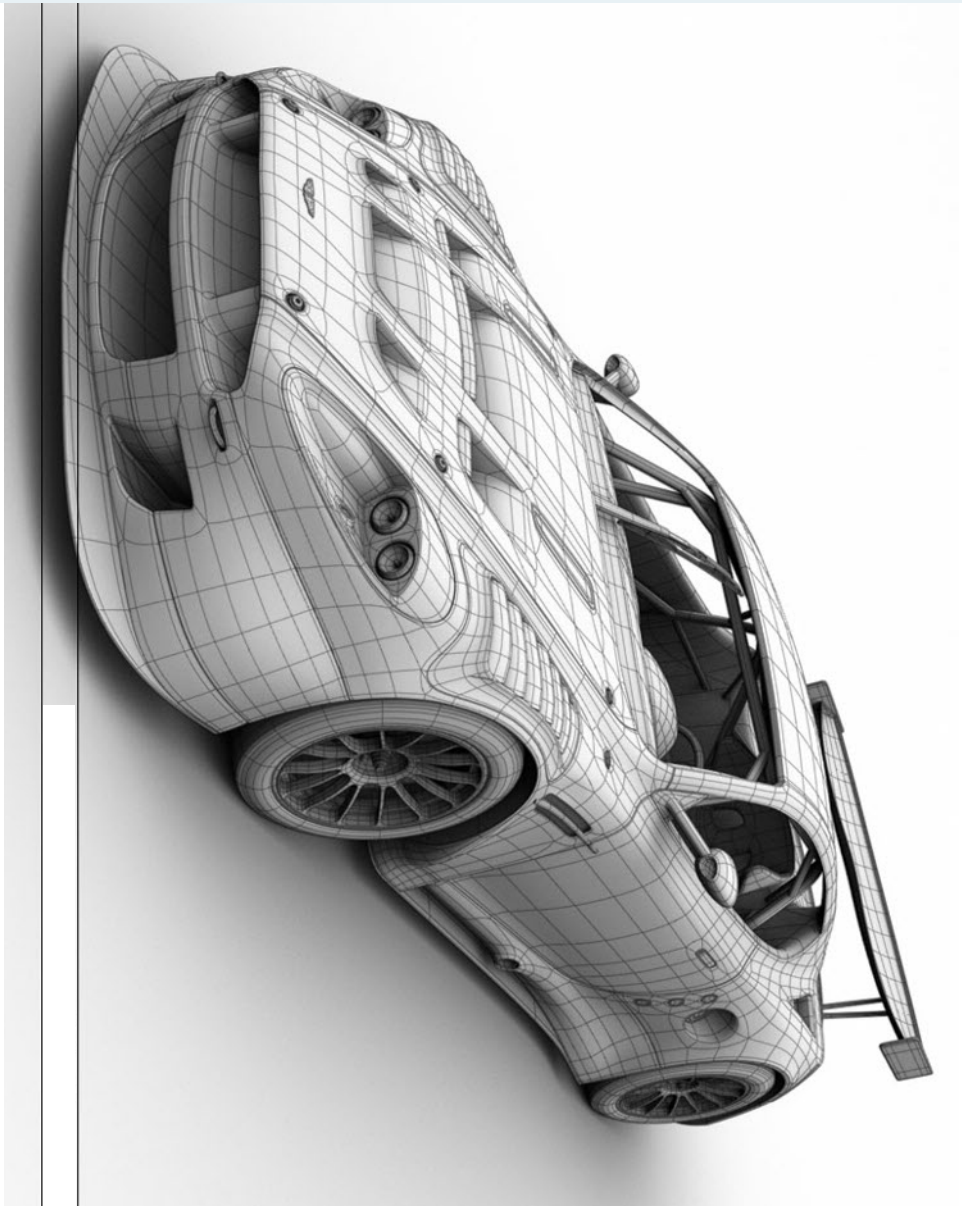
ADVANCED HIGHER GRAPHICS

# Course Notes



# physical printing

## INK JET

The most common format of printer to be found in homes, schools or offices. They are popular because they are easy to use, reliable and the printers are inexpensive.

However, printer ink is expensive, so they are only suited for short print runs or text based documents such as letters or essays.

pros + cons

- ✓ photographic quality
- ✓ can print on different paper types
- ✓ quick for short print runs
- ✗ ink cartridges are horrendously expensive
- ✗ liquid ink can take time to dry and can smudge
- ✗ only print on limited paper sizes, typically A5 to A3

## COLOUR LASER

Laser printers are very quick and the 'cost-per-print' is actually very low. Laser printers work by 'fusing' coloured toner dust to the paper. Toner is expensive, but you get a lot of prints. However, when parts such the 'drum' and 'fuser' start to go, costs soon mount up…

pros + cons

- ✓ printers are fairly inexpensive to buy
- ✓ good quality, but not photographic
- ✓ very quick for short and medium print runs
- ✗ can only print on normal, non-gloss paper
- ✗ toner is expensive
- ✗ the expensive 'fuser' and 'drum' also need replaced
- ✗ only print on limited paper sizes, typically A5 to A3

## SCREEN PRINTING

Screen printing is actually a very old fashioned method of printing graphics. It works by ink being squeezed through a 'mask' onto the material below. It is slow, but great for making t-shirts, posters and other novelty items.

pros + cons

- ✓ low cost print for mid-volume runs
- ✓ bright, vibrant colours
- ✓ can print on different materials - from paper to fabric
- ✗ a slow and sometimes messy process
- ✗ expensive to set up equipment
- ✗ liquid ink can take time to dry and can smudge
- ✗ cannot print photographs or high resolution graphics

## WIDE FORMAT BANNER

Wide format printers are similar to inkjet except they use solvent based inks - bad for the environment, but vibrant and good for high coverage. Wide format printers can make huge posters or 'vehicle wraps'

pros + cons

- ✓ can print in huge sizes
- ✓ photographic quality, including spot-colours
- ✓ can print on different paper types
- ✓ quick for short print runs of posters or displays
- ✓ printers can also cut contours of graphics
- ✗ liquid ink can take time to dry and can smudge
- ✗ solvent inks are very, very expensive

## OFFSET LITHOGRAPHY

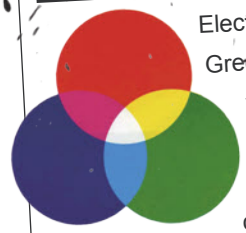
Offset Lithography is fantastic for quick, high volume printing such as leaflets, books and magazines. Offset Litho can also print metallic colours and 'duplex' paper to print on both sides. However, they are expensive to setup!

pros + cons

- ✓ low cost for high volume print runs
- ✓ photographic quality, including spot-colours
- ✓ can print on different paper types and sizes
- ✓ quick for large print runs
- ✗ time consuming to set up
- ✗ specialist triaining required
- ✗ expensive initial set-up costs

# colourful language

## ELECTRONIC DISPLAYS



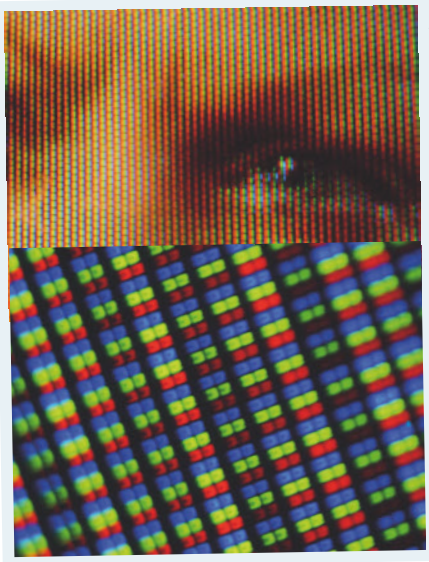
Electronic displays only use RGB or Red, Green and Blue pixels. These are normally very small LEDs' that are turned on via an electrical current. When all the LEDs' are turned on they make white light. We call this effect 'additive colour'. So, next time someone tells you an iPad has billions of colours, you can correct them. They only have three…

## PRINT MEDIA

Print media uses CMYK printing. This means they use four cartridges of colour - cyan, magenta, yellow and 'key', which is usually a pure black.

When the CMY are mixed together, they create a near black equivalent. The colours, as they overlap subtract one another so this is usually called subtractive colouring.

## COLOURFUL PIXEL PERFECTION



All electronic displays use pixels. The more pixels, the better the display, We describe screens in many ways - however, the most important is 'pixels-per-inch' or PPI.

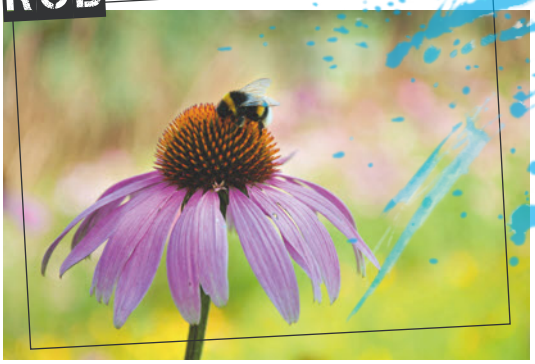
Screens can adjust colour, tint and shade by changing how bright each individual pixel is and this changes quickly - at least 24 times per second for a smooth animation!

To create 'black', pixels are turned off…

Many things control the quality of the print. Most importantly will be the quality of the image or graphic being printed. Low resolution graphics will never print well.

However, the quality of printer also has an impact. The number of 'dots-per-inch' or DPI will impact the quality of print. Better printers can also control the size of each 'dot'. Mixing dots of CMYK allows billions of colours, tints and shades to be shown.

## RGB



A photograph taken by a digital camera will be recorded as RGB. The image above has been left in RGB mode (Remember, if you print these notes it will be in CMYK…)

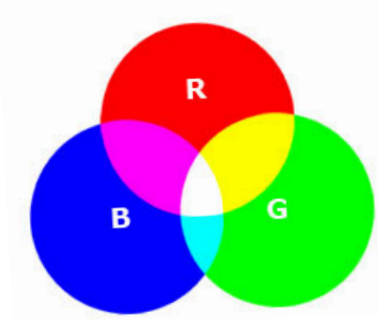
## CMYK

The same image here has been converted into CMYK. On a screen, the colours may appear less vibrant, however the tone of the colours would be more realistic when printed.

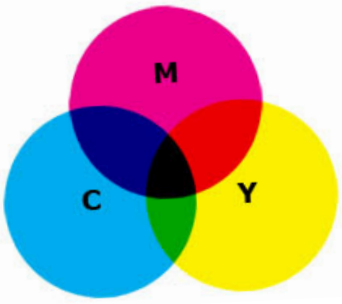
## RGB VS CYMK

Working together with web and print designs can be tricky and learning how colour works can be the key to getting a successful colour calibration for both your website and your printed designs such as business cards and brochures.

An easy way to remember is anything dealing with the web or computer displays should be in RGB (red, green, blue) mode and anything dealing with printed material should be in CMYK (cyan, magenta, yellow, black) mode. But what exactly does that mean?




RGB - Additive Colours




CMYK - Subtractive Colours

If you think of it this way it is pretty simple: *monitors emit light and paper absorbs light*. Computer monitors show colour as red, green and blue light at a low-medium resolution usually 72-75 dots per inch. Print production usually requires the four-color process CMYK in high resolution of at least 300 dpi. By combining the primary colours red, green and blue in equal amounts you will get the secondary colours cyan, magenta, and yellow, with an overlap of all three primary colours giving white. So when you want to convert your graphics for printing for business cards or brochures, changing the format from RGB to CMYK is very important for those printed documents. Printing companies who accept RGB files automatically covert the images to CMYK and that can result in faded, dull or inaccurate colour representation in the final project. Converting your file to CMYK gives you better control over the final image outcome.

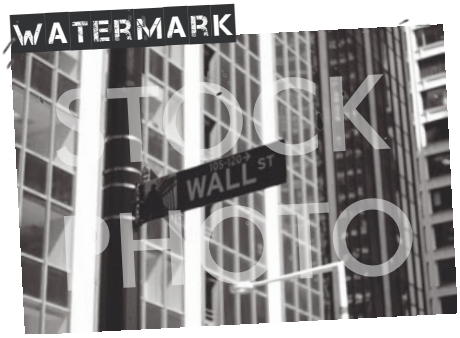

The images show the effect of

## PANTONE COLOUR

The Pantone Colour Matching System is largely a standardized colour reproduction system. By standardizing the colours, different manufacturers in different locations can all refer to the Pantone system to make sure colours match without direct contact with one another.

# protect your rights

## WATERMARK




## NO WATERMARK


## BE A MODEL

Stock photography, textures and graphics are big business. Many businesses or graphic designers do not have time to take their own photography. Research these companies and find out how much they charge!

123RF 123RF.COM
fotolia
gettyimages
shutterstock
Thinkstock

All graphic work is worth money! Every photo, sketch, layout design or art work can command a price. It is worth whatever someone is prepared to pay.

High quality photography, textures, typefaces and graphics can command a high price.

To protect graphics or photographs, designers will often 'watermark' their creations to prevent fraud or theft.

You need to know about protecting graphics, artwork and images for your exam… …and to protect your own work!

## GETTING IT PICTURE PERFECT

Not all cameras are the same. You do not need to know about photography for your exam, but may want to know more for your own graphic design work.





### DIGITAL SLR

Digital SLR are the professionals choice tool for photography.

These cameras can range from hundreds to thousands of pounds… and that is just for the camera. SLR - which stands for Single Lens Reflex - can change lens for particular viewing angles. Lens are expensive, but worth it.

### BRIDGING

Bridging cameras are between digital SLR and Point & Shoot. They have the same type of sensor as Point & Shoot but a full function fixed lens.

You cannot change lens like an SLR, but you have far more control over the photography you take. Bridging cameras are often not much more expensive than Point & Shoot, but are more complex to use.

Great if you are wanting to develop your skill in photography.

### POINT&SHOOT

The most common of all camera types - almost every house will have a Point & Shoot camera. They range from ridiculously low cost to very expensive.

These cameras have been designed to make the image taking process very simple. They have full automatic mode that will adjust all the settings behind the scenes.

The quality of image will depend on the cost of the camera and sometimes you may be better with a camera phone…

### CAMERA PHONE

Cameras on mobile phones are becoming ever more powerful and sensitive. Some camera phones use the same sensor as point-and-shoot and can achieve incredible results.

Camera phones are still not good in low light situations and the lens can distort the angles on mid-distance items. Camera phones can be fantastic for macro images - close-up shots of items.

Where ever you are, you can start building your library of stock images.

# GRAPHICS WARS

## VECTOR VS. RASTER

Think all graphics are the same? Think again. Graphics fall into two categories - Vector and Raster.

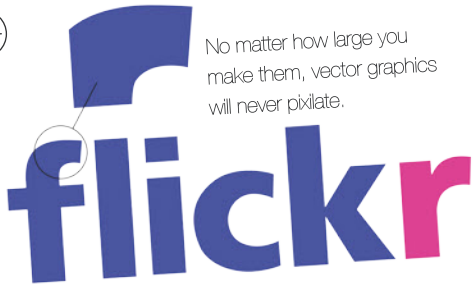
You are expected to know about both formats for your exam. Knowing how to use these formats can help you with your assignment and are absolutely essential if you work in any graphics industry.

### VECTOR

Vector graphics rely on plotting points - called nodes - mathematically. The computer can join these nodes to form a shape.

Enclosed shapes can be filled with a colour. Vector graphics can be scaled up to any size and will never pixilate.

Vector graphics are most commonly used for logos.




No matter how large you make them, vector graphics will never pixilate.


Lots of control nodes…


…That can be edited anytime…

### FROM RASTER TO VECTOR

Some powerful software will allow you to change a raster image into a vector graphic. You will lost significant levels of details, however, this does allow you to create some impressive graphic effects and the images can be scaled up without loss of resolution.

### KNOW YOUR FILE TYPES!

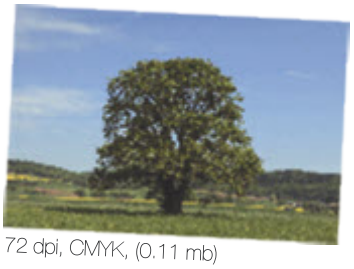
| VECTOR | RASTER |
|---|---|
| .SVG | .BMP |
| .DXF | .JPG |
| .PLT | .PNG |
| .AI | .TIFF |
| .EPS | .GIF |

### RASTER

Raster images are those used to create photographs - although any graphic can be converted into a raster easily. Raster graphics work by specifying each individual pixel with a colour.

These individual pixels build an image. The more pixels, the sharper the image and the bigger the file size…

300 dpi, CMYK, (5.6 mb)



72 dpi, CMYK, (0.11 mb)

20 dpi, CMYK, (0.0026 mb)
(we're being silly now)

### VECTOR pros + cons

- ✓ Great for making logos or graphics that scale up
- ✓ Can be used as 'cut paths' for cutting machines
- ✗ Cannot be used for photographs
- ✗ Vectors graphics require good CAD drawing skills to make

### RASTER pros + cons

- ✓ The image type used for photography
- ✓ All software can handle raster images
- ✗ Scale up too big and it will suffer pixelation
- ✗ The file sizes can be absolutely huge!

# printing on paper is simple, right?

## OGRE'S HAVE LAYERS - DTP DOCUMENTS HAVE LAYERS...


### PREFLIGHT

Preflight is the term used when the document is ready to go to the printer!

Preflight will flatten all layers onto one layout - however retains data about layers, colour profiles and even breaks the document into C,M,Y & K layers!

### IMAGE LAYER

The image layer will contain all the photographs used (unless edited).

Photographs can be very memory and process hungry. Having them on a separate layer allows the layer to be 'switched off' - so they are not shown, processed and allows computers to run faster.

### GRAPHIC LAYER

The principle domain of the graphic designer. They will apply any graphic effects or vector artwork to a separate layer so it can be easily edited without impacting text or stock photography.

Many powerful DTP packages will allow the graphic designer to create artwork within the same software. Otherwise, material will be imported from a vector graphics application.

### BODY TEXT LAYER

Body text layers are for journalists and those not involved in the layout or graphics.

Body text is kept separate so it can be easily changed or even swapped with foreign language versions by journalists or copy editors.

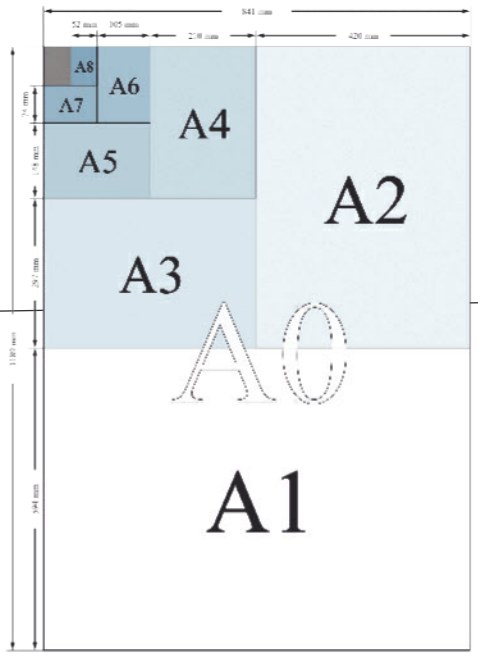
### PREPRESS LAYER

Prepress layers contain all the information required to print the layout.

These will include registration marks, crop marks and possibly colour calibration and densitometry bars.

DET STUDIO www.DETstudio.com

## PAPER SIZE I PAPER WEIGHt | Paper finish




Paper comes in a range of sizes for different jobs. Paper sizes in the UK are controlled by BSI and are based around 'A' format sizes. You will be familiar with A4 and A3. You may have noticed that A3 is twice the size of A4. This is the rule - A2 is twice the size of A3, A1 is twice the size of A2.

For offset lithography printing, where a bleed is required, oversize versions are used. These are called oversize A sizes. For example oversize A3 or 'oA3'.

Paper weights describe how heavy the paper is in grams per square meter, gsm. The heavier the paper, the thicker and firmer it will be.

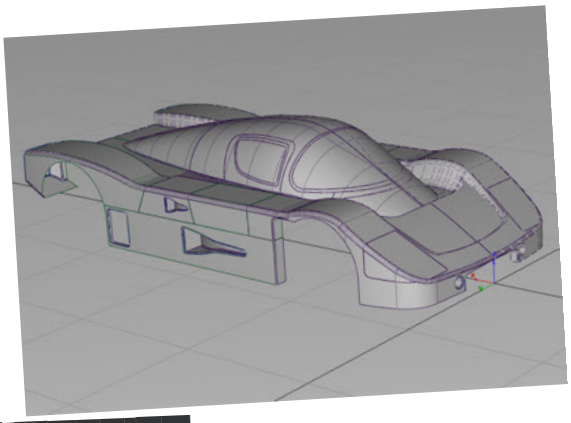
Most paper used at home, school or in an office is 80 gsm - it is inexpensive. Heavier - thicker - paper is significantly more expensive. Heavier paper can be used to give a sense of quality to a document or stop ink bleeding through.

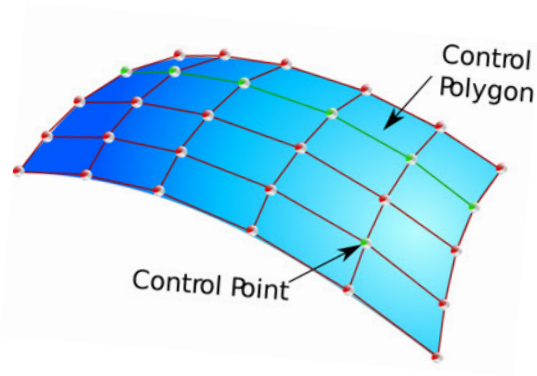
# 3D modelling & rendering

## SURFACE MODELLING

A mathematical technique for representing solid-appearing objects. Surface modelling is a more complex method for representing objects than wirefame modelling, but not as sophisticated as solid modelling. Surface modelling is widely used in CAD (computer-aided design) for illustrations and architectural renderings. It is also used in 3D animation for games and other presentations.

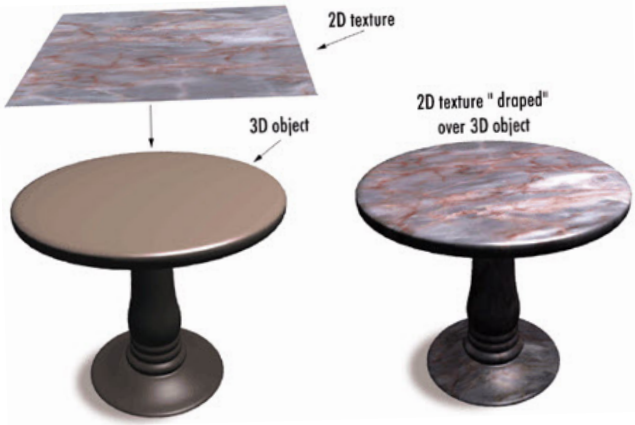
Although surface and solid models appear the same on screen, they are quite different. Surface models cannot be sliced open as can solid models. In addition, in surface modelling, the object can be geometrically incorrect; whereas, in solid modelling, it must be correct.






## TEXTURE MAPPING

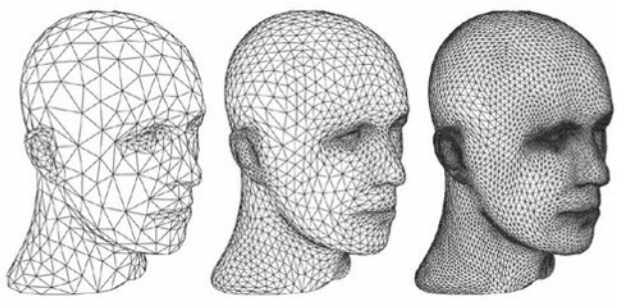
Applying a texture to the surface of a 3D CAD model, to represent a real material. Often used in conjunction with bump mapping.




## BUMP MAPPING

A method of suggesting that materials have a rough or tactile surface, whilst not increasing the polygon count. **Bump mapping** is a technique in computer graphics for simulating **bumps** and wrinkles on the surface of an object.

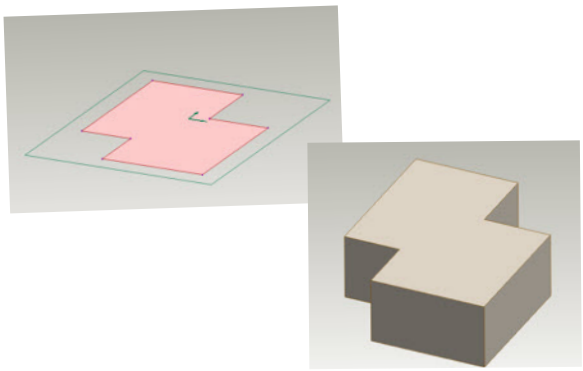
## POLYGONAL MODELLING

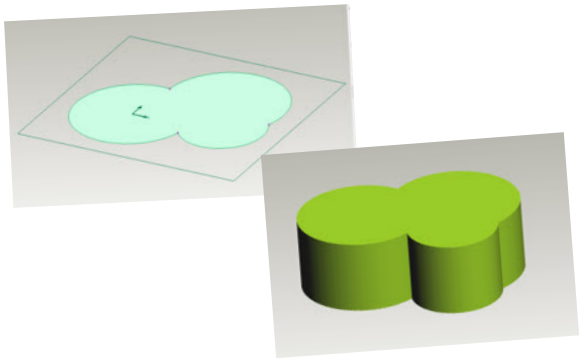


*Polygons are used in computer graphics to compose images that are three-dimensional in appearance. They object is spilt into lots of polygons which are sometimes but not always triangular. This is quicker to display than a shaded model. It also allows for texture mapping to be placed on the polygons to give a more realistic looking surface. The advantage is that polygons provide faster rendering for animation.*

## SOLID MODELLING

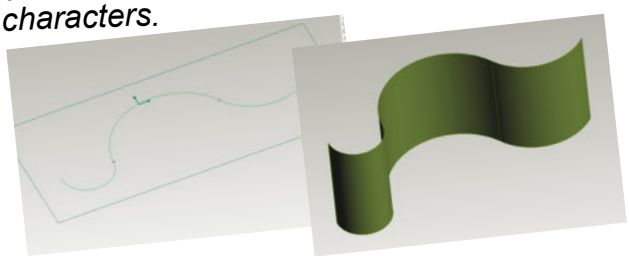
*Solid models are made by drawing 2D shapes and using a 3D feature (extrude, loft etc) to create various 3D forms which can then be edited. The starting point of the solid model is a closed shape.*





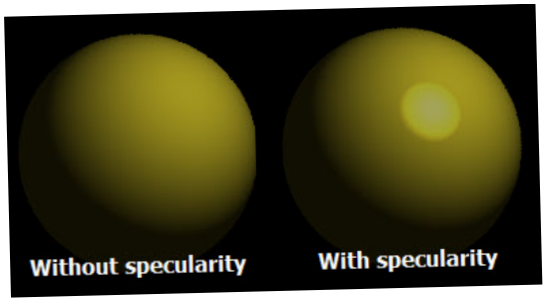
## SURFACE MODELLING

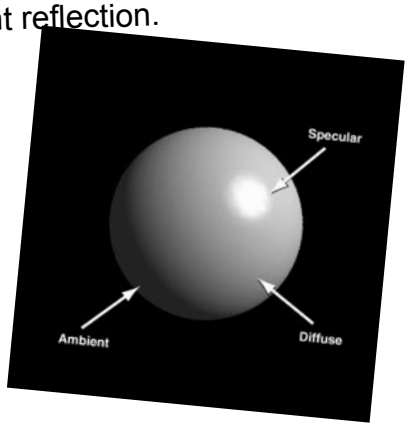
*For the purposes of this course surface modelling begins with an entity (a line) which can be extruded or revolved and given a thickness in order to create a surface. In industry surface modelling develops a "Skin" between 2D or 3D curves (like a mesh). The intersections between the surfaces are very controlled so they can be very smooth or crisp like a crease. It allows for more freeform and organic structures than an object that was created with solid modelling. These surface models have no thickness and the object can be geometrically incorrect; whereas a solid model must be geometrically correct. Think, video game characters.*



## SPECULARITY

In computer graphics, it means the quantity used in three-dimensional (3D) rendering which represents the amount of reflectivity a surface has. It is a key component in determining the brightness of specular highlights, along with shininess to determine the size of the highlights. This reflective capacity of the material creates 'rings' of light reflection.




## IMAGE BASED LIGHTING (IBL)

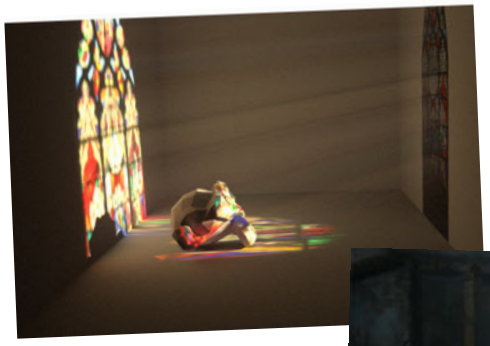
simulates how light and shadow from a real environment would interact with a 3D CAD model. Image-based lighting often uses a **high dynamic range image (HDRI)** for greater realism. This image is then projected onto a dome or sphere similar to environment mapping, and this is used to simulate the lighting for the objects in the scene. Almost all modern rendering software offers some type of image-based lighting, The spheres below are lit by the kitchen and the forest scene.

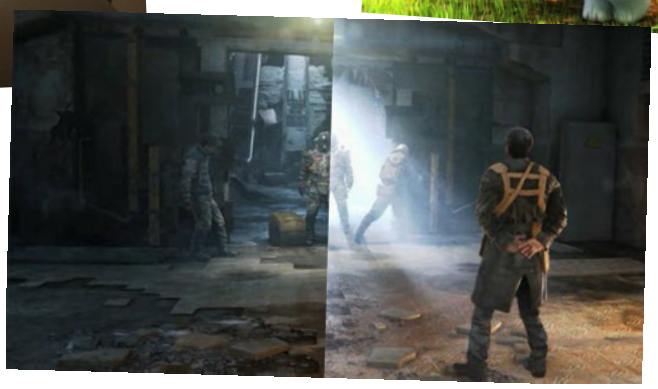
## HIGH DYNAMIC RANGE IMAGERY (HDRI)

creates multiple exposures of an image and combines them to enhance colour and shadow. These can be used as 3D environments to enhance your 3D model in rendering software.

## VOLUMETRICS

a method of giving a light source a sense of volume or substance. For example, light streaming through a stained glass window or light rays passing through a forest canopy or light passing through smoke ina computer game.



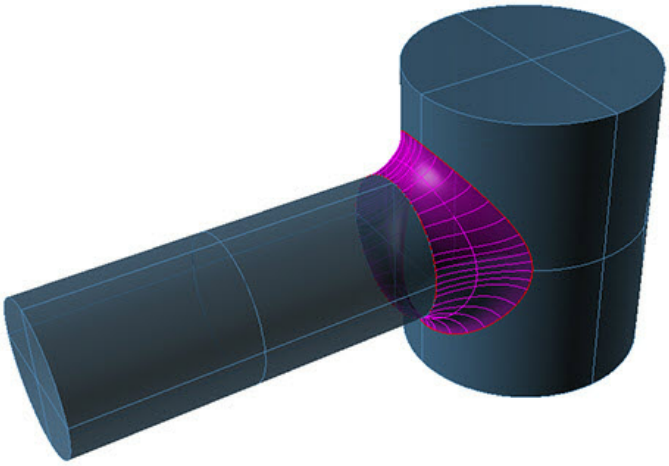


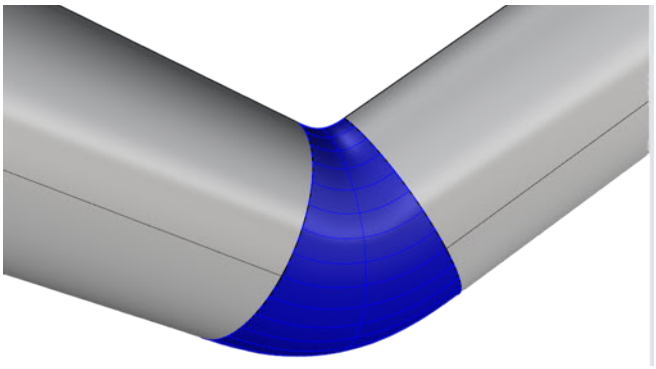
## DEPTH OF FIELD

This is a technique that is used in photography to help focus a viewer's eye where the photographer would like it to go. This is accomplished by blurring areas of the image while other areas remain in focus. The images below show examples of depth of field.
In rendering software such as keyshot , we can select the focus point by clicking an area on the model. This will be what remains in focus. The amount of blur can be controlled by "F-stop." Lower values will have more blur, whereas higher values will have less.

## BLENDING

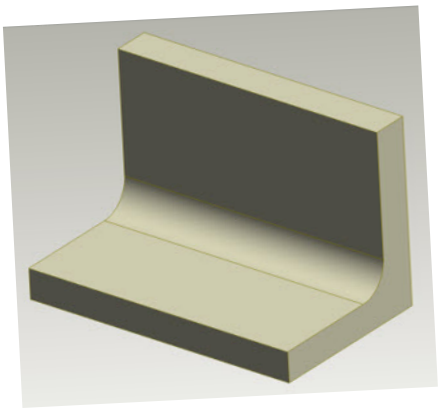
**Blending** is an equivalent of the curve editing tool that lets you smoothen the edges of your solids or surface models. Blending is particularly useful for creating a smooth, variable-curvature joint



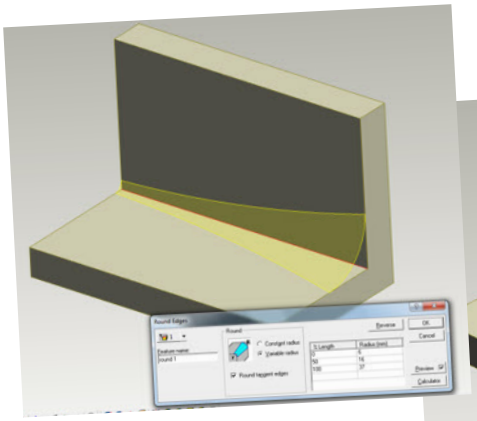


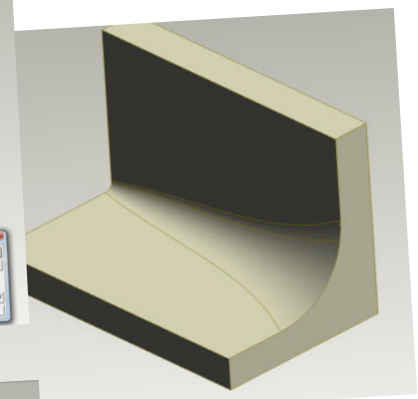
## REGULAR AND IRREGULAR FILLETS

A **regular fillet** can be applied in 3D modelling by defining a radius for the fillet to blend smoothly between surfaces. An **irregular fillet** requires the definition of different radii at offset distances along the face.

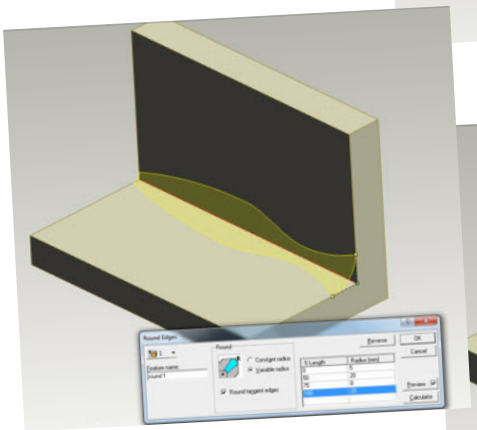


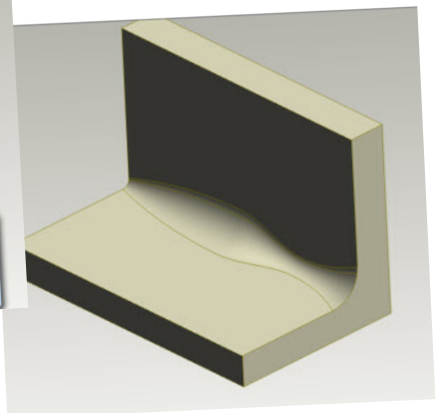
Regular Fillet





Irregular Fillets

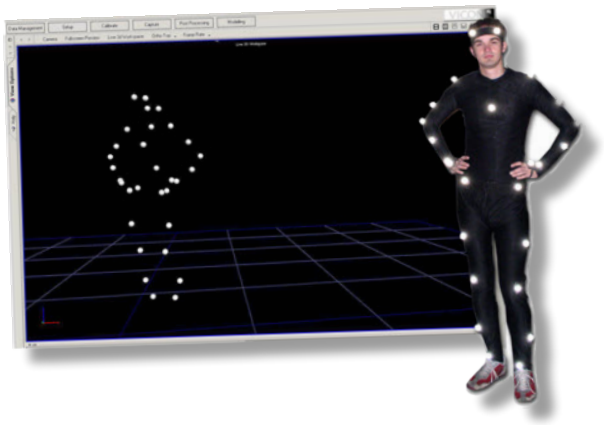




# Animation - I like to move it!

## MOTION CAPTURE ANIMATION

Motion capture is the process of recording the movement of objects or people. It is used in military, entertainment, sports, medical applications, and for validation of computer vision and robotics. In filmmaking and video game development, it refers to recording actions of human actors, and using that information to animate digital character models in 2D or 3D computer animation. When it includes face and fingers or captures subtle expressions, it is often referred to as performance capture.

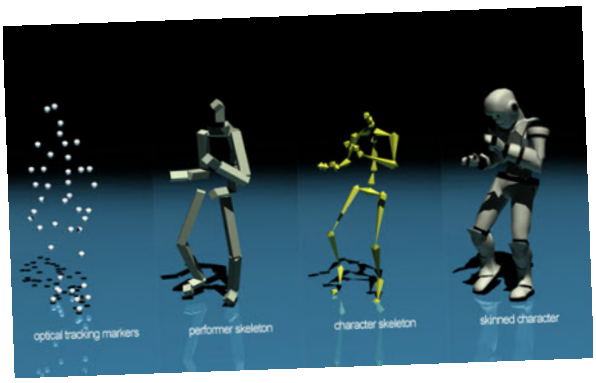


In motion capture sessions, movements of one or more actors are sampled many times per second. Whereas early techniques used images from multiple cameras to calculate 3D positions, often the purpose of motion capture is to record only the movements of the actor, not his or her visual appearance. This animation data is mapped to a 3D model so that the model performs the same actions as the actor.
Camera movements can also be motion captured so that a virtual camera in the scene will pan, tilt, or dolly around the stage driven by a camera operator while the actor is performing, and the motion capture system can capture the camera and props as well as the actor's performance. This allows the computer-generated characters, images and sets to have the same perspective as the video images from the camera. A computer processes the data and displays the movements of the actor, providing the desired camera positions in terms of objects in the set. Retroactively obtaining camera movement data from the captured footage is known as match moving or camera tracking.

# MOTION CAPTURE ANIMATION

## ADVANTAGES

- More rapid, even real time results can be obtained. In entertainment applications this can reduce the costs.
- The amount of work does not vary with the complexity or length of the performance to the same degree as when using traditional techniques. This allows many tests to be done with different styles or deliveries, giving a different personality only limited by the talent of the actor.
- Complex movement and realistic physical interactions such as secondary motions, weight and exchange of forces can be easily recreated in a physically accurate manner.
- The amount of animation data that can be produced within a given time is extremely large when compared to traditional animation techniques. This contributes to both cost effectiveness and meeting production deadlines.
- Potential for free software and third party solutions reducing its costs.




## DISADVANTAGES

- Specific hardware and special software programs are required to obtain and process the data.
- The cost of the software, equipment and personnel required can be prohibitive for small productions.
- The capture system may have specific requirements for the space it is operated in, depending on camera field of view.
- When problems occur, it is easier to reshoot the scene rather than trying to manipulate the data. Only a few systems allow real time viewing of the data to decide if the take needs to be redone.
- Movement that does not follow the laws of physics cannot be captured.
- Traditional animation techniques, such as added emphasis, secondary motion or manipulating the shape of the character, as with squash and stretch animation techniques, must be added later.
- If the computer model has different proportions from the capture subject, errors may occur. For example, if a cartoon character has large, over-sized hands, these may intersect the character's body if the human performer is not careful with their physical movement.

# Animation - I like to move it!

## STOP FRAME ANIMATION

is an animation technique that physically manipulates an object that appears to move on its own. The object is moved in small increments between individually photographed frames, creating the illusion of movement when the series of frames is played as a continuous sequence. Dolls with movable joints or clay figures are often used in stop motion for their ease of repositioning. Stop motion animation using plasticine is called clay animation or "clay-mation". Not all stop motion requires figures or models; many stop motion films can involve using humans, household appliances and other things for comedic effect. Stop motion using objects is sometimes referred to as object animation.

## ADVANTAGES

- The resources needed for stop frame animation consist of a camera, plasticine, tools a computer and some wood, cardboard and paints for a set design. All these resources are readily available.
- As the models can be made from plasticine they don't have to be professionally manufactured.
- The technique to animate is easy to practice and easy to learn.
- Inanimate objects can be made to move.

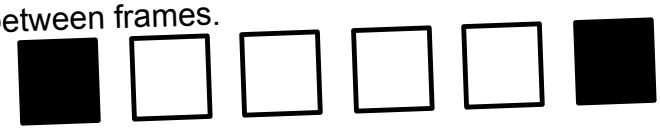
## DISADVANTAGES

- The movement of the characters is very time consuming and there is still lots of work to do in editing once all the movement has been captured.
- All the shots in a scene should be done in one session as the lighting, camera angle, positions of characters must be the same. This causes issues with timing as you may need to work on for hours longer than you anticipated to complete a scene.
- It's difficult to synchronise speech and sounds and hard to get things to move at the right speed.
- Difficult to get smooth fluid movement.

# Animation - I like to move it!

## MOTION TWEENING

One way of creating an animation is to create a first frame by hand, then manually create another frame a few frames away that is significantly different from the first one. Then use an automatic process to create the in-between frames.



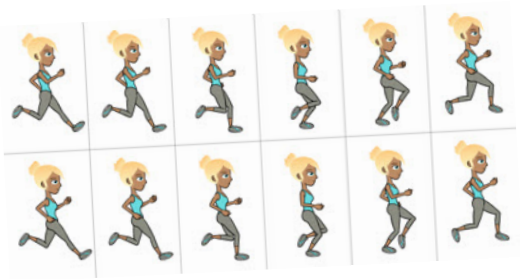
The 'automatic process' mentioned above is called 'tweening'. Tweening is the process where the content of the frames between the keyframes are created automatically by the animation software so that the animation glides smoothly from one keyframe to the next.

The ‘in between’ the key frames of an animation to give the impression of continuous movement. When compared with stop-frame animation, keyframe animation offers a more powerful and efficient technology that saves you from having to draw every single frame.

Essentially, the technique lets you generate key frames containing key objects that can be assigned a position, rotation, and different attributes or actions. Intermediate steps between key objects are created automatically by software and produce a smooth natural transition.


## ADVANTAGES

- Keyframe animation offers a powerful and efficient animation system—it saves having to draw every frame, letting your computer do the hard work
- Essentially, the technique lets you create user-defined keyframes through which objects animate, with each keyframe containing key objects which can be assigned a position, rotation, attributes, etc
- Motion tweening is very good for publishing animations on the Internet

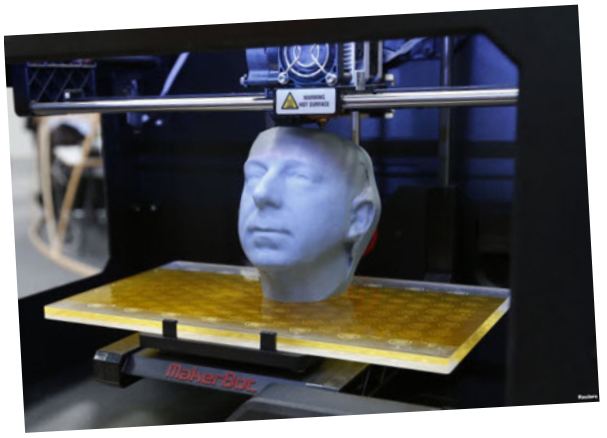


## DISADVANTAGES

- You do not have control over the motion as well as you would if the animation was created with individual frames.
- the computer may not animate the ’in between’ frames correctly which can result in the animation not looking right when it is being previewed.

## 3D PRINTING

3D printing a method of converting 3D CAD data into a physical object, by 'adding' material, rather than cutting from exisiting material. 3D printers require a **STL** file format (**Standard Tessellation Language)**. In 3D printing, successive layers of material are formed under computer control to create an object. These objects can be of almost any shape or geometry, and are produced from a 3D model or other electronic data source. A 3D printer is a type of industrial robot.




## COMPUTER-AIDED MANUFACTURE

is technology used to take 2D or 3D CAD data and machine the shapes or forms from a material. Typical CAM machines are the CNC router, CNC Lathe, CNC milling machine, CNC Plasma Cutter or Laser Cutter.

### ROUTERS


### LATHES

### LASER CUTTERS

### MILLING MACHINES

## COMPUTATIONAL FLUID DYNAMICS

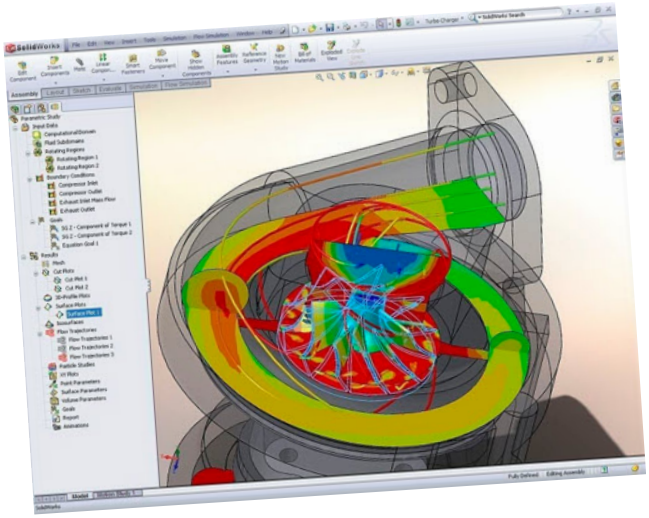
a method of testing how well a 3D CAD model would pass through a liquid or gas (or how the liquid or gas would pass through the 3D CAD model).

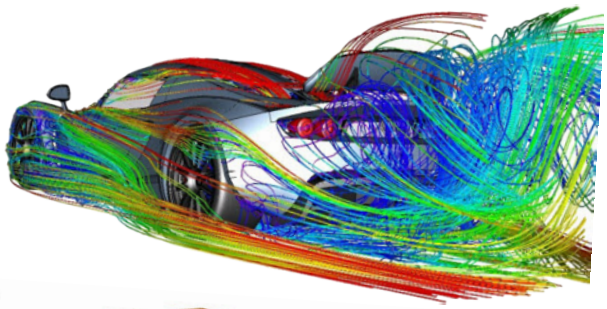
**What is it?** CFD is a form of digitally testing the airflow through the internals of a building and can be beneficial to Architects for the following reasons;

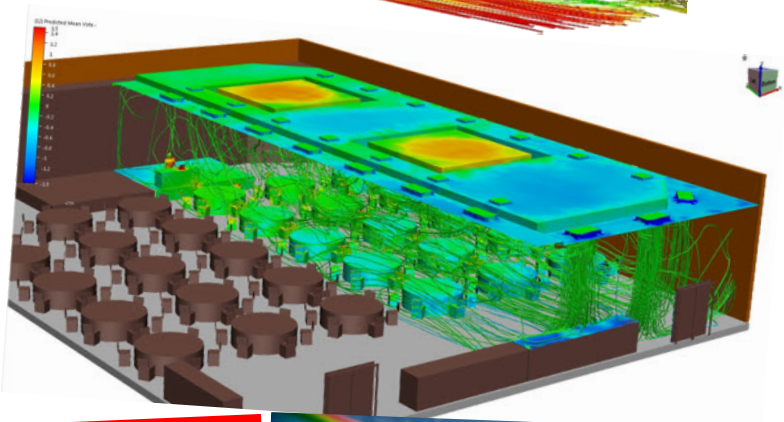
- It is a cost effective way of improving internal/external building design.
- The use of CFD can increase building design performance by establishing how the air flow through rooms is going to affect the people working/living in that area.
- It could be used to establish where to locate various furniture, heating systems, height of ceilings, etc.
-

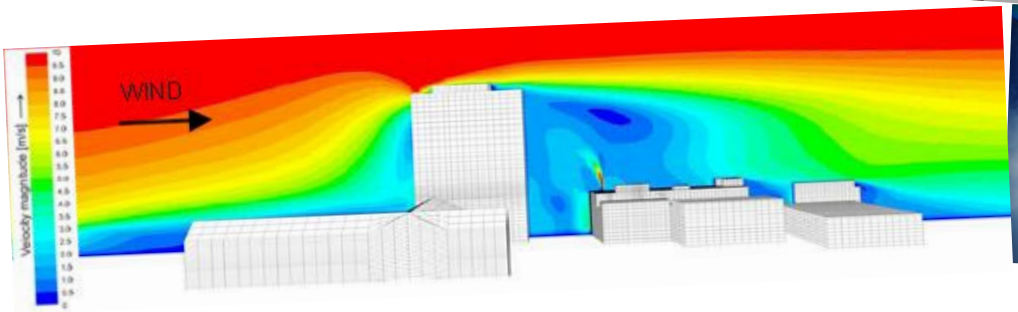
**How does it work?** It shows Architects how the airflow through a design of say an office could be detrimental to the workers, i.e. warm/cold areas thus allowing fact based decisions to be made, e.g. where to place duct venting, positions of internal walls and furniture, height of ceilings, etc. As with FEA it uses complex mathematical formula to analyse and establish volumes and flow rates through confined areas.

**What benefits does it provide?** It instantaneously yields volume data which is useful to the overall design. It allows Architects to visualise and manipulate new building designs, determine heat flow and heat control and loss and the environmental efficiency of the build at an early stage.









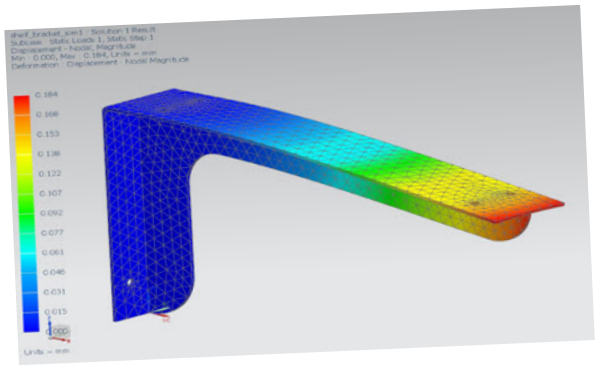

## FINITE ELEMENT ANALYSIS

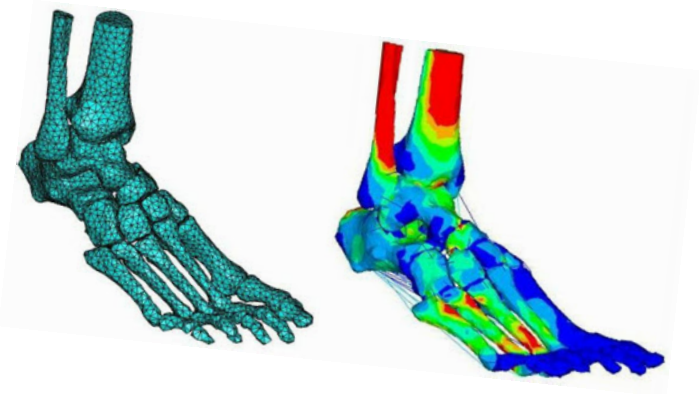
(FEA) is a computerized method for predicting how a product reacts to real-world forces, vibration, heat, fluid flow, and other physical effects. Finite element analysis shows whether a product will break, wear out, or work the way it was designed. It is called analysis, but in the product development process, it is used to predict what is going to happen when the product is used.

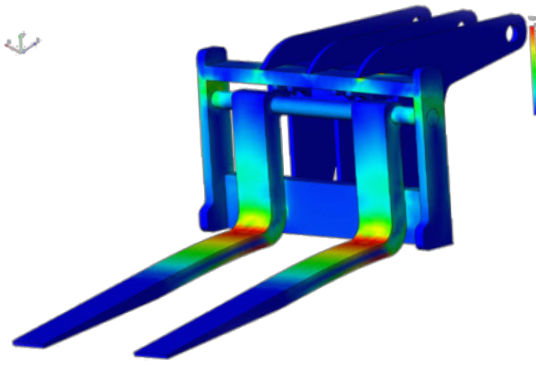
Features:- visual simulation for testing the failure of the product, as opposed to destructive testing.
the colours give a very clear graphical indication of stresses within the sample.
it is a cost effective solution to the testing of real components.
It is easy altering the product and re-test without re-manufacture of the component.
It reduces lead time in manufacture.

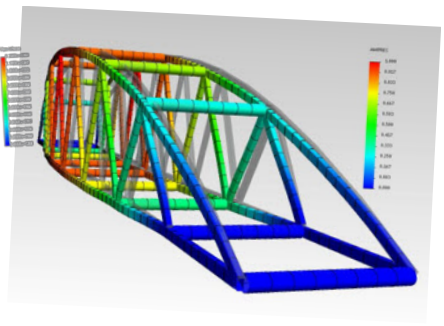
**How does it work?** The computer is able to analyse and calculate areas of a structure and determine how strong or weak each area is. It then adds all these areas together to give an all over strength/weakness for a given component.

**What benefits does it provide?** Instead of needing to build multiple physical prototypes and then testing them to see if they'll work, companies can conduct testing digitally throughout the process by using Digital Prototyping, reducing the number of physical prototypes needed to validate the design.
Using Digital Prototyping to catch design problems up front, manufacturers experience fewer changes downstream. Companies can also perform simulations in early stages of the product development cycle, so they avoid failure during testing or manufacturing phases.



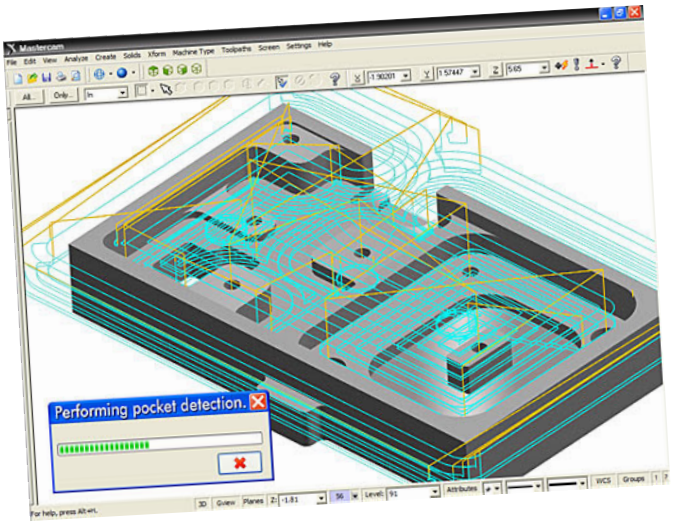


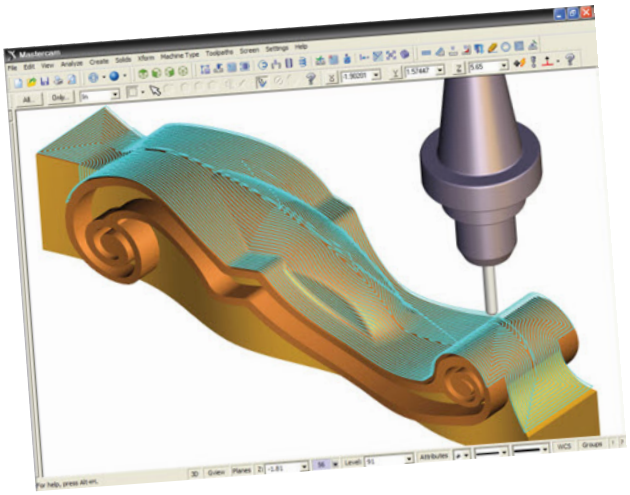




## TOOL PATH GENERATION

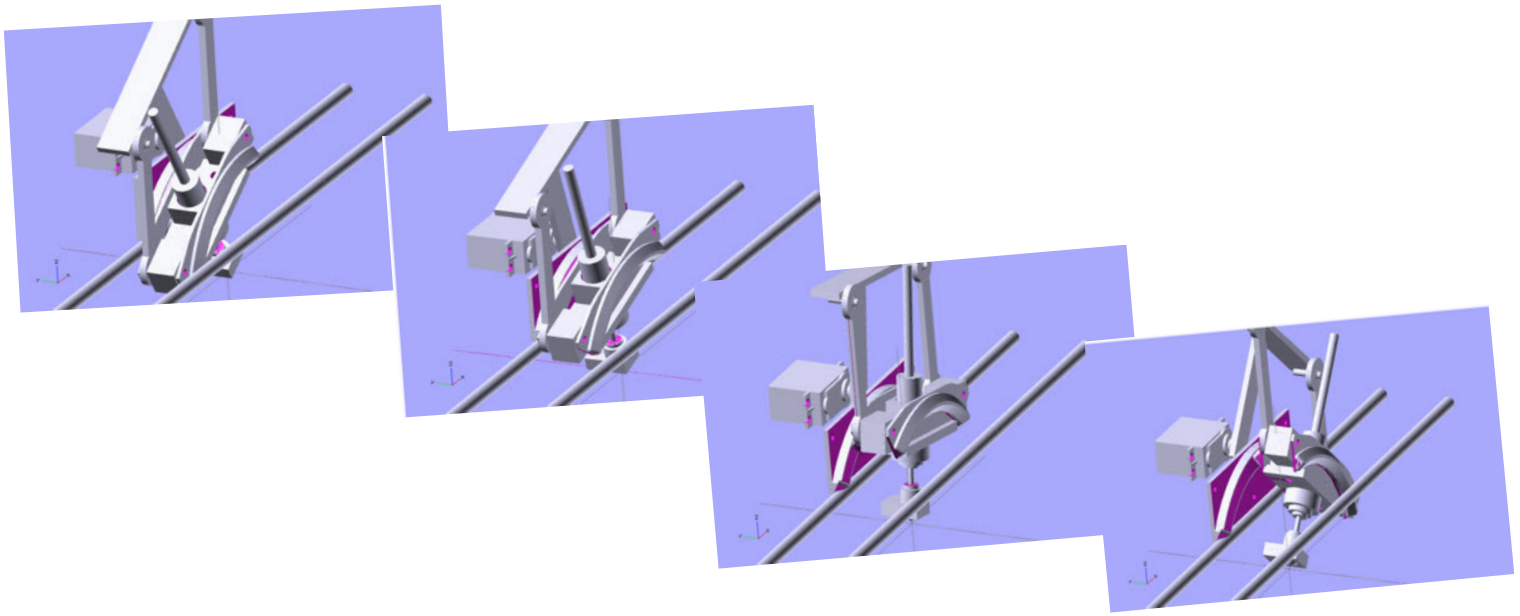
Software used to plan the movement of cutting or shaping tools in CAM systems.



## MECHANICAL ANIMATION

Mechanical product animation is the process of creating realistic three-dimensional animation in CAD to visually represent the configuration, assemblies and movement of various mechanical products and their components. It allows the engineer to easily monitor the movement of parts within an assembly. Such simulations also provide a better overview of the final product, its performance and overall efficiency. Mechanical 3D product animation is also an ingenious way to demonstrate a virtual prototype to potential clients and help them understand the operation of a product and its features. It gives presentations an added flavour of reality which is otherwise downrightly impossible by the conventional methods.



# File Types - How should I save it?

## STANDARD TESSELLATION LANGUAGE STL


The **STL** file format is supported by many other software packages; it is widely used for rapid prototyping, 3D printing and computer-aided manufacturing. STL files describe only the surface geometry of a three-dimensional object without any representation of colour, texture or other common CAD model attributes.

## DIRECT EXCHANGE FORMAT DXF


**DXF** is a file extension for a 2D graphic image format typically used with AutoCAD and AutoSketch (2D Computer Aided Drawing) software. DXF stands for Drawing eXchange Format.

## DRAWING FORMAT DWG


The **DWG** file format is probably the most widely used format for CAD drawings. **DWG** (from drawing) is used for storing two and three-dimensional drawing data. DWG files can be opened in 2D CAD packages and used to input 2D CAD drawings into 3D modelling packages.

## VIRTUAL REALITY MODELLING LANGUAGE VRML


**VRML** is a graphics file format used by Virtual Reality Modelling Language (VRML). VRML files are used for 3-D information, primarily on web pages. These files contain information regarding the graphics of the site, such as sounds, animations, lighting, and objects. VRML files are designed with web pages in mind, allowing for user interaction.

## DIRECT EXCHANGE FORMAT 3DS

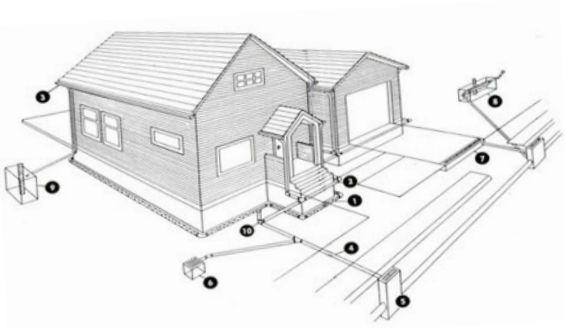

**3DS** is one of the file formats used by the Autodesk 3ds Mzax 3D modelling, animation and rendering software. It was the native file format of the old Autodesk 3D Studio DOS which was popular until its successor (3D Studio MAX 1.0) replaced it in April 1996.

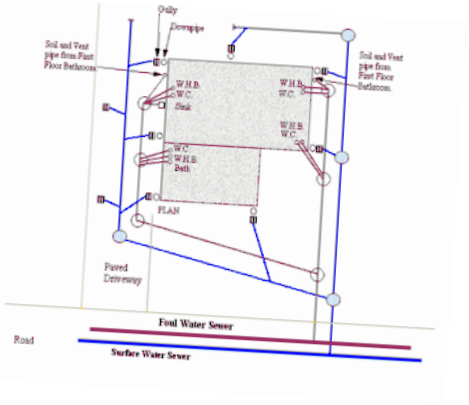
## TOPOLOGICAL SURVEYS

are used to identify and map the contours of the ground and existing features on the surface of the earth or slightly above or below the earth's surface (i.e. trees, buildings, streets, walkways, manholes, utility poles, retaining walls, etc.).If the purpose of the survey is to serve as a base map for the design of a residence or building of some type, or design a road or driveway, it may be necessary to show perimeter boundary lines and the lines of easements on or crossing the property being surveyed, in order for a designer to accurately show zoning and other agency required setbacks.


## DRAINAGE SURVEYS

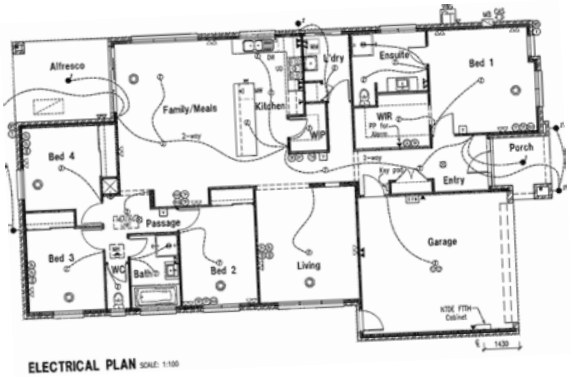
deal with locating and cataloguing the existence, location and condition of drainage systems and their components. They can comprise of tables containing data on the locations and conditions of components, drawings and diagrams of the systems, and CCTV footage/images showing internal details of pipe networks and components. These will be prepared by drainage surveyors/engineers and CAD Technicians/Draughtsmen. Drainage surveys are useful for planning and creating new engineering works, modifying existing ones, or for maintenance of drainage systems themselves. As such they may be used by a range of people including civil engineers, site engineers architects, planners and drainage engineers.

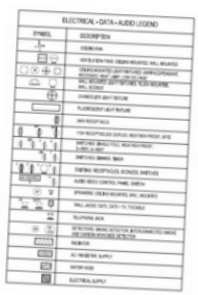





## ELECTRICAL DRAWINGS

Produced by Electrical Draughtsman/CAD Operators, electrical drawings are schematics which contain information about the electrical and wiring needs for a given project. These may include power, lighting, data and telephony wiring; the location of outlets, switches, connections, breakers and distribution boards; other “hardwired” electrical systems and devices (fans, alarm systems, public address systems etc.). Drawings may be in the form of a floor plan showing location of features (outlets, devices, switches etc) and the general connections between, or wiring diagrams showing specific wiring and interconnection information. Drawings use an standard library of symbols to ensure understanding.



# What job do they do?

## ARCHITECTS

Design buildings ranging from small house extensions to large public buildings like schools,theatres and hospitals

**Graphic types required**: Architects are responsible for producing drawings of buildings that adhere to planning and building regulations and inform/instruct construction. Producing orthographic drawings using 2D CAD software (AutoCAD, Vector Works) including: plans,sections, elevations and technical details at different scales (1:1250, 1:200, 1:100,1:50, 1:20,1:5) to achieve building warrants, planning permission and inform construction. Will also produce 3D CAD models using 3D modelling software (Sketch-Up, Revit/BIM, Rhino) to communicate what a building will look like to planners, communities, other members of the design team and clients. 3D models may also be produced to communicate the construction of a particular feature of the building i.e. non-standard windows.

**Graphic Technologies required**: BIM = Building Information Management. BIM is a single 3D CAD model shared and worked on by all members of the design team simultaneously from architects and engineers to suppliers and manufacturers of components like windows and doors.

**Users:** Builders, plumbers, electricians, brick layers, joiners, roofers, landscape gardeners. They all Interpret Architects drawings for instruction on how different parts of a building are to be constructed and from what materials i.e. foundations, external wall construction and internal wall positioning, positioning of windows and doors, roof construction, energy saving features.

## BUILDING SURVEYORS

Measure sites and buildings to give an accurate representation of existing sites and structures. They may also investigate the structural condition (rot, cracks, subsidence) and fabric (water ingress, roof condition, external walls) of an existing building.

**Graphic types required**: Produces measured drawings (plans and elevations) of existing buildings and sites prior to any design or construction.

**Graphic Technologies required**: Laser levels, Measuring rods, tripod, Ranging poles, Moisture meter.

## CONSERVATION BODIES

UNESCO George to

UNESCO World Heritage, Historic Scotland. Edinburgh's New Town is a World Heritage site which protects the architectural heritage of the New Town. Heriot's School (old building) is a grade A listed building. This grading is assigned protect the most architecturally important buildings in Scotland.

**Graphic types required:** Conservation bodies may hold historical drawings and information of

## INTERIOR DESIGNERS

Responsible for the interior design of a building, including colour schemes, tiling, wall paper, paintwork, soft furnishings and sometimes lighting.

**Graphic types required:** Use photoshop to edit/manipulate images and may produce 3D CAD models to generate rendered visuals to communicate the mood and style of interior spaces. Will also produce materials and texture sampling and mood boards.

## ARCHITECTURAL TECHNICIANS

Produce orthographic drawings of buildings and/or parts of buildings at varying scales from 1:200 to 1:5. They will mainly produce plans and sections that detail the construction of walls, floors and the roof and the junctions between these features. The primary role of a technician is to ensure compliance with building regulations. This means understanding the minimum size requirements for all manner of building features from disabled toilets to corridor widths to the spacing of fire dampeners in wall construction and ensuring adequate ventilation for the size of room. Technicians do not have any involvement with building design.


**Graphic technologies required:**
2D drawing software such as Autodesk AutoCAD, Vector Works, power CAD, Microstation.Many technicians will also now use 3D Building Information Modelling (BIM) software such as Autodesk Revit. *BIM = Building Information Modelling. BIM involves a 3D model that can be shared and worked on by all members of the design team simultaneously from architects and engineers to suppliers and manufacturers of components. The model allows information such as technical specifications to be assigned to elements in the model like windows and doors. This allows schedules of items like windows to be generated directly from the model.

## QUANTITY SURVEYORS

Use highly detailed architect's drawings to add up how much a construction project will cost. Quantity Surveyors interpret Architect's and Engineer's drawings (plans, sections and elevations at varying scales from 1:200 to 1:5) to price the cost of construction and produce Bills of Quantities based upon the quantity of different features of the building. Once a construction job has been costed, a quantity surveyor will advise on how costs can be saved. Often changes to finishes (flooring, tiling, kitchen and bathrooms), glazing and roofing is a way to save money.

Graphic Technologies required:
Quantity Surveyors often receive packages of physical drawings to work from. They tend to produce Bills of Quantities, based upon the drawings they have received, on Excel spreadsheets.

## TOWN PLANNERS

**Town planners**
Review Architect's drawings including: location plans, site plans, building plans, sections and elevations and rendered visual images produced from 3D CAD models to determine the suitability of the proposed development on the given site. These drawings are typically drawing at a scale of 1:200 for building information. Location and site information is usually at a scale of 1:1250 or 1:500. 3D walk through animations are produced to give client or the public a more realistic impression of the intended design from a users perspective.

**Graphic Technologies required:**
Contractors will view copies of location and site plans, sections and elevations, usually in pdf format on a planning portal website run by the local authority. For very large public developments, communities may also view full scale printed drawings and images at consultation events. Sometimes rendered images of the final building will appear on temporary security hoarding around the site during construction. A feature of major public developments is the use of 3D animated walk-through visuals to give the public a realistic feel

## BUILDING SURVEYORS

Measure sites and buildings to give an accurate representation of existing sites and structures. They may also investigate the structural condition (rot, cracks, subsidence) and fabric (water ingress, roof condition, external walls) of an existing building. Produces measured drawings (plans and elevations) of existing buildings and sites prior to any design or construction, usually to a specification dictated by an Architect or client. The scale, level of detail and content of the survey depends upon the specification. Typically, detail is drawn at a scale of 1:50 to 1:100 for building information and 1:200 to 1:500 for site information.

**Graphic technologies required:**
Surveys are drawing up digitally using 2D CAD software like Autodesk AutoCAD and exchanged in .dwg (drawing) format.

## HEATING ENGINEER

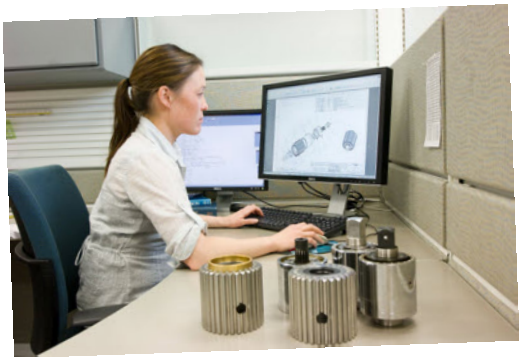
Heating and ventilation systems ensure that buildings provide the right environment for living and working. All buildings (including shops, offices, factories and laboratories) have complicated, precise heating and ventilation systems to make them work effectively. These can take many forms, such as a series of ventilation grilles on classroom walls or a large network of pipes across factory ceilings.

**Graphic types required and their purpose:**
3D Pictorial of gas / water pipe runs to show position of main inlets and outlets for water and sewage. CFD data showing optimal positions of radiators.

**Graphic Technologies required and their purpose:**
CFD Simulation software to simulate heat transfer in the room / building. 2D/3D CAD drawings of heating system in the building. Isometric view of heatingsystem shows exact position of fixtures and fittings and lengths of pipe runs in 3 dimensions.

# Product Design & Manufacture

## DESIGN ENGINEER/INDUSTRIAL DESIGNER



The Design Engineer works on the project at the beginning and at the end. It is their responsibility to fully understand what the client expects of them. They need to; be fully aware of the time frame by which the client wants the product to be completed, know the specification of the product and be able to produce concept sketches to help the client visualise what the engineer believes the finished product could look like.

Their initial drawings would generally be sketches drawn up after a client meeting these could be produced manually or electronically. Once approved and with the consent of the client the Design Engineer would then have the authorisation to produce the production drawings. The production drawings would then be produced by the Design Engineer or they would pass it on to the Designer depending on the size of the company they worked with.

The drawings involved in the Production drawings are: assembled orthographic and pictorials, component orthographic and pictorial, exploded, detailed views, sectional views and any range of movements. A parts list would be expected along with a bill of materials and even a Sequence of Operations to aid the assembly. The drawings would have to be produced to the standard for the country requiring them for example BSI in the UK or ANSI in the USA.

These drawings would be approved and authorised before being passed on to the Manufacturing Engineer. The Design Engineer then reviews the finished product once it has been fully manufactured and assembled to ensure the product conforms to the client's specification.

## MANUFACTURING ENGINEER

The Manufacturing Engineer makes the physical product components. They are generally experienced in the machinery that they use to manufacture. However some can be qualified in a range of manufacturing areas such as; turning, milling and welding. The Manufacturing Engineer must take a piece of raw material and create a functioning component using the production drawings.

The production drawings they would use are; component orthographic and pictorial drawings. On those drawings there would need to be sufficient dimensions and tolerances and technical detail (sectional views, exploded views etc) to allow the Manufacturing Engineer to have a clear understanding of the components that they are producing.

The Manufacturing Engineer would have to ensure accuracy of production and always work to the tolerances stated on the production drawings. He will manage the manufacturing process to ensure a high quality is achieved and do so within the agreed time frame. In doing this he will ensure the components will work and assemble correctly and pass inspection and quality assurance procedures in place and managed by the Conformity Engineer. Meeting agreed time scales will ensure that no financial loss is accrued during the manufacturing process.

In some instances the Manufacturing Engineer may never see the other components or the product fully assembled if their workshop cannot manufacture all of the necessary components. This heightens the importance of clarity and accuracy of the production drawings so that they fully describe the intended function

# Product Design & Manufacture

## ASSEMBLY TECHNICIAN

The Assembly Technician plans and organises the assembly of the components that the Manufacturing Engineer(s) produce. Prior to them assembling the product the components must be quality assured and inspected by a Conformity Engineer. Only once the batch of components pass inspection and are approved for use in this product can the Assembly Technician begin to assemble the product. Their main role is to ensure that all of the components are assembled in the product and that they fit securely to enable the product to function correctly.

In order for the Assembly Technician to assemble the product they must refer to the Production drawings. They would be focused on the assembled & exploded pictorial drawings, sections and assembly notes, parts list and sequence of operations for the main assembly and visualisation of the final product. However, they would also refer to the orthographic and in particular sectional/detailed views to show the location and placement of any internal components. The product must be assembled correctly and to the exact requirements specified on the Production drawings to ensure it functions correctly. It is then put through the next stage of the production process which is product testing.

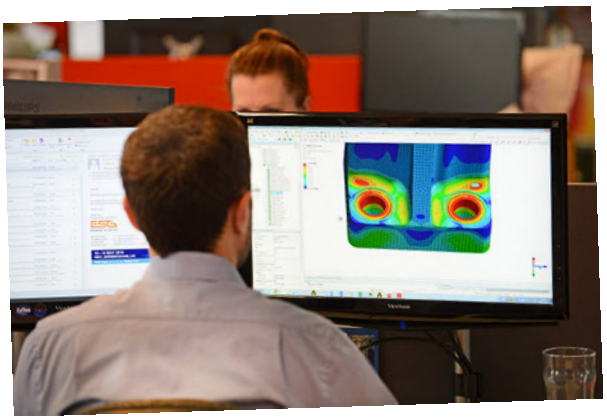
## CONFORMITY ENGINEER / COMPLIANCE TECHNICIAN

Compliance engineers ensure that products are free of hazards whether they be electrical, mechanical, thermal or other hazards. They need mechanical ability and good communications skills to work with design and manufacturing teams. Compliance engineers will work closely with Test Engineers.

Compliance engineers create procedures and guidelines to ensure that industry regulations are met by manufacturers in both international (CE) and domestic (BSI) markets .

Compliance engineers will use orthographic drawings, assembly drawings, test data etc. in their day to day role in addition to making reference to CE and BSi Standards. BSI - BRITISH STANDARDS INSTITUTE
CE - "Conformité Européene" (European Conformity).

## TEST ENGINEER



Test engineers are responsible for the quality of a product. They perform tests on a product to ensure that it will work properly under certain conditions and meet the product specifications by simulating the load and abuse that real users will place on the Product.

Test engineers have to be able to read detailed technical drawings and use measuring equipment to ensure that the product complies with the dimensions and tolerances on the drawings.

Test engineers are also likely to use Finite Element Analysis (FEA) and Computational Fluid
Dynamics (CFD) software to test structures, products and buildings.

# MODEL MAKER

Model makers make three-dimensional (3D), physical scale models of products. Model makers work closely with the client or designer, either independently or as part of a team. They use freehand drawing skills or computer-aided design (CAD) to illustrate initial ideas, which may need to be amended as a result of further consultation before a detailed final model is produced.

They will need to be able to read detailed engineering drawings, showing dimensions, assembly details etc. to allow accurate manufacture of a model.

A model maker is now likely to make physical model from a 3D CAD model using rapid prototyping technology.