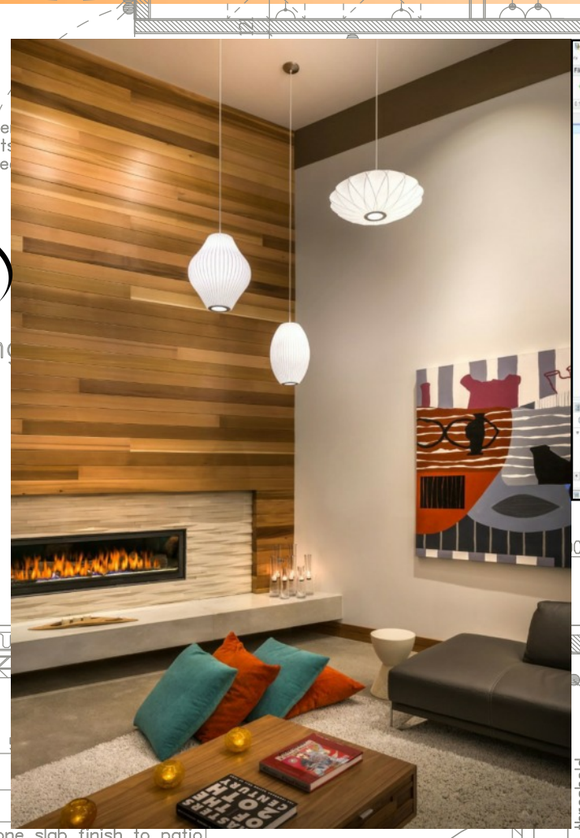
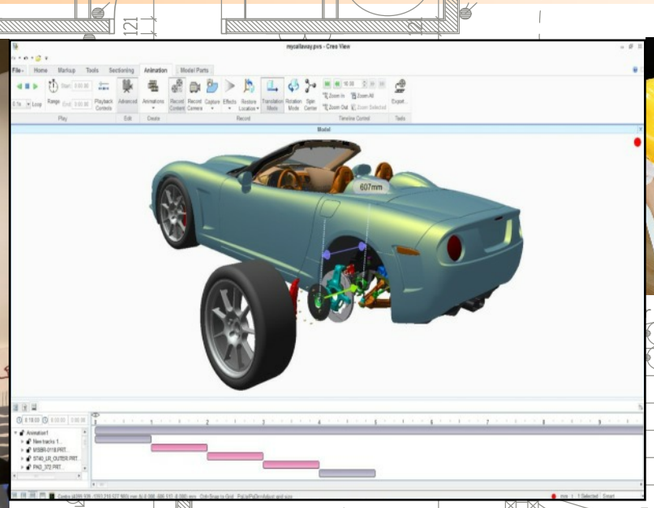
ADVANCED HIGHER GRAPHIC COMMUNICATION

theory notes





http://facweb.cs.depaul.edu/sgrais/images/ColorPrint/Untitled-9.jpg

ADVANCED HIGHER GRAPHIC COMMUNICATION

Contents

Unit 1 Technical Graphics

Introduction

Common elements to technical graphics, including creators and users:

- Graphic types/ Techniques/ Drawing standards, protocols and conventions/ Computer-aided design/ Computer-aided illustration

Section 1.1

Built environment, including creators and users

- Planning drawings/ Surveys

Section 1.2

Manufacturing and engineering including creators and users

- Simulation/CAD CAM systems/Technical graphic file formats and their use

Section 1.3

Graphic ownership

- Issues of ownership/Digital rights management

Unit 2 Commercial and Visual Media Graphics

Introduction

Common elements to commercial and visual media graphics including creators and users

- Desktop publishing/ Graphic media file formats and their use/ Design elements and principles

Section 2.1

Graphic technologies

- **Printing technologies:e.g. laser, solid ink etc.., Colour space,printing terms including edge to edge, camera ready copy etc...**

Section 2.2

Animation

Printing technologies:e.g. laser, solid ink etc.., Colour space,printing terms including

Section 2.3

Graphic ownership

- Issues of ownership/Digital rights management

Unit 1 and Unit 2

Graphic project planning

- Gantt Charts/ Planning charts Commercial and Visual Media: Thumbnails/visuals/pre-press/camera ready copy and for Technical Graphics: analysis of the brief/research, graphic specification, using research, preliminary graphic techniques, variety of solutions, graphic solution etc..

Appendix 1 SQA terms for exam purposes

Unit 1 : Technical Graphics

Introduction

Common elements to technical graphics, including creators and users (the creators and users in Manufacturing and Engineering)

- Graphic types/Techniques/ Drawing standards, protocols and conventions/ Computer-aided design/ Computer-aided illustration
- Creators and users are anyone who could encounter, use, draw read or explain any form of technical, engineering or production drawing

TECHNICAL GRAPHICS - Graphic Types & Techniques

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Graphic Types	Knowledge, understanding and skills in interpreting audience requirements and producing effective graphic responses for: *preliminary*, *production* and *promotional* graphics.
Preliminary: Planning (Gantt charts) manual sketching, illustration.	Write briefly, describing the Audiences, Purpose and Benefits of: **Planning (Gantt charts) for an example see section 1.3** Purpose: *Gantt charts are used to visually plan and allocate time to tasks which are required to be completed as part of a project. Each individual task is given a start date and deadline for completion. These charts allow those who are in charge of the projects to track the progress of the project ensuring that all task are completed on time.* *Audience:* *Project Managers, Lead Designer, Manufacturing Engineer, Quantity Surveyor etc* *Benefits:* *This visual method helps user to understand the length of time each task has in proportion to the other tasks. It also helps to minimise down time.* **Manual Sketching** Purpose: *Manual sketching is a skill that is used during the preliminary phase of the design process. It enables the designer to record the ideas quickly; it is immediate. It requires no specialised equipment or power source. It is a free-flowing, intuitive method not restricted by the limitations of software drawing tools. Manual sketches are also used to communicate early stages of the design process with either clients or other professional before the time is then spent creating production or promotional materials. Free-hand sketching can also be done on an electronic sketch pad which enables sketches to be saved and sent electronically etc..* Audience: *Designers, Engineers, Trades, Clients etc* Benefits: *Sketching is a quick and immediate process and allows the designer to produce and record a range of solutions quickly. These ideas can then be shown to and discussed with the design team. If mistakes are made during this phase their are quick and inexpensive to fix. Can be used to create both 2D and pictorial graphics sketched ideas can be scanned and sent to clients or team members. Scanned images can be developed directly on an electronic sketch pad or as access to hardware improves, sketches can be generated Directly on both graphics tablets, on increasingly on conventional tablet devices.* **Illustrations** Purpose: *Illustrations are used to share design ideas with Clients. These promotional graphics use Light, shade, texture, materials and environments to create realistic renderings of products that Clients will be able to visualise and gain an understanding of what the final manufactured product will look like. Illustrations can also be used for promotional materials i.e. billboard advertisements.* Audience: *Clients, Customers, Design team.* Benefits: *Final ideas can be shared with clients without the expensive cost of creating a prototype. Files be easily sent digitally. Products can be visualised in a range environments and lighting conditions without the expense of photographing a prototype in numerous locations.*

TECHNICAL GRAPHICS - Graphic Types & Techniques

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Graphic Types	Knowledge, understanding and skills in interpreting audience requirements and producing effective graphic responses for: *preliminary*, *production* and *promotional* graphics.
Production Graphics: CAD, orthographic projection, pictorials, dimensional Tolerances.	Write briefly describing the Audiences, Purpose and Benefits of: CAD Production drawings: *Audience: Engineer, assembly technician.* *Purpose: To allow the product to be manufactured using CAD/CAM.* *Benefit: Can simulate prior to manufacture to see if it works/fits together. Easily modified. Can support manufacture through CNC processes. Can support rapid prototyped modelling.* Orthographic Projection: Audience: *Engineer, Building Contractor.* Purpose: *Representing 3D objects as 2D. It is a universally understood drawing method and the application of appropriate drawing standards means that the drawing can be readily understood by all users.* Benefit: *Can show section/detail views for specific requirements or trades. Shows true shapes of surfaces. Always drawn to scale. Can be easily dimensioned. Can show internal details and technical details required by the manufacturer.* Pictorial drawings: Audience: Client, advertising team, interior designer. Purpose: To represent image in 3D. Benefit: More readily understood by a non-technical audience. Can simulate the look of a real 3D product. Exploded pictorial views can be useful in providing assembly details. The image can be rendered to look realistic; useful in advertising and marketing. Dimension Tolerances *Audience: Manufacturer, fitters (trades), construction trades.* *Purpose: Dimensions are normally applied to orthographic drawings aid manufacture and construction. Tolerances are applied to dimensions to allow acceptable variations in manufacturing dimensions. Uses symbolic language on a drawing to allow for variation on sizes.* *Benefit: Specifies the degree of accuracy and precision required to make the part to e ensure it will function in the product. A manufacturer cannot make components exactly to the sizes specified on a drawing and requires a range of acceptable error (limits). The tolerance specifies these acceptable manufacturing limits.*

TECHNICAL GRAPHICS - Graphic Types & Techniques

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Graphic Types	Knowledge, understanding and skills in interpreting audience requirements and producing effective graphic responses for: *preliminary*, *production* and *promotional* graphics.
Promotion: Creative layout techniques, Interactive screens, web sites.	Write briefly describing the Audiences, Purpose and Benefits of: Creative layout techniques: ● *Applying creative layout techniques to graphic design work can:* ● *Enhance the user experience by creating predictable patterns for users to follow.* ● *Lead to a more enjoyable audience experience.* ● *Be used to appeal to a specific target audience.* ● *Influence fashion trends in graphic design.* ● *Be used to reflect or convey the brand identity of a company.* ● *Convey an important message through use of elements and principles* ● *Can make a company stand out, motivate potential customers, cultivate brand recognition,* ● *and influence public perception of a company/service/product.* Interactive screens: Interactive screens refers to more than touchscreen smartphones or tablets, they can also be interactive kiosks used in retail or marketing. General benefits include: ● They can make technology more intuitive to use. ● Multiple languages can be added to the software, reaching out to a wider audience. ● Can hold the attention of an audience due to dynamic effects *"By interacting with a display, an opportunity for interacting with the brand and retailer is created. And, by interacting with the brand, customers are provided with a specific experience that allows retailers to build a relationship with their audience". (mechtron.com)* Web sites: General benefits of a website to an audience include: ● Accessible worldwide and in multiple languages. ● Can be accessed on multiple devices (Smartphones, tablet, computer, smart TV, etc) ● Can be accessed 24/7 ● Audiences can look at more than one page at the one time by opening numerous windows. ● Interactive media content can be displayed on a website. Can also include dynamic effects, videos/multimedia and links to social media. Advantages to a company include: ● Websites can be easily updated. ● Can link to other websites ● They are less expensive to promote/advertise a company compared to printed media, television advertising. ● They are more environmental friendly when it comes to advertising and marketing compared to printed media. ● Increases the credibility of a company/brand.

Graphic Input Devices

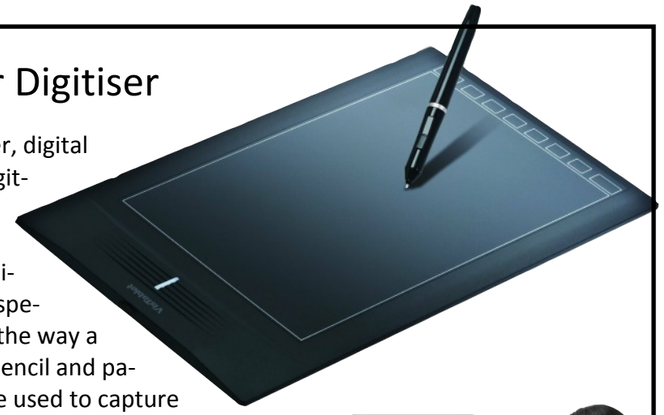
3D Scanner

A 2D (or paper) scanner detects colour. A 3D scanner detects distance and can therefore record the position and form of a 3D object. It is particularly useful when recreating complex shapes in a digital environment. It does this by recording the surface info as a series of adjoining shapes known as polygons. The larger the number of polygons the more accurate the representation of the surface.

http://www.dirdim.com/applications.htm

http://www.dirdim.com/lm_everything.htm

Graphics Tablet or Digitiser



A graphics tablet (also digitiser, digital drawing tablet, pen tablet, digital art board) is a computer input device that enables a user to hand-draw images, animations and graphics, with a special pen-like stylus, similar to the way a person draws images with a pencil and paper. These tablets may also be used to capture data or handwritten signatures. It can also be used to trace an image from a piece of paper which is taped or otherwise secured to the tablet surface. Capturing data in this way, by tracing or entering the corners of linear poly-lines or shapes, is called digitising

Digital Camera

Digital cameras can save images in the following file formats: **still image** (RAW, TIFF, JPEG) **moving image** (AVI, DV, MPEG, MOV (often containing motion JPEG), WMV, and ASF (basically the same as WMV). Recent formats include MP4, which is based on the QuickTime format and uses newer compression algorithms to allow longer recording times in the same space

Uses for digital cameras include…

Textures and Objects for Presentations

Digital cameras are great for recording textures for Web sites/3D models and presentations. You can also shoot exactly the objects you need, such as your business' products, to use in Powerpoint presentations on your laptop.

Create Graphics for Web sites

Because digital photos are electronic, you can use your digital camera to create your own photos and graphics for your Web site, if you have one.

Create Virtual Reality Tours

Digital cameras are also good for creating virtual reality tours of you're your home or business to present on the Web or to clients via a laptop computer

Create Digital Photographic Art

Using a combination of your digital camera and more sophisticated photo editing software such as Adobe Photoshop, you can get creative and produce your own artistic creations–photo montages, blends, screen savers and wallpapers

2D Scanner

Colour scanners typically read RGB (red-green-blue colour) data from the array.

Colour depth varies depending on the scanning array characteristics, but is usually at least 24 bits. High quality models have 36-48 bits of colour depth.

Another qualifying parameter for a scanner is its resolution, measured in pixels per inch (ppi)

The third important parameter for a scanner is its density range (Dynamic Range) or Drange (see Densitometry). A high density range means that the scanner is able to record shadow details and brightness details in one scan

Drawing Standards, Protocols and Conventions

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Knowledge and skills in applying: Recognised standards, protocols and conventions in engineering and construction drawings, including line types, symbols for sections, including stepped sections according to context, display variances in use of scale, detail, layout, measurement, layering functions, materials and symbols, tolerances.	
Standards, protocols and conventions in engineering and construction drawings, including line types, materials and symbols.	Write briefly describing the Audiences, Purpose and Benefits of: Standards, Conventions and Protocols in engineering and construction drawing: *Standards, Protocols and conventions in engineering and construction drawings exist to allow absolute coherence and universality across all technical graphic audiences. Technical Audiences could include, but are not limited to, the following:* • Designers • Manufacturers • Architectural technicians • Landscape architects • Construction trades • Building/Quantity surveyors • Consultant engineers • Architects *Protocols and standards exist to eliminate ambiguity within engineering and construction drawings. As drawings will be used by and produced for a number of graphic audiences certain rules must be followed to allow for clear understanding.* *Technical drawings can also be used for a variety of purposes and may require more than one company/audience input meaning working drawings could be edited/formatted by different people. Standards, conventions and protocols allow for this to happen as drawing conventions create a universal language.* *Standards, Conventions and Protocols refer to BS 8888 which is British Standard for technical product documentation, geometric product specification, geometric tolerance specification and engineering drawings.*
Sections and stepped sections	Write briefly describing the Audiences, Purpose and Benefits of Sections and Stepped sections in engineering and construction drawing: *There is variety of sectional views than can be employed to aid the clarity and understanding of production drawings. For complex engineered objects there may be a requirement for multiple or even stepped/part sections these are commonly known as local or part section, half section, revolved section or removed section.* *Step sections are used when it would not be desirable to show a full section or multiple sections of the same object. Stepped or Partial sections allow the audience to see interior details without over complication. Partial Views can also be used to enlarge a detail from a section to improve clarity. The benefit of these drawings are to allow technical graphic audiences to draw relevant information from drawings with minimal confusion/ambiguity. Section drawings allow an interior view or internal information to be explored in orthographic views. Drawings should be clear and use standard conventions*.
According to context, display variances in use of scale, detail, layout, measurement, and layering functions	Write briefly describing the: Audiences, purpose and benefits of: scaling, tolerances and layering in engineering and construction drawings: Scaling: *Scale, in construction and engineering drawings, means the proportion or ratio between the dimensions adopted for the drawing and the corresponding dimensions of the object. Scaling is used in a variety of contexts in multiple technical graphic drawing types. Scaling allows drawings to be printed or published on smaller or larger scale. Most commonly drawings are "scaled down" to allow printing within the bounds of common paper sizes. "Scaling up" is usually associated with small details being explored/shown at a larger size to improve clarity. Scaling is not always possible, and users should not assume a drawing can be scaled to infer a dimension not labelled. This is bad practice and will often be noted on a drawing 'DO NOT SCALE DRAWING'.* Tolerances: *Tolerancing is the practice of specifying the upper and lower limit for any permissible variation in the finished manufactured size of a feature. The difference between these limits is known as the tolerance for that dimension. Tolerances are often used on manufacture drawings to allow for some movement in manufacturing accuracy. In practice, all dimensions are subject to tolerances. There are however, two distinct types to consider: functional and non functional dimensions. Tolerances will also be used when manufactured items go through quality control testing. Tolerances ultimately exist to allow 'breathing space' for objects to be manufactured as absolute accuracy is very difficult to achieve.* Layering: *Layering in construction and engineering drawings often refer to a drawing or CAD file being split up into specific parts. Layers are commonly used in architecture and construction drawings as a means of splitting up the vast amount of information that could be on any one CAD file. The use of layers allows users to switch information on and off as and when desired. This allows greater clarity while working on drawings and when printing drawings for specific audiences. The use of layers and layer management allows users to apply certain conventions to each layer for example line type, line weight etc. Layers also allow for multiple input to a drawing allowing easier sharing and multi user drawings.(NOTE layering can be used differently in a Commercial and Visual Media Context ref UNIT 2 Introduction).*

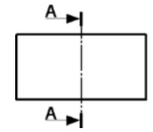
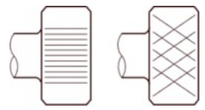
Discussed in Section 1:2

Discussed in Section 1:1

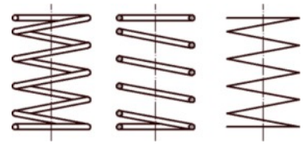
Technical graphic line types

These are the technical graphic line types that you should use in your work.

Outline solid	Projection line	Hidden detail line	Centre line
———	———	- - - - - - - - - - -	— · — · — · — · — · —
Continuous thick line for visible edges and outlines.	Continuous thin line for projecting between views.	Dashed thin line for hidden detail.	Long dash – dot chain line for centres of symmetry. Please note that BS308 (long dash – short dash chain) is also acceptable.

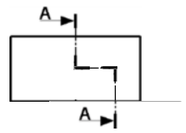
Fold line	Cutting plane	Knurling
— · — · — · — · — · —		
A thin double-dash chain line to indicate folds on surface developments.	Continuous thin line for projecting between views.	

Springs



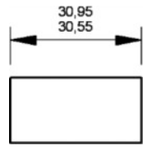
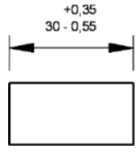
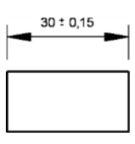
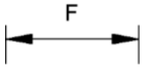
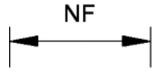
Cutting Plane for Stepped Section

This would be the cutting plane used to create a stepped section end elevation A-A on the left hand side.



Note the thicker lines where there is a change of direction

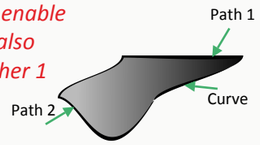
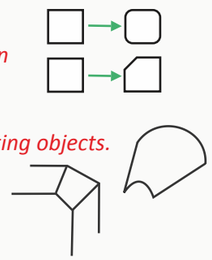
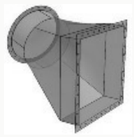
Tolerances

Common tolerance	Asymmetrical tolerance	Symmetrical tolerance	Functional tolerance	Non-functional tolerance
				
The **Common** method shows the upper limit of the size placed above the lower limit.	The **Asymmetrical** method shows the nominal size plus the upper and lower limits of the tolerance.	The **Symmetrical** method shows the nominal size and the symmetrical tolerance expressed as a plus and minus.	A dimension that is **essential** to the function of a component or space.	A dimension that is **not essential** to the function of a component or space.

For the rest of this document refer to the SQA website: Graphic Communication Standards and Conventions : Information and support for candidates READ the WHOLE document. You will be expected to know it all for ADVANCED HIGHER

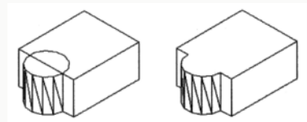
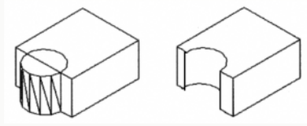
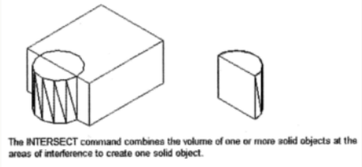
COMPUTER-AIDED DESIGN & DRAWING

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

Topics	Information Gathered
Knowledge and skills in applying: Recognised techniques, customs and practices across 3D modelling and 2D drawing software, including drawing and editing commands and terms	
Recognised techniques, customs and practices across 3D modelling and 2D draw software, including drawing and editing commands and terms. Standard 2D draw commands including import and export.	Describe the use and benefits of the following 3D CAD techniques: **Morphing:** *The simplest way of looking at Morphing is to imaging that your 3D model is surrounded by a mesh which you can pull, stretch, scale etc. Morphing can be used to manipulate your 3D design so that it can be manufactured effectively - for instance, smoothing out a bottle design so that it can be blow moulded. Morphing can also add strength to areas which, under testing show weakness.*
Standard 3D modelling techniques and including **morphing**, **extrusion along a path (sweeps)**, **regular** and **irregular fillets and chamfers, lofting, blending** and **surface modelling**. Techniques in the production of orthographic and pictorial work using computer-aided design	**Extrusion along a path (sweeps):** *Sweep is a 3D command to enable a profile to follow a path (like a handle on a cup). Sweep can also generate surfaces where a curve is created and can follow either 1 or two paths (used to create body work for vehicles).*  **Regular** and **irregular fillets and chamfers:** *A fillet is a curve to smooth off an edge. A chamfer is a 45 ° cut on an edge an irregular version of either of these describes tapering or adjusting the size or angle at either end of the feature.* *This is especially useful when applying these features to intersecting objects.*  **Lofting, Blending:** *Lofting is creating surfaces or solids between 2 or more profiles/curves on different work planes. This feature is particularly useful when creating transition pieces (prisms or pyramids with different shapes top and bottom). Classic examples of lofting are toilets or wash basins or ducting like the extractors in the workshop.*  **Solid and surface modelling** (explain the difference between the two techniques) **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:** *(Explain the difference between surface and solid 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.*

Computer Aided Design

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

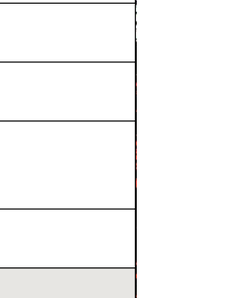
Topics	Information Gathered
CAD Techniques	
The use of polygons in the production of 3D graphics, including Boolean functions of add, subtract and intersect, slice.	List of CAD Illustration techniques: explain and describe the benefits of: Use of polygons in the production of 3D graphics. *Polygons are 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.* Boolean functions of **add**, **subtract** and **intersect**, **slice:** Sketch and annotate simple graphics which explain these Boolean operations **Add:**  *Add allows the user to combine the total volume of two or more solids or two or more regions into a composite object.* **Subtract:**  *Subtract allows the user to remove one volume of two solids or one of two or more regions into a composite object.* **Intersection:**  *Intersect allows the user to create a composite solid from the common volume of two or more overlapping solids. INTERSECT removes the non-overlapping portions and creates a composite solid from the common volume.* **Slice:** *Slice allows for a solid model to be clipped along a work plane to show a sectional view in the modelling mode using the sketch plane.* *This can allow for you to utilise project geometry mode of parts that can't be seen normally.*

Graphic types

The three graphic types are **Preliminary, Productions and Promotional Graphics**

The table below shows how these graphic types fit into the **design process.**

Stages	Graphics Types		
	Preliminary	Production	Promotional
Research			
Analysis			
Generating Ideas			
Final Idea			
Manufacturing Detailing			
Evaluation			
Marketing/Sales			



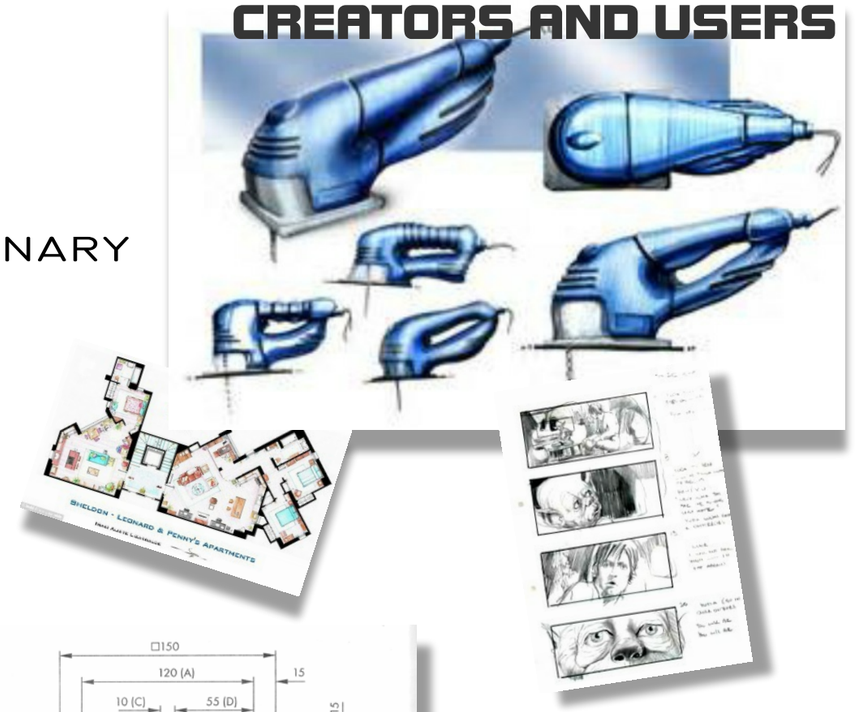
Preliminary graphics are normally done using manual graphic techniques. However as the quality of graphic tablets and sketch software improves even preliminary graphics are changing with the digital revolution. Check out hardware such as Wacom tablets and software such as Sketchbook Pro, 3ds Max, Mari 2.0. (http://www.animationcareerreview.com/articles/top-20-most-essential-software-artists-and-designers?page=0,1)

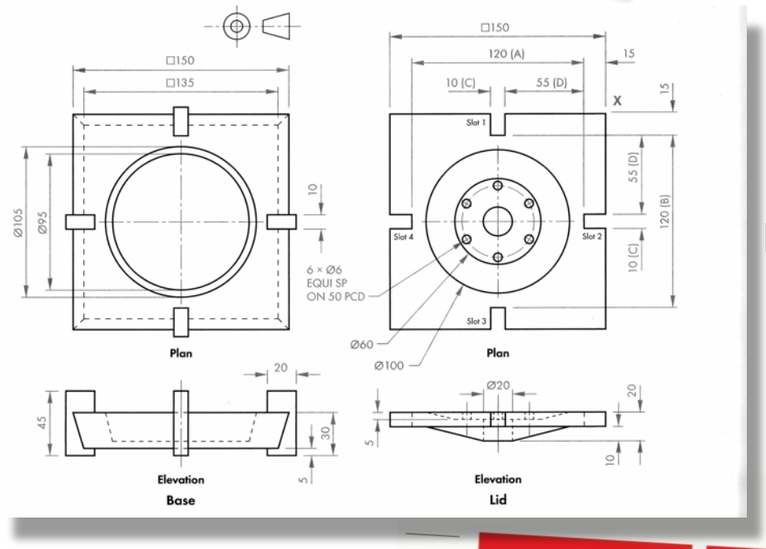
Production graphics can be produced using AutoCAD (2D drawing) software (and this is still the preferred method in some industries such as building and architecture) but 3D modelling software is generally used to produce models and then production graphics are generated from the model. Remember production graphics can now include animations. Basically production graphics are any graphics that make the manufacturing, assembly and maintenance of a product possible.

Promotional Graphics are normally produced using Desk Top Publishing software. Items such as magazines, leaflets, posters, point of sales displays). However there is a crossover between 3D modelling software, Illustration software (such as Adobe Illustrator, Photoshop) Visual effects software (Maya) and DTP software (Ser-

Examples of Graphic Types

Preliminary





Production

Promotional

Preliminary, Productions and Promotional Graphics

The table below shows how these graphics fit into the **design process and some professional who would make use of them.**

Type of Graphic	Purpose	Who produces them
Preliminary Graphics		
Freehand Sketching	to generate and compare concept ideas	designers and architects
Market research charts	graphs or tables showing results of consumer surveys providing information to the design team	marketing and sales teams
DTP thumbnails, roughs and visuals	sketches and drawings used to **plan** promotional publications such as advertising leaflets and posters	graphic designers
Production Graphics		
Orthographic Drawings including sectional views, exploded views, assembly drawings and surface developments (see Drawing Types)	Fully dimensioned drawings (usually CAD drawings) used in the manufacture and assembly of a product. Dimensions have what are called tolerances (an allowable margin of error)so that parts are neither to	Design engineers and draughtsmen and women
Location Plans, Site plans, Floor plans and sections	Scaled and fully dimensioned and toleranced building drawings give builders, joiners, electricians and construction engineers the information they need to construct a new building or structure	Architects and architectural technicians.
Promotional Graphics		
DTP * Proofs	In publishing a camera ready copy (i.e. a completed desk top publishing document which is then photographed) is needed before a publication goes to print.	graphic designers and printers
Illustrations, rendered 3D models, animations, photographs, some types of graphs and charts	These are used in promotional materials such as sales brochures, instruction manuals, advertising leaflets	Graphic Illustrators and Graphic Designers

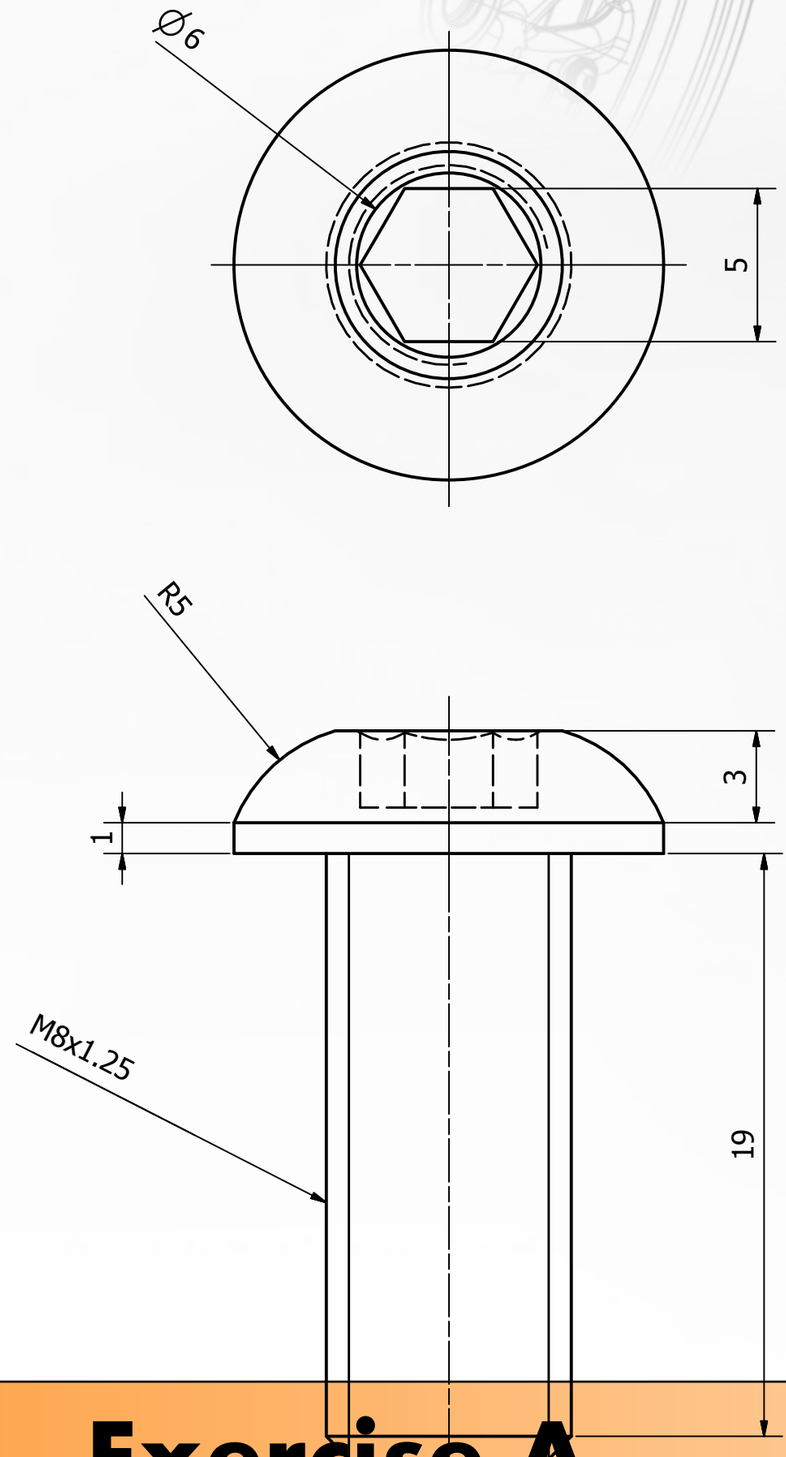
* **DTP: Desk Top Publishing**

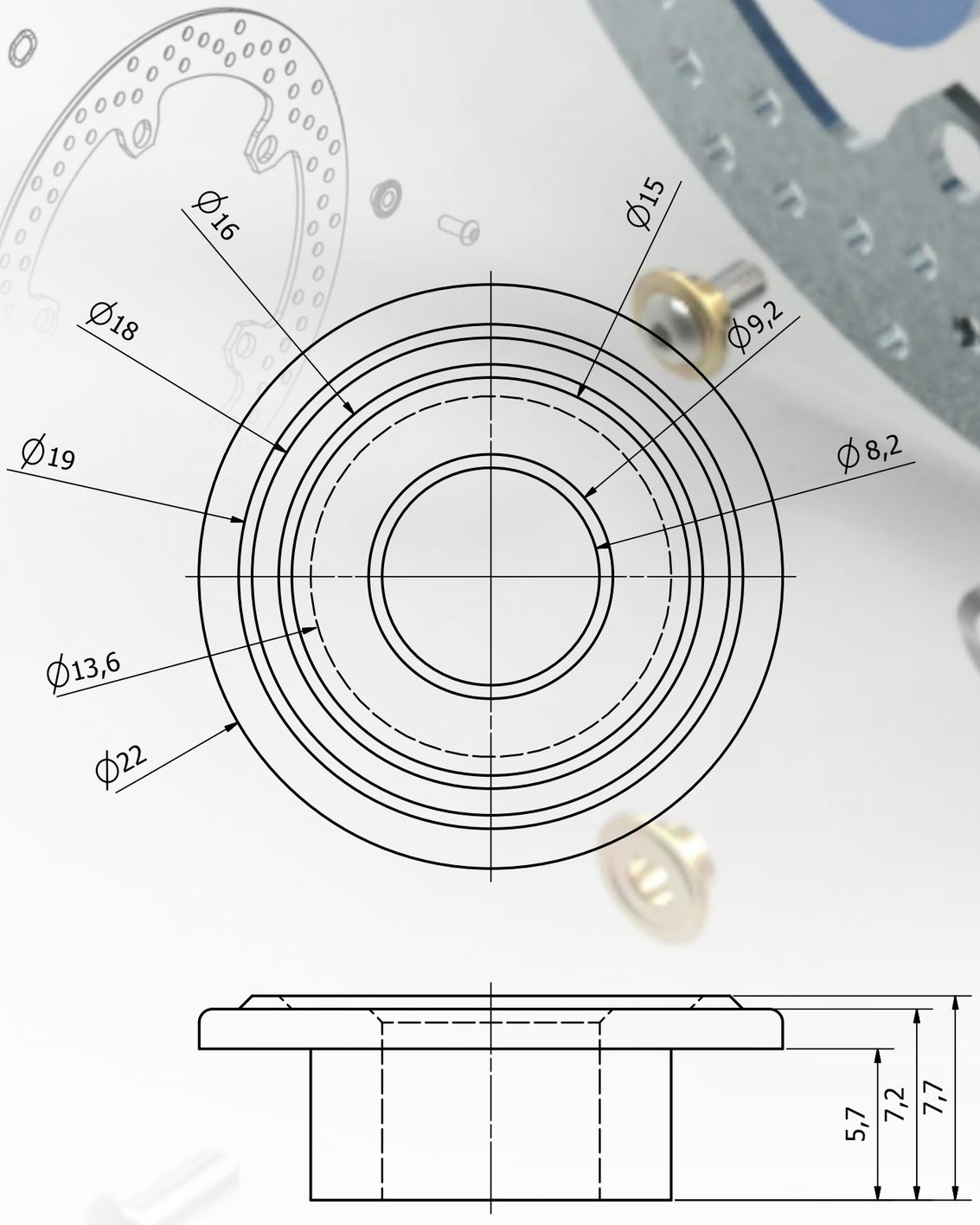
Homework 1: Using Technical Graphics

You could refer to the techniques in the A3 Higher Graphic Communication Technical Graphics Booklet.

Exercise Copy and complete the table in your jotter explaining the purpose of each of these graphics and how they might be used by a professional

Graphic Technique	a What is its purpose? b A Professional user?
Orthographic Drawings	**a** Production graphic that shows different views of the same object. Their purpose is to show the objects dimensions and and additional information to support the manufacture of the product. This includes information on scale, type of projection (e.g. third angle), units and tolerances and could include materials, surface finishes, centres of gravity etc. **b** manufacturing engineer: to ensure the correct sizes, tolerances of each part.
Exploded View	
Assembled View	
Half section	
Enlarged View	
Isometric	
Perspective	





Exercise A

1. **Identify what is missing from this B.S. Production drawing , ignore any missing dimensions (6 marks)**

Floor Plan

Site Plan

Location Plan

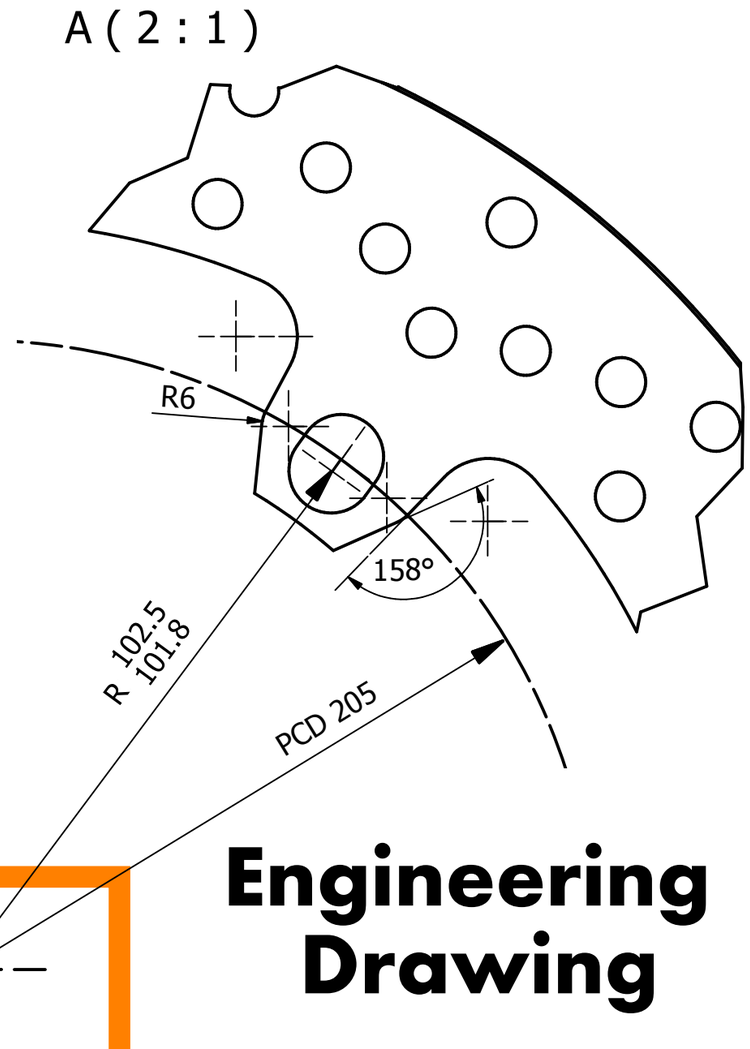
Construction Drawings

Knowledge and skills in applying:

Recognised
- standards, (e.g. British Standards)
- protocols (e.g. use of a title block) and
- conventions I(e.g. use of third angle projection) in **engineering** and **construction** drawings,

including …
- line types,
- symbols for sections, (including stepped sections)

According to context understand variations in…
- The use of scale,
- The amount of detail (enlarged views)
- Layout,
- Measurement,
- Layering functions,
- Materials and
- Symbols,
- Tolerances



Engineering Drawing

Homework 2: Interpreting Technical Graphics

Complete in your jotter

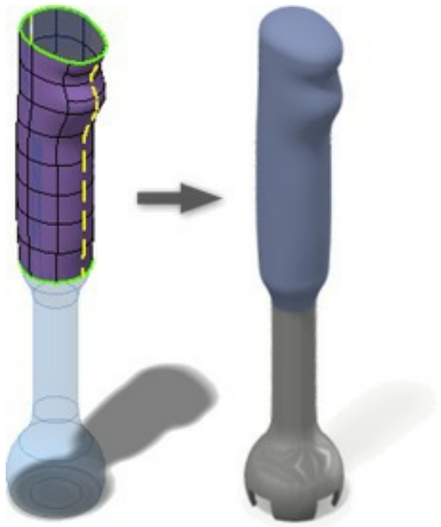
1. Give a reason why a different scale would be used in each of the construction drawings.
2. Explain the different layers likely to be used in the site plan drawing
3. What symbol is missing from both the site plan and the location plan and explain why this is important
4. Identify all the B.S. symbols, line-types and conventions used on the engineering drawing

Techniques used to generate 3D computer models

Autodesk 2016 Advanced Higher.

Files you must know how to create

morphing



Use powerful new commands and workflows in the Freeform modeling environment. Some of the highlights are:

Work with open surfaces or closed shapes.

Convert existing model faces to freeform geometry for shape refinement.

The new Freeform Thicken command creates solids, offset surfaces, or shell walls.

Unweld edges to split and move a freeform body segment.

Delete faces.

Note you must use the term morphing in the exam (no not use Freeform)

Sweep (also known as Extrusion along a path)

Note this technique can be asked about at Higher but is more likely to feature in in the advanced higher project and exam.

Projects a single sketch profile along a single sketched path.

The path can be open or closed.

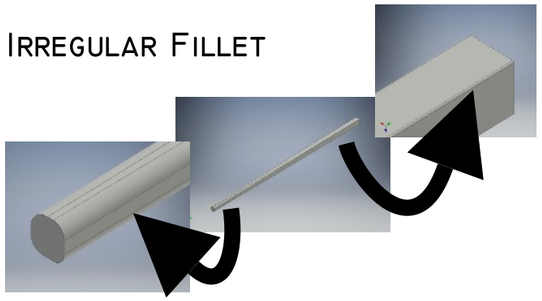
A sketch profile can contain multiple loops that reside in the same sketch.

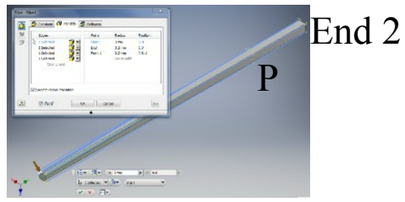
Can create a body.

Surface Modelling

You should be aware that it is possible to create surfaces rather than solids. For example you might create a a thin material, or some sort of casing as a surface rather than a solid. To do so you would use the commeands shown on the right

Irregular Fillet





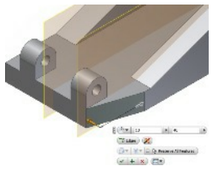
A irregular fillet is one there the radius changes along the length of a product. In this example of a chop stick one end is nearly round and the other almost square.

When fillet is selected the variable tab is clicked and radius at one end is enters and the radius at the other end are entered. If the the radius changes at a a particular point along its length than this value can be entered.

In this example the irregular fillet ends at Point P and a regular fillet runs from point P to end 2.

Irregular Chamfer

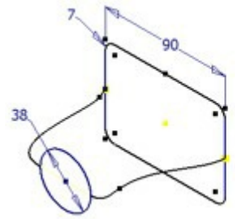
Start the Chamfer command. Select the Two Distances option from the fly-out button on the mini-toolbar.



In the left value input box in the mini-toolbar, enter a value of 13 mm for Distance 1, and a value of 40 mm for Distance 2 in the right value input box. Click the Edges button and select the vertical edge on the outside of the part. If your preview image does not look like the preview in the following image, reverse the values for the distance input, or use the flip direction arrow to reverse the reference face.

Loft/ Blend

Note this technique can be asked about at Higher but is more likely to feature in in the advanced higher project and exam.



Constructs features with two or more profiles.

Transitions the model from one shape to the next.

Aligns the profiles to one or more paths.

Can create a body.

Computer Aided Design and Illustration

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

Topics	Information Gathered
CAD Techniques	
The use of polygons in the production of 3D graphics, including Boolean functions of add, subtract and intersect, slice.	List of CAD Illustration techniques: explain and describe the benefits of: Use of polygons in the production of 3D graphics. *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.* Boolean functions of **add**, **subtract** and **intersect**, **slice:** Sketch and annotate simple graphics which explain these Boolean operations **Add:** *Add allows the user to combine the total volume of two or more solids or two or more regions into a composite object.* **Subtract:** *Subtract allows the user to remove one volume of two solids or one of two or more regions into a composite object.* **Intersection:** *Intersect allows the user to create a composite solid from the common volume of two or more overlapping solids. INTERSECT removes the non-overlapping portions and creates a composite solid from the common volume.* The INTERSECT command combines the volume of one or more solid objects at the areas of interference to create one solid object. **Slice:** *Slice allows for a solid model to be clipped along a work plane to show a sectional view in the modelling mode using the sketch plane.* *This can allow for you to utilise project geometry mode of parts that can't be seen normally.*

Computer-aided Illustration

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

Topics	Information Gathered
Knowledge and skills in applying: Professional use of rendering technology to create scenes or illustrations with visual impact	
Including the use of texture mapping, bump-mapping, lighting, reflection, specularity, ambience, depth-of-field, Image Based Lighting/High Dynamic Range Imagery (IBL/HDRI) and volumetrics	List of CAD Illustration and lighting techniques: explain and describe the benefits of: **Texture mapping**: *Used by CAD Technicians Texture Mapping is the process of applying a 2D pattern or texture to a 3D object. The 2D bitmap image is 'wrapped around' the 3D object similar to applying wallpaper or paint to a real object. The software will distort the pattern or detail on the image so the detail appears to be correctly applied. Benefits of this include the production of realistic renderings which enhance the realism of a 3D CAD model. It Allows the designer to visualise the finished product.* **Bump-mapping**: *Used by CAD technicians Bump Mapping is the process of applying a texture to a particular surface. In its simplest form each pixel within the image has its own designated level of brightness which creates the appearance of light shining down the edge or the creation of a shadow. By turning each pixel into a vector the level of brightness can be changed as the software carries of a series of calculation to create the desired effect. For more complicated textures within the gaming industry more complex calculations are required. Benefits include the ability to create complex scenes and environments in the gaming and architectural industries* **Lighting techniques:** **Reflection**: *Light that is bounced of an object or subject, the light retraces back into the same medium, meaning that it must bounce off at the same angle that it was initially generated. Some surfaces reflect better than others, a shiny metal object will reflect light better than a darker dull wood surface. A darker object will absorb more light meaning less light that is reflected. This will allow engineers to create realistic rendered images of products.* **Specularity:** *This determines the level of reflectiveness a particular surface has, working with bitmap images white pixels will provide full specular highlights and black remove the highlights completely. Adjusting the levels of the specular highlight will determine how reflective the appeared image is, equally an object can be made to appear glossy and or blurry in its reflection by changing the level of specular reflection. If a surface is deemed to be rough, it will spread the light out more meaning it will have a blurred reflection.* **Ambience (ambient lighting)**: *Ambient or Available light is a source of light which is used for providing an area of a 3D environment with a constant illumination. Ambient lighting applies the same lighting, of a fixed intensity and fixed colour, to all surfaces. Ambient lighting appears to have no particular source and no particular direction. This style of lighting is mainly used to provide an environment* ***with a simple form of lighting,*** *it can look bland and is generally not used when completing dramatic rendered views in CAD packages.* **Depth-of-field:** *DOF is the distance between the nearest and farthest objects within an image. The primary purpose of the depth of field is as a visualization aide, for improving the understanding of the relationship between objects in a 3D projection. The applications of depth of field include visualization of highly complex data sets, such as CAD designs and file structures. Depth of field has the potential for being an intuitive way to increase the users sense of depth in both projected and immersive environments* **Image Based Lighting/High Dynamic Range Imagery (IBL/HDRI)**:*IBL is the process of illuminating objects and scenes with objects from the real world. It allows you to light your scene by applying an HDR image to a virtual sphere that encompasses your scene or environment. This is particularly useful if you want your object to appear in a real environment. When using the HDR image the reflections used on this environment will also appear on your model.* **Volumetrics:** *Volumetric rendering refers to a technique for generating a visual representation of data that is contained in a three dimensional space (volume). It is used to render objects based on their complete structure as opposed to the surface render. These type of renders are used within the scientific and medical professions. Particularly good for rendering of smoke in the games based industry.*

Getting to know Technical Graphic Audiences

Technical Graphics: Built Environment

Audiences:
Designers, architects, architectural technicians, landscape architects,construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model-makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public

Types of graphic they are most interested in

- Elevation views (i.e. orthographic views of buildings/structutres)
- Sectional views
- Topographical views (i.e. views showing contour lines, neighbouring waterways, drainage etc)
- Floor plans
- Site plans
- Location plans

File types they might use

- Standard Tessellation Language/stereo lithography file format (STL),
- Direct Exchange Format (DXF),
- Drawing Format (DWG),
- Virtual Reality Modelling Language (VRML)
- 3D Studio (3DS) files

Section 1.1

Technical Graphics: Manufacturing and Engineering

Audiences:
Designers, Consultants, Engineering trades (civil, structural, electrical, mechanical, structural, systems)
Manufacturers, fabricators, model makers, test labs, materials technologists, specification/conformity engineers, suppliers, production and planning.

Types of graphic they are most interested in

- Orthographic views (individual parts, assemblies and possibly exploded views)
- Pictorial views (isometric, perspective, planometric and/or oblique including parts, assemblies and exploded views)
- Sectional views
- Cutaways
- Auxilliary views
- Enlarged views
- Assembly animations

File types they might use

- Standard Tessellation Language/stereo lithography file format (STL),
- Direct Exchange Format (DXF),
- Drawing Format (DWG),
- Virtual Reality Modelling Language (VRML)
- 3D Studio (3DS) files

Section 1.2

Commercial and Visual Media Graphics

Audiences
graphic designers, artists, sales and marketing, public, community, advertising, creative industries, retailers, cinematic, television, electronic and interactive media, animation, web designers

Types of graphic they are most interested in

- Printed media e.g. brochures, leaflets, pull up banners, magazines, posters, points of sale in retail
- Digital media e.g. websites, apps, digital displays including interactive displays, television/videos, cinema, creative industries including games design and advertising

File types they are most likely to use

- Joint Photographic Experts Group (JPG),
- Portable Network Graphics (PNG),
- Bitmap Image file (BMP),
- Portable Document Format (PDF),
- Adobe Illustrator file (AI),
- Windows Media Video (WMV),
- Audio Video Interleave (AVI),
- Third Generation Partnership (3GP),
- Apple QuickTime Movie (MOV),
- Moving Picture Experts Group (MPEG),

Unit 2

Exercise B

1. **Create a one note account (microsoft 365 free on GLOW) or keep a record in your jotter: write a one sentence job description for each of these professionals (refer to the next page to get you started).**
2. **Create a pinterest account (android and apple apps available) and collect images or sketch out examples in your jotter, of each of the types of graphics these audiences would be interested in**

Unit 1 :
Technical Graphics

Section 1.1 Built Environment

- Creators and Users
- Planning Drawings and Surveys including

Drawings: floor, site and locations plans, elevations, sections and illustrations.

Surveys: Drainage Surveys, Underground Surveys, Feature Surveys and Topographical Surveys.

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users	
Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their work. Creator 1: **Architect** *Designs 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.* User 1: **Construction trades** *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.* Creator 2: Building surveyors *Measures 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.* User 2: **Conservation bodies** *UNESCO World Heritage, Historic Scotland. Edinburgh's New Town is a UNESCO World Heritage site which protects the architectural heritage of the New Town. George Heriot's School (old building) is a grade A listed building. This grading is assigned to protect the most architecturally important buildings in Scotland.* Graphic types required: *Conservation bodies may hold historical drawings and information of some listed buildings. May provide mapping of an urban area and comment on its architectural character and heritage for planning consultation.* Creator 3: Consultant Engineers: Graphic types required:

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users	
Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their work. Creator 4: **Interior designer** *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.* Creator 5: **Production and planning** *Production: detailed construction information (drawings and schedules) in order to assemble a building. Planning: the creation of Gantt charts (usually by an Architect) to plan out the stages of construction.* Graphic types required: *Production: technical detail drawings that inform construction including Location, Site & Floor Plans, sections, elevations and details at a range of scales from 1:50, 1:20 and 1:5. Planning: gantt charts are typically produced on Microsoft Excel.* Creator 6: **Architectural Technicians** *Will 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. Printer /plotter.* User 3: **Prospective purchasers :** *Potential end users of a building development who can be consulted during the design stage to influence the specification of certain elements of a project. i.e. home buyer purchasing a new house 'off-plan' specifying what kitchen they would like.* Graphic types required: *View (floor) plans, sections, elevations and rendered visuals of proposed developments.*

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users	
Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their work. Creator 7: **Quantity Surveyor** Graphic Types required: *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.* User 4: **Suppliers** Graphic Types required: *Produce highly technical graphic information to communicate how their product, i.e. a window system, is manufactured and can be constructed. Will produce 3D CAD models to communicate how components fit together along with detailed 2D production drawings to inform the manufacture of their product. Will also work with Architects and engineers to design bespoke components. Will produce details at a scale of 1:10 to 1:2 showing how their product or system is constructed and can be installed.* Graphic Technologies required: *3D modelling and rendering software (Sketch Up, Rhino, Autodesk Revit, 3D Studio Max, Maya, Inventor and many other software packages). 2D Drawing software (Autodesk AutoCAD, Vector Works, Microstation etc.) Files will generally be emailed between suppliers and Architects, Engineers and clients.* User 5: **Town planners** Graphic Types required: *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 for the interior space of the building. In major developments, physical 3D models are built in order to sell the development to the client and the public.*

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users	
Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their work. Drawings are usually received physically in packages which are then scanned in to a computer system and uploaded onto a planning portal website for the public to view and comment on. Creator 8: **Building Surveyors** Graphic Types required: *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 file.* User 6: **Communities** Graphic Types required: *Consulted with to give input into new developments. May be invited to attend consultation events whereby developers and some members of the design team, principally architects, present drawings depicting what a new development is going to look like and how it is going to impact upon the local community. Drawings are typically those used for planning purposes (location and site plans, building plans, elevations and rendered visuals produced from 3D CAD models).* Graphic Technologies required: *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.* Creator 9: **Model makers:** *Makes physical scale models of proposed building designs which are typically made from card, wood, mount board, plastics. May also build 3D CAD models and create physical models via-rapid prototyping.* Graphic types required: *Measures plans, sections and elevations (produced by Architects) to get the correct sizes to build scale models of the proposed building.*

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users	
Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their work. Creator 10**: Production Engineer** Graphic Types required: *Freehand sketches, initial computer sketches, initial computer models, 3D computer models, Manual drawings (drawing board), Orthographic drawings (assembled and parts), Technical detail drawings (sections etc), FEA Analysis, Exploded pictorial drawings, 3D prints, Animations, Flow diagrams, Parts lists, Model plans, tolerances, material details, systems diagrams, operation diagrams, instruction manuals, safety signage.* Graphic technologies required: *CAD packages (2D, 3d or multifunctional), 3D printer, animation packages, graphics tablets, digital photography, tablet computers, personal computers, printed materials (books, manuals etc), industrial printers, drum plotters. A Production engineer is mainly concerned with the efficient and safe production of whatever they are manufacturing, their interaction with graphics is both in relation to the products being manufactured and also the maintenance of the machinery used. They may use digital and print media in the process of production, both for direct production reasons and also to enhance quality and efficiency of the process. They need a complete understanding of the product.* Creator 11: **The General public** Graphic Types required: *Promotional materials such as brochures, leaflets, instructions, adverts, magazines, posters. Digital media such as Websites, digital publications, digital instructions, CD covers, DVD covers, Packaging, Logos, signage, digital applications, Digital interfaces,physical interfaces, wayfinding, animation, animated films, entertainment* Graphic technologies required: *Tablet computers, personal computers, actual signage (vinyl, etched etc), Print media (on paper or packaging), Televisions, Digital media players, 2D interfaces (digital lecterns, phones, tablets etc), physical interfaces (from cars to coffee machines to ATMs), Paint.* *The General public use graphics every single day, from getting from place to place to making a phone call. Without thinking about it they interact with graphics in both simple and sophisticated ways, the general public are very aware of when graphics work and when they don't, they understand when an interface is intuitive, they react to a well designed graphic on packaging and they can appreciate a well animated movie, the converse is also true. They may not have the technical understanding of how the graphics are generated (or care) but they have sophisticated and varied tastes.*

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Planning drawing: Knowledge of the use of: ● electrical drawings, plumbing drawings, drainage surveys, underground surveys — storm water, foul water, services, gas, electric and telecommunications ● feature surveys; paving, seating, lighting ● topological surveys; standards, layout and use	Investigate and prepare brief notes on the following planning drawings: Who will produce them, who might use them, what content do they have and how are they produced. **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.* **Drainage surveys:** *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.* **Topographical Surveys:** *Topographical survey is used to create maps containing details of the land and the features on it. These include natural features such as trees, rocks and waterways , and man made ones like buildings, walls, fences, telecoms poles etc. The survey will also detail the contours of the land. A land surveyor (a specialist profession in it's own right) will make use of a variety of specialist equipment and GPS to take readings about the shape of the ground and the height and location of objects in and on it. The information gained from topographical surveys is used in construction for planning and building by architects, engineers and builders but may also be used by cartographers when preparing and updating maps.* **Underground Surveys** *Make-up of land in terms of geology, soil composition/mechanics, depth of bedrock, previous use, water table, any mining reports. All of this information will determine the suitability of the land for construction, the type/depth of foundations required and what type of constructions are possible on that type of land (eg. The skyscrapers in New York are only possible because of the solid bedrock under Manhattan Island)* **Feature Surveys** *Location of hard-standings. This survey may involve the locating and assessment of existing paving, lighting and seating. However it is more likely to be used to determine the most suitable type of new paving for type of land and the indended purpose (for instance mono-block driveways, slab pathways, concrete access ramps), lighting (e.g street lighting, security lighting, ground level lighting, nighttime illumination (lighting of Edinburgh Castle at night) and public seating (benches, individual seats, how decorative)*

Built Environment

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Topics	Information Gathered
Creators and users Creators and users - Knowledge and understanding of the roles and needs of designers, architects, architectural technicians, landscape architects, construction trades, building surveyors, quantity surveyors, consultant engineers, town planners, conservation bodies, communities, model makers, interior designers, suppliers, production and planning, prospective purchasers and members of the general public.	Select one creator and one user and describe the types of graphics and the types of graphic technologies they require in order to carry out their jobs. User 1 **Heating Engineer (example of a consultant engineer)** 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 heating system shows exact position of fixtures and fittings and lengths of pipe runs in 3 Dimensions.* User 2 **Interior Designer** Graphic types required and their purpose: *3D Renderings of proposed room layouts to show positions of furniture, doors, fixtures and fittings.* Graphic Technologies required and their purpose: *CFD Simulation software to simulate heat transfer in the room / building.* *3D Modelling software complete with rendering functions, texture mapping and lighting. IBL images could also be useful.*

Simulation in the Built Environment

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

Topics	Information Gathered
Simulation Knowledge and skills in the use of: ● digital testing methods, eg Finite Element Analysis (FEA) or Computational Fluid Dynamics (CFD) to simulate how parts of a 3D model would perform if produced in reality, mechanical animation	**Investigate and describe the benefits of the following simulation methods:** **Finite Element Analysis (FEA)** What is it? It is the digital testing of parts of a building used to test all sorts of mechanical components from roof trusses to steel beams and other load bearing members. I t is also to referred to as DigitalPrototyping and allows conceptual designs (new designs) the ability to be virtually tested. Architects and structural engineers use Digital Prototyping to design, test, optimize, validate and visualize their products digitally throughout the product development process. Innovative digital prototypes can be created via CAD to meet multiple design objectives (such as maximised output, energy efficiency, highest speed and cost-effectiveness) reducing development time and time-to-market. Marketers also use Digital Prototyping to create photorealistic renderings and animations of products prior to manufacturing. It gives product development teams a way to assess the operation of moving parts, to determine whether or not the product will fail, and see how the various product components interact with others. In a nutshell, FEA is determining how a solid body will respond to various forces applied to it. 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. **Computational Fluid Dynamics (CFD)** 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.

Construction Drawings, Symbols and Conventions

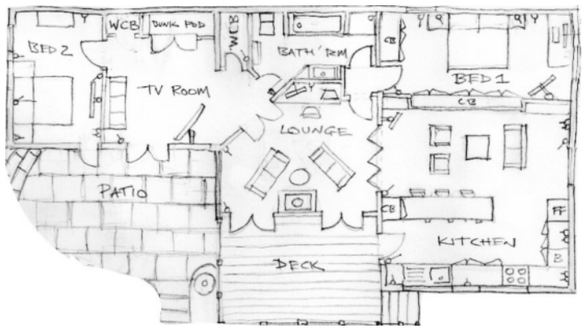
Construction drawing

Several types of specialised drawings are used during building projects. These are known as a **project set**, and include;

- Floor plans
- Site plans
- Location plans
- Elevations
- Sectional views
- Rendered illustrations

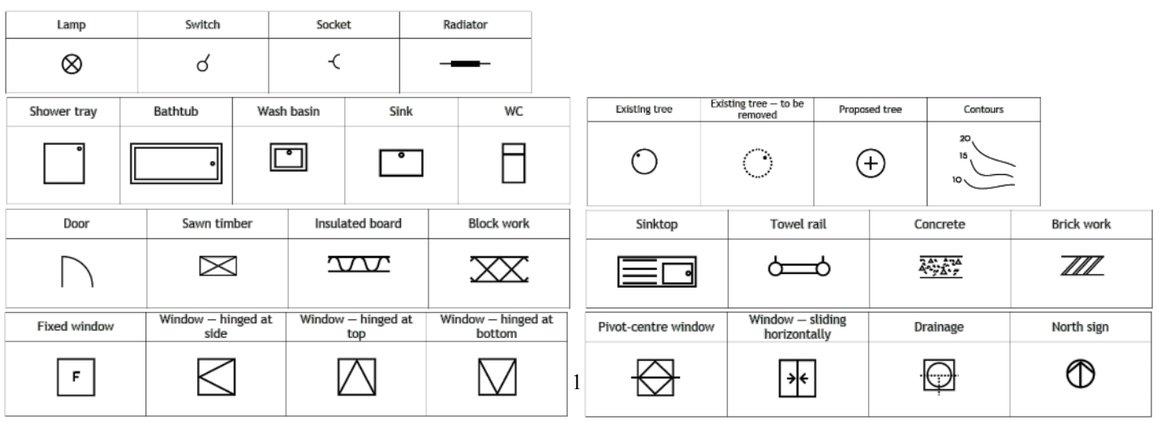
Floor Plan

This type of drawing shows the layout of the rooms inside a building and the position of the doors, windows and important fittings like a bath, sink and toilet. It is viewed from **above** and is used by all trades (bricklayers, plumbers, electricians, and joiners) to plan/ cost their work. Floor plans are generally drawn on a scale of **1:50**.



Floor plans may include:

- dimensions and layout of the rooms in the building
- the layout and positions of windows and doors
- the layout of bathroom and kitchen fixtures and fittings
- lights, light switches, electrical sockets, electric cables and fuse boxes
- the layout of water pipes (plumbing)
- the scale of the drawing



Site Plan

This type of drawing is concerned with one or more buildings which are within the same area and shows these buildings within their own **site** (or plot) boundary. The site plan allows the builder to mark out the site before digging trenches for foundations and drains. The scale is normally **1:200** for domestic buildings.

Site plans may include:

- boundaries of the plot
- the position (dimensions) of the building within the plot
- access paths
- drainage information for the removal of waste: pipe runs, manholes and the location of the main sewer
- contour lines to indicate the direction and gradient of sloping ground
- existing trees and the positions of any new trees that are required
- a north direction arrow
- the scale of the drawing

Location Plan

A Location Plan shows where the site is located within the local area. It shows road, outlines of buildings and site boundaries (garden boundaries). A new build in an existing street is highlighted by a thick outline and shading or colour.

The scale is normally **1:1250**.

Location plans include:

- all the neighbouring buildings and their plot boundaries
- street names and house numbers
- roads, pavements, footpaths, parks and fields
- a north direction arrow
- the scale of the drawing

Elevations

The planning department checks that the style of the building is in keeping with the local environment. Elevations are orthographic views of the outside of the building that enable these check to be made. The builder needs information about the style of the roof and the wall finishes while clients and customers also want to know what a building will look like. Elevations can provide this information.

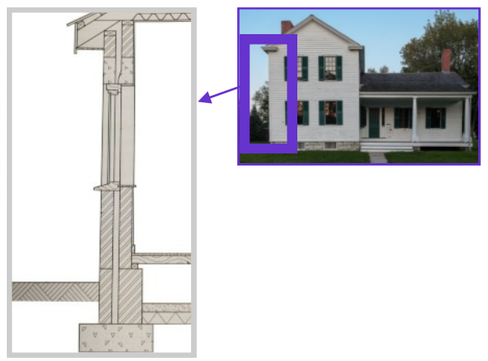
Elevations show:

- the style of the building (bungalow, villa, flat etc.)
- the external proportions of the building
- the external features of the building; window styles and wall finishes etc.
- the type of roof: gable hipped or flat roof
- the position of doors and windows from the outside

The scale is normally **1:100** or **1:50**.

Sections

Sectional views are detailed technical drawings showing a **slice** through a wall. The section is normally taken through a part of the building that will show most detail. In the example shown the section passes through a window. The detail in a sectional view shows the bricklayers and joiners how the building is to be constructed.



The scale is normally **1:20**.

Sections show:

- the material used: brick, engineering block, hardwood, softwood, concrete, insulation board and damp-proof membranes
- Construction details (how the various materials fit together)
- wall construction: brick and blockwork or brick and timber framed
- dimensions (especially heights and wall thicknesses)
- floor and ground levels inside and outside the house
- the design of the foundations and floor
- the design of the eaves
- the type, thickness and position of insulating materials
- the scale of the drawing

Rendered Illustration

Marketing the property for sale or for renting is a vital part of new building developments. Promotional documents will include illustrations of the proposed houses and floor plans showing the main room dimensions. To maximise the impact and realism, illustrations may be fully rendered and shown in mature surroundings; trees and shrubs are often included.

Promotional graphics will show:

- external views of the building
- coloured and rendered views that are easily understood and appeal to the consumer
- simplified floor plans enabling the consumer to determine which size of house will best suit the family's needs
- a new property in pleasant, mature surroundings
- text that explains the benefits of a particular property but does not get bogged down in technical detail
- prices

The illustrations may not be printed to scale but the proportions will be accurate.

Landscape Architects

Landscape architects create the landscape around us. They plan, design and manage open spaces including both natural and built environments. They work to provide innovative and aesthetically pleasing environments for people to enjoy, while ensuring that changes to the natural environment are appropriate, sensitive and sustainable. Their work can help clients visualise proposals for new designs by;

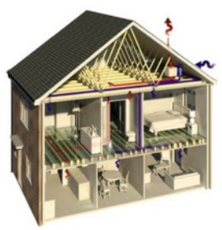
- Showing/communicating the location of different features in gardens, building complexes, open areas etc.
- Helping to visualise the ways in which spaces might be used
- Showing/communicating the materials that might be used in the solid landscaping
- Showing possible colour schemes/colour combinations
- Showing possible planting schemes
- Showing the position of critical features/buildings in relation to other surrounding buildings/areas.

Architectural Technicians

Architectural Technicians use their skills in science and engineering to help bring architects' construction ideas to life. They work on design plans, advise on the best use of building materials and monitor progress of projects. Furthermore, they prepare plans using computer aided design (CAD) software and can work on anything from extensions through to new designs for sports stadiums. Architectural Technicians will produce a variety of graphics, many of which will be used to communicate relevant technical data to the construction trades. Graphics will include information which;

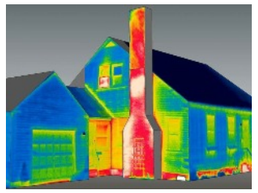
- Shows where structural elements will need to be built
- Shows where energy saving materials and/or features are required
- Indicates where services will be required
- Supports pricing/cost and labour calculations for estimates/bills and quantity
- Indicates where material junctions occur/materials converge or meet

Below are some examples of graphics produced by an Architectural Technician.



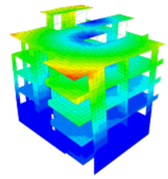
A 3D model of a house could also be used to evaluate aspects of the design, prior to construction. It could be used to calculate, evaluate or determine;

- Flood risk
- The strength of a part of the structure using FEA
- Ventilation and extraction
- Thermal efficiency
- Lighting and illumination levels

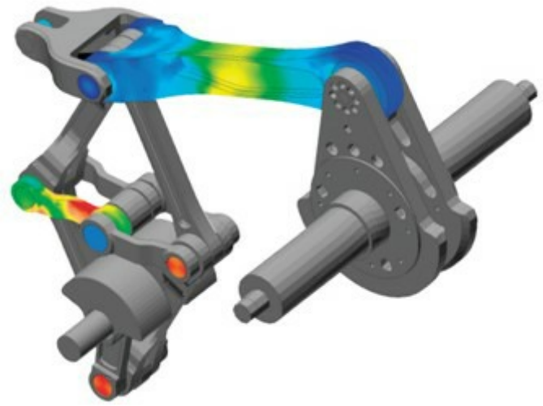


Finite Element Analysis (FEA)

FEA is a computational tool for performing engineering analysis. It can predict how a product/structure reacts to real-world forces, vibration, heat, fluid flow, and other physical effects. FEA software can be an excellent tool in construction projects to help make proposed buildings as safe and structurally sound as possible.



Finite Element Analysis is also regularly used in the testing of products. The image below, taken from Inventor software, demonstrates FEA being used on a mechanical feature to determine the level of stress/strain being exerted on individual parts of the assembly. See booklet labelled **Finite Element Analysis** for further information.

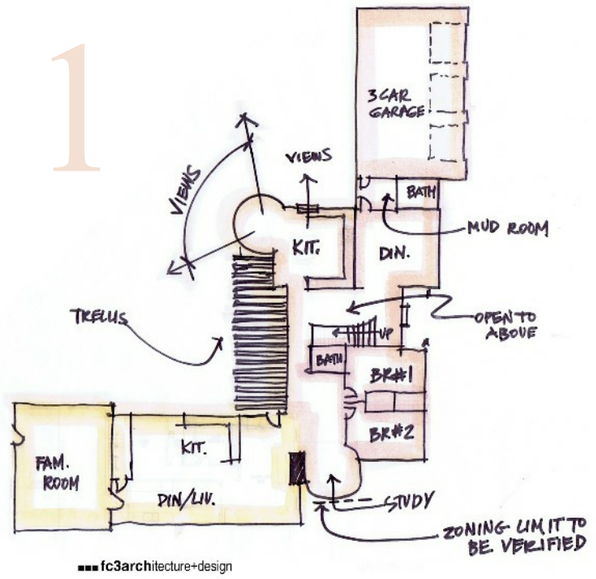


PLANNING DRAWING and the BUILT ENVIRONMENT

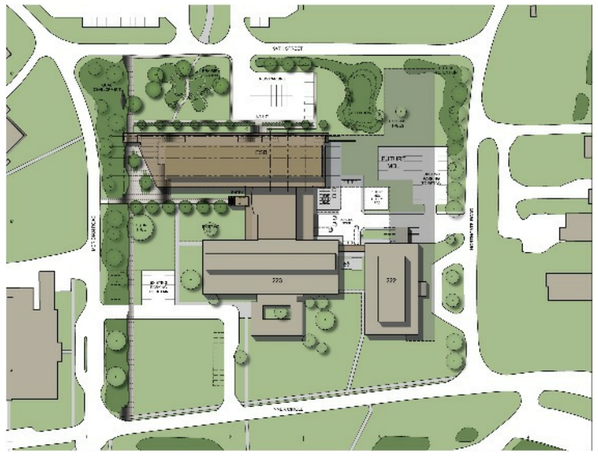
Job Title	Job Description	General information they require	Graphic information they produce/use
Architects	**Architects transform the client's brief and the outline specification into schematic drawings of the proposal.** They are involved in the planning, design and usually the construction phases of a build. They work alongside a team of Architectural Technicians, Structural and Services Engineers and others who produce the construction drawings required for a project. They ensure the building is structurally sound, meets planning limitations, building standards and fulfils the requirements of client brief. They work with Quantity Surveyors who are responsible for the building economics and completing the project on budget. The team must have a sound knowledge of material specifications and performance, construction methods and construction planning. Architects may be involved in the oversight of site activities, but this is often the job of a Project Manager and/ or Site Manager, depending on the size of the build.	• design brief > • building regulations> • budget > • environmental considerations > • economic factors > • construction methods> • health and safety > • construction materials	**The graphic information they produce>** • concept sketches> • mood boards of existing designs, materials, source ideas> • various drawings alongside the Architectural Technician (see below)> **How the graphic information is used >** • comparison of ideas> • preservation of ideas> • determining layout, orientation, materials function and technical performance
Architectural Technicians	Architectural Technicians support the architect in producing the detailed construction drawings.	Schematic drawings> • location plans> • site-plans> • floorplans> • elevations> • sections> • specifications	Detailed construction drawings for site use:> • location plans> • site-plans> • floorplans> • elevations> • sections> • specifications

Examples of graphics

1



2



Homework 3

Identify the category of the graphic shown opposite (i.e. which of the 3P's is)it most likely to be)

_____

Explain how this graphic has been enhanced to assist communication with the audience

What type of construction drawing is this

_____

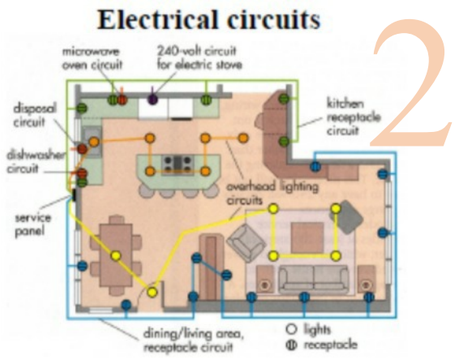
What additional information would it contain if it was to become a production graphic

PLANNING DRAWING and the BUILT ENVIRONMENT cont.

Job Title	Job Description	General information they require	Graphic information they produce/use
Landscape Architects	Landscape Architects support the Architect by producing the detailed landscape drawings.	Schematic landscape drawing (hard and soft) > • location plans> • site-plans> • vehicular and pedestrian access> • outline specifications for hard landscaping> • building elevations> • services drawings>	Detailed landscape drawing (hard and soft) based on the architect's schematic drawings and consideration of existing defining features:> • planting schemes on site-plans> • vehicular and pedes-trian access on the site> • Specifications for hard landscaping> • External drainage schemes >
Construction trades: electricians, joiners, plumbers, bricklayers, masons, services engineers, plasterers, tilers, > decorators, scaffolders, labourers	Skilled, semi-skilled or unskilled personnel.> Skilled – usually have served an apprenticeship of up to four years (time served)> Semi-skilled (eg scaffolders)> Unskilled (eg labourers)	Detailed drawings used by skilled trades	Sketches, using detailed drawings as a source of information for their own information or to pass on to other site operatives
Building > Surveyors	Usually involved in the operation of renovation projects, reconstruction and complex maintenance work on all types of buildings. Building Surveyors are qualified to degree level in construction techniques, materials, > materials' deterioration and building economics. Surveyors may specialise on one building type.	Schematic building and landscape drawings and specifications > • location plans> • site-plans> • vehicular and pedestrian access> • material specifications> • building drawings> • services drawings>	Detailed construction drawings for site use:> • location plans> • site-plans of existing and proposed construction> • floorplans> • elevations> • sections> • specifications

Examples

1



2

3

Homework 3cont

Exercises

Identify the category of the graphic shown (i.e. preliminary, production or promotional)

_____

Explain the purpose of the graphic shown

Describe the information an electrician could gain from the floor plan shown at 2

How would the electrical information be kept separate from the furniture information in a CAD drawing?

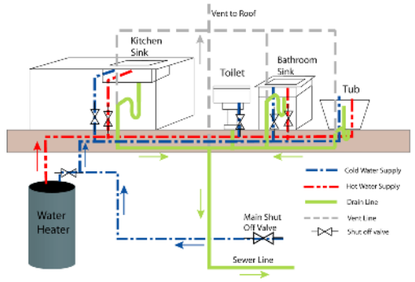
Explain why the sectional view shown at 3 might be included in a brochure aimed at potential customers.

PLANNING DRAWING and the BUILT ENVIRONMENT cont.

Job Title	Job Description	General information they require	Graphic information they produce/use
Quantity > Surveyors	Usually involved in the building economics of all types of buildings. Quantity Surveyors are quailed to degree level in construction techniques, materials, contracts and building economics. A QS will produce a Bill of Quantities and may be employed by the client and expected to liaise with the contractor's QS to agree the cost of the work completed in an agreed time period	All building and landscape drawings, specifications and forms of contract. Bills of quantities compiled from an analysis of building drawings	Detailed construction drawings for site use:> • location plans> • site-plans of existing and proposed construction> • floorplans> • elevations> • sections> • specifications
Consultant engineers (could include site engineers?)	Consultant engineers are quailed to degree level in their own discipline which may be structural, heating and ventilation, electrical or other special ism. Each provides specialist information to the architect based on the drawings of the building.	All building and landscape drawings and specifications	The consultant engineer will produce specialist drawings relating to their discipline. For example a structural engineer approves the structural integrity of a building or earth retaining structure.
Town Planners	Usually employed by a Local Authority to ensure that proposed developments meet the requirements of Town Planning directives. Planners works closely with Building Controllers – one deals with Planning rules and the other ensures that the building is constructed to meet Building Standards. Both are usually quailed to degree level in their related discipline.	All building and landscape drawings and specifications	A town planner will propose amendments to presented drawings
Conservation Bodies	Some bodies will have an interest in the conservation of the land e.g. building in a national park or area of outstanding natural beauty. So permissions for building will need to be granted by such groups .Some bodies will have an interest in the type of building (e.g. an historical building that is to be restored using traditional methods **or** a new building that must be built using local materials and fit in with the surround ings). Sometimes funding is available for restoration projects (e.g. a grant from Historic Scotland)	Information related to traditional building techniques. Examples of local buildings and samples of materials that must be used. Surveys that show impact on the environment including access roads, the impact of the building project as well as the impact when the building is used.	Detailed construction drawings for analysis by the conservation body> • location plans> • site-plans> • floorplans> • elevations> • sections>

Examples

1



2

3

4

Homework 3cont.

Explain why a section and a floor plan would be necessary when a quantity surveyor is costing a project.

A consultant heating engineer produced this schematic diagram (Image 2). What additional technical graphics would be required before the heating system could be installed?

What additional information would these technical graphics provide?

A shopping mall proposal is being displayed at a meeting for local residence. Explain why both graphics are required

What indications are there in this photograph that a Conservation body may have been involved in the planning process for both the building on the left and the courtyard area?

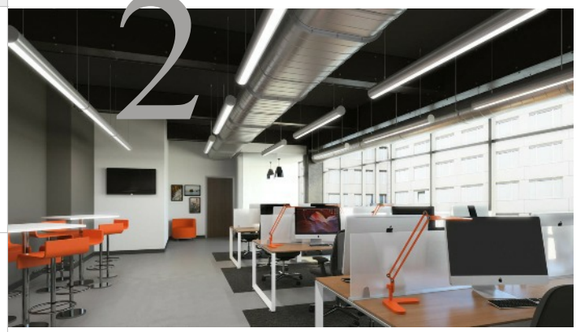
PLANNING DRAWING and the BUILT ENVIRONMENT cont.

Job Title	Job Description	General information they require	Graphic information they produce/use
Model Makers	Architectural model makers produce scale models of finished projects/buildings. Gives a stronger indication of how the building or environment will be used than can be visualised with a computer model alone.> Some model makers produce models for display purposes. They may be be shown in a visitors centre to explain a functional aspect of the design (e.g. Falkirk Wheel) or to show how it was built (e.g. the shard in London), > Some models are produced to be physically tested in some way, e.g. buildings in a wind tunnel or earthquake simulator. Although this is done more and more in a virtual environment physical testing is still necessary in some projects. > Model makers usually qualified to HND level	Scaled drawings of proposed Solutions solution.> Information on materials, and manufacturing/ modelling techniques	Detailed dimensioned drawings (orthographic views)> Computer Generated rendered images of proposed solution. photographs of similar models so model is an accurate representation of the finished design
Interior Designers	Interior designers may be qualified to degree level in interior design or a related discipline Their role is to liaise with the client and the architect and produce proposals for décor, finishes and furnishings based on the drawings of the building	Foorplans, 1 and 2 point perspective sketches and drawings and illustrations of interiors, mood boards, material samples	Production of visual in-formation for décor, fin ishes and furnishings based on the drawings of the building
Suppliers	Specialist suppliers may be nominated by the architect. More commonly a supplier is first contacted by a contractor to cost the materials or components to be used in a building based on the drawings, specifications	All building and landscape drawings,and specifications	Use of brochures, speci-fications or detailed drawings

Examples

1

2



3

Homework 4

Exercises

Explain what drawings would be required by he model maker to produce the architectural model shown at 1

Sketch one of these drawings in the space below

State the name of an audience that would make use of the CAD render of the office interior show at 2

Explain why **your chosen** technical audience would find a CAD render useful.

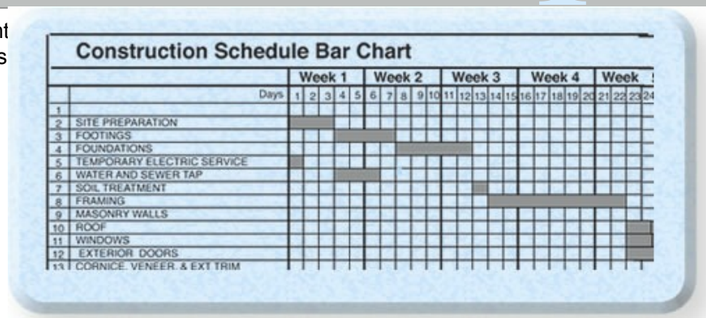
Explain why a floor plan drawing would be essential before confirming an order with a supplier of building materials?

PLANNING DRAWING and the BUILT ENVIRONMENT cont.

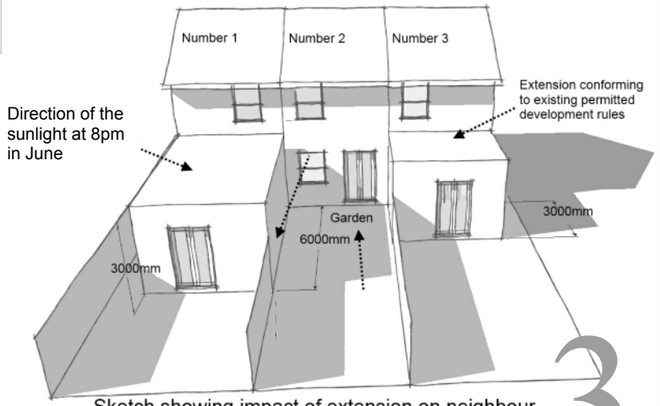
Job Title	Job Description	General information they require	Graphic information they produce/use
Production (managers)	Production, site, contract or project managers are appointed by the construction company to be responsible for the management of the site from inception to completion. They are responsible for planning the operation of the site to meet the programme set by the client. Many have a degree or higher qualification in construction management or come from a skilled trade background	All building and landscape drawing, specialist drawings and specifications	Propose amendment drawings based on s conditions or other unforeseen circumstances
Prospective purchasers (end users)	Designers should be particularly aware the size of groups that will inhabit buildings: workforce, families, individuals; the age of the users and users that have particular needs.	Site plans, property boundaries, diagrams maintenance procedures, operation manuals for heating , lighting, gas, electricity, water. etc	Site plan, floor plan. Users will be particularly interested in accessibility, roads, paths, lifts, stairs, width of doorways, corridors. They will be also be interested in the location of different rooms, features and the appearance or potential appearance of the interior, exterior.
General public	The general public may be particularly interested in public building like a hospital or a tourist attraction like the eiffel tower, or if the building has a specific impact on them (being a neighbour to a someones proposed new property)	Site plan. Elevations.	Site plan, elevations and other drawings contained in the planning permission document

Examples

1



2



Sketch showing impact of extension on neighbour

3

Homework 4cont

Exercises

Explain how a project manager would make use of a gantt chart during a building project?

A 'fly through ' annimation was produced for a homebuilder website. It was designed to help potentail purchases visualise the interior? Suggest a file type that would be suitable for this purpose?

In addition to the fly through graphic 2 was also produced What additional information does image provide that would not be clear from a fly though.

By interpreting the pictorial skectch 3, explain the objections to planning permission put forward by the resident of property Number 2

Section 1.2 Manufacturing and Engineering

For Creators and Users see previous section

- Simulation: including Finite Element Analysis and Computational Fluid Dynamics. Techniques used to simulate how a 3D computer model would perform in different situations helping designers make decisions
- CADCAM how to manipulate a model to prepare it for CAM production including 3D printing or manufacturing
- Knowledge about, and skills in the use of different file types.

TECHNICAL GRAPHICS - CREATORS and USERS

REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Knowledge and understanding of the roles and needs of those who may encounter, use, draw, read or explain any form of technical, engineering or production drawing. Describe the roles of the following professionals and describe the graphic types the use and/or produce:

● Designers and Consultant engineer (A Design Engineer can fulfill both of these functions).	*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.*
● engineering trades (civil, structural, electrical, mechanical, structural, systems)	*Civil Engineer: is involved in large scale structural projects for example the building of bridges, dams, high rise buildings. They will make full use of topological survey and underground to ensure the suitability of the site for construction.* *Structural Engineer: once a product or building has been designed a structural engineer will ensure each part of the structure or product will withstand loads placed upon . These can be stationary loads: the weight of a roof on a house or dynamic loads: the force on the end of a hammer drill.* *Electrical Engineer: Involved in ensuring the correct electrical power supply and the correct electrical circuits are available to make different products (and buildings) work. Electrical engineers often have specialities like transmission (how electricity is carried around the national grid) renewable (for example generating electricity from a wind turbines etc..). They work closely with conformity and electronic engineers and trades involved in heating and lighting.* *Mechanical Engineer: Understands how the physical parts of product function including, gears, pulleys and other way of changing one type of movement into another and how power is transmitted within a product including pneumatics, hydraulics* *Systems Engineer: Understands how the different parts of a product, manufacturing machine or engineered product <u>interact.</u> Different systems within a product might be power systems, electronic systems, electrical systems, pneumatic systems, hydraulic systems or mechanical systems and the sytems engineer will connect these successfully so the product functions correctly.*

TECHNICAL GRAPHICS - CREATORS and USERS

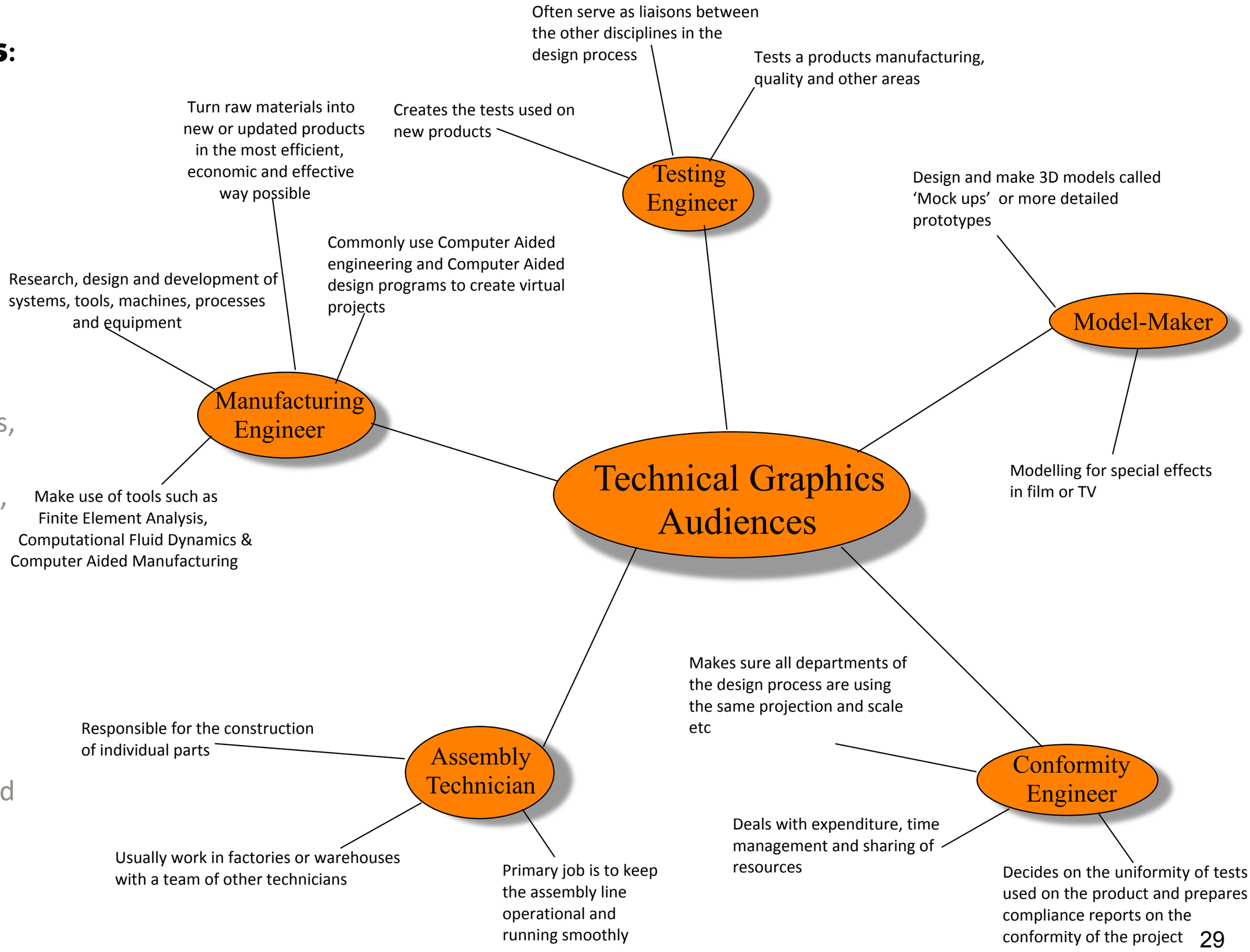
REVISION MATERIAL - MAKE NOTES FROM YOUR EXPERIENCES IN THE COURSE OR FROM RESEARCH

Knowledge and understanding of the roles and needs of those who may encounter, use, draw, read or explain any form of technical, engineering or production drawing. Describe the roles of the following professionals and describe the graphic types the use and/or produce

● Manufacturers/ Fabricators/ assembly technician (see next page) ● Model makers (see next page) ● Test labs technicians,(see next page) ● Materials technologists, ● Specification/ conformity engineers, (see next page) ● Suppliers, production and planning.	*Materials technologist: The materials technologist determines the correct material for each part of a product. For example a piece of outdoor play equipment might need to colourful, durable, waterproof and resistant to UV rays and the materials technologist would determine which materials has these characteristics and is available at the right price.* *They often make use of <u>graphs and charts</u> that allow the characteristics of different materials to be compared. For example a strength versus cost graph would allow the maximum strength material to be selected for a given price.* *Suppliers: Supply raw materials to manufacturers or building sites: supply sub assemblies to factories or assembly facilities or building sites.* *A supplier might be interested in graphics that show how they would access a building site. They may also be interested in maps showing the transport network so that raw materials or sub-components can reach manufacturing facilities or assembly plants as efficiently as possible.* *Production: any company or individual who is involved in making something, usually on a commercial scale. (See Manufacturing engineer paragraph 2 for the graphics they are interested in).* *Planning. Any company or individual within a company responsible for determining and sharing deadlines. They also ensure that parts employees and manufacturing facilities are available to produce the product/building by a certain deadline.* *Makes use of GANTT charts or other project planning tools to determine: start and finish times, key dates, revisions, review dates as well as work out contingency plans if their are problems..*
● Manufacturing Engineering (Case Study)	*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 productiondrawings.* *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 productfully 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 of the components they are manufacturing.*

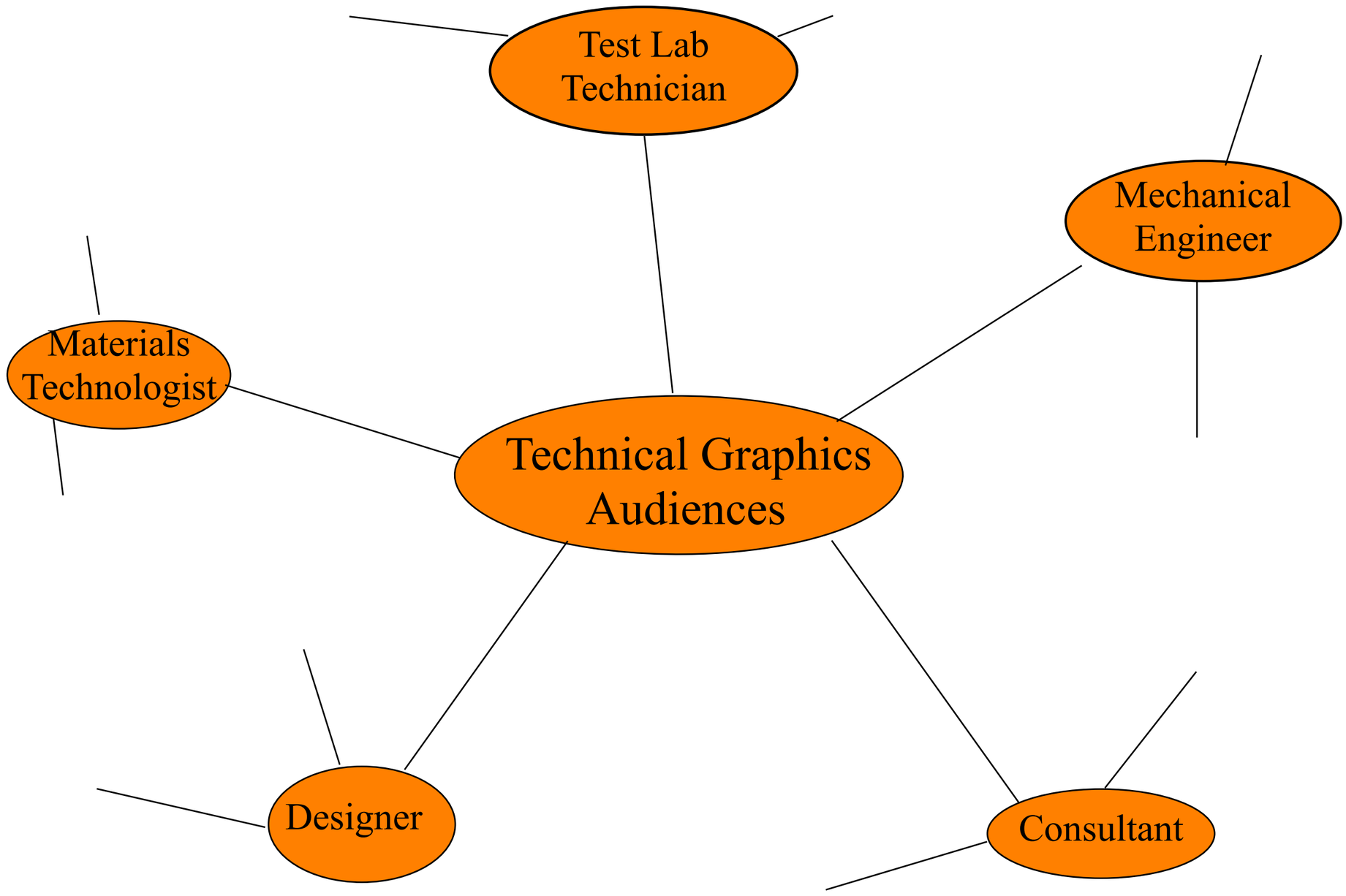
Audiences:

Designers, Consultants, Engineering trades (civil, structural, electrical, mechanical, structural, systems) Manufacturers, fabricators, model makers, test labs, materials technologists, specification/ conformity engineers, suppliers, production and planning.



Audiences:

Designers, Consultants, Engineering trades (civil, structural, electrical, mechanical, structural, systems) Manufacturers, fabricators, model makers, test labs, materials technologists, specification/conformity engineers, suppliers, production and planning.



Exercise D

1. **Complete the diagram above by adding in information about their profession, the graphics they might use**

Technical Graphic

FILE TYPES IN MORE DETAIL

STL (STereoLithography) file>

STL is a file format native to the stereolithography CAD software created by 3D Systems.[1][2][3] STL has several after-the-fact backronyms such as "Standard Triangle Language" and "Standard Tessellation Language".[4] This file format is supported by many other software packages; it is widely **used for rapid prototyping, 3D printing and computer-aided manufacturing.**[5] STL files describe only the surface geometry of a three-dimensional object without any representation of color, texture or other common CAD model attributes. The STL format specifies both ASCII and binary representations. Binary files are more common, since they are more compact Only holds data on geometry not colour.[6] Ë

DXF (Drawing Exchange Format) file>

Data format developed by Autodesk and used for CAD (computer-aided design) vector image files, such as AutoCAD documents; similar to the .DWG format, but is more compatible with other programs since it is ASCII (text) based.Ë
The DXF format was developed as a universal format so that AutoCAD documents could be opened more easily with other programs. For example, the Valve Hammer Editor can export 3D models as DXF files, which can be opened and edited with other 3D modelling applications. Another advantage is that they include the layer function allowing different sections of a drawing to be edited/displayed as necessary.

DWG (Drawing Format) file >

DWG files are CAD drawing files; DWG is the file format supported by most CAD programs. DWG files can contain two- and three-dimensional design data—they can range from simple technical drawings and design plans all the way up to full-blown 3D building layouts. DWG files are used by architects, engineers, drafters, artists, and others. can be edited in Autodesk 360 as well as other AutCAD programs but is fairly platform dependent. As well as being a Vector file format another advantage is that they include the layer function allowing different sections of a drawing to be edited/displayed as necessary.

VRML (A Virtual Reality Modeling Language) file>

VRML is a graphics file format used by Virtual Reality Modeling 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. Similar to both .WRL and .WRZ files, which both contained zipped versions of VRML files. The main **advantage of VRML** it is that is truly platform independent Ë

3Ds (3D Studio) file>

A 3DS extension is used by Autodesk 3D Studio (now commonly called 3D Studio max). It contains mesh/polygon data, **material** attributes, bitmap references (ie. Decals) , smoothing group data, viewport configurations, camera locations, **lighting** information and **object animation data**. 3DS files consist of chunks of data that contain an ID and length description. Chunks store the shapes, lighting, a viewing information that together represent the three-dimensional scene.

Case Study:

PLANNING BRAKE DISC MANUFACTURE

A. A part file (.ipt in Autodesk software) is **exported** as a .stl file

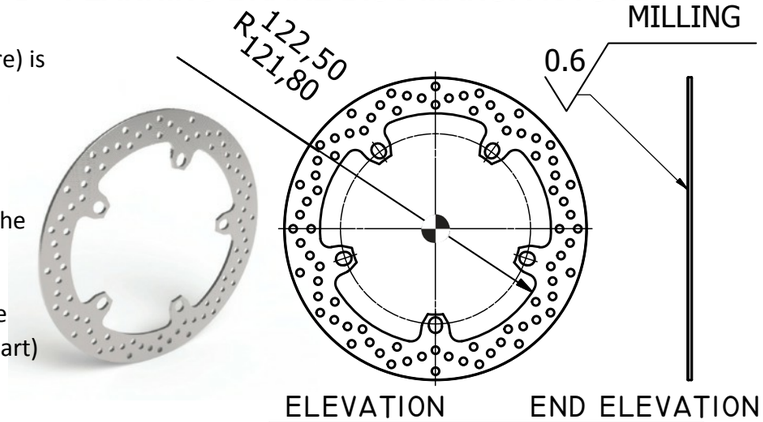
B. The .stl file allows the designer to **simulate** on the computer the manufacturing process used to make the part.

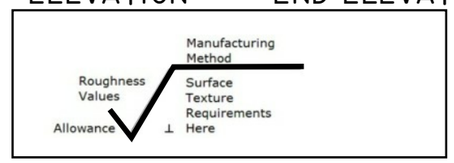
C. The stl file holds information on the **geometry** (i.e. the dimensions of the part) and therefore the volume of the part.

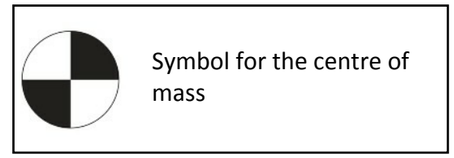
D. Once a manufacturing process is chosen then a suitable material can be selected.

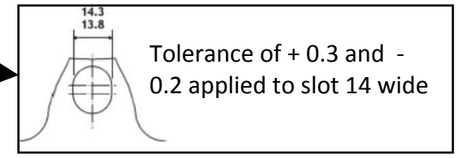
E. Once a material is selected then the following information can be decided/ determined.

- the **surface finish**
- the **centre of gravity** of the part
- the dimensional **tolerances**









F. In preparing the simulation

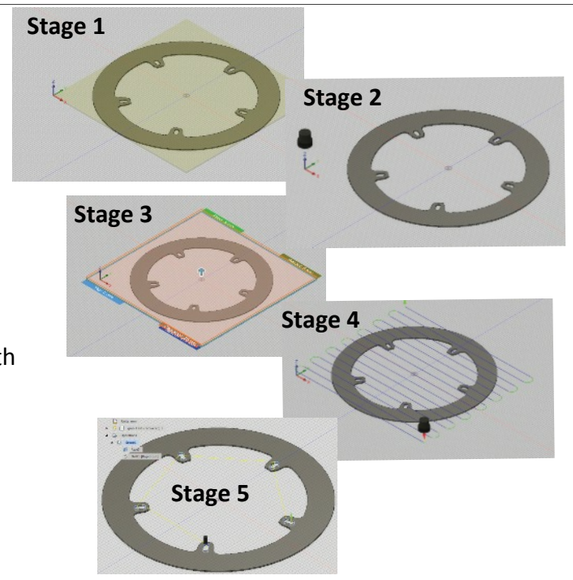
Stage 1 — the correct orientation of the part is determined

Stage 2 — the correct tool is being selected for the manufacturing process (in this case milling)

Stage 3 — the correct clearance dimensions are being determined

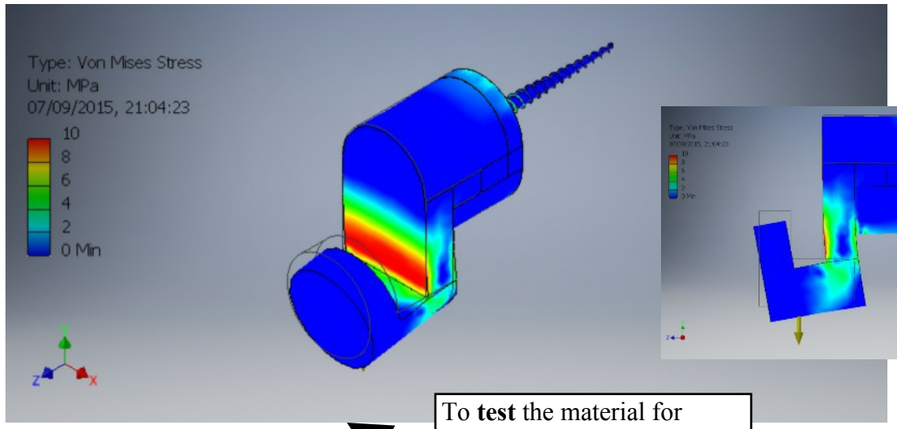
Stage 4 — the correct tool path (for the vertical mill tool) is being determined

Stage 5 — the correct tool, location, depth and sequence is being determined for cutting the slots



G. The .stl file is then converted into a g code which can be understood by the CAD/CAM machine; in this case a milling machining

Why create a computer generated 3D model



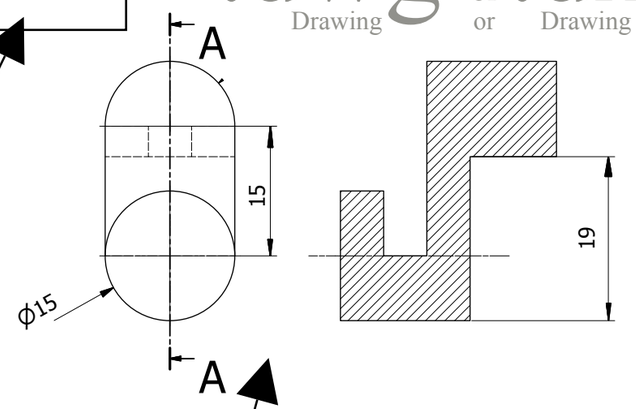
To **test** the material for strength using Finite Element Analysis (FEA) or to test the shape for aerodynamics or hydrodynamics, using Computational Fluid Dynamics (CFD). To test the airflow around a building also uses CFD.

Mainly used to put images on the web

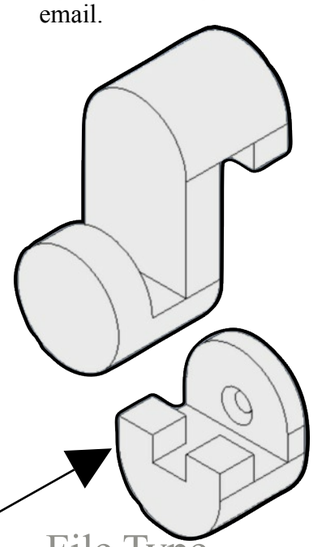
File Type
.vrml
Virtual reality modelling language

File Type
.dwg or .dxf
Drawing or Drawing Exchange Format

Can also be exported as a image file (e.g gif or jpeg) if it is be used on a webpage or exported as a pdf if the image is to be sent via email.

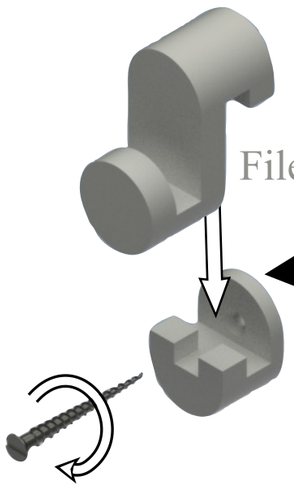


To generate a **production drawings** that can be used to manufacture components.. Contains info on dimensions, tolerances, surface finishes and materials.



File Type
.3ds

To generate **technical illustrations** that might be used in assembly instructions or in maintenance manuals

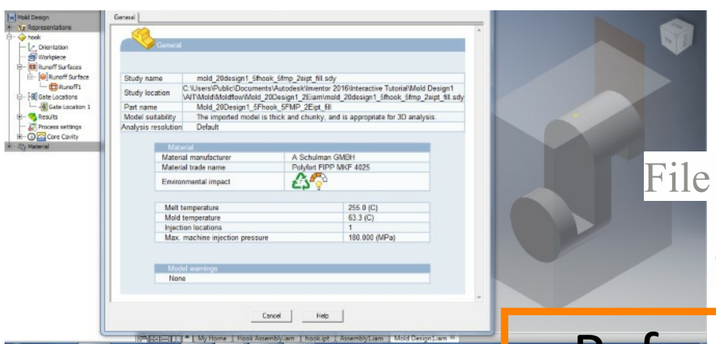


File Type
.3ds

To show the assembly process as an **animation** that makes it clearer the sequence of the assembly and direction of movement. Sometimes called a mechanical animation

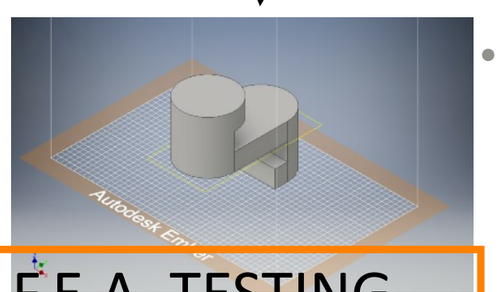
To **simulate** a **manufacturing** process such as injection moulding, milling or turning.

For a CNC milling process a **tool path generation** can be simulated showing how the milling tool will cut the surface of the material.



File Type
.stl

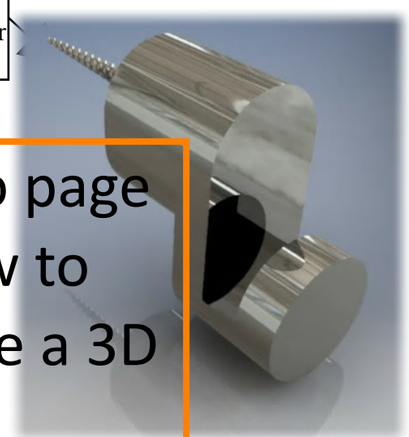
To **simulate** a **prototyping** process such as 3D printing



File Type
.stl

To generate a photorealistic **illustration** that could be used in a marketing brochure or an advertisement.

File Type
.png/jpeg/bmp
Ref file types for more information



Refer to page on F.E.A. TESTING

Refer to page on ‘How to enhance a 3D model’

advantages

Advantages of using graphics over other means of communication

- communicates information quickly
- avoids language barriers
- can be used as a promotional aspect for the product
- simple to understand
- adds relevant visual impact

Advantages of a computer simulation testing rather than physical testing

Digital testing methods characteristics will include:
- numerical simulation for testing the failure of the product, as opposed to destructive testing
- cost effective solution to testing
- ease of altering the product without re-manufacture

Advantages of a computer model over a scale model (architecture)

- for a building clients can see a 'fly through of the property' and imagine themselves inside the building
- different colour schemes , materials, fixtures and fittings can be trialled in different positions (e.g. kitchen layout)
- Lighting conditions can be altered to picture the building at night/ day/ different times of the year (could be combined with specularity, IBL, HDMI, volumetrics for photorealistic images

Advantages of using computer simulation of manufacturing processes before production

- reduces lead times, as all decisions about set-up are determined before manufacture
- reduces waste, as most errors can be rectified on the virtual model
- reduces time taken to manufacture the part, as tool paths and clearance distances can be optimised before manufacture
- optimises size of the part prior to milling, reducing amount of material required

Advantages to a mechanical animation rather than a drawing of an exploded view

- indicates the sequence of assembly more clearly than the paper versions (see how it actually happens)
- would be more effective at crossing language barriers:
- drawing standards vary from country to country but an animation is universal language
- animations can show information about the movement of parts and assembly methods (e.g. screws rotating into position)

disadvantages

Disdvantages of using graphics over other means of communication

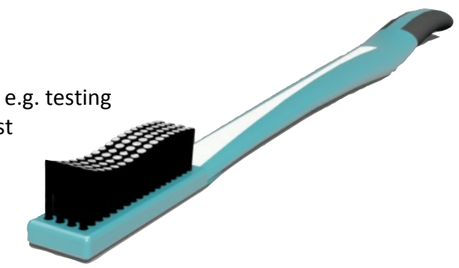
- training would be required to understand some types of drawing e.g. BS drawings undersatnding the layout of vies, symbols, dimensioning techniques

Disadvantages of a computer simulation testing rather than physical testing

Testing using computer simulation has its limitations

- some products can only be tested using a physical model e.g. testing the weight of product that will be carried or testing the best position of buttons on a mobile phone, or the balance of toothbrush.

- training would be required to set up the simulation



Disadvantages of a computer model over a scale model (architecture)

- a physical scale model is often used to display a proposal to a local community or to shareholders.

- physical model is a fixed reference points that all changes in the designed can be compared with.

- because it is physically real(and not in a virtual environment) it bears greater resemblance to the final product.

Disadvantages of using computer simulation of manufacturing processes before production

although a lot of decisions can be made using the virtual model testing of the manufacturing process

- using the actual manufacturing machinery and using the actual material used in the product will necessary to confirm there are no problems with mounting the component on the machine, checking the compatibility of material and manufacturing tooling and confirming the time per operation.

Disdvantages to a mechanical animation rather than a drawing of an exploded view

- training would be required if animation videos were to be used more widely across a company

- It would stillbe necessary to retain understanding of exploded views if an old product (only available in a drawn format) was to be redesigned

- if there was a problem with software compatability, broadband speed, internet access when using the animation then drawn exploded/assembly views would be used a s a back up.option.

Simulation in an Manufacturing and Engineering Environment

HOMEWORK - RESEARCH THE TOPICS LISTED BELOW AND WRITE CONCISE DESCRIPTIONS

Topics	Information Gathered
Simulation Knowledge and skills in the use of: • digital testing methods, eg Finite Element Analysis (FEA) or Computational Fluid Dynamics (CFD) to simulate how parts of a 3D model would perform if produced in reality, mechanical animation	**Investigate and describe the benefits of the following simulation methods:** **Finite Element Analysis (FEA)** What is it? It is the digital testing of products used to test all sorts of mechanical components from pipelines to controlled car crashes. It is also to referred to as Digital Prototyping and allows conceptual designs (new designs) the ability to be virtually tested before it's built. Industrial designers, manufacturers, and engineers use Digital Prototyping to design, test, optimize, validate and visualize their products digitally throughout the product development process. Innovative digital prototypes can be created via CAD to meet multiple design objectives (such as maximised output, energy efficiency, highest speed and cost-effectiveness) reducing development time and time-to-market. Marketers also use Digital Prototyping to create photorealistic renderings and animations of products prior to manufacturing. It gives product development teams a way to assess the operation of moving parts, to determine whether or not the product will fail, and see how the various product components interact with others. In a nutshell, FEA is determining how a solid body will respond to various forces applied to it. 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. **Computational Fluid Dynamics (CFD)** What is it? CFD is a form of digitally testing the airflow tor fluid flow around a product. Two common examples include 1. Wind tunnel testing of cars, aircraft and other landbased and airborne craft to test for aerodynamics, which relates to fuel efficiency, rates of acceleration etc… and 2. The testing of ships and other water based transportation and how they interact with the water when the transport is travelling at different speeds, in different water conditions and when the transport is empty or fully laden How does it work? Digital testing allows decisions to be made about the shape of the Vehicle, for example optimum weight of the vehicle, materials of the vehicle, surface finish to be decided upon to maximise the fuel efficiency of the vehicle, acceleration of the vehicle. 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 designers and engineers to visualise and manipulate new product designs so that design decisions about shape, materials, fuel efficiency data can be determined and decided upon early on in the design process

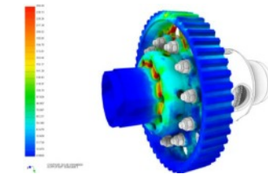
Finite Element Analysis (FEA)

Definition

AUTODESK.

Finite element analysis (FEA) is a computerised 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. Finite element analysis helps predict the behaviour of products affected by many physical effects, including:

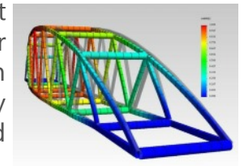
- Mechanical stress
- Mechanical vibration
- Fatigue
- Motion
- Heat transfer



Other methods, such as destructive testing, are commonly used in industry to test products/structures. Each method has its own set of characteristics, uses and benefits. Some of the key characteristics of Finite Element Analysis (digital testing) are;

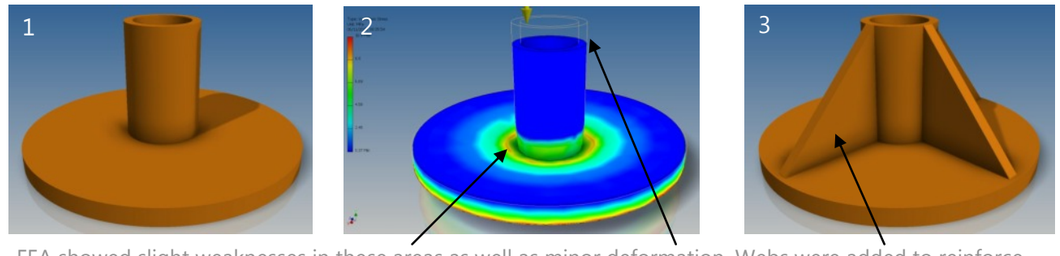
- It is a numerical simulation for testing the failure of products, as opposed to destructive testing
- It is a cost effective solution to testing
- It offers ease of altering the product without re-manufacture
- It can reduce the lead time to manufacture

In FEA a '**load**' is often applied to a product to test whether or not it can withstand the maximum weight that it could potentially bear when in use. A good example of this is a bridge. Digital tests can determine the strength of the bridge when loaded at its full capacity (possibly during rush hour) and whether or not the structure would be safe and fully functional when at maximum load.



Reinforcing Structures—Webs

Conducting tests on products can highlight high levels of stresses and strains on weaker sections of the product which could potentially lead to failures. Structures, such as the plastic base of a microphone stand shown below, can be reinforced after testing to strengthen the structure. Four **webs** have been added to strengthen the central extrusion after initial tests highlighted minor areas of weakness and possible deformation under certain loads. **Webs** are commonly added to reinforce weak areas of a structure.



FEA showed slight weaknesses in these areas as well as minor deformation. Webs were added to reinforce the boss.

ADVANCED HIGHER GRAPHIC COMMUNICATION SECTION 1.1 MANUFACTURING & ENGINEERING

BRIEF

Using the stress analysis program contained within AutodesK Inventor, simulate the deflection of various mmetal bars subject to a point loading and compare the results to real life measurements.

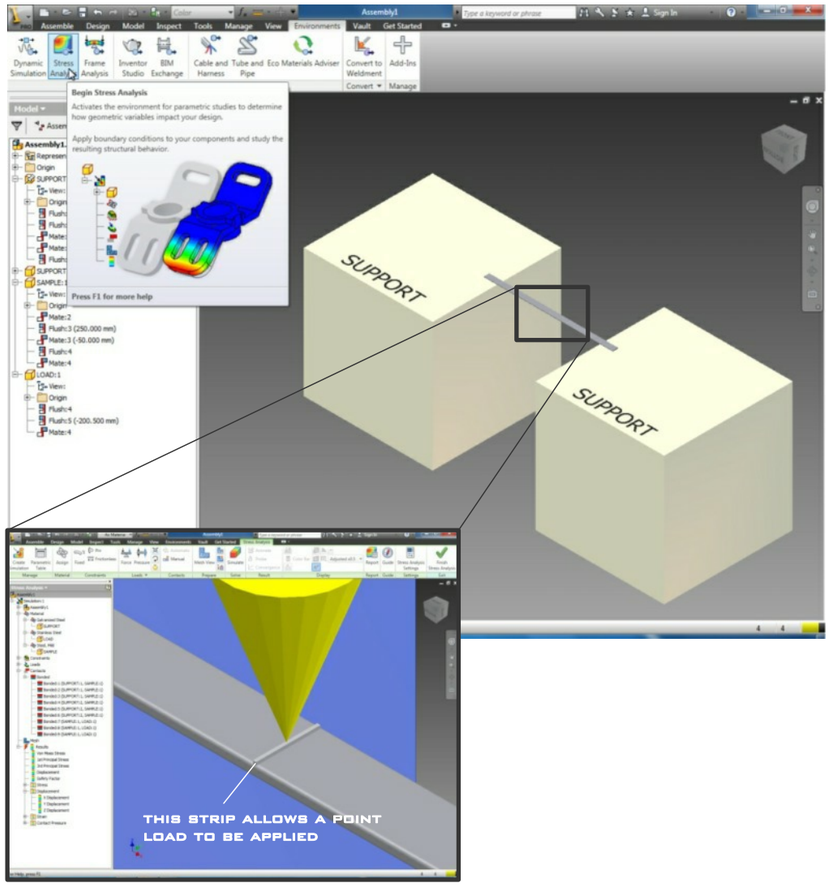
SUBMISSION

3 a3 sides including fully annotated screenshots and photographs. a comparison of results, suggested reasons for differences between experimental and simulated results. conclusions.

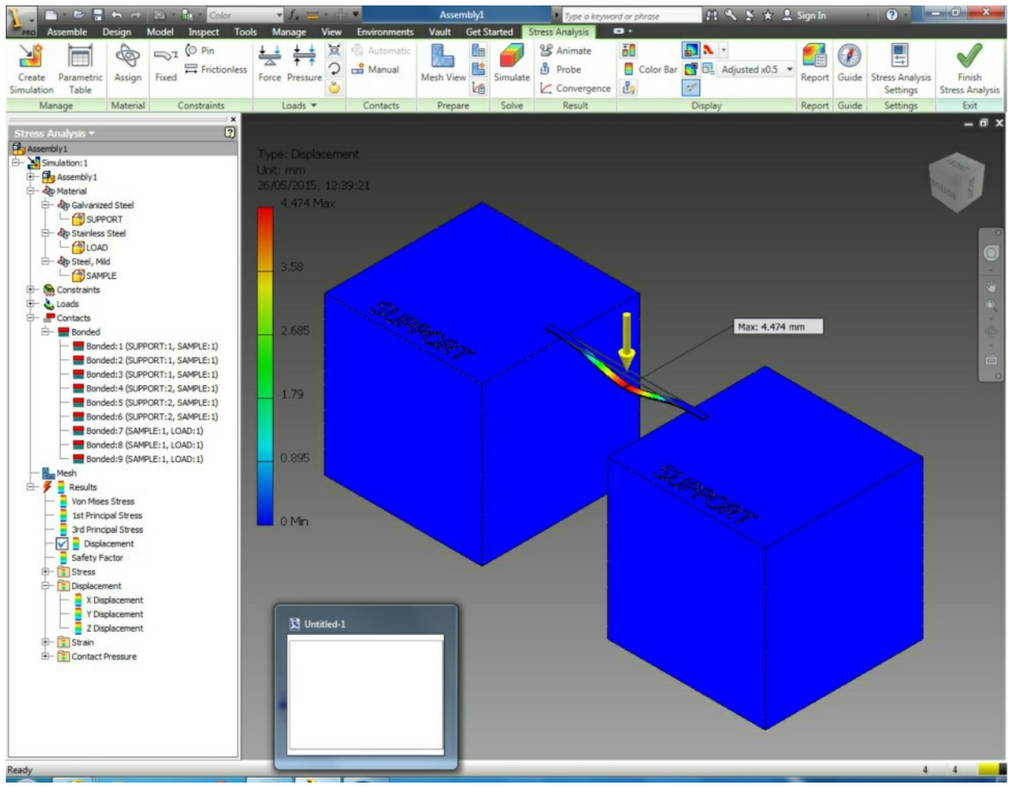
THIS PROJECT IS PART OF THE TECHNICAL GRAPHICS UNIT

INVENTOR SETUP

1. construct an assembly similar to the one below



2. on the environment tab select stress analysis
   set materials
   set the load along the small middle strip
   set constraints and contacts
   run the simulation
   adjust for various different loads and repeat



EXPERIMENTAL SETUP

RECOMMENDED TIMESCALE

MAXIMUM 6 CLASS BLOCKS FOR SIMULATION AND EXPERIMENTATION

FINITE ELEMENT ANALYSIS USING INVENTOR

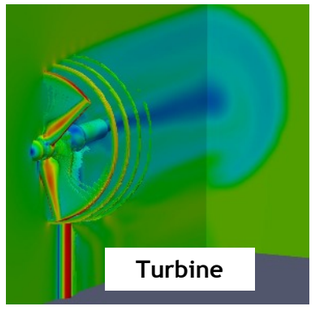
3. try altering the simulation settings if the results differ significantly.

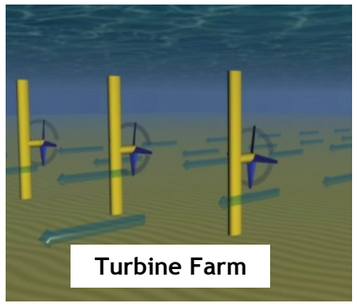
Homework 5

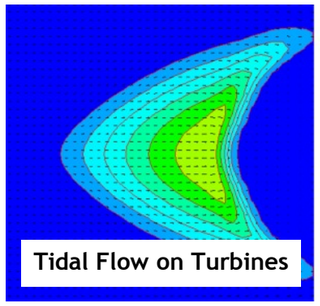
Marks

DO NOT WRITE IN THIS MARGIN

3. An engineering company has tasked a conformity Engineer to check the plans for a Tidal Energy generation scheme, to be mounted on the sea bed. The impact on the sea life and ocean currents is to be investigated and checked for any potential negative effects. A selection of graphic communications used by the conformity Engineer are shown below.







(a) Describe how the graphics have been used in the project and their purpose within the project. 3

The engineering company has been tasked with developing project graphic communications. These graphics will be used by the engineering and manufacturing trades to: design, test, build, assemble the turbines.

(a) Describe the type of technical information that the graphics will contain. 2

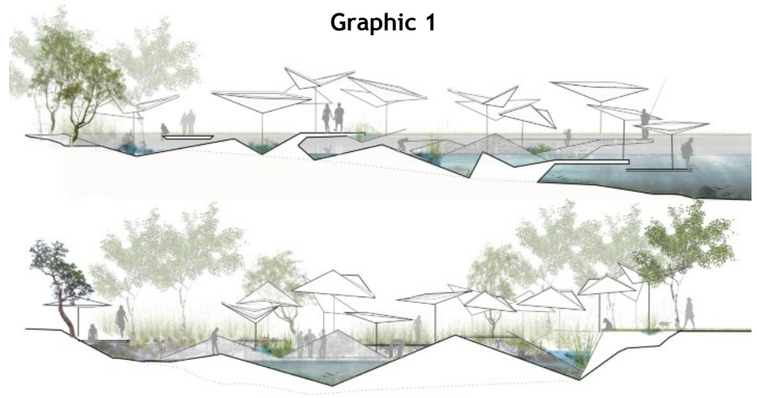
Homework 6

Marks

DO NOT WRITE IN THIS MARGIN

4. A Landscape Architecture company has been developing ideas and concepts for a customer requiring a public space, for recreation. The location is within a large city centre in a hot climate and has natural drainage channels and requires emergency flood channels. For safety reasons, the customer needs the designs of the channels and grassy areas tested, in case of large unpredictable flood events.

Graphic 1



(a) A 3D landscape model has been created.

Describe three types of technical information on the model. 3

(i)_____

(ii)_____

(iii)_____

(b) The customer has asked for digital testing information and graphics.

(i) State a suitable digital testing method for the flood events.

_____ 1

(ii) State a suitable file type for presenting the information to the customer at a presentation. 1

_____

The Architects have modelled shade canopy designs on graphic 1. These 3D CAD models are assembly files of the canopy support structure.

(iii) Describe the benefits of digital testing of the canopy structure design concepts, before manufacturing them. 2

The canopy assemblies and individual parts are being emailed as a step file to the manufacturer.

(iv) State two benefits of this method.

_____ 2