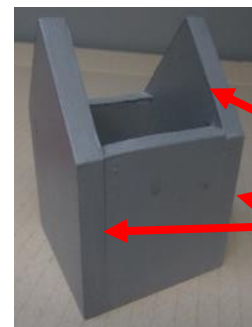
### Painting

- Smooth finish
- Invisible brush strokes
- 1 Direction
- No patches
- No build-up of paint on edges
- More than 2 coats



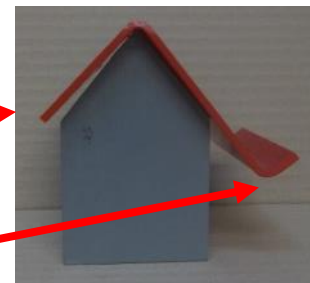
### Sanding

- Smooth edges
- No 'fluffy' edges
- Can't feel or see where 2 pieces have been glued together
- All sides the same shape/ size



### Roof/ Acrylic

- Smooth edges
- Roof fits house with no gaps
- No burn marks on acrylic
- Phone sits without wobbling



# ***LESSON 1 & 2***

# MODELLING

Most designers will model their design throughout the process. Modelling is great because:

- It's **quick**
- It's **cheaper** than making a design out of the actual materials
- It helps to show **sizes, proportions** and can often be made life-size
- It's easy to **make changes** to a cardboard model, rip bits off, add ideas on, cut things out of the design etc.
- Easy way to **test** parts of the design to see if they will work.

The first thing we are going to do is to make a exact scale (1:1) model of the money box we are making in school. This means than if it's 25mm in school you will make yours 25mm at home, hence the 1:1 ratio.

Follow the dimensions below to make the parts and then stick them together either using masking tape, PVA glue or a hot glue gun (if you're lucky enough to have one kicking about at home!)

# WHAT YOU NEED FOR MODELLING

Any cardboard you can find. But try to make it the thicker type that boxes are made from. This is called corrugated card.



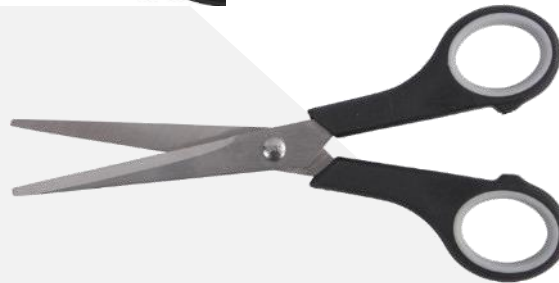
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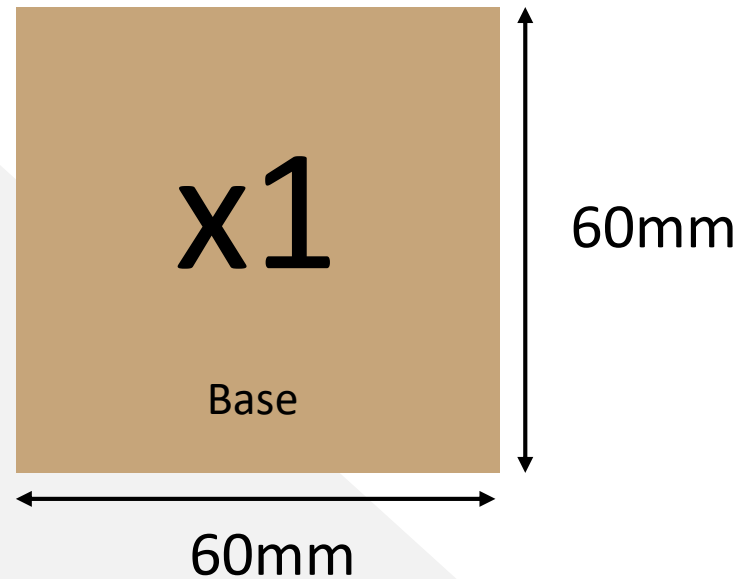
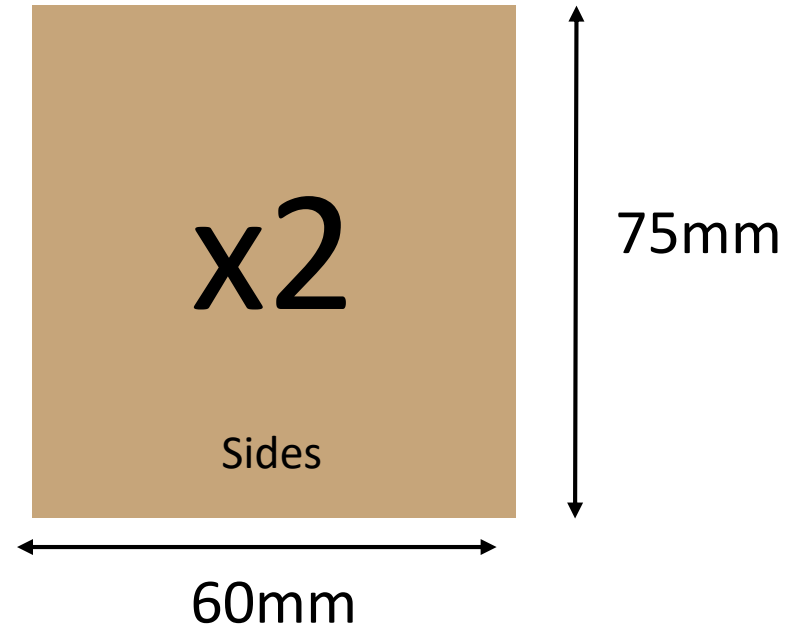
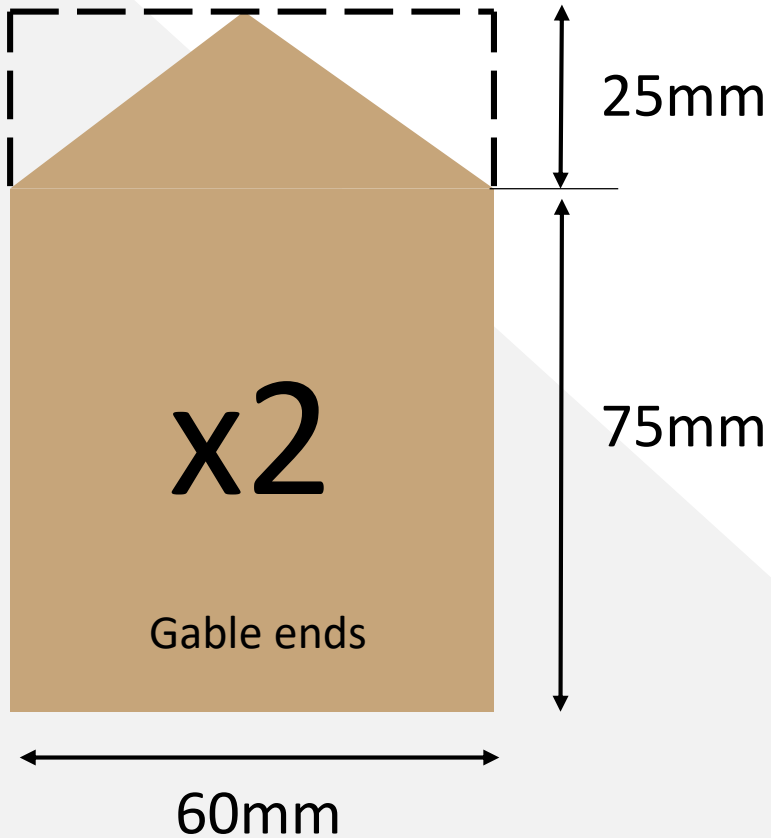
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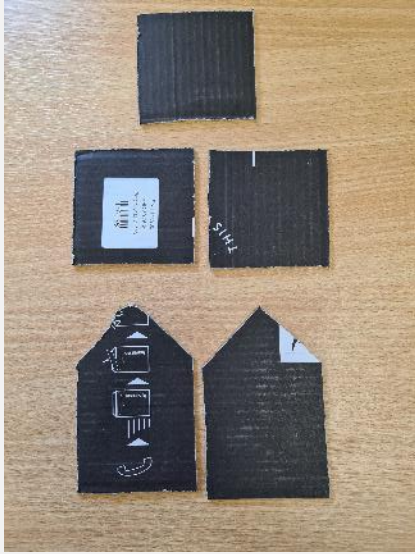
You don't need a craft knife, scissors are fine. **If you use a knife be very careful!**

# MODEL DESIGN

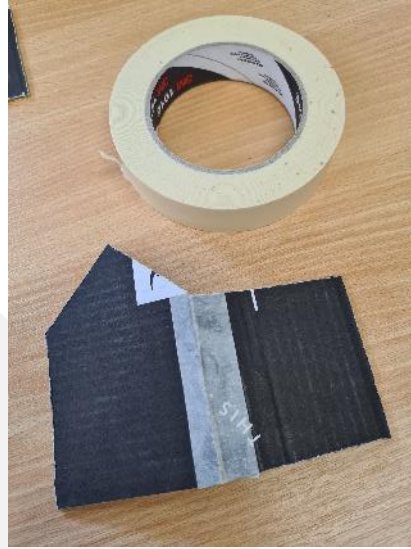
Cut out the shapes above as accurately as you can.



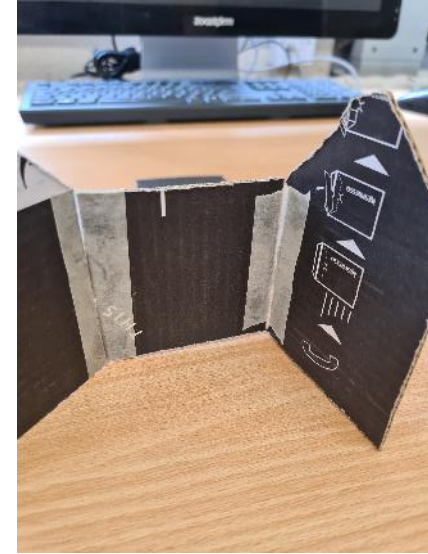
# MODEL DESIGN: HOUSE



Your 5 shapes cut out of corrugated card.



Using masking tape, sellotape, PVA glue or a hot glue gun carefully stick one of the gable ends to the side piece. Try to do the taping/ gluing on the inside so the outside looks as neat as possible.



Continue around the sides making sure the two gable ends are opposite each other.

Glue to square base to the bottom of the house.



You finished house should look like this.

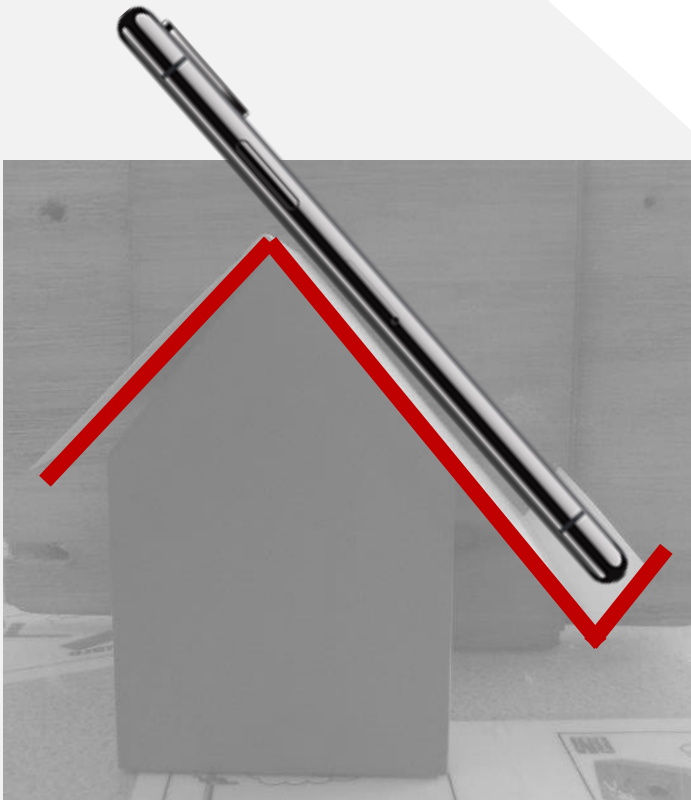


# ***LESSON 3***

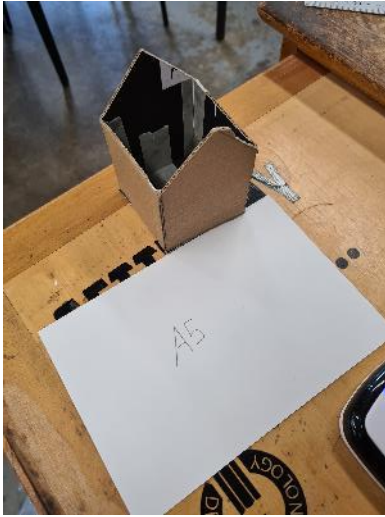
# TESTING

Once a model has been made it can be tested to make sure it does what it is supposed to do. You are going to do exactly this to make sure the moneybox will also hold your phone.

You can choose how big the roof should be, where the gap for the money should go and where you want your phone to sit.



# TESTING: ROOF MEASUREMENTS



Using a piece of A5 paper/ thin card measure out the width of your house and then add a little overlap each side.



Draw a line and cut out. You now have the correct width for your roof. If it's too small/ big, start again. This is testing after all!



Look at how much overhang you want on the non-phone side



Then neatly fold the roof at the top. This will leave a much longer side for your phone



Now get your phone out to calculate where the final fold should go.

# ***TESTING: BONUS ROOF DESIGN***

Not everyone will have to do this, but if you would like to be able to charge your phone you might want to think about cutting a hole for a charger. You'll need to think about where the charger goes on your phone. Again, it's always best to test this with you phone.

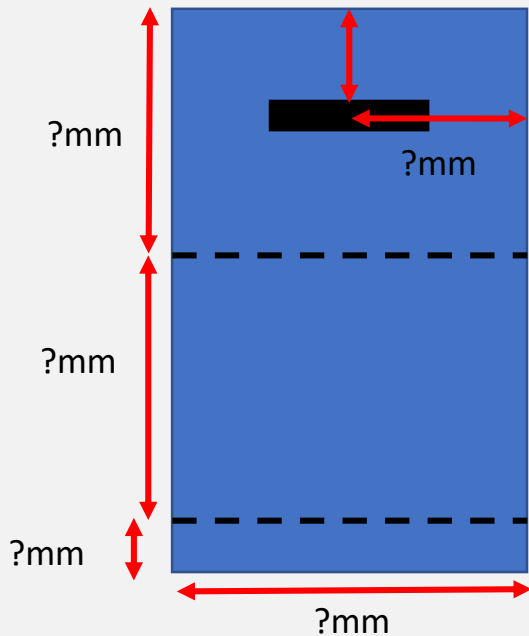


# TESTING

Use thin card or paper for this. You will probably end up making more than one roof.

Here are some things to think about:

Where will the folds be?



How could I use it with a charger?

How do I stop the phone toppling forward?

Why are we using thin card instead of corrugated?

How big does the money slot need to be?



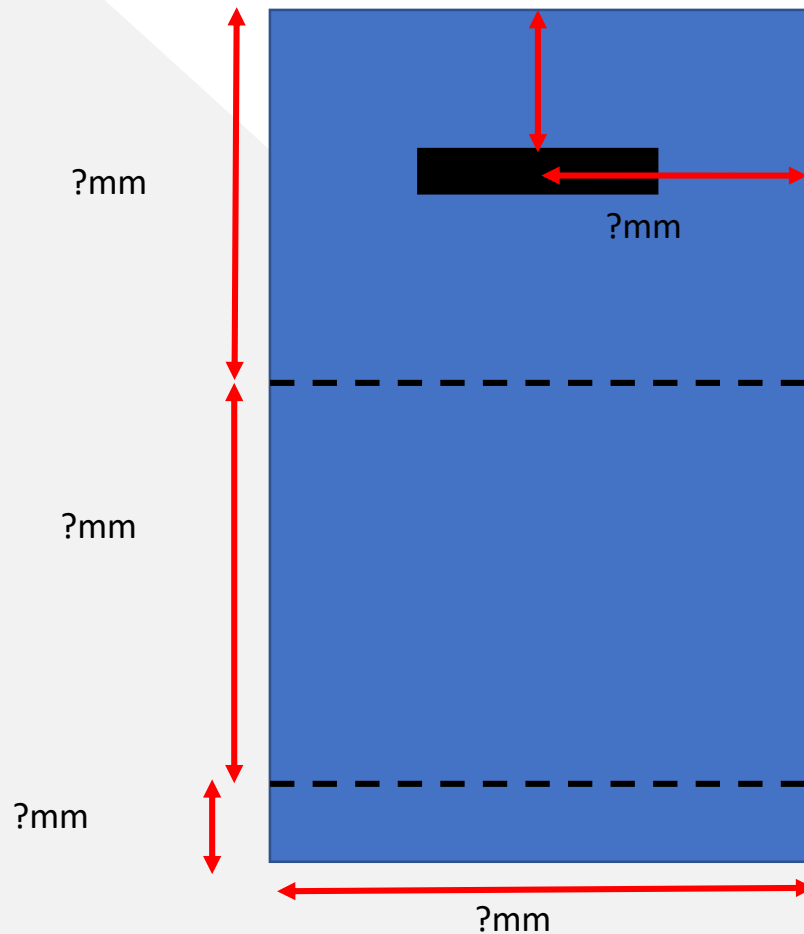
Tip: A £2 coin is 28.4mm in diameter and 2.5mm thick



Will it work if I flip the phone into landscape?

# TESTING

When you have the perfect sized roof, measure the dimensions. You will need this for when you are in school and designing it on the computer.



# ***LESSON 4***



# MATERIALS

Conduct some research into these different materials. Explain where the material comes from, the benefits of using the materials and the common uses for it. Find an example product that is made from the material and add to the box.

MDF (Manufactured Board):

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Example Product

Acrylic (Polymer):

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Example Product

Corrugated Cardboard:

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Example Product



# ***LESSONS 5 - 8***

# GOOGLE SKETCHUP!

Following the link below, you are going to create a 3D model of your moneybox house using Google SketchUp.

It will take a while, which is why you have 4 sessions to work your way through the videos. You will need a desktop computer with a mouse for this project

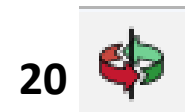
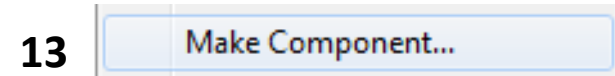
<https://www.youtube.com/watch?v=cGo86EHDjxY&list=PLwOPy8apk9id4SAWMXihavojWlwZJEFxu>

If you don't have access to this then you will need to just watch the videos and take notes ready for when you get back into class. You should try to 3D sketch your house using a pencil and paper.... Old skool!



# SketchUp *QUIZ*

Now that you have watched the SketchUp videos, you need to write down what each of the following tools on SketchUp do.



# ***LESSON 9***

# ***CAD/ CAM INTRODUCTION***

Over the next few slides you will be introduced to CAD/ CAM and why it is used so much in the design world.

We will use CAD (computer aided design) and CAM (computer aided manufacture) in our project in Year 9. It is important to think why we do this. Always compare the software and machines discussed in the next few slides with how things used to be designed and made. CAD has replaced hand drawings in most of the design work and CAM is responsible for most of the products you have at home.

**Look out for the videos on each slide!**

# COMPUTER AIDED DESIGN / CAD

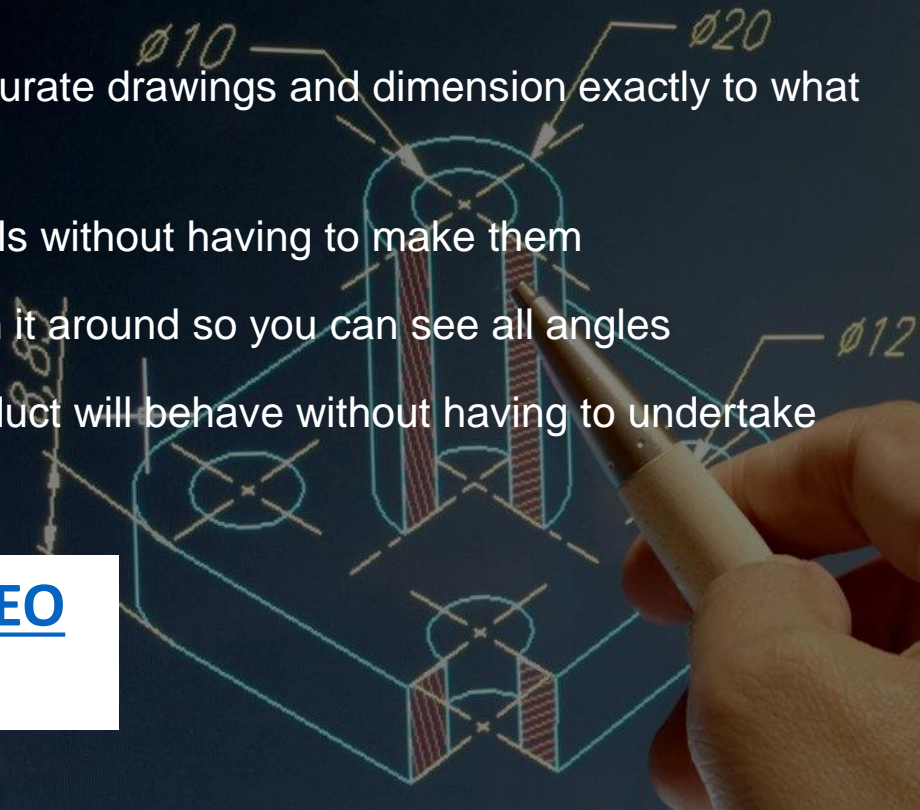


CAD software is used to create precision 2D or 3D drawings, models or technical illustrations. It is commonly used by designers, architects, engineers and artists.

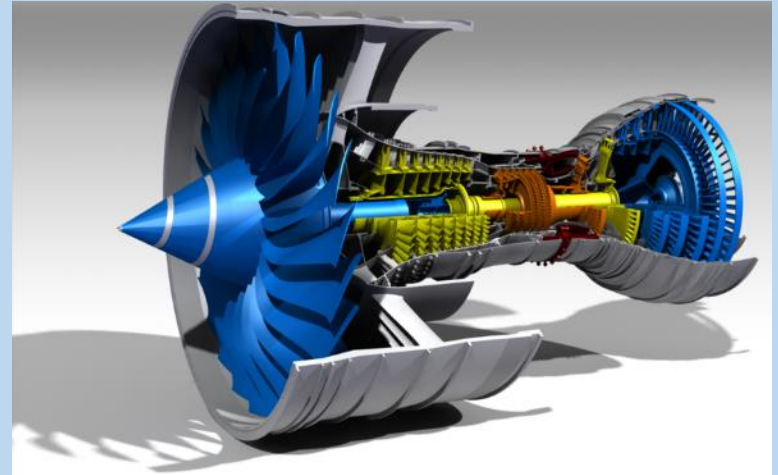
Designers can use computer packages like 2D Design, Autocad, Google SketchUp to design, Model and Test ideas before they go into production. It is particularly useful because;

- Computers can be used to make changes to a design and edit it without having to redraw it.
- Computers can be used to produce very accurate drawings and dimension exactly to what is drawn.
- Computers can produce photorealistic models without having to make them
- You can see what it will look like in 3D – spin it around so you can see all angles
- Computers can show or simulate how a product will behave without having to undertake expensive testing.

[CAD/ CAM VIDEO](#)  
[CLICK HERE](#)



# EXAMPLE OF CAD DESIGNS WHICH HAVE BEEN RENDERED



# ADVANTAGES AND DISADVANTAGES



Advantages of CAD	Disadvantages of CAD
Designs can be created, saved and edited easily, saving time	CAD software is complex to learn
Designs or parts of designs can be easily copied or repeated	Software can be very expensive
Designs can be worked on by remote teams simultaneously	Compatibility issues with software
Designs can be rendered to look photo-realistic to gather public opinion in a range of finishes	Security issues - Risk of data being corrupted or hacked
CAD is very accurate	
CAD software can process complex stress testing	



# COMPUTER AIDED MANUFACTURE / CAM



- Automated machinery is controlled by software to manufacture physical parts
- CAM uses Computer Numerical Control (CNC) and CAD files to generate 3D tool paths for the machinery to follow
  - CAM machinery includes laser cutters, embroidery machines, CNC milling machines, routers and lathes
  - Where is CAM currently used?



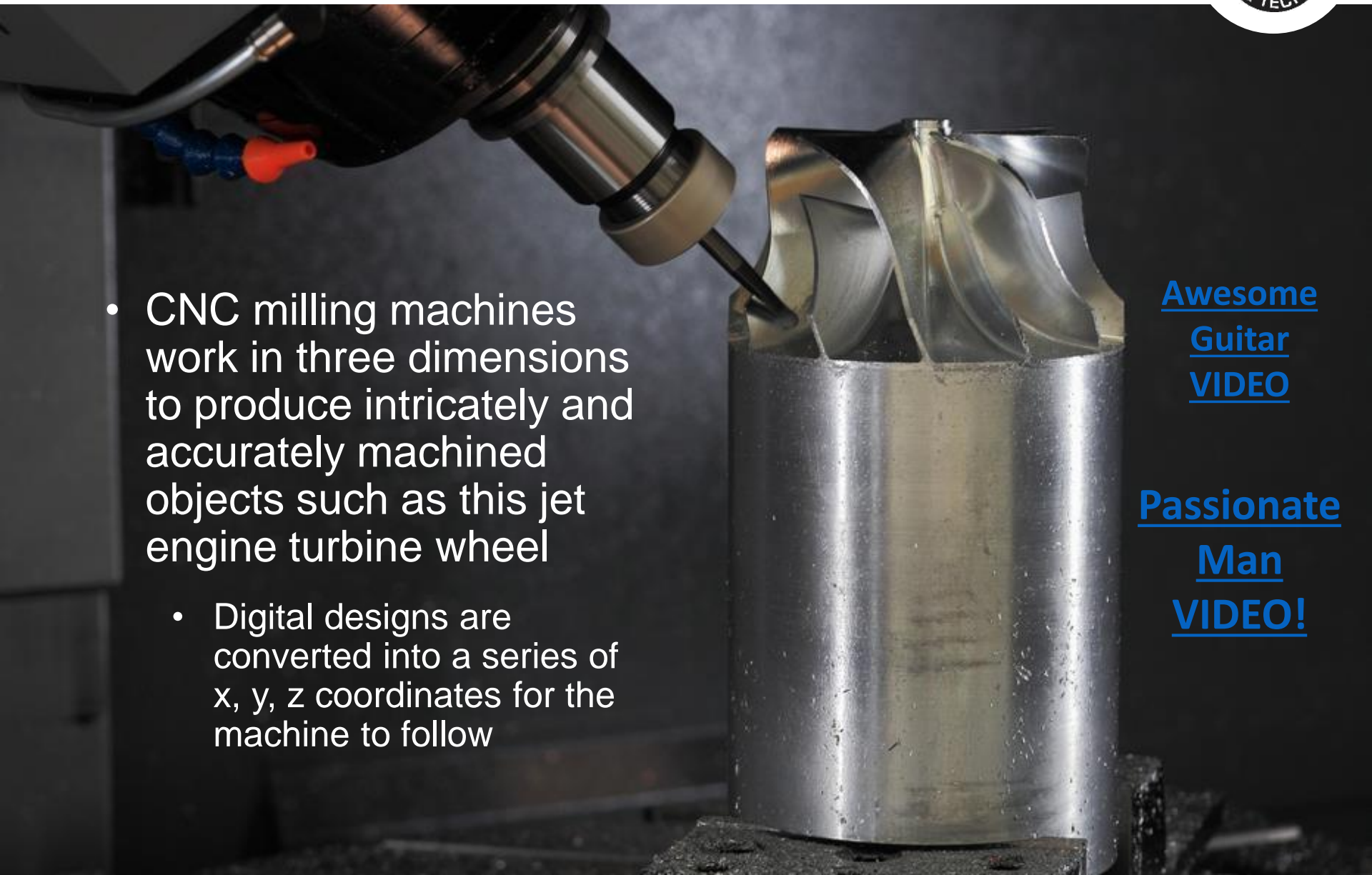
# CNC MILLING MACHINES



- CNC milling machines work in three dimensions to produce intricately and accurately machined objects such as this jet engine turbine wheel
  - Digital designs are converted into a series of x, y, z coordinates for the machine to follow

[Awesome  
Guitar  
VIDEO](#)

[Passionate  
Man  
VIDEO!](#)



# CNC LASER CUTTING



- By cutting at different speed rates, laser cutters can burn through or etch the surface of a material
- They can cut complex shapes in a wide range of materials including:
  - Paper
  - Polymers
  - Timber
  - Metals and
  - Textile based materials



[Laser cutting fidget spinner design VIDEO](#)

# VINYL CUTTING



A vinyl cutter is a type of computer-controlled machine. Small vinyl cutters look like computer printers. The computer controls the movement of a sharp blade. This blade is used to cut out shapes and letters from sheets of thin self-adhesive plastic (vinyl).

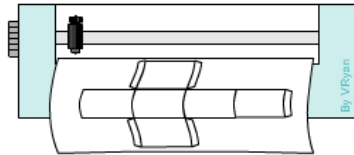


## INPUT



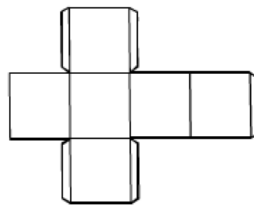
COMPUTER AIDED DESIGN (CAD) SOFTWARE IS USED TO DESIGN THE DEVELOPMENT / NET OF A SIMPLE PACKAGE.

## PROCESS



THE SOFTWARE CONVERTS THE DESIGN INTO COORDINATES. THE CUTTER FOLLOWS THE COORDINATES, CUTTING OUT THE PACKAGING SHAPE.

## OUTPUT



THE WASTE CARD IS REMOVED, REVEALING THE FINAL DEVELOPMENT / NET. THIS IS THE OUTLINE OF THE PACKAGE. THE FLAT DEVELOPMENT IS FOLDED ON PERFORATED LINES, ALSO CUT BY THE VINYL CUTTER.





# 3D PRINTING



The action or process of making a physical object from a three-dimensional digital model, typically by laying down many thin layers of a material in succession.



[3D Printing Explained VIDEO](#)

# ADVANTAGES & DISADVANTAGES



Advantages of CAM	Disadvantages of CAM
Computers do not make mistakes if programmed properly	CNC Machines can cost a lot of money, more than manual machines
Computers give reliable and consistently high standards of manufacture	Specialist knowledge is needed to programme computers
Computers achieve quicker production times	May lead to rise in unemployment (less workers needed)
Complex shapes and designs can be created easily	
Production can run 24 hours a day, 7 days a week, so more efficient	
Designs can be produced quickly to gather public opinion in a range of finishes	

# ***LESSON 10***

# CAD/ CAM QUESTIONS

Now that you have watched the videos and read the information about CAD/ CAM answer the questions below

- 1) What does CAD stand for? C.....A.....D.....
- 2) What does CAM stand for? C.....A.....M.....
- 3) What are 4 benefits to using CAD? Explain why they are a benefit when comparing to hand drawing design ideas

- 1) .....
- 2) .....
- 3) .....
- 4) .....

- 4) What are the disadvantages of using CAM? Give 2 examples and explain why.

.....

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- 5) Why do we use a laser cutter in school to make the acrylic roof?

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.....

- 6) What are the dangers of 3D printing?

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.....

- 7) List 4 ways 3D printing is used in the world (see video)

1. ....
2. ....
3. ....
4. ....

- 8) Why do you think we would use a vinyl cutter instead of cutting things by hand with a craft knife?

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