4 Engineering: Testing and Investigating

Non-negotiable Knowledge (What you need to know)

- what is meant by quality control
- the importance of quality control
- how different types of quality control methods are used.

Key words/ terminology	
Modelling	Creating a representation of a solution or system. It can be virtual 9computer generated, mathematical or physical
Testing	Performing a series of tests on a prototype, model, material or system

Quality Control

QC involves checking a product after a process to ensure it meets the required quality standards.
Quality control methods – devising QC checks for a product

Examples of quality control

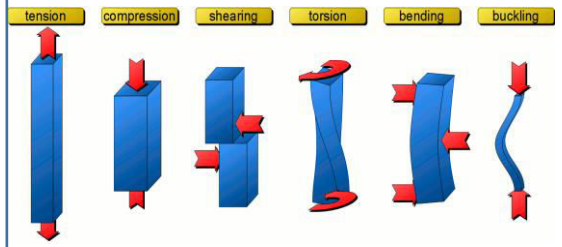
- Visual checks to ensure that the product looks as it should
- Measurements of length, width, depth, etc. to ensure that the product has the correct dimensions.
- Checks to ensure that it is of the correct weight.
- Fitting/assembly checks to ensure that parts fit together as required.

Destructive and non-destructive testing

Testing of an engineered product can be either destructive or non-destructive.

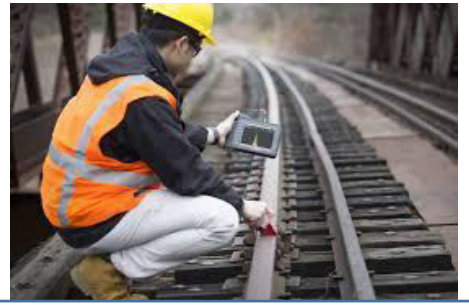
Destructive Testing

- Destructive testing is where the product is tested to the point where it is damaged or destroyed. The main purpose is to find out where the failure point les. it enables engineers to find weaknesses that might not be obvious during the normal day to day use of the product.
- A disadvantages is that the object being tested cannot be used again, which can effect cost.
- Example- car crash testing, materials testing (e.g. tensile tests, compressive tests, hardness tests, toughness tests)



Non- Destructive Testing

Non- destructive testing does not cause damage to the product or material. Use of this testing can save time and can be used at different stages of manufacture and production. Examples include visual checking e.g. surface finishes or defects. ultrasonic testing to check weld or product integrity .



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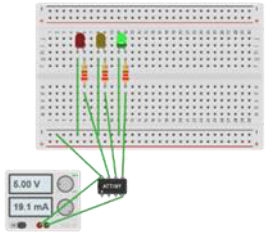
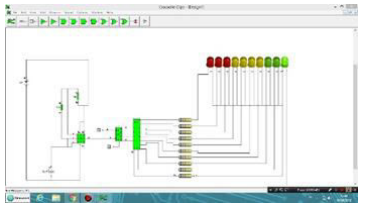
Non-negotiable Knowledge (What you need to know)
- How to model using CAD (Virtual modelling)
- Physical modelling
- Materials testing
- Quality testing processes

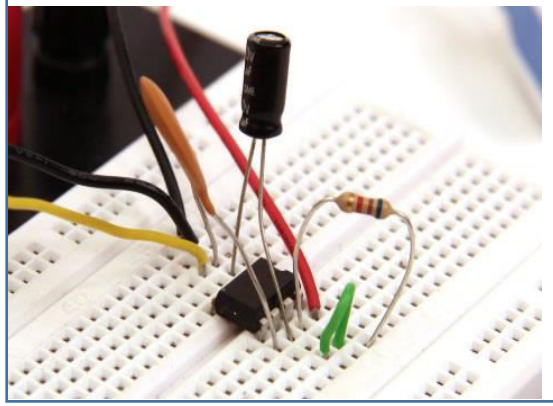
Virtual Modelling
These programmes allow different products to be tested. These include materials and electronic circuits. These are simulation processes.

Advantages-
- Easy to change/ modify.
- Alternative methods can be modelled and compared.
- Errors can be flagged up and identified.

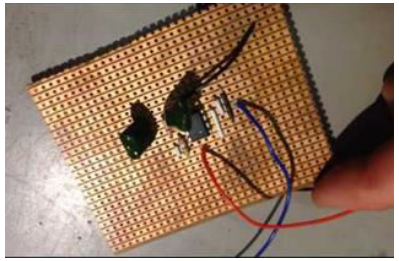




Breadboards
- Also known as prototype boards
- Plastic boards with holes for placing the components into
- Rows of metal strips underneath the plastic make electrical connections between the holes.
- Components and wires are slotted into the holes, thus forming a circuit
- Completely solderless, so components can be put in and pulled out very quickly, and with no damage to them.
- Can get very large and can become difficult to follow when modelling complex circuits.

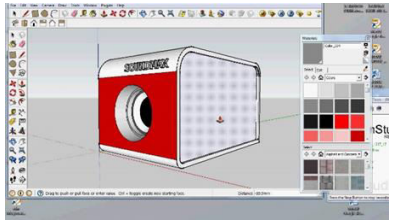


Stripboards
- A plastic board with rows of copper strips on top and holes for the placement of components.
- Components must be physically soldered to the strips to make a circuit.
- Produces a sturdier, more robust outcome than when using breadboard.
- Changing the circuit is more difficult and time consuming.
- Components often cannot be re-used after soldering.



Possible methods of CAD modelling-

- **2D Design** – 2D design can be used to create 2D components that can be cut out on a laser cutter and put together to create a physical model/ prototype. 2D design can also be used to create isometric drawings and exploded views.
- Google Sketch up- Good for creating virtual models. Hasn't got the same capability as Autodesk fusion, however it is really effective to use at designing and development stage.
- **Autodesk fusion-** Very accurate for modelling components and products. Prototype ideas can be sent to 3D printers and CNC machines to be manufactured. The best choice for final production of a prototype. (Autodesk fusion will also be useful for creating engineering/ orthographic drawings)



Physical Modelling
- Once a program has been written or modelled virtually, it can be downloaded to the device. Checks can then be made to see if it works as expected.
- Similarly, components can be physically modelled, e.g. metal panels, polymer parts etc. Then checks can be made on them to see if they work as expected.

Advantages and disadvantages of physical modelling
Advantages-
Able see how an engineered product would look
Able to see how an engineered product functions
Able to detect any issues e.g. Components fitting together or electronic components not being compatible
Disadvantages-
The final material may not be the same as models and so may not have the same properties/ qualities

http://www.technologystudent.com/despro_flsh/mats_model1.html

4 Engineering: Testing and Investigating

Non-negotiable Knowledge (What you need to know)
- Aerodynamic principles
- Tolerance and its importance

Tolerances

Tolerance is a range of how far a true measurement can range from what is intended. Physical **tolerances** specify the deviation from a specific dimension. Any dimension between any two points can have a **tolerance.**

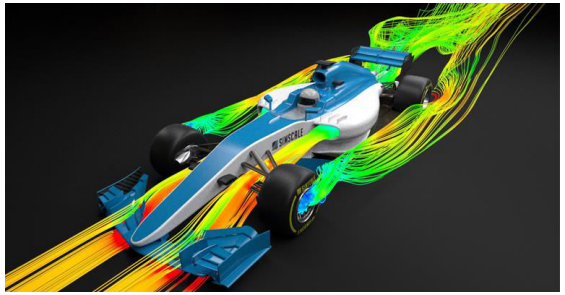
Checking that a product is manufactured within an upper and lower limit.
Example: Thousands of steel bolts are manufactured by a company. Samples are check that they are the correct size. Each bolt must fall within a maximum and minimum length.

The tolerance of the bolt is said to be:

$$80.5\text{mm}^{+\ 0.5\text{mm}}_{-\ 0.5\text{mm}}$$

Then a product is mass produced in thousands and hundreds of thousands, samples are regularly checked to ensure that they fall within the tolerance allowed.

This ensures:
The quality and consistency of the product.
Each copy of the product is the same and works exactly the same way.
Products that have many parts, will fit together and work in the way that they are supposed to.
Products that do not fit with the set tolerances, are rejected and do not reach the customer.

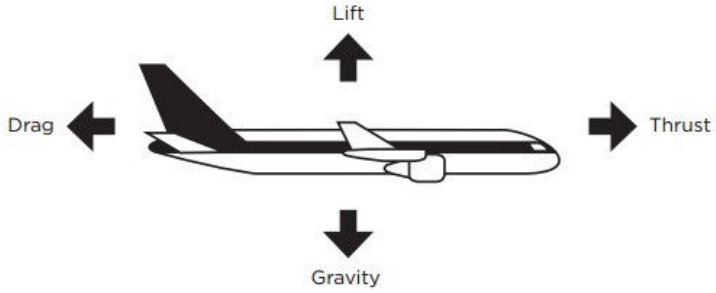


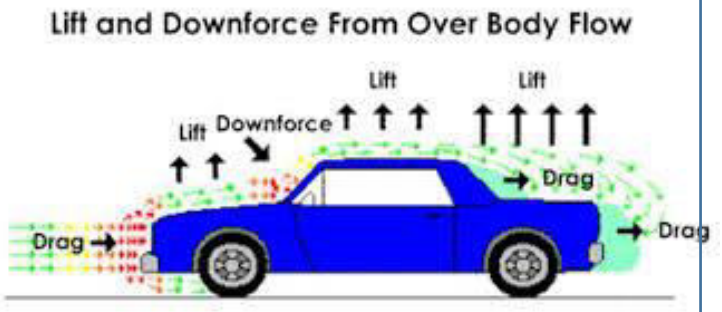
Aerodynamics
- Aerodynamics is all about how air moves around objects, or the way objects move through the air.

- Lift is the pushing force that causes something to move upwards. It opposes (works against) the weight of the object being lifted.

- Drag is the force that opposes the forward motion of an object through the air. It is often thought of as aerodynamic friction.

- Thrust is the pushing force that causes an object to move forwards. It therefore opposes drag.





Further Reading-
- https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-aerodynamics-k4.html
- https://www.livescience.com/47930-what-is-aerodynamics.html
- https://howthingsfly.si.edu/aerodynamics