Design and Communication Graphics

A guide to the

Student Assignment

TECHNOLOGY
SUBJECTS
SUPPORT
SERVICE

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Foreword

Design and Communication Graphics affords the student the opportunity to develop skills in graphical communication, creative problem solving, spatial visualisation, design capabilities, computer graphics and CAD modelling. The Student Assignment provides the medium through which some or all of these skills may be expressed and assessed. 40% of the total marks in Design and Communication Graphics are allocated to the production of the student assignment.

Skills such as freehand sketching to communicate ideas, appreciation of aesthetics and good design, ability to conduct effective research, constructive reflection, presentation skills and competence in the use of CAD as a design tool are seen as essential for the successful completion of the student assignment. The importance of structured file management, time management, protection of data, and the acquisition of the necessary I.T. skills cannot be understated.

This further emphasises the importance of an integrated approach to the teaching of Design and Communication Graphics. CAD should be seen not just as a means of accurately modelling designs but also a medium through which students can visualise and comprehend concepts in a manner previously inaccessible. In the same way, freehand sketching skills may be acquired and developed through the exploration of 3-dimensional problems and the application of geometric principles in their solution.

The ability on the part of the student to communicate the thought process throughout the production of the assignment is of utmost importance. It is essential this thought process is evident to any person that reads, or indeed assesses, the portfolio. Annotations, sketches, questions and conclusions on each section of the assignment will allow the student to communicate their thoughts distinctly to the reader. Therefore, it is critical that the process of reflection become an everyday activity in the Design and Communication Graphics class.

The purpose of this document is to offer guidance to both teachers and students on possible approaches to successfully completing the DCG Student Assignment by drawing on the knowledge, experience and wisdom gained from the development of the Student Assignment process to date.

T4 Technology Subjects Support Service

What is a DCG Student Assignment Brief?

The DCG assignment brief is a written description that outlines the problem posed and the requirements of a design situation.

There are two distinct parts to the assignment, (a) and (b). Part (a) deals with the analysis, investigation, evaluation and illustration of an existing object(s). This section is considered to be essential preparation for Part (b). Part (a) requires you to closely observe, examine, compare and contrast the design features of the object(s) while using sketches and SolidWorks drawings to enhance the overall outcome. Part (b) is more about the actual process of designing, whether it is modifying existing design features of the object in question ***or*** developing a completely new design solution to the brief. The success of Part (b) is dependent on the analysis and the research undertaken in completing Part (a).

The DCG Student Assignment Brief, which was issued in the pilot project, is outlined below:

Design and Communication Graphics
Student Assignment
Pilot Brief

Exterior lighting in the vicinity of our front doors and entrance ways serves to enhance appearance and increase safety and convenience. This lighting can be provided by a variety of lamp types, from traditional lantern styles to sleek and modern wall mounted units. Many of these have additional features such as daylight and/or motion sensors, low energy (CFL) bulbs to minimise energy use while models with built in CCTV capability are also available. Some are designed to operate independently of connection to an electrical supply and take their energy from other sources.

All are designed and manufactured to withstand exposure to wind and rain in varying degrees, while retaining a pleasing appearance.

(a) *(Outputs 1 to 6)*
You are asked to investigate developments in exterior domestic lighting. Analyse and communicate these developments graphically

and

(b) *(Outputs 7 to 9)*

1. *Suggest graphically the modifications which you would make to an existing light*

or

2. *Develop and graphically communicate an exterior light as a concept design.*

How important is the Student Assignment?

The Student Assignment is worth 40% of the overall marks for the subject.

Of the 160 marks allocated to the student assignment, approximately two thirds are allocated to Part (a) and one third to Part (b).

How am I expected to know everything about the particular area in which the Student Assignment Brief is dealing with?

You're not. The vast majority of students and teachers are in the same position as you. However, with careful and thorough analysis of the brief you will lay the foundation for an excellent assignment. Throughout the assignment you will find yourself taking your own unique direction through the design situation.

Where do I start?

Simply start with Output 1 and progress to Outcome 9 in chronological order. However, it is important to note that the process of design is cyclical by nature, and further research may uncover areas which were not previously considered. This in turn may warrant a revision of any of the previous outputs.

What is Output 1, how much do I need to produce?

Output 1 – Exploration of the brief and presentation of existing artefacts in graphic format

Students at Higher level are expected to produce one to two A3 sheets for this output. The same is expected at Ordinary level.

Where do I go from here?

Explore the brief carefully. A very useful group exercise at this stage is ***brainstorming***. Through group discussion, this exercise serves as vital preparatory work for identifying the direction you may wish to go with your own individual assignment.

Brainstorming is a group creativity technique designed to generate a large number of ideas for the solution to a problem. Exploring a brief is essentially a brainstorming process. All good design companies start with this exercise. Remember:

- Focus on quantity.
- No criticism is allowed.
- Unusual ideas are welcome.
- There are no wrong answers at this stage.
- Combine and improve ideas.

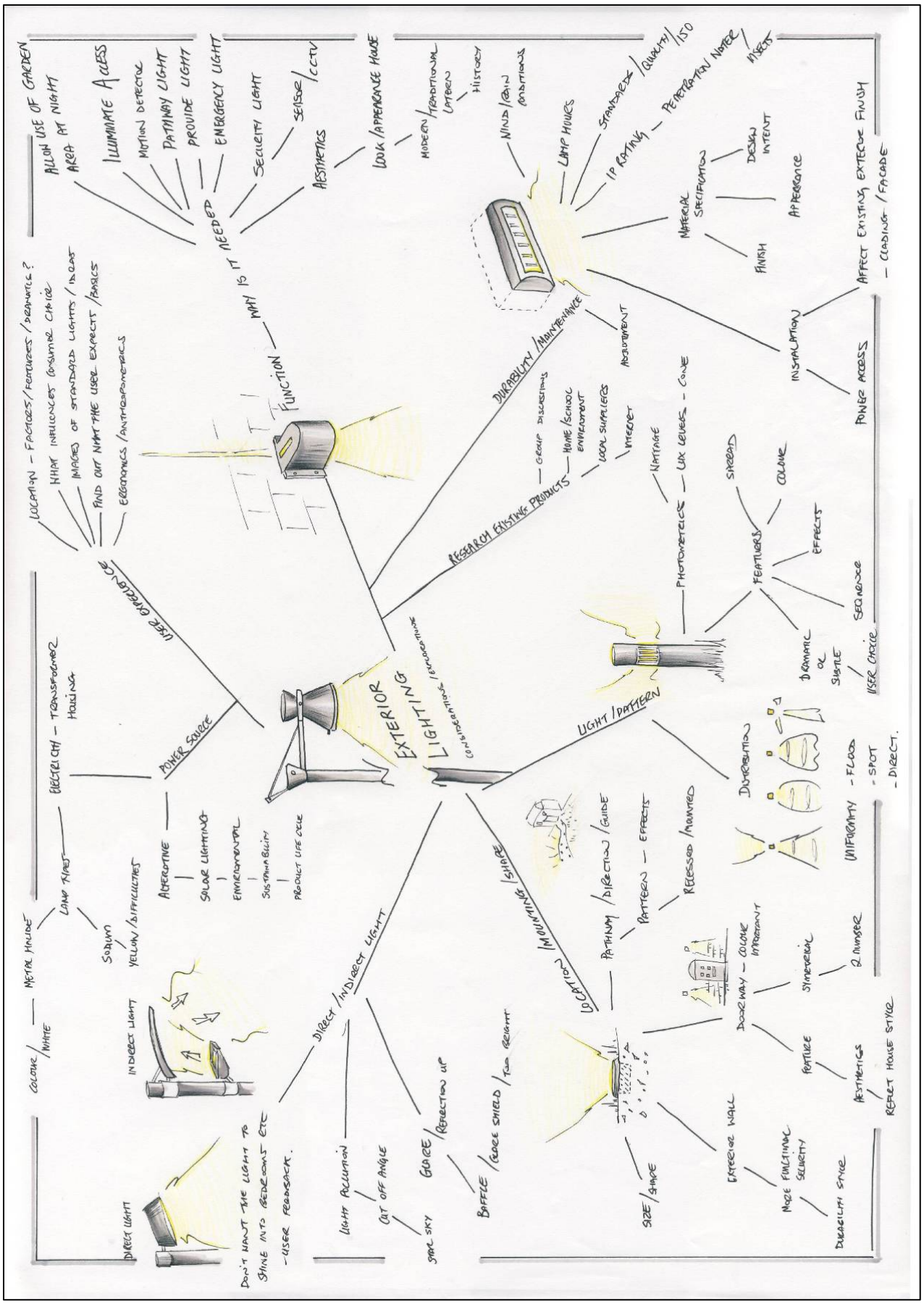
These three photographs show a group of students actively participating in a brainstorming session during the pilot assignment. On this occasion one particular student records all the suggestions on the interactive whiteboard. The group is seated in a U shape to generate discussion. The teacher takes a passive role but facilitates and guides the situation as necessary.

Highlighting keywords and phrases.

- Highlighting keywords and phrases can help to isolate elements and break down the design situation one step at a time.
- From your own experience what do you know about any of the keywords?
- Keep adding more and more suggestions to the diagram.
- After all possibilities as a group have been exhausted, each student should capture the discussion in a personalised ‘mindmap’ or ‘spider diagram’. It could take two or three attempts before something resembling the example on the next page is generated.

Exterior lighting *in the vicinity of our front doors and entrance ways serves to* ***enhance appearance*** *and increase* ***safety*** *and* ***convenience****. This lighting can be provided by a variety of lamp types, from* ***traditional lantern styles*** *to sleek and* ***modern wall mounted units****. Many of these have additional features such as* ***daylight*** *and/or* ***motion sensors****,* ***low energy*** *(CFL) bulbs to* ***minimise energy use*** *while models with built in* ***CCTV capability*** *are also available. Some are designed to operate independently of connection to an electrical supply and take their energy from other sources.*

All are designed and manufactured to withstand ***exposure to wind and rain*** *in varying degrees, while retaining a* ***pleasing appearance****.*


EXTERIOR LIGHTING
CONSIDERATIONS / EXPLORATIONS
FUNCTION — WHY IS IT NEEDED
ALLOW USE OF GARDEN AREA AT NIGHT
ILLUMINATE ACCESS
MOTION DETECTOR
PATHWAY LIGHT
PROVIDE LIGHT
EMERGENCY LIGHT
SECURITY LIGHT
SENSOR / CCTV
AESTHETICS
LOOK / APPEARANCE HOUSE
MODERN / TRADITIONAL LATERN
HISTORY
WIND / RAIN CONDITIONS
LAMP HOURS
STANDARDS / QUALITY / ISO
IP RATING — PENETRATION WATER / INSECTS
MATERIAL SPECIFICATION
DESIGN INTENT
APPEARANCE
FINISH
AFFECT EXISTING EXTERIOR FINISH
— CLADING / FACADE
INSTALLATION
POWER ACCESS
DURABILITY / MAINTENANCE
ADJUSTMENT
RESEARCH EXISTING PRODUCTS
GROUP DISCUSSIONS
HOME / SCHOOL ENVIRONMENT
LOCAL SUPPLIERS
INTERNET
NATTAGE
PHOTOMETRICS — LUX LEVELS — CONE
FEATURES
SPREAD
COLOUR
EFFECTS
SEQUENCE
DRAMATIC OR SUBTLE
USER CHOICE
LIGHT / PATTERN
DISTRIBUTION
UNIFORMITY — FLOOD
— SPOT
— DIRECT.
LOCATION / MOUNTING / SHAPE
PATHWAY / DIRECTION / GUIDE
PATTERN — EFFECTS
RECESSED / MOUNTED
DOORWAY — COLOUR IMPORTANT
SYMMETRICAL
2 NUMBER
FEATURE
AESTHETICS
REFLECT HOUSE STYLE
EXTERIOR WALL
MORE FUNCTIONAL SECURITY
DURABILITY STYLE
SIZE / SHAPE
DIRECT / INDIRECT LIGHT
GLARE / REFLECTION UP
BAFFLE / GLARE SHIELD / TOO BRIGHT
LIGHT POLLUTION
CUT OFF ANGLE
STAR SKY
DIRECT LIGHT
DON'T WANT THE LIGHT TO SHINE INTO BEDROOMS ETC
— USER FEEDBACK.
INDIRECT LIGHT
COLOUR / WHITE
METAL HOLIDE
LAMP TYPES
SODIUM
YELLOW / DIFFICULTIES
ALTERNATIVE
SOLAR LIGHTING
ENVIRONMENTAL
SUSTAINABILITY
PRODUCT LIFE CYCLE
POWER SOURCE
ELECTRICITY — TRANSFORMER HOUSING
USER EXPERIENCE
LOCATION — FACTORS / FEATURES / DRAMATICS ?
WHAT INFLUENCES CONSUMER CHOICE
IMAGES OF STANDARD LIGHTS / IDEAS
FIND OUT WHAT THE USER EXPECTS / BASICS
ERGONOMICS / ANTHROPOMETRICS

- Evaluate all information known about the design situation posed and identify areas which will require further research. In this way scrutinising the brief will direct you along the necessary research paths.

- A guest speaker, who is knowledgeable in the area under investigation, may be invited to speak to the group in relation to various aspects which may be overlooked in the brainstorming session.

What methods of research should I use?

There are two types of research you should undertake – Primary Research and Secondary Research.

Primary Research

This involves the observation of associated objects in your immediate environment or locality. For example the students shown here are photographing and recording important details including dimensions of some of the exterior lights in their vicinity.

Secondary Research

This may include any or all of the areas listed below.

Libraries - Books - Magazines - Catalogues - Interviews

Surveys - Supply Stores - Exhibitions - Websites

Inspiration will be derived from all of the above methods of research. Keep an open mind as you work through them. Internet research is probably the most accessible method but it must be clearly stressed it is not the only one.

"I think we are sometimes too quick to go straight to the web for inspiration or to look something up, so much so that we forget to take a look around our environment and take inspiration from that." *James Dyson 2008*

What is the best way to store all the information I receive?

Hardcopy materials

You will need an A3 folder to store all the hardcopy items such as photographs, charts, practice sketches and so on. Although this folder is not submitted as part of the finished project it is important that all research materials are stored for the completion of the various outputs.

Electronic data

To facilitate the secure storage of all electronic data in relation to the Student Assignment the IT facilities in the DCG room could be configured as follows.

DCG Network

- All computers should be networked so that each PC can communicate with one another and access printers, the Internet and other hardware devices. Students may access their individual accounts through any computer and an automated backup of student material can be facilitated.

- It is impossible to guarantee the safety of data if it exists in only one place. All files should be backed up automatically every 3 to 7 days. This process minimises the effects of any potential loss of data.
- Backup media should be stored in a safe location, ideally located in a remote area away from the school.
- Adequate protection such as up-to-date anti-virus software and a firewall must be put in place.

User Accounts

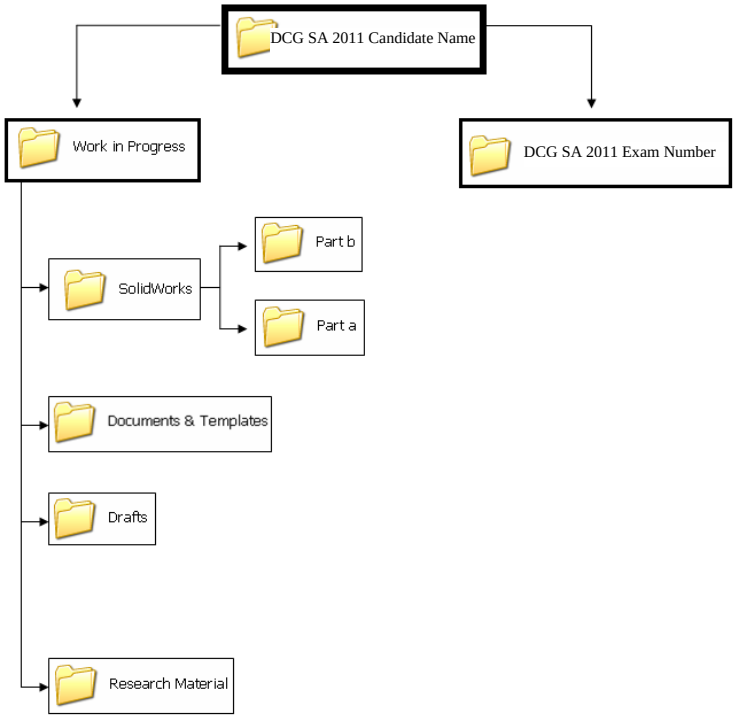
- An account should be created for each individual student upon commencement of DCG.
- The account should provide an individual logon/username/password and folder for each student.
- The students may only access/save files/view contents of their own folders.
- Students must be alerted to the importance of keeping their username and password confidential.

File Management

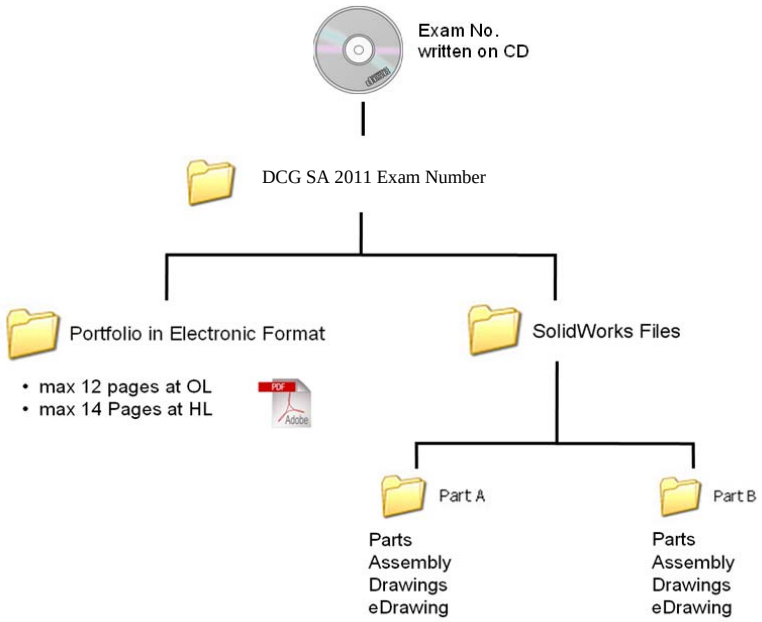
File management is an essential part of the assignment process.

The following approach to file management is suggested:

- A new folder must be created within your student profile to store all electronic materials for the assignment. This folder can be named ***"DCG S.A. Candidate Name"*** for example.
- All work relating to the assignment must be saved to this folder. This will ensure that all work can be saved onto a CD for submission to the SEC when the assignment is finished.
- Sub folders should be created to manage files efficiently, an example is shown below left.
- Two sub-folders should be created within the 'SolidWorks Files' folder;
    - A folder for Part (a) of the assignment
    - A folder for Part (b) of the assignment



On completion of the assignment, the folder "DCG SA 2011 Exam Number" should be created with subfolders for the portfolio in electronic format and the necessary SolidWorks files.



Note: The SolidWorks files and the completed assignment in electronic format (.pdf) will be required on the CD for submission to the SEC along with the bound assignment folio in hardcopy format.

A lot of the images I have collected do not include dimensions. How will I be able to model one of these later in Output 4?

You will need sufficient detail of the particular item you intend to model in Output 4. Inferring detail, scaling or estimating the dimensions are all skills which are necessary when creating a model based on a number of images. However, every effort should be made to obtain as much information about the object being modelled e.g. specifications, dimensions, method of assembly etc.

How do I present the information I have collected?

Your thought process should be clearly conveyed in the manner in which you present your analysis and investigation. Individual approaches are encouraged including photographs, sketches, handwritten notes or typed details.

The following points should be considered in your approach to output 1;

- The presentation, in whatever format you choose must tell its own story, as opposed to a random mural of images/sketches/annotations that the reader is expected to interpret for themselves.
- Virtually any conceivable method of presentation can be used to convey the thought process.
- Try to be as creative and unique as possible.
- If you have prior knowledge of any word processing/desktop publishing software you should use it here.
- Present one or two A3 pages in a graphic format of your choice. These can include sketches, annotations, digital photos, images from magazines, books, newspapers and the Internet.

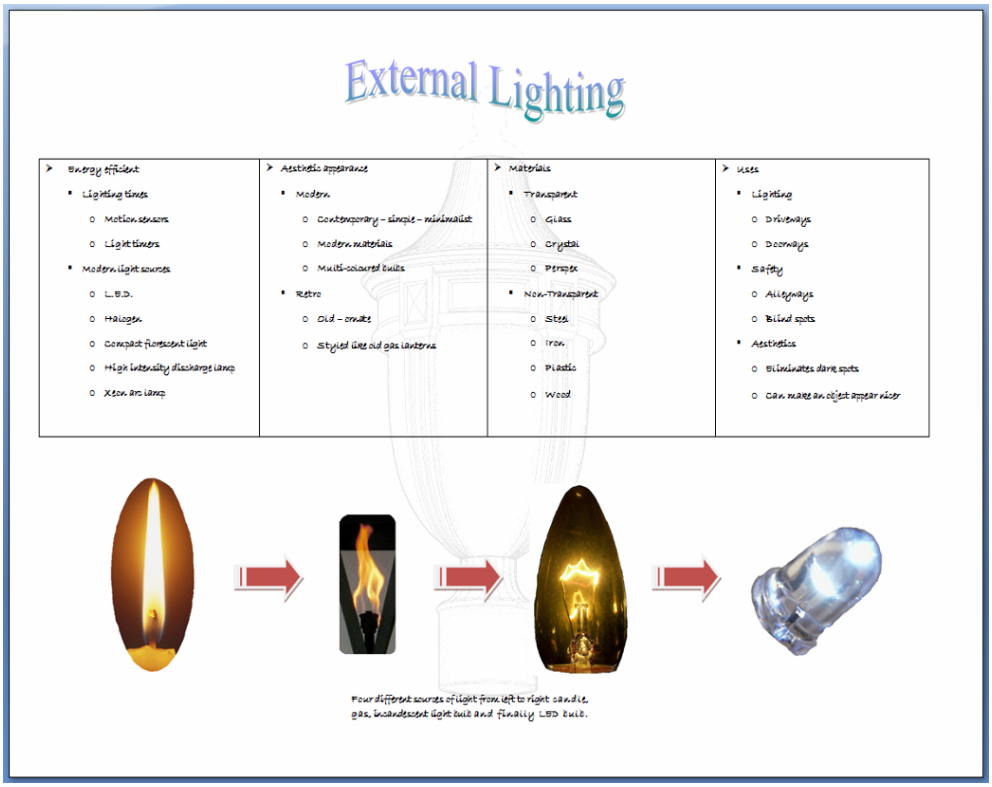
The presentation must tell its own story through images, sketches and annotations.

This example below looks quite good. However, further examination reveals:

- No chronological order or sequencing.
- No information in the form of text.
- A rather cluttered array of photographs.
- No indexing.
- It doesn't tell a story.

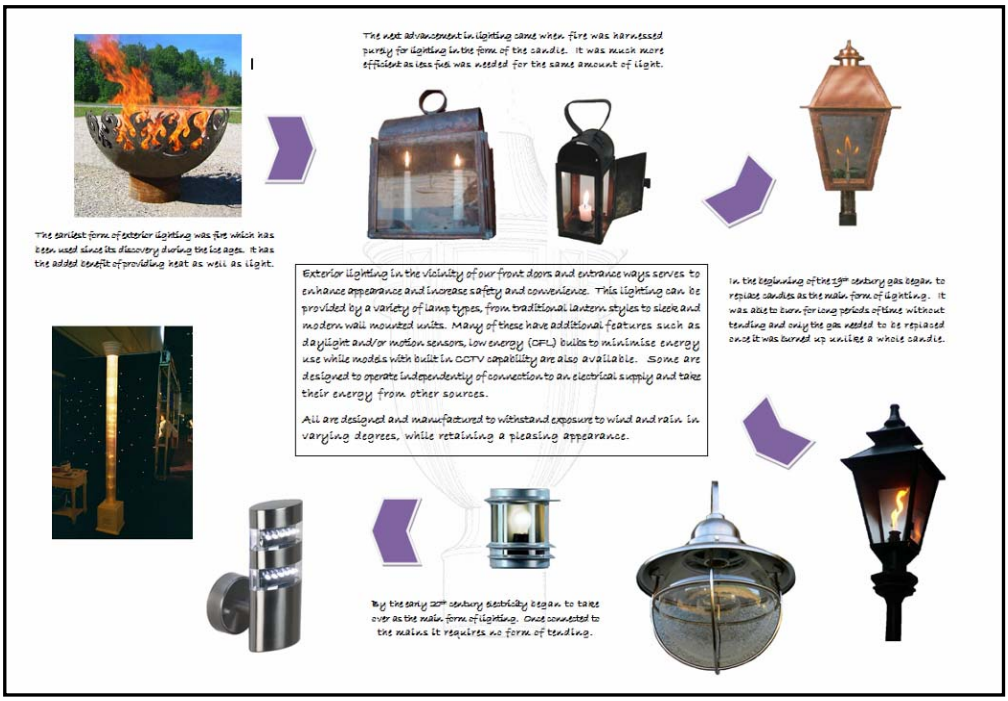
One option would be to reduce the size of the presentation thus allowing an area for annotations and sketches to convey the significance of the selection of images and the thought process involved.

This example gives a very clear separation of all the various categories in which the analysis was conducted, i.e. aesthetics, materials, efficiency, safety and uses. However, the presentation of the work could be improved if a greater link was created between the text and the images.



The images only convey one aspect of the investigation, the light source. Maximum use should be made of the available space to convey fully the thought process.

In this example, the connection between the various images is portrayed by the use of annotations. It may not be necessary to use up a significant amount of page space rewriting the assignment brief.



Sketches and hand-written annotations could be used to enhance and personalise the presentation in the available space.

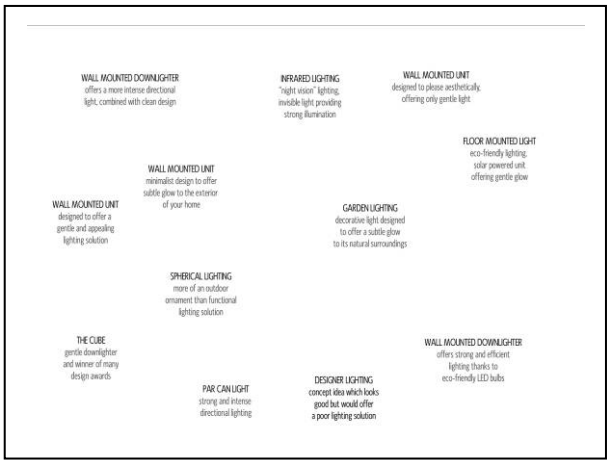
- The images with common features could be grouped together to satisfy the requirements of the brief. In the case below, presenting the lights in chronological order was in keeping with what was required in the design solution.
- Notes and explanations can be inserted wherever it is deemed necessary.
- The example below is a magnified section of another approach to meeting the requirements of Output 1. Note the grouping of similar features in relation to weather exposure. The slight overlapping of photographs along with text adds to a more appealing appearance.

- Experiment with various types of print paper other than standard cartridge paper. If your output is in electronic format make sure the paper you select is suitable for the classroom printer.

    - Heavy gauge cartridge paper
    - Coloured paper
    - Watercolour paper
    - Coated paper / Photographic paper / Trace paper

- Keep your layout very clear. It should be easy to follow but unique to your creative ability. It should have a logical format and evidence of good research.

The example below (left) uses visual effects on glossy photographic paper and the text is supplied in the form of a transparent trace overlay (right).



Time management for each output?

Time management is a crucial aspect of the overall project. Each teacher may decide to allow different time constraints for each individual output. If so, a spreadsheet depicting the dates and projected outcomes could be clearly displayed in the classroom. The example shown overleaf was one used by a teacher on the pilot programme and serves as a guide, open to interpretation by teachers or students.

Student Name or Examination Number	Distribution of Brief		Output 1		Output 2		Output 3		Output 4		Output 5		Output 6		Output 7		Output 8		Output 9 & Completion
1																			
2																			
3																			
4																			
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Output 2

What is Output 2, what do I need to produce?

Select two images and illustrate/explain the main design features. Insert the main dimensions. Compare and contrast the main design features of both using suitable freehand sketches and other presentation techniques.

Students at Higher Level are expected to produce two to three A3 sheets for this output. At Ordinary Level one to two sheets are expected.

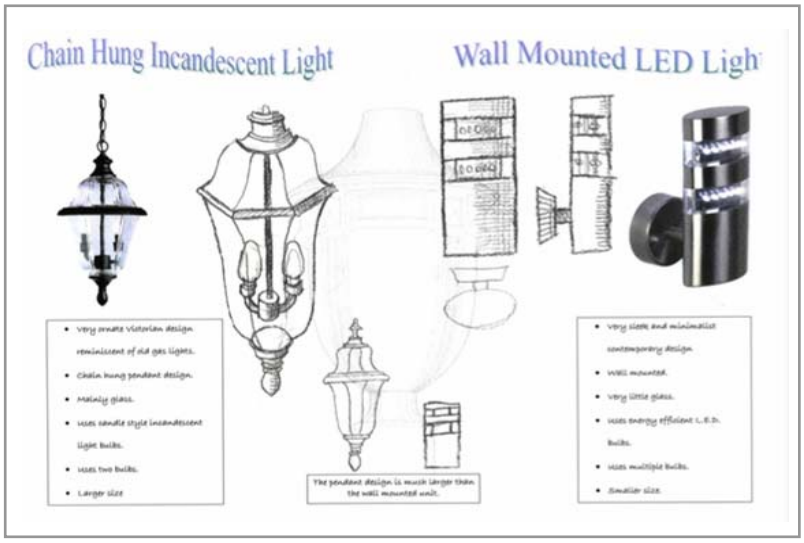
What are the best two images to select?

Select two images from the existing objects in Output 1 and compare and contrast them under several headings. These may include features such as:

Physical size (ergonomics) - **Shape** (form) - **Material** (durability) - **Finish** (exposure to the elements) – **Texture** – **Colour – Weight** - **Style** (features that link it to a particular period) - **Date of manufacture / Manufacturer** - **Cost** - **Other design features……**

Note: One of these chosen artefacts must be modelled using SolidWorks in Output 4.

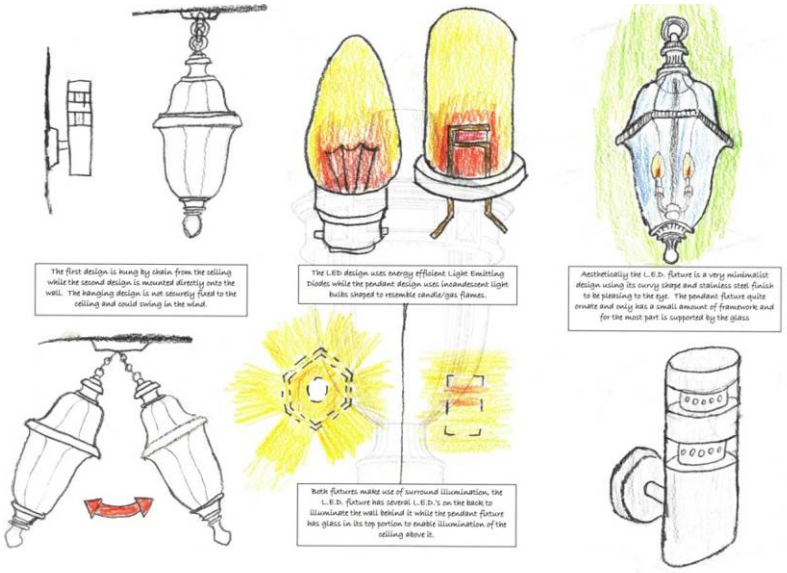
How should I present this output?



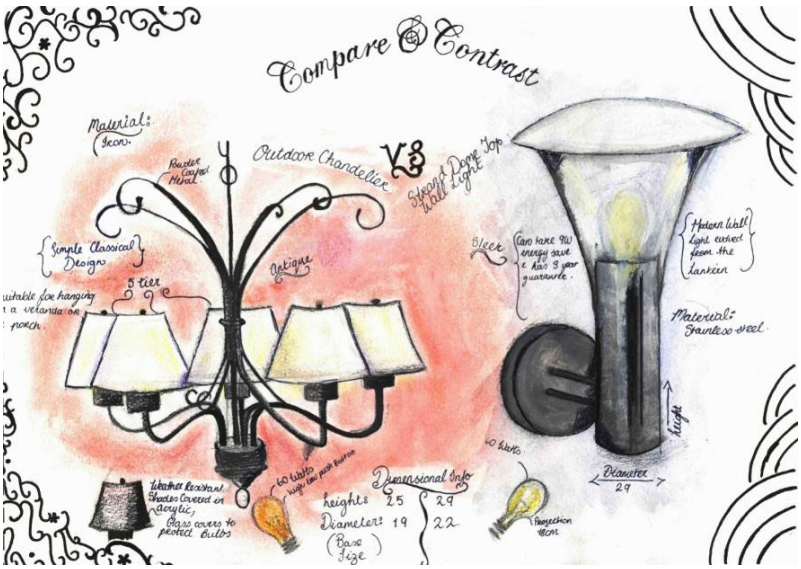
The communication of your ideas, as in Output 1, should be clear and easy to follow with ample information demonstrating a good knowledge of the chosen artefacts.

The example shown presents the selected objects, represented by digital images, sketches and text, which compare and contrast their design features. Like the other samples in this section, they have been taken from the recent pilot project dealing with *'Exterior Lighting'*. The illustrations above could possibly have been enhanced with more detailed written information. The overall dimensions of the objects should also have been included here. More relevant information could have been included in the available space. Colour rendering could have been used to further enhance the presentation

The second page to this output shows a clear set of freehand sketches. These sketches identify features such as mounting techniques and the advantages of one over the other, the efficiency of LEDs over filament bulbs, surround illumination technique and light pollution, aesthetics, style, materials and cost. More detailed investigative research could have been included in annotation format. Shortcomings in the designs could have been identified which will inform the modifications/concept design in Part (b)



This example shows two contrasting exterior lights represented using freehand sketches. The pendant outdoor chandelier on the left is enhanced using pastels (if choosing this form of representation don't forget to spray it with a fixative to prevent future smudging) while the wall mounted lamp on the right is finished with watercolours. Hand written notes (annotations) including dimensions are inserted.



These annotations are where the real *'critical thinking'* takes place. Insert these throughout this output as much as possible. It demonstrates a good understanding for the design features of the article and further prepares the student for deconstructing the item during the modelling phase.

The first step in completing this output is to analyse both objects and compare and contrast their design features. The second stage of the process is to choose suitable presentation techniques and media to present this information. Decide what techniques you will use when freehand sketching and

practice them several times before producing the final presentation.

These may include:

Cross hatching / Pointillism - Colour pencils - Water-colours / Gouache

Pantone / Pro markers – Pastels - Shadows / Shading

The choice of paper used will depend on which of these rendering techniques you apply.

These may include:

- Heavy gauge cartridge paper (pencils, charcoal, pastels)
- Coloured paper (contrasting background)
- Watercolour paper (watercolours / gouache)
- Coated paper / Photographic paper (markers)
- Trace paper (pencils / markers)

What is the reason for this output?

The purpose of this output is to:

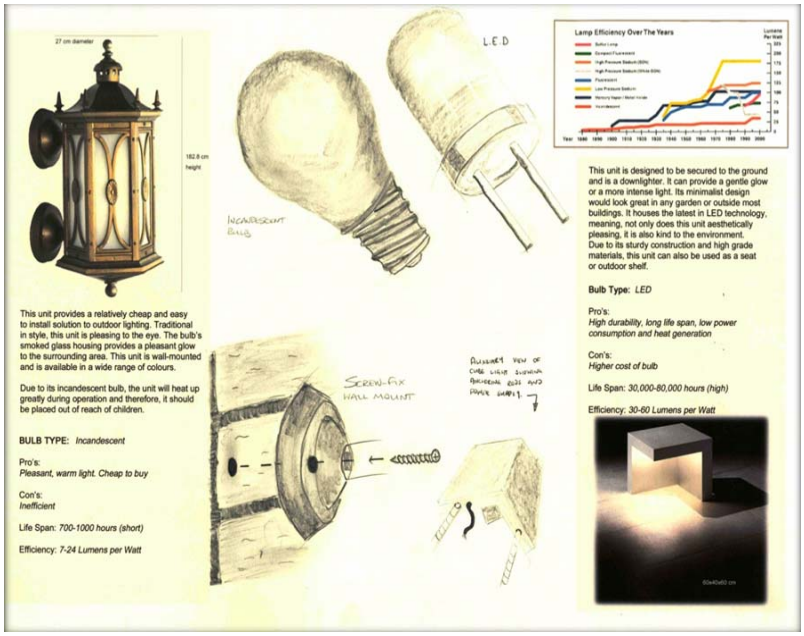
- Draw your attention to the main components and physical design features that make up the objects you are analysing.
- Encourage awareness of **aesthetics, durability, dimensions, materials and other relevant characteristics of the product** (see example below).

It is important that the model is broken down into its component parts, thus creating an awareness of how it goes together, thereby informing the modelling of the artefact in SolidWorks.

The samples shown throughout this chapter are taken from the pilot project and are not intended to be definitive but they should act as examples of some of the several ways in which this output may be presented.

The student is encouraged to be as expressive as possible but in a clear and concise format.

Good quality factual information and dimensions of the chosen objects should be included.



Which of the 2 artefacts shall I select to develop further in Outputs 3 and 4?

At Higher Level the artefact selected should contain at least 5 components (parts).

At Ordinary Level an artefact with at least 3 components (parts) is required.

The object selected should have the potential to demonstrate the range of skills that the student has acquired in SolidWorks over the course of the DCG programme.

Some styles may tend to be minimalist in design and may not provide enough of a challenge during the modeling process. This is evident from the example shown (left). The lantern (right) was chosen because it offered the potential of demonstrating a wider range of skills (remember that factor of difficulty will be considered in the marking scheme).

Output 3 - Choose one of the artefacts and make a detailed graphical presentation of this artefact. This should include a rendered freehand presentation quality drawing in 3D format.

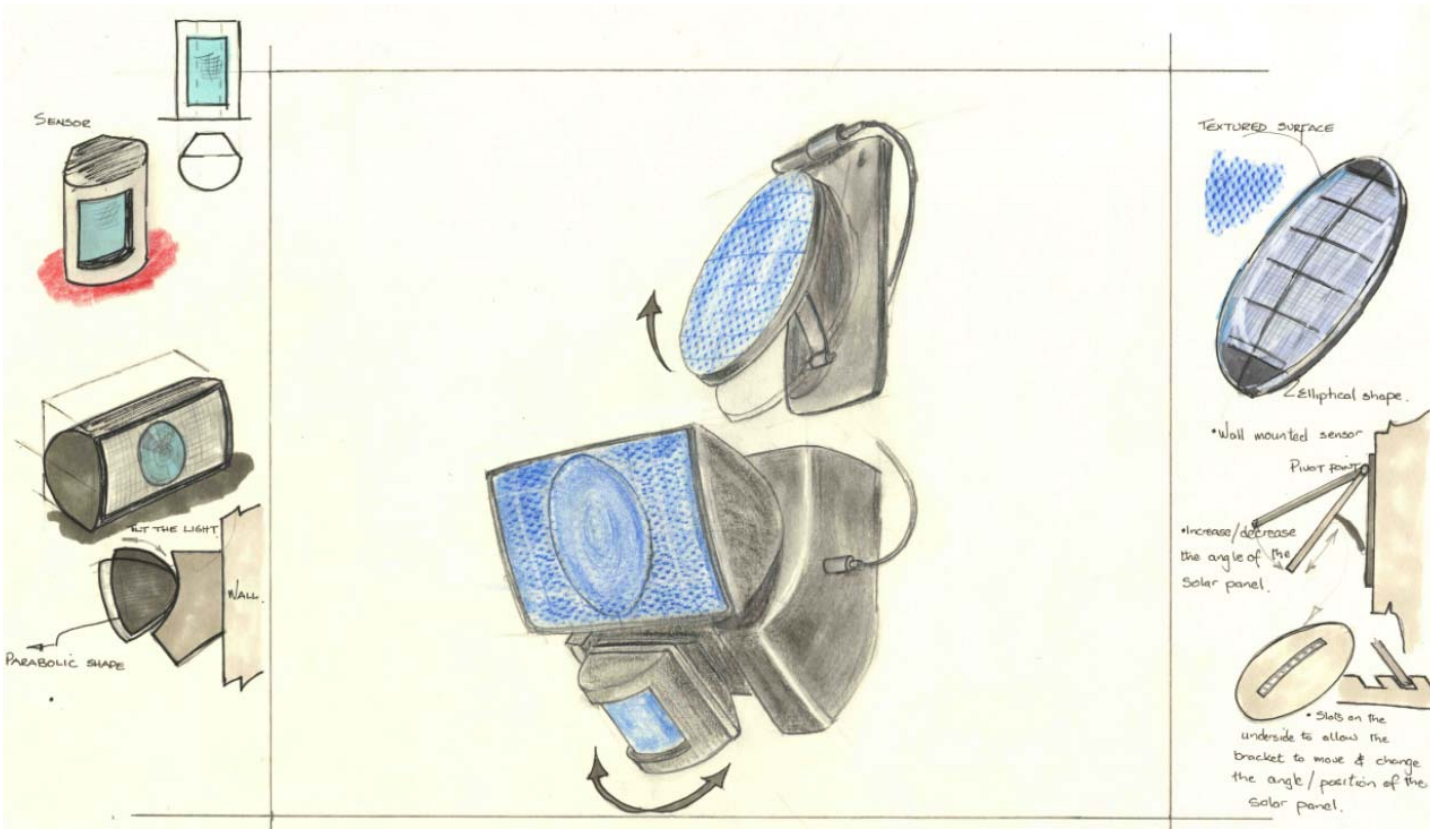
How many sheets do I need to produce?

Students at Higher level are expected to produce at least one A3 sheet for this output. The same is expected at Ordinary level. The original sketches must be submitted on the sheet(s) for this output as part of the final bound hardcopy portfolio (scanned sketches will not meet the requirements of this output).

What exactly are you asked to do in output 3?

In Output 2 you have closely examined the composition of two separate artefacts. In output 3, you are required to choose one of the artefacts and make a detailed graphical presentation of the artefact. This should include a rendered freehand presentation quality drawing in 3D format.

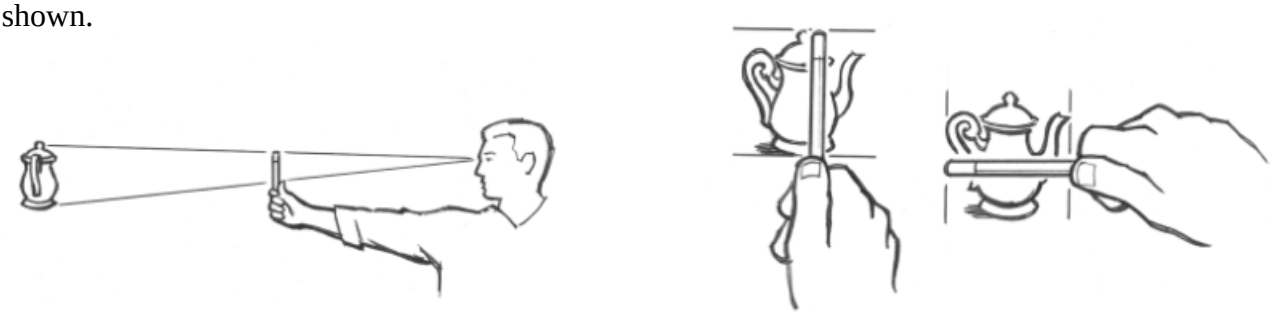
Some of the following views could also be used in the production of this output: Elevations, Plan, Sectional view, Exploded view, Detail view or any other view which the person may deem necessary. The use of colour, texture and annotations may also help graphically convey information about the artefact; the use of arrows in the example demonstrates the direction or movement of the buttons.



Having chosen one of the artefacts what is my next step?

At this stage, a good deal of knowledge has been acquired about the chosen artefact, which should include its shape, form, size and how the parts go together. Now you need to decide on what further information you are going to convey in this output. You are trying to represent and not reproduce the artefact using freehand sketches. It is important that the sketches drawn are in proportion; this is as simple as making sure that the width and height in your drawing is proportionally similar to the actual object.

If we look at the sketches shown above it is clear that the sketch on the left has clearly observed and represented the proportions of the exterior light effectively, while the sketch on the right has failed to do so. You don't need to know the actual measurements of the artefact: instead measure the relative sizes of the elements to achieve an accurate representation. This can be done using various methods as shown.

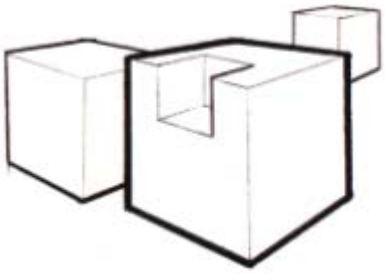


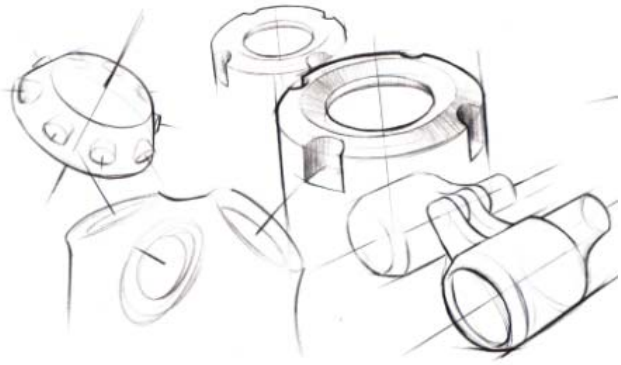
Do I have to use freehand sketching to complete this output?

Yes, all drawing on this sheet must be sketched and all drawing submitted in this output must be the original freehand sketches. You don't have to draw your initial sketches on quality paper or use watercolours or pantone pens; don't be self conscious just sketch and develop your own style. Freehand sketching is really important; it's a way to show people what you are thinking, to record

your ideas and to solve problems. Sketching also helps to capture the design process and promotes reflection and debate. It takes a great deal of practice to become good at freehand sketching. Aside from the essential ability to draw, a good knowledge of basic theories like perspective and shading is required to create credible and attractive sketches.

If the chosen object is very complex in its shape break it down into shapes that you recognise and can draw. Remember that many complex objects are based on basic geometric shapes. Sketch these parts roughly and practice drawing the parts until you have the overall form clear in your head. Do not be afraid to add **annotations** - brief notes or descriptions to your sketches to help explain a particular detail. Show your sketches to others and see if they understand what you are conveying on the drawings? Do they have any suggestions/ observations? Some examples of practice sketches are shown below.





How should I decide on which media to use?

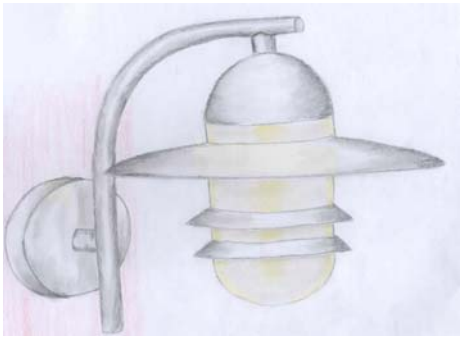
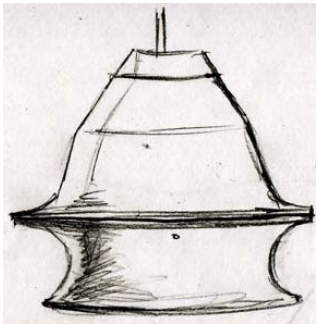
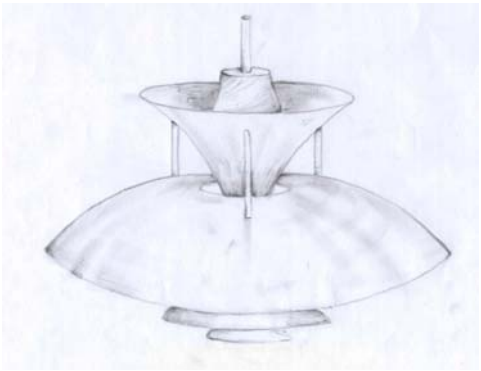
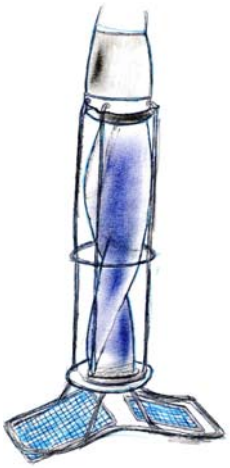
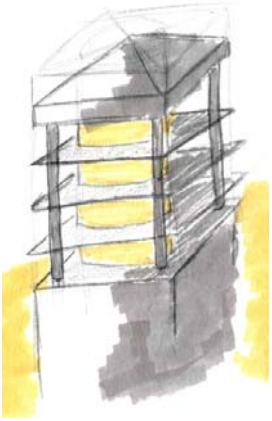
Paper is available in a wide range of weights, textures and colours. The character of the paper can influence a drawing quite dramatically. A paper's grain or smoothness will determine how fine and clearly lines can be drawn, and can affect the appearance of rendered sketches.

Is it pen, pencil, markers, or is it a mixture of several. Is it watercolour paper, cartridge paper, colour card, glossy paper, tracing paper or is it a collage of some of them. That decision must be made by the individual student. Work with media that you are comfortable with or materials that you have used before. Some of the following media were used by the students in the pilot project.

2B and 3B graphite pencils - Polychromos pencils – Markers - Chalk pastels - Felt tip pens Watercolours - Tracing paper - Watercolour paper - Colour paper - Cartridge paper - Glossy paper

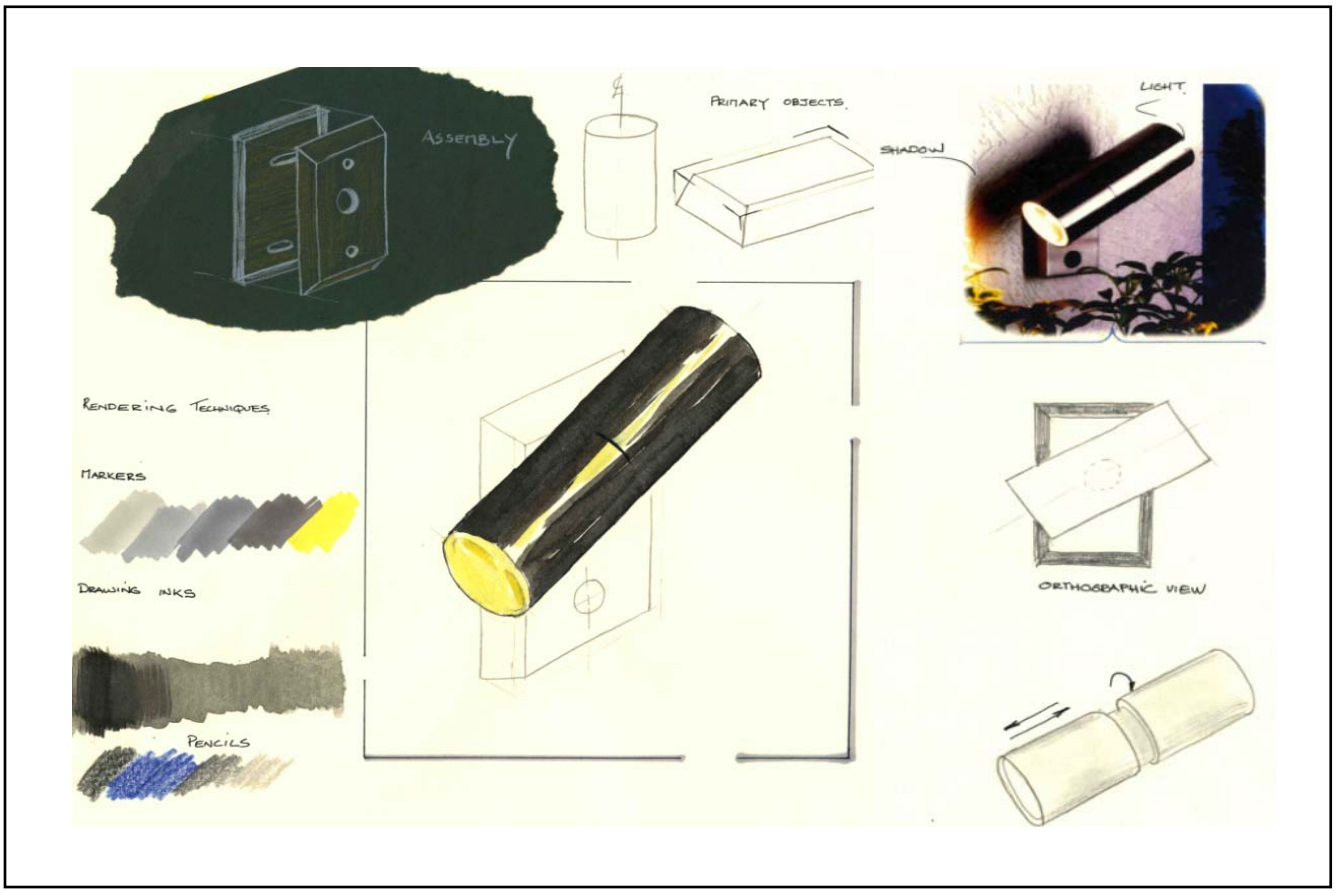
How many drawings must I sketch in this output?

It is not a question of quantity, but rather quality. However, one of your drawings must include a rendered freehand presentation quality drawing in 3D format. Sketching is about recording and communicating your ideas on paper in a manner that allows others to clearly understand your train of thought. A series of sketches dealing with the same artefac(exterior light) showing sketches of its individual parts and their relationship with each other might tie it in better with the preceding statement

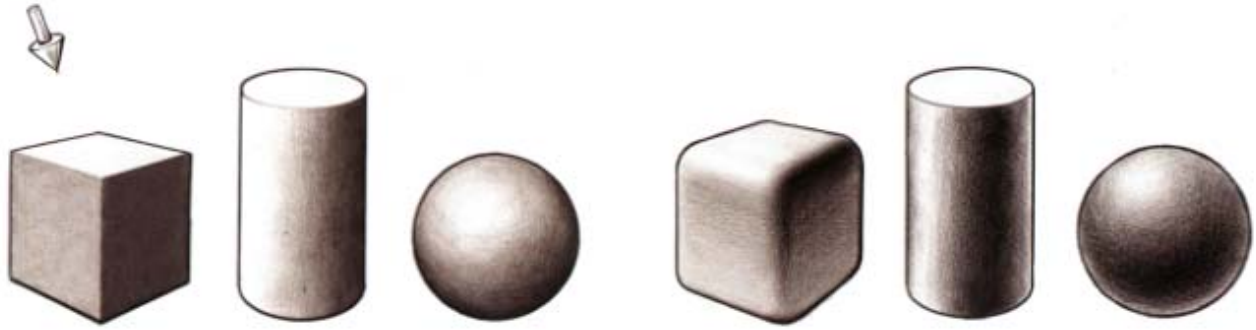
How should I layout my sketches on the sheet?

The composition and layout of your sketches on your page will depend on your individual graphic style and the depth of information you want to communicate. Make sure that the rendered freehand presentation quality drawing in 3D format captures the viewer's attention. To ensure that this occurs this sketch should be larger than any other sketches. All other sketches, details and annotations should be placed carefully on the sheet so that you are focussing the viewer's attention towards the rendered freehand 3D. The following sheet may be considered as one possible layout.



How do I render the freehand presentation quality drawing in 3D format?

To generate a good render, one must be familiar with the 3 H's. How to draw? How to see? and How to apply? Here we need to concentrate on how to apply rendering to the artefact that you have already sketched lightly. Rendering is based on a solid understanding of light and its characteristics, including shade and shadow. Before rendering any object, the direction of the light should be chosen wisely, as the shadows it produces can help describe the objects form and/or create a specific mood. In the following two examples, the lighting has been chosen to make simple objects appear clearly. The arrow next to the cube indicates a light source direction behind and above the object. This light source makes the top surfaces the brightest, its right side the darkest and the left side a shade in between.



Any media type can be used to render. Graphite pencils, felt tip pens and charcoals can be used to give a black and white finish, while polychromos pencils, markers and pastels are often used to create gradient or for covering large areas on an object. When applying a render we should also be aware of the material the object is made from and also textures that may be on the object. Rendering can be improved by observing the way the material and textures reflect light.

For example, **Shiny Plastic Handle with a Textured Grip**;

The **Textured handle** is created by placing a textured surface underneath your sheet, use a pencil to transfer the texture onto your page. Many different surface textures can be tried to achieve the desired effect, for example by using sand paper, plastic folders, metal screens etc.

The **Shiny plastic surface** is created using a blue marker, to create the impression of a lit or shiny surface; layering stokes of the same colour will darken an area, while omitting an area will create the impression of a shiny surface.

Each media has its own benefits and challenges. Make sure that you experiment on practice sketches so that you are confident enough to use them on the final sketch. Be sensible and do not over render an object. Remember, we are looking to bring the initial pencil sketch of the artefact to life.

Output 4 – Generate a detailed computer model, comprising at least 5 parts at Higher Level and at least 3 parts at Ordinary Level, an Assembly and an eDrawing of the selected artefact. Economy of design and design intent will be considered in the marking of the assignment.

What must be submitted to satisfy the requirements of this output?

The following CAD files must be submitted on the CD for assessment:

- Required number of part files (at least 5 parts at HL and 3 at OL)
- Assembly file of the artefact chosen in Part (a)
- Solidworks drawings (produced for Output 5)
- An eDrawing of the assembly

Document Properties

Document Properties contain the default settings for templates. Creating a template with the appropriate settings at the outset will avoid unnecessary duplication of work.

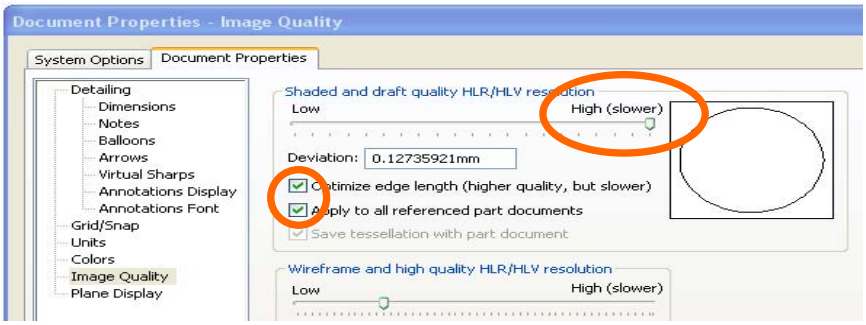
Image Quality

Image quality needs to be balanced between the quality of the image and software performance.

Shaded and draft quality HLR/HLV resolution controls the tessellation of curved surfaces for shaded rendering output. A higher resolution setting results in slower model rebuilding but more accurate curves.

Setting the Image display quality options:

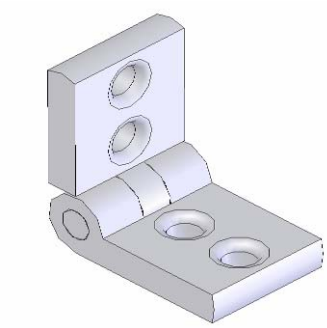
- Click **Tools**, **Options**.
- In the **Document Properties** tab, select **Image Quality**.
- Move the slider to a high setting as this slider controls the image quality resolution.



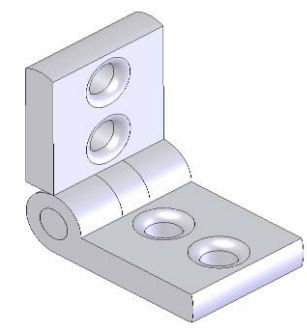
- Select **Optimize edge length (higher quality, but slower)** if even further improvement is required.

  Note: This option causes slower system performance and increased file size.

- **Apply to all referenced part documents:** This setting is only available within the assembly environment. Choosing this option applies the image quality settings to all of the part documents related to the assembly.



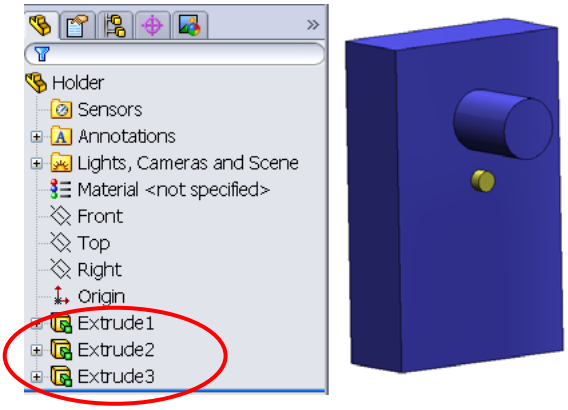
Model with low image quality

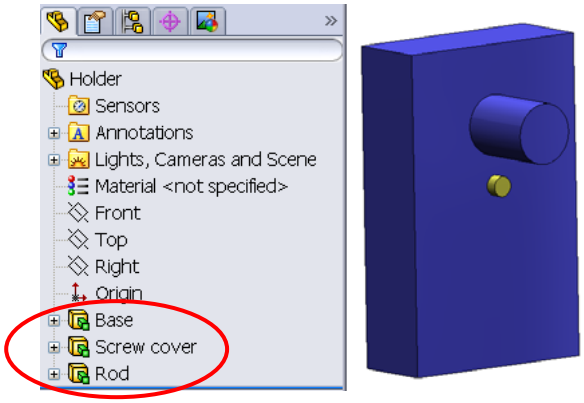


Model with image quality increased

Renaming Features

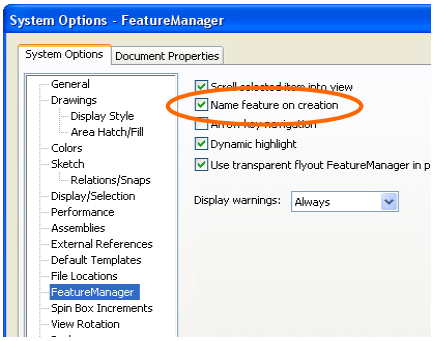
Renaming entries meaningfully in the FeatureManager is good practice. The diagram below (left) shows a model of a holder for fixing a light to a wall. It is created from three extrude features - Extrude1, Extrude2 and Extrude3. The diagram below (right) shows the same model with the features renamed. It is good practice to name features appropriately as it adds clarity to the model.





Naming Features on creation option

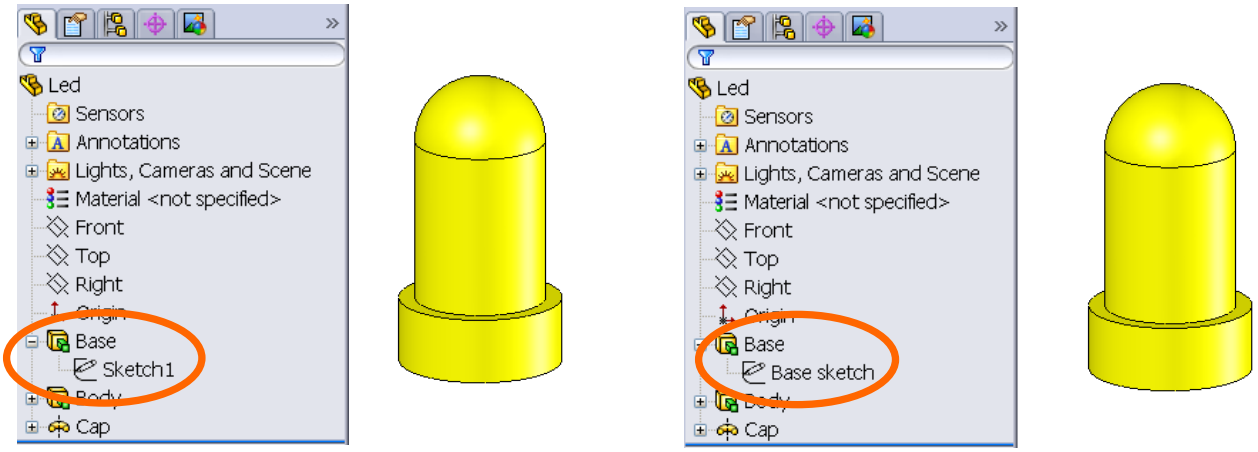
SolidWorks allows the user to name a feature on creation.



- Click on **Tools, Options, System Options, FeatureManager.**
- Select **Name feature on creation** and click **OK**.
- With this option, the feature name in the FeatureManager design tree is automatically selected when a new feature is created and is ready for an appropriate name to be entered.

Renaming Sketches and Features

Renaming sketches by selecting on the text in the FeatureManager is good practice. Two LED parts are shown below. **Sketch1** is the name of the sketch used to create the **Base** feature. The diagram on the left shows the FeatureManager where the sketch has not been renamed. The one on the right shows the FeatureManager with the sketch renamed appropriately.

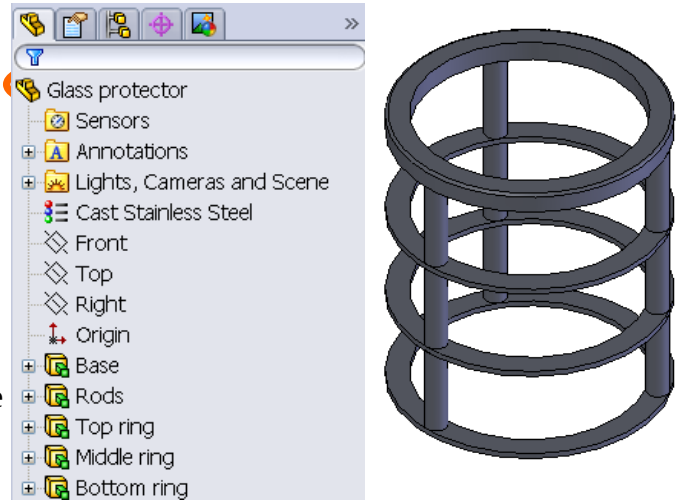


Fundamentals of Part Modelling

Managing Parts

In a SolidWorks session, the first system default part filename is named: Part1.sldprt. The second created part in the same session, increments to the filename: Part2.sldprt.

In order to avoid confusion, and to help identify the various parts, it is recommended that each part should be saved, on creation, with an appropriate filename that describes that part. For example, the part over is named "**Glass protector"**.



Steps in Creating a Part:

Before setting out to model an artefact it is essential that it is thoroughly analysed. Where do you start? What is the best approach to modelling it? What geometry exists within the object? How do parts go together? It may be advantageous to have the object but if that is not possible a similar object may aid modelling.

Choosing the best plane on which to create a sketch:

If the best profile of a part is viewed in plan, the best plane to create this profile of sketch is on the Top Plane. Choose a plane which generates the best profile of the object.

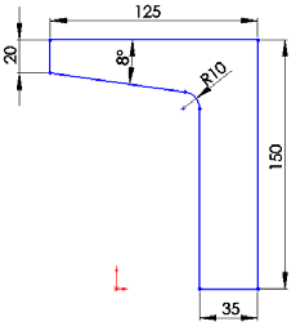
Choosing the best profile:

The best profile of a part to sketch is the profile which generates more of the model than any other profile.

Status of a Sketch

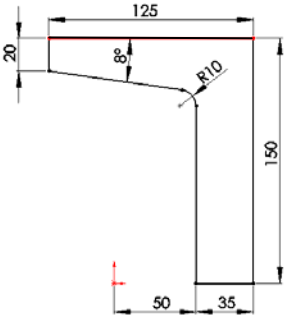
- All sketches must be **fully defined.**
- Many of the SolidWorks files in the pilot assignment contained under defined sketches.
- Although features may be created in SolidWorks without dimensions, dimensions provide location and size information. Models require dimensions for manufacturing.
- By creating fully defined sketches, future rebuild problems are prevented and faster rebuild times are obtained.

Four states are used when describing the status of a sketch:

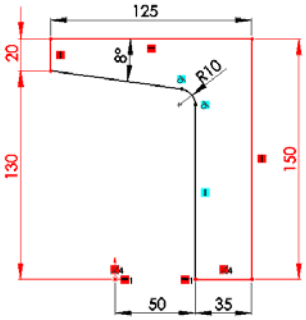


1. **Under Defined**: This sketch does not have sufficient dimensions or sketch relations or its location in relation to the origin has not been defined. In an under defined sketch (see over), the entities that require position, dimensions or sketch relations are displayed in **blue**.

2.



3. **Fully Defined**: The sketch has sufficient dimensions and relations to completely define its geometry. Its location in relation to the origin is defined through dimensions or relations. In a fully defined sketch, all entities are displayed in **black**. The sketch can be extruded or revolved and the design intent is captured.



4. **Over Defined**: The sketch has too many relations or dimensions. The sketch will be displayed in red.

5. **Dangling**: Dimensions and relations are said to be dangling when they reference something that has been deleted or that is otherwise unresolved.

It is imperative that all sketches are **fully defined**

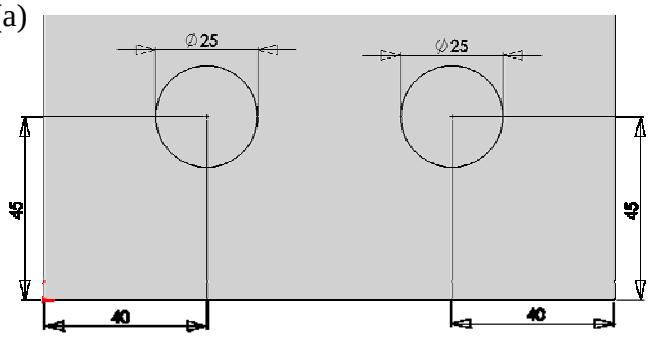
When creating a sketch, the following sequence is considered good practice;

Sketch – Add Relations – Add Dimensions – Fully Defined Sketch

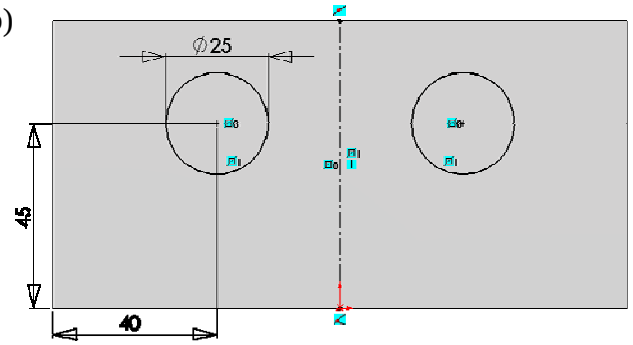
Sketch Relations

The use of appropriate relations and geometry will reduce the amount of dimensions necessary to fully define a sketch and will embed good design intent.

(a)



(b)



Adding Materials, Appearances and Colour to models

A **material** may be applied to an entire part within SolidWorks. The physical properties of that material are applied to the model. The 'Evaluate' toolbar can then be used to determine such properties as mass, density etc. The material will give the part a realistic appearance.

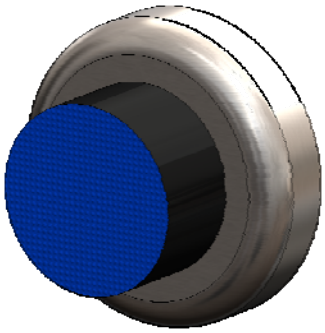
Appearances can also be added to models in SolidWorks to make them look more realistic. Appearances add the likeness of materials to models without adding the physical properties of the material. As part of applying appearances, you can modify color and their mapping properties on to various surfaces e.g. spherical, cylindrical, etc.

Appearances may be applied to parts, bodies, features or faces. The application of an appearance will override the visual appearance of a material.

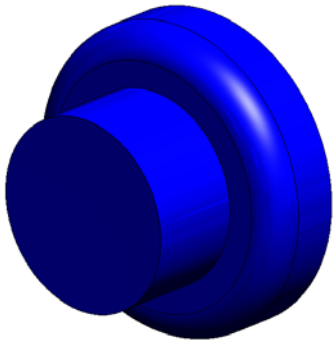
When you apply appearances to models, the following hierarchy prevails:

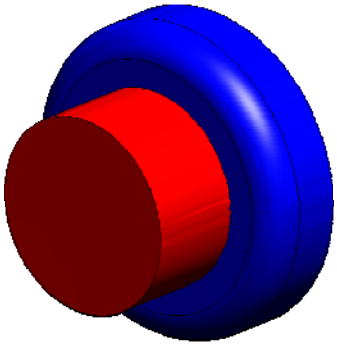
- Component appearance (assemblies only) overrides face appearance.
- Face appearance overrides feature appearance.
- Feature appearance overrides body appearance.
- Body appearance overrides part appearance.

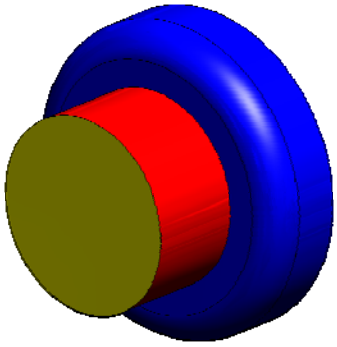
In the diagram shown a **'Brushed Steel'** appearance was applied to the entire part. '**Black high gloss plastic'** appearance was then applied to the boss feature which changed its appearance. This in turn was superseded by a **Blue dimpled plastic** appearance, which was applied to the face of the boss feature.



Colour may also be applied to parts, bodies, features or faces. Colours observe the same hierarchy as that which exists with textures. Face colour will override feature colour which will override body colour, as shown below.

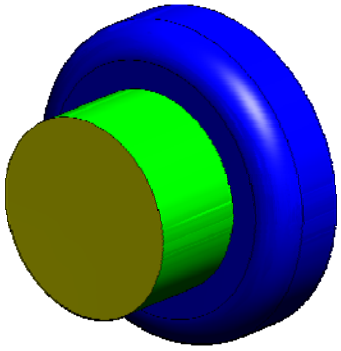






If an appearance/colour has been applied to a face, changing the colour of the feature containing that face will not affect the appearance of the face.

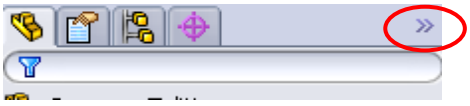
In the part shown opposite, the boss feature colour from above has been edited but the face colour has remained the same.



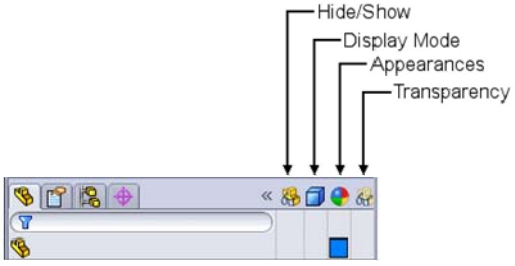
To avoid confusion when applying colours and textures be aware of the hierarchy that exists between them.

The 'Display Pane' may be useful when editing appearances as it indicates the various appearances and display settings applied to various features of the part file

To expand or collapse the Display Pane, click at the top of the Feature Manager pane (to the right of the tabs)



The Display Pane appears to the right of the FeatureManager pane. The four columns indicate the features that are hidden/shown, the display mode, the appearance applied and the transparency of each.



Assemblies

When creating an assembly, part files are drawn together. **It is critical that all of the necessary files to create the assembly be stored in one location along with the completed assembly**.

For this reason, when setting out on a new project the first step is to create a folder to contain all of its component parts.

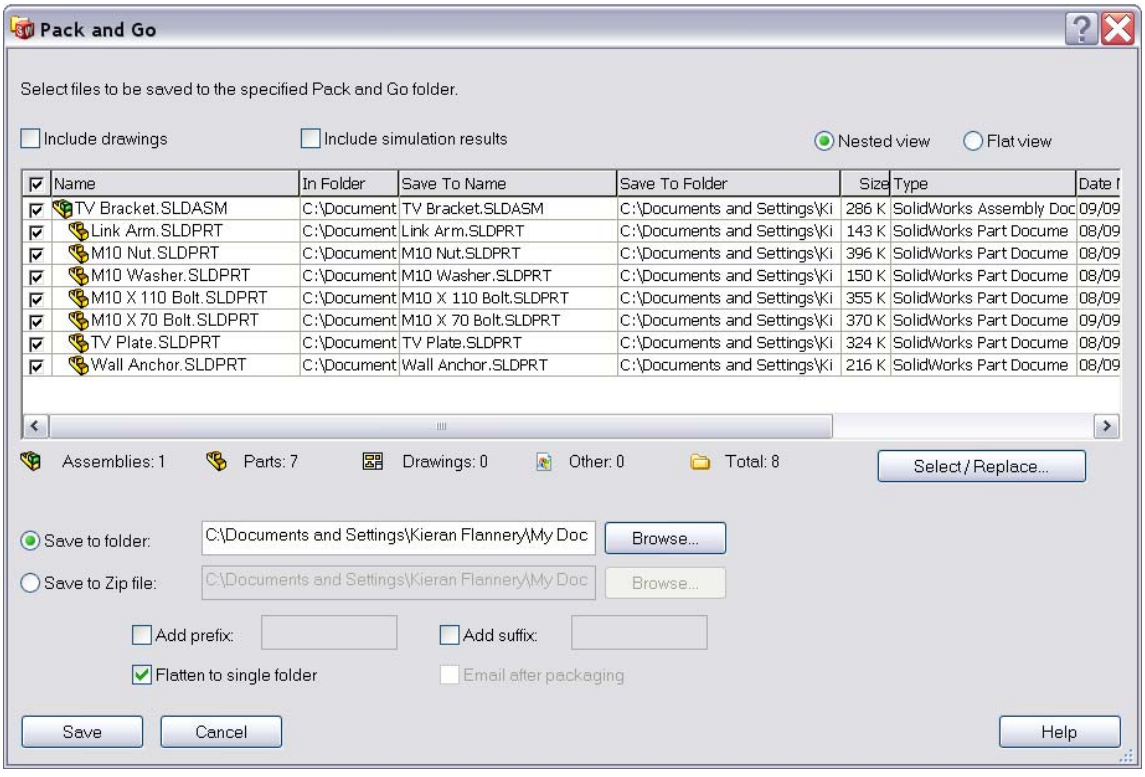
Save the assembly under a recognisable name eg. **Light Assembled.**

Pack and Go

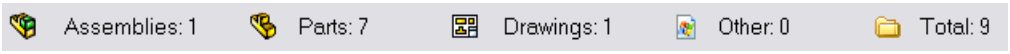
Pack & Go gathers all related files for a model design (parts, assemblies, and drawings) into a folder or zip file.
We will use the TV Bracket project to demonstrate this feature.

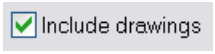
We will first create the folder into which the files will be saved. Create a folder in an appropriate location and call it **TV Bracket Complete**.

With the TV Bracket assembly opened choose **File, Pack and Go…**The window shown below will appear.



The details of the files which are associated with the assembly are displayed in the display window along with the number of assemblies, parts etc underneath.



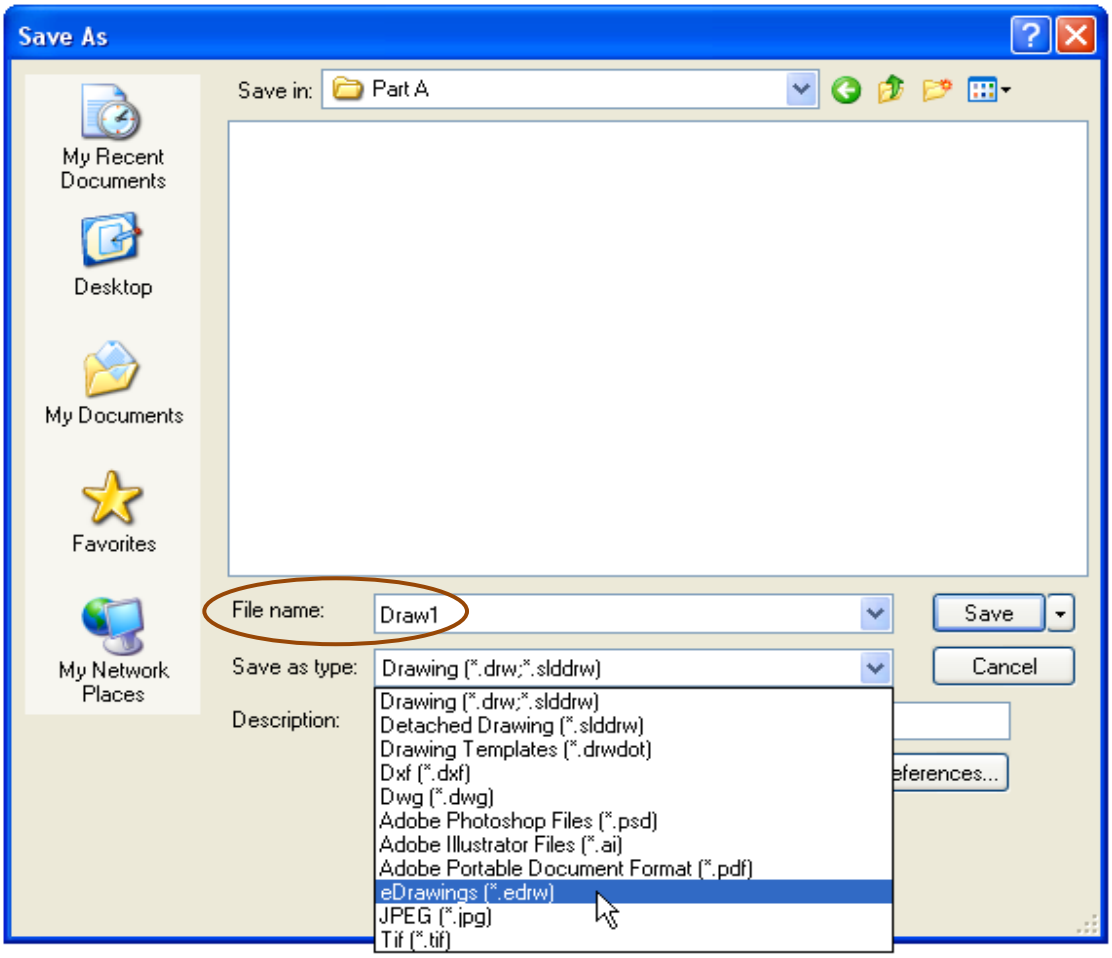
Check **Include drawings**  to ensure all drawing files are included in the new destination folder

Note: Should a file be stored in a different location SolidWorks will find it and include it in the list.

eDrawings

An eDrawing is a file format which allows a SolidWorks document to be viewed in an eDrawing viewer or **eDrawings 2009** without having the SolidWorks software.

Saving a SolidWorks document as an eDrawing



With a SolidWorks document open

1. Click **File**, **Save As**.
2. Input the **File name**.
3. Select **eDrawings(*.edrw)** from the **save as type** options
4. Click **Save**.

Note: The eDrawing file may be opened using **eDrawings 2009** *or* by downloading **eDrawings Viewer** from **www.solidworks.com/pages/products/edrawings/eDrawings.html**

Output 5 – Detailed orthographic views, rendered pictorial view and an exploded view.

Requirements of Output 5

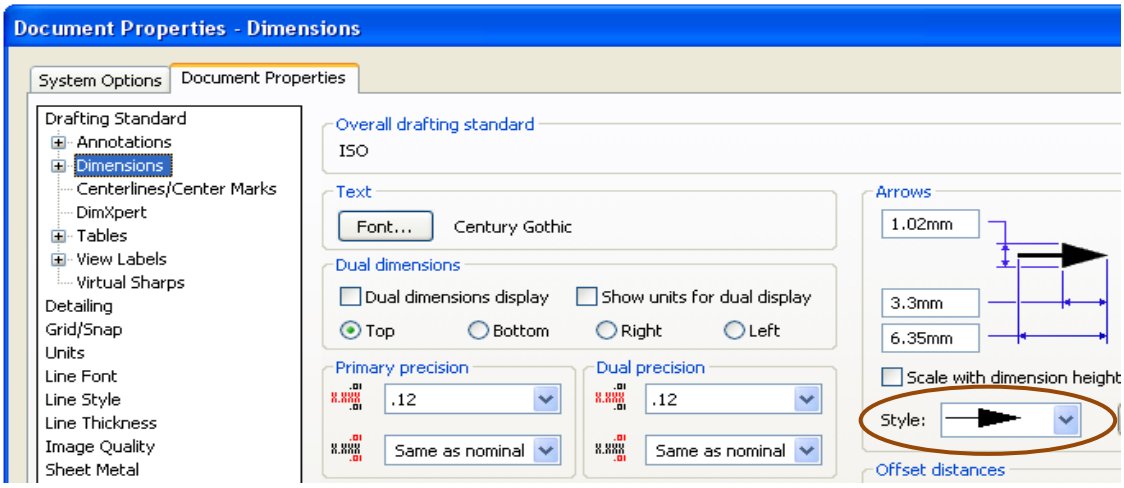
You are required to produce the following SolidWorks drawings from the model created in Part (a):

1. Detailed orthographic views
2. A rendered pictorial view
3. An exploded view.

Before creating the required drawings it may be useful to be able to customise drawing templates and sheet formats.

Drawing Templates

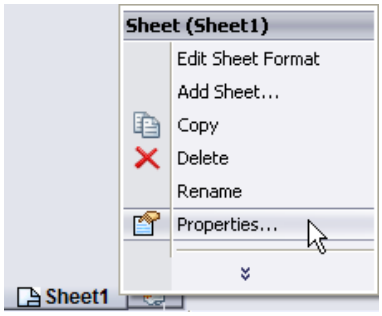
The presentation drawings should be created using pre-prepared drawing templates. A drawing template stores document property settings. These settings are displayed in the document properties tab. This is accessed from the **Tools** drop down menu under **Options, Document Properties**. The T4 drawing templates use the ISO (International Organization for Standardization) standard. This template can be edited and form the basis for a customised template. Properties such as dimensioning standards which determine things such as arrowhead style (highlighted below), units of measurement, image quality, etc can be specified to suit your own needs. The advantage of setting up your own template is that these settings are saved prior to creating a drawing thereby avoiding repetitive editions afterwards.



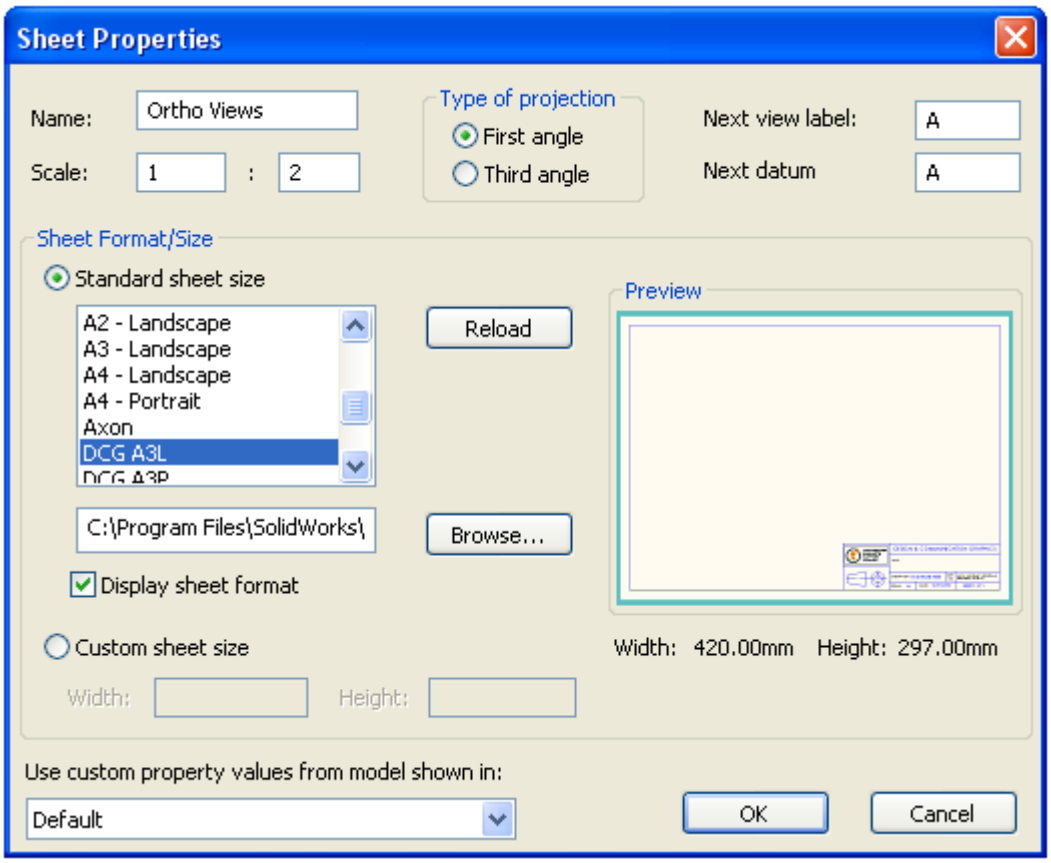
You should refer to the "Creating Drawings" CAD notes for further information on creating, saving and editing templates.

Sheet Properties

You can set the sheet properties by right-clicking the sheet tab at the bottom of the drawing window (shown across), any blank area of the drawing sheet or the sheet icon in the Feature Manager design tree and selecting **Properties**.



The **Sheet Properties** dialogue box (shown overleaf) will appear.



- The default sheet name is **Sheet 1**. A new name can be entered (e.g. Ortho Views)
- The scale can be set
- It is preferable that the drawing views be in **First Angle Projection**. The Type of projection setting appears in the top middle of the box. Ensure that **First Angle** is selected
- The letter of the alphabet to be used for the next section and detail views can also be specified.

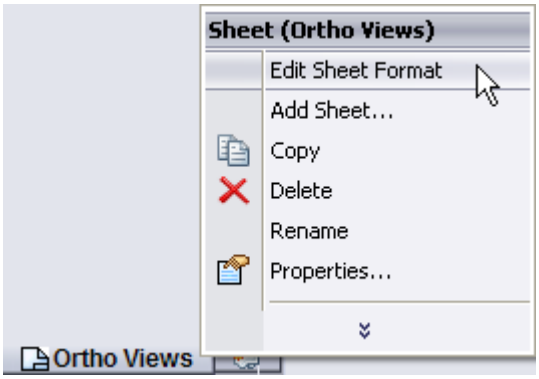
The sheet properties can be set when you edit an existing sheet such as DCG A3L or add a new sheet.

Sheet Format/Size

- **Standard sheet size**
  - Select a standard A3 sheet size and orientation (Landscape or Portrait).
- **Sheet format**
  - Sheet format helps create drawings with a uniform layout. The sheet format is stored within the template and may include a border and a title block.

Edit Sheet vs Edit Sheet Format

There are two modes in the drawing:



- **Edit Sheet**
  - This is the mode you use to make detailed drawings
  - Add/modify views, dimensions or text notes
- **Edit Sheet Format**
  - Change the border
  - Change the title block size and text headings
  - Add standard text that appears on every drawing.

You can edit the title block by right-clicking the sheet tab at the bottom of the drawing window (shown above) or right-clicking in the graphics area and selecting **Edit Sheet Format** from the shortcut menu.

The title block should contain the drawing name, your exam number, sheet number, projection symbol, scale, units and date. This can be done by editing the **sheet format** of one of the T4 drawing templates.

In order to access multiple sheets of the same format within a drawing document, it will be necessary to extract the sheet format and save it as a separate file in a separate location.

Saving Sheet Format

With the template open

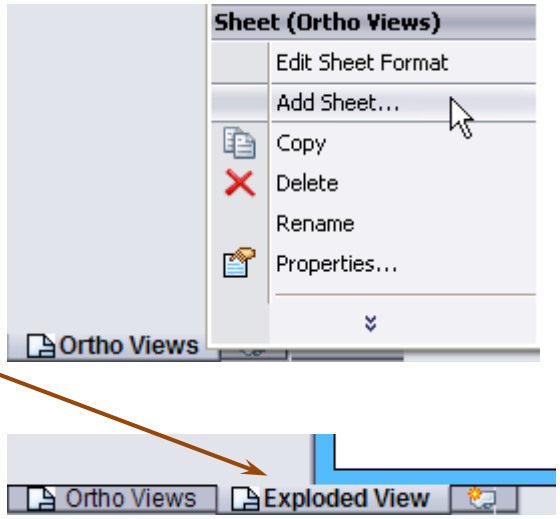
1. Click **File**, **Save Sheet Format** from the drop down menu
2. By default, SolidWorks will choose the correct location in which to save the file – C:\Program Files\SolidWorks\data
3. Click **Save**.

Creating a Drawing File with Multiple Sheets

Any number of drawing sheets, containing different views, can be created within one drawing file. This reduces the need for several drawing files of the same assembly/part. This is done by adding sheets.

Adding Sheets

- Right-click in the Graphics window
- Click **Add Sheet**
- Display the Sheet Properties dialog box
- Name the sheet to reflect the views which will be contained on the sheet
- Edit other properties as required
- Click **OK**.



Repeat the process to add as many sheets as necessary.

Hardcopy output from SolidWorks

It is important to consider the following points when you produce the drawings for this output:

- **<u>All</u> of the drawings must be generated from the SolidWorks models**
- All of the drawings must be in in SolidWorks format; screengrabs of the drawings should not be imported into a Word/Publisher document
- The drawing sheets must be printed out and submitted as **hardcopy outputs from SolidWorks** for this output of your assignment

Suggested number of A3 pages

- Students at Higher level are expected to produce between two and four A3 sheets for this output
- At Ordinary level one to three sheets are expected.

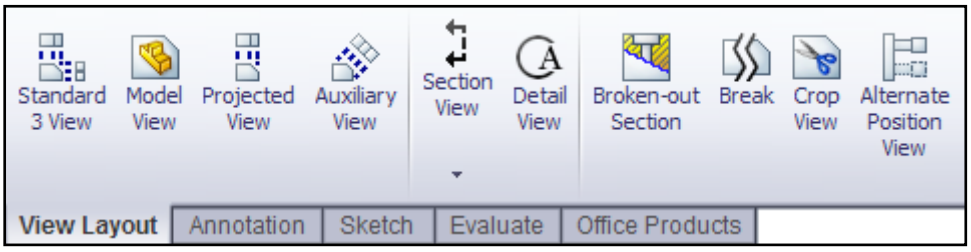
Description of output

As mentioned earlier, you are required to produce the following SolidWorks drawings from the model created in Part (a):

1. Detailed orthographic views
2. A rendered pictorial view
3. An exploded view.

1. Detailed orthographic views

In order to fully describe an object a number of detailed orthographic views are required. These two dimensional drawing views are created from the three dimensional model or assembly. When creating a drawing, it is important to select the most appropriate views to use. It is equally important to understand the reason for choosing a particular view. The View Layout toolbar contains numerous tools to create the orthographic views; you should take time to plan out your sheets in advance of creating the drawing views to ensure all information about the object is fully conveyed:



a) **Standard 3 View:** This is used to create the three standard orthographic views - elevation, plan and end view - at the same time. The views form the basis of your drawing. The plan (Top) and end view (Right) are aligned to the elevation (Front). The plan can be dragged up or down, and the end view can be dragged left or right

   When the first view is added to the drawing, the file name of the referenced part or assembly will automatically be filled in in the title block.

b) **Model View:** This is used to insert standard views (Front, Top, Isometric, etc), the current model view or custom views that you saved by name into the drawing. In complicated models it is sometimes necessary to include a left, back or bottom view to show all the details

c) **Projected View:** This is used to add a new view from an existing orthographic view

d) **Auxiliary View:** This is used to create an auxiliary view by selecting an angled edge from a previously defined view. It is similar to a Projected View but is unfolded at right angles to a reference edge in an existing view

e) **Section View:** This is used to show internal features of the model

f) **Detail View:** This is used to show an enlarged view of something - the scale should be included

g) **Broken-out Section:** This is part of an existing drawing view and is used to expose inner details

h) **Break:** This is used to display the drawing view in a larger scale

i) **Crop View:** This is used to crop an existing drawing view

j) **Alternate Position View:** This is used to show the range of motion of an assembly.

2. Rendered pictorial view

A pictorial view is a model view that shows the assembly in a specific three dimensional orientation. Examples of pictorial views include:

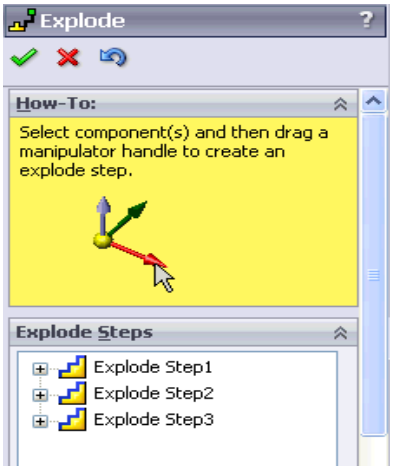
- Standard Views such as Isometric, Dimetric or Trimetric
- User-defined view orientations (including Perspective) that were created in the assembly; these must be saved in the assembly as a named view and placed in the drawing using the view name
- The current view in the assembly.

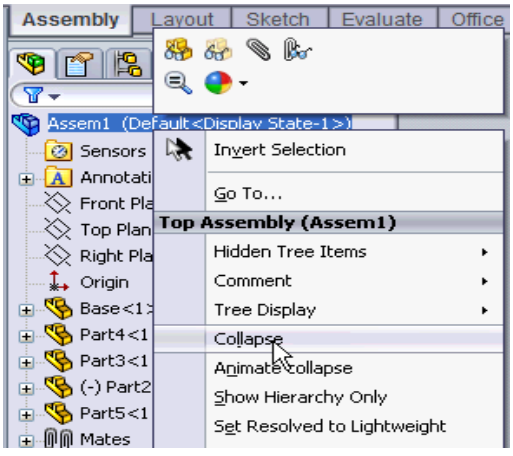
Place the view in the desired location on the drawing. The Display Mode must be changed to make it a shaded (rendered) view.

3. An Exploded View

An exploded view enables you to display the assembly taken apart so that you can see how all of the parts fit together. It is useful for visualising internal parts of the assembly that are concealed.

An exploded view must first be created in the assembly document. With the assembly open choose **Exploded View** from the **Assembly** toolbar and drag the various parts to the desired location. Be careful to explode the parts to show how they are taken apart. When creating an exploded view, mates are temporarily suspended. The figure (below left) shows the Explode PropertyManager.





To “un-explode” the exploded view, right-click on the assembly filename and click **Collapse** (above right). This ensures that the drawing views in the View Palette appear as collapsed.

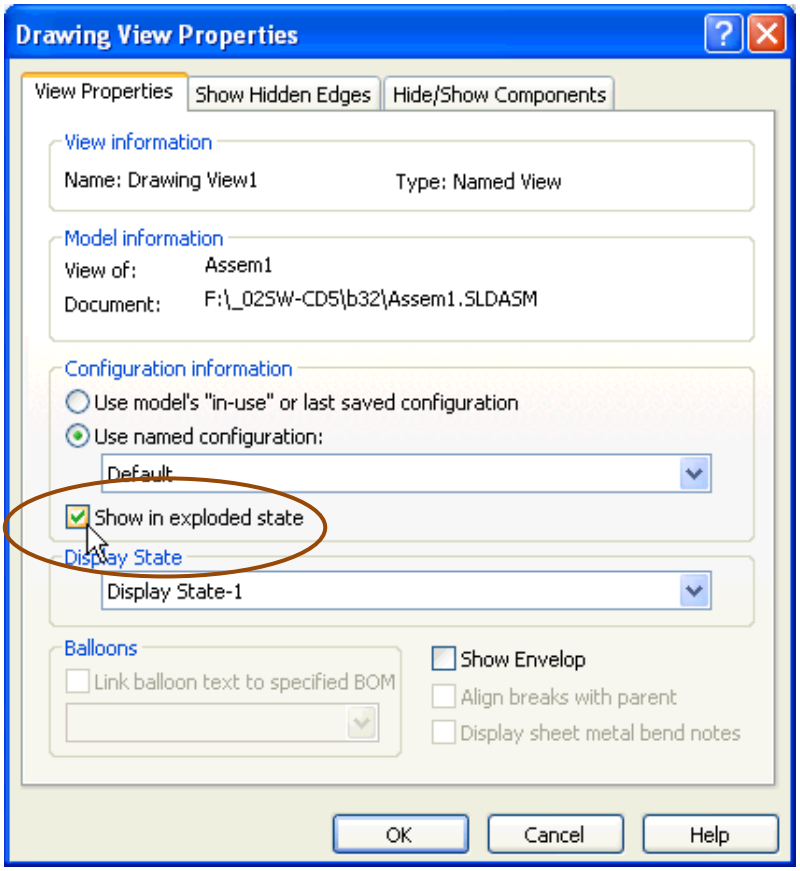
> Ensure that the assembly is **collapsed** prior to creating a drawing.
> Otherwise, all drawing views in the view palette will show as exploded.

Exploded view in a drawing

The exploded view is created as a configuration in the assembly document. You can create an exploded view in a drawing document by using the exploded configuration of the assembly. An exploded view in a drawing is a model view showing the exploded configuration.

Any pictorial view may be used. The **Display State** may be changed to make it a shaded (rendered) view. Select a suitable **Scale**. Drag the view to place it in the drawing and click **OK**.

Right-click in the drawing view and select **Properties**. The **Drawing View Properties** dialogue box appears. On the **View Properties** tab, there is an option to **Show in exploded state**. Select this and click **OK**. The exploded view appears in the drawing dcoument.



A detail view to show a portion of the exploded view at an enlarged scale may also be created. The detail view makes it easier to see some smaller components.

Note: Saving the exploded view of the model as a jpeg and importing it into a Word/Publisher document will not suffice. The reason for this is obvious – if you make a change to the model, it will not be updated in the "static" jpeg image.

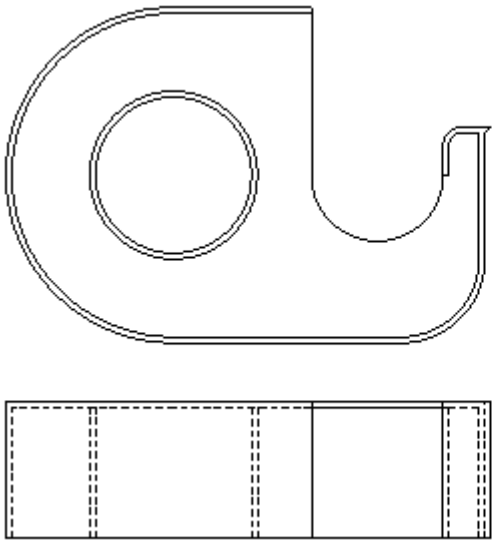
Hidden Line Representation

Hidden Lines Visible is usually used in orthographic views. **Hidden Lines Removed** is usually used in isometric views.

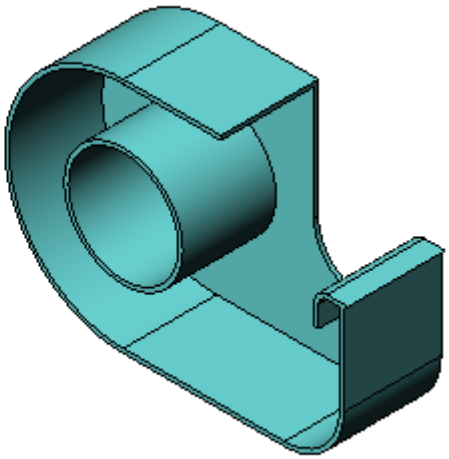
Tangent Edge Display in orthographic drawings

Tangent edges should not be visible in orthographic views. These are the lines where a flat edge begins to go into a curve. SolidWorks often tries to put these lines in; it is up to you to eliminate them.

- Right-click inside the view border
- Select **Tangent Edge, Tangent Edges Removed** from the shortcut menu.



Tangent Edges Removed



Tangent Edges With Font

Tangent Edge Display in a Pictorial View

In an isometric view where there are rounded edges, it is sometimes helpful to include the tangent edges for clarity. When this is the case, do not use solid lines, use tangent edges with font or phantom lines. This shows the tangent edges with phantom lines which are clearly discernable from the regular edges.

- Right-click inside the view border
- Select **Tangent Edge, Tangent Edges With Font** from the shortcut menu.

Scale

The scale should be chosen to give appropriately scaled views on the sheet. The views should be repositioned neatly on the sheet to give an excellent layout. It may also be necessary to add detail

such as dimensions, notes and symbols to document the drawings.

Inserting and arranging the dimensions on the drawing

The dimensions used to create the model can be imported into the drawing. SolidWorks will automatically dimension each drawing view. However, when dimensions are added to a drawing they will very often become cramped. It is up to you to place the dimensions in the proper places and on the proper view. The following points are worth noting when inserting dimensions:

- Dimension features in the view where they can be seen in true shape and size
- Allow space between individual dimensions
- The size and style of leader line, text, and arrows should be consistent throughout the drawing
- Neatness counts - dimensions should be positioned to give a neat layout
- It is not necessary to include all of the dimensions as it is not a working drawing. If a dimension is not needed, simply delete it.

Inserting Notes

The standard views should be clearly labeled “elevation”, “plan” and “end view”. This applies to the various section views and auxiliary views as well.

Finish the Drawing

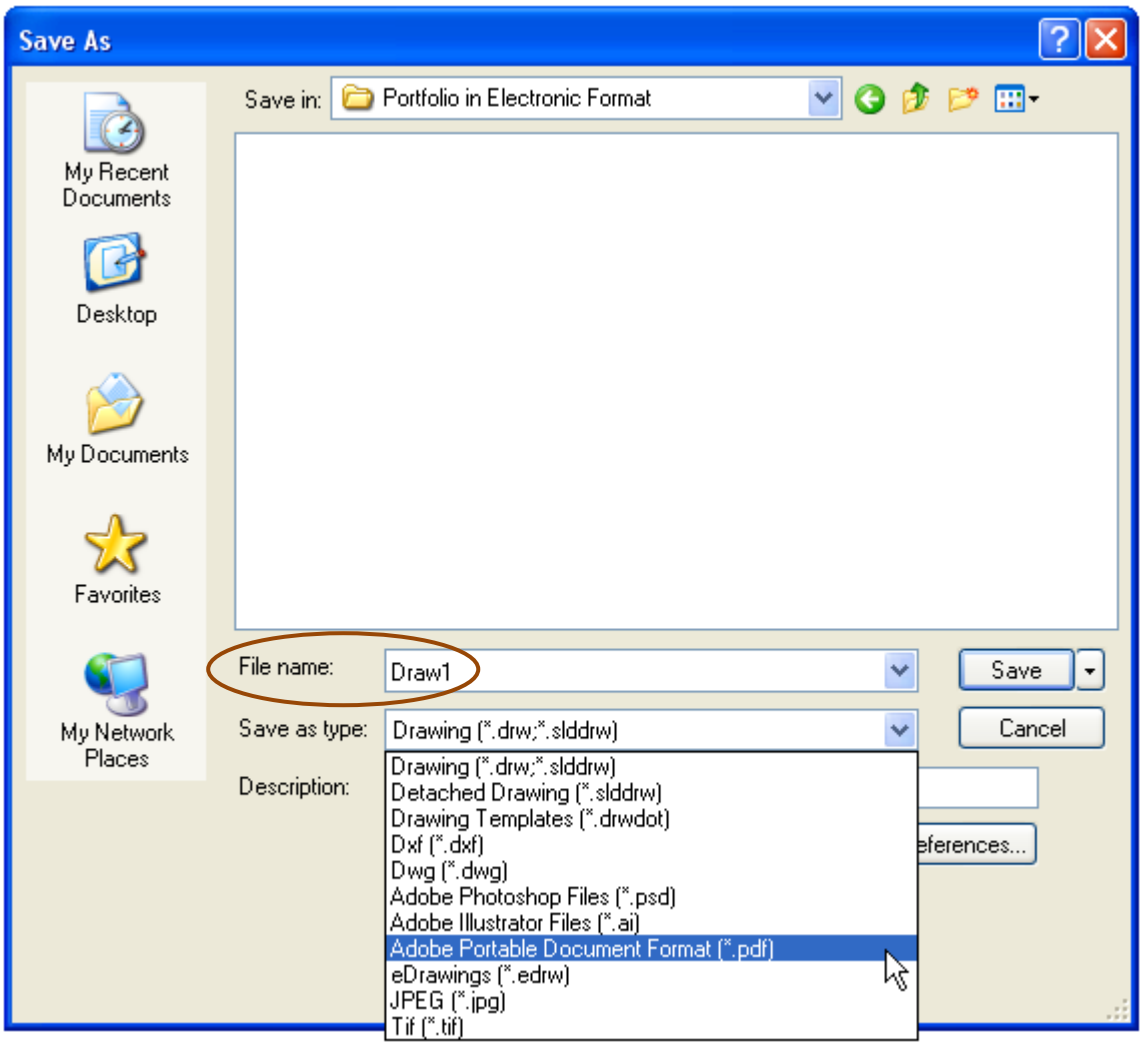
Drawing views can be sized individually or for each sheet. The Sheet Properties dialogue box shows the sheet scale. If this is changed, all of the views on the sheet that use the sheet scale are updated. If you select a view and activate the Drawing View Property Manager, you can use the Scale panel to toggle from Use Sheet Scale to Use Custom Scale.

Associativity

The associativity of SolidWorks is worth highlighting again – the ability of the software to update without you having to do any work. Once a drawing is set up, the views will always be correct and any changes made by you to the model are automatically updated. Conversely, changing a dimension on a drawing changes the part and the assembly.

All the files are related. Once a part is placed into an assembly or a drawing, the file name may not be changed arbitrarily. Get in the habit of giving the files the proper names when they are created. A drawing may not be opened if the part file from which it was created cannot be located. This often happens if a file name is changed. When you submit an electronic copy of a drawing, be sure all supporting part and assembly files are included as well.

Saving a SolidWorks drawing as a PDF file



With a SolidWorks drawing open

1. Click **File**, **Save As**
2. Input the file name in **File name**
3. Select **Adobe Portable Document Format (*.pdf)** from the **Save as type** options
4. Choose "Portfolio in Electronic Format" folder to **Save in**
5. Click **Save**.

This allows the drawing files to be viewed by someone who does not have the SolidWorks software.

The PDF files must be opened in Adobe Reader® 5.0 or later. If opened in an earlier version, an error message appears prompting the user to download the latest Adobe Reader version.

An updated copy of Adobe Reader can be downloaded from **http://www.adobe.com**.

Notes:

1. When the pdf is created, the "SolidWorks Educational Edition. For Instructional Use Only" stamp appears across the page as shown below. This is perfectly acceptable.

2. PrimoPDF and other free pdf converters may be used to convert the SW drawing file to pdf format – these will push the same stamp to the lower left corner of the page as showm below

SolidWorks Educational License
Instructional Use Only

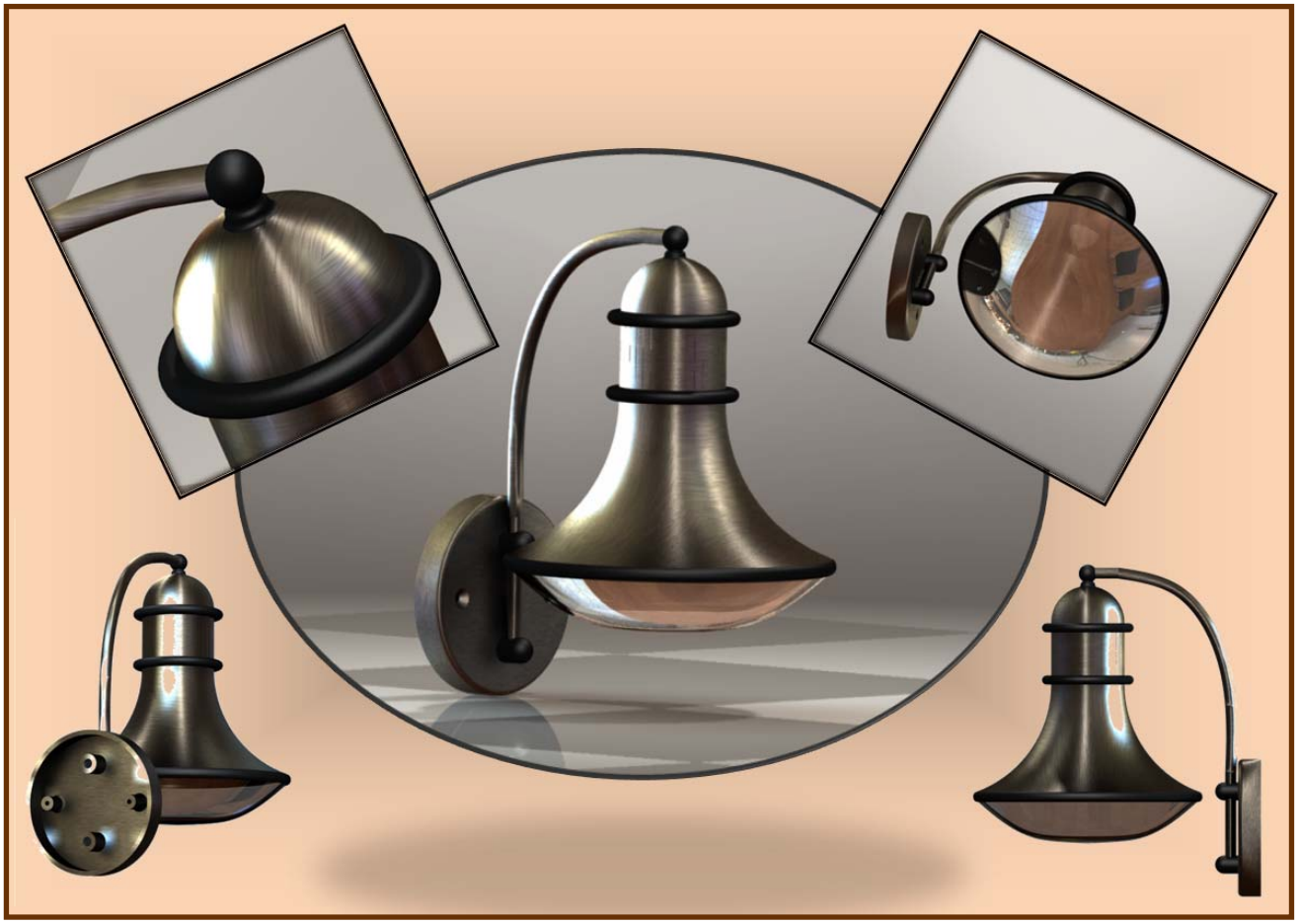
3. When the SolidWorks drawings are printed out in SolidWorks format, the same stamp appears in the lower left hand corner of the sheet. Again, this is perfectly acceptable for assessment purposes
4. You should take account of the "SolidWorks Educational License" stamp apppearing on the left corner of the sheet when you are editing the sheet format in the creation of your own personalised drawing template.

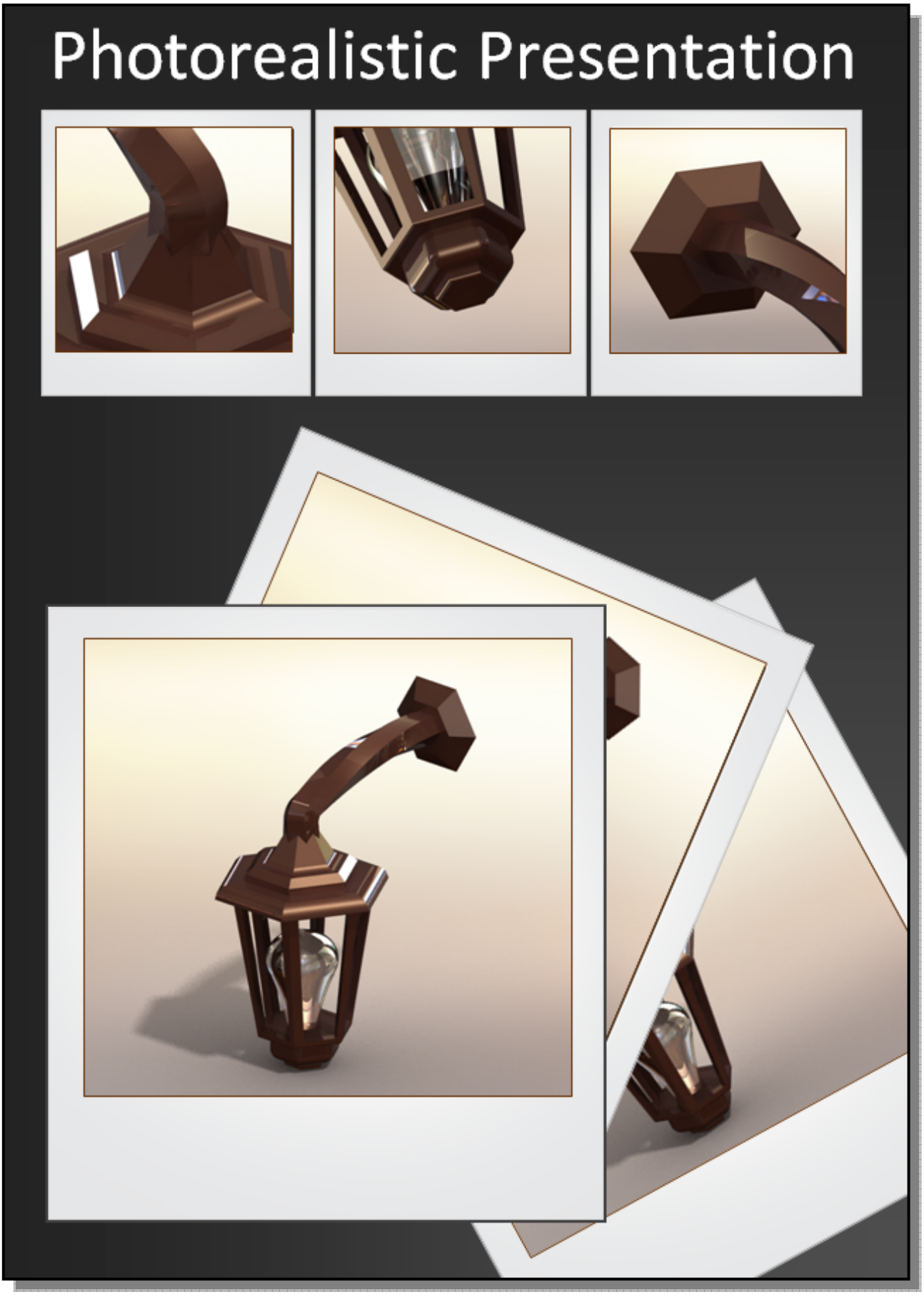
Output 6 – Produce a photorealistic computer generated image of the artefact**.**

Students at Higher level are expected to produce at least one A3 sheet for this output. The same is expected at Ordinary level.

Photorealistic imaging is a rendering tool that allows designers to create photorealistic images from 3D CAD models and include them in presentations and proposals. PhotoWorks and PhotoView 360 are examples of two photorealistic imaging software packages. PhotoView 360 is included as a standalone package when SolidWorks is installed whilst PhotoWorks is an add-in within SolidWorks. A SolidWorks model may be imported into PhotoView 360 or PhotoWorks and a photorealistic image generated based on appearances, lighting, shadows, environment etc.
Decals (images) may be imported onto the surface of the model and these will be displayed in the photorealistic image. One such example is the label on the battery shown opposite.

Note: Decals may only be imported into PhotoView 360 from SolidWorks 2009 when service pack 4.0 or later is installed. *(You may update SolidWorks by choosing Help, Check for Updates…)*
A number of sample sheet layouts in response to this output are detailed in the following figures.




Photorealistic Presentation

Part (b) of the Student Assignment

Before we move on to Part (b) let us look back and summarise what we have done in Part (a) so far.

"You are asked to investigate developments in exterior domestic lighting. Analyse and communicate these developments graphically"

In summary, you may have adopted the following structure:

- Analysed various exterior lights under various headings, shape, form, function, durability and styles.
- Selected two exterior lights and compared and contrasted their main design features.
- Graphically represented one of the exterior lights.
- Generated a detailed computer model comprising of a number of individual parts.
- Produced detailed hardcopy outputs from Solidworks to include Orthographic views and rendered pictorial of the light.
- Produced a Photorealistic view of the light.

In completing Part (a) you have built up an invaluable wealth of information about exterior lights, how the various components go together, how the light works and the geometry that exists in the light. But also, you would also have generated your own thoughts, ideas and criticisms of the chosen light. In Part (b) you are now asked to assume the role of a designer, who must now look at the exterior light though a different set of eyes, that of a designer.

Design is not just what it looks like and feels like. Design is also how it works."

Steve Jobs, Apple

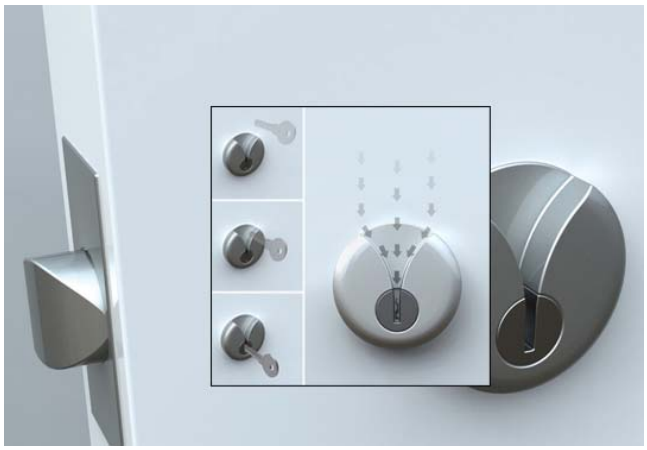
You must now make change(s) to the existing light to improve upon its design. This can be done by making a design modification or embarking on a concept design. The body of knowledge that you have gathered in Part (a) should inform you at this stage. The questions that must be asked at this stage are what you will use for inspiration, how many solutions you need. Moreover, having an idea and sticking to it without exploring other options may result in overlooking alternative, more appropriate solutions. Designers use various techniques to inspire them; some may include the use of image boards and mind maps. To illustrate both we are going to work through image boards and mind maps. The mind map will be used to explore the design modification while the image board

will be used to explore the concept design. **Both techniques are equally suitable for either a design modification or concept design;** the most important element of these is the fact that they can stimulate the creative process; they are not designed to give you a solution but help direct you towards one. Try to work to a number of possible solutions, if you narrow your focus at this stage it may lead to a solution that you are unhappy with.

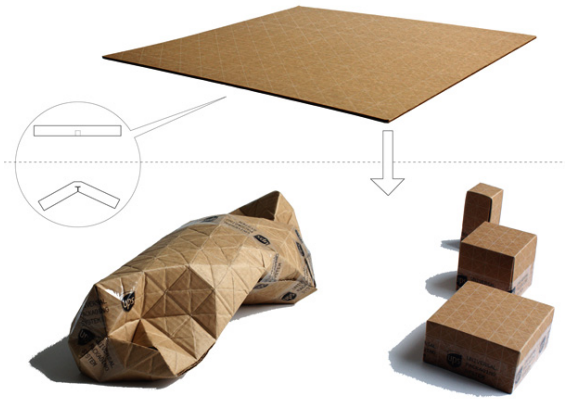
"To design is to solve human problems by identifying them, examining alternate solutions to them, choosing and executing the best solution"

Ivan Chermayeff, Graphic Designer

Keep an open mind; do not be afraid to design objects that are futuristic, look different, that do not conform to existing objects. Below are some designs that are progressive, thought provoking but functional.



Never miss the key hole



Universal packaging

Laser Virtual Keyboard

Duofone- multiple devices

Output 7 – Analysis of the brief and an illustration of the progression of ideas and solutions

What are the differences between *Design Modification(s)* and a *Concept Design?*

Design modification(s) are changes or improvements you might make to an existing design. A Concept Design is a completely new design which can be inspired by a theme or research material collected.

We will first look at Design Modification(s) and some of the questions you might have. The examples provided are purely guidelines and therefore should not be taken as the only approach. Your creative style is key to achieving individual design sheets.

I want to choose the Design Modification(s) option, where should I start?

As a starting point you should concentrate on what you have learned from the exploration of the brief in Outputs 1 and 2. A design modification is based on your observations of the chosen artefact selected in Part (a). These modifications can be subtle changes to improve the user's experience. Modification is not always about adding on elements but often assessing what is missing or what features present are not actually used. Keep in mind the success of the Apple iPod range, its simplicity and unnecessary detailing meets the market needs.

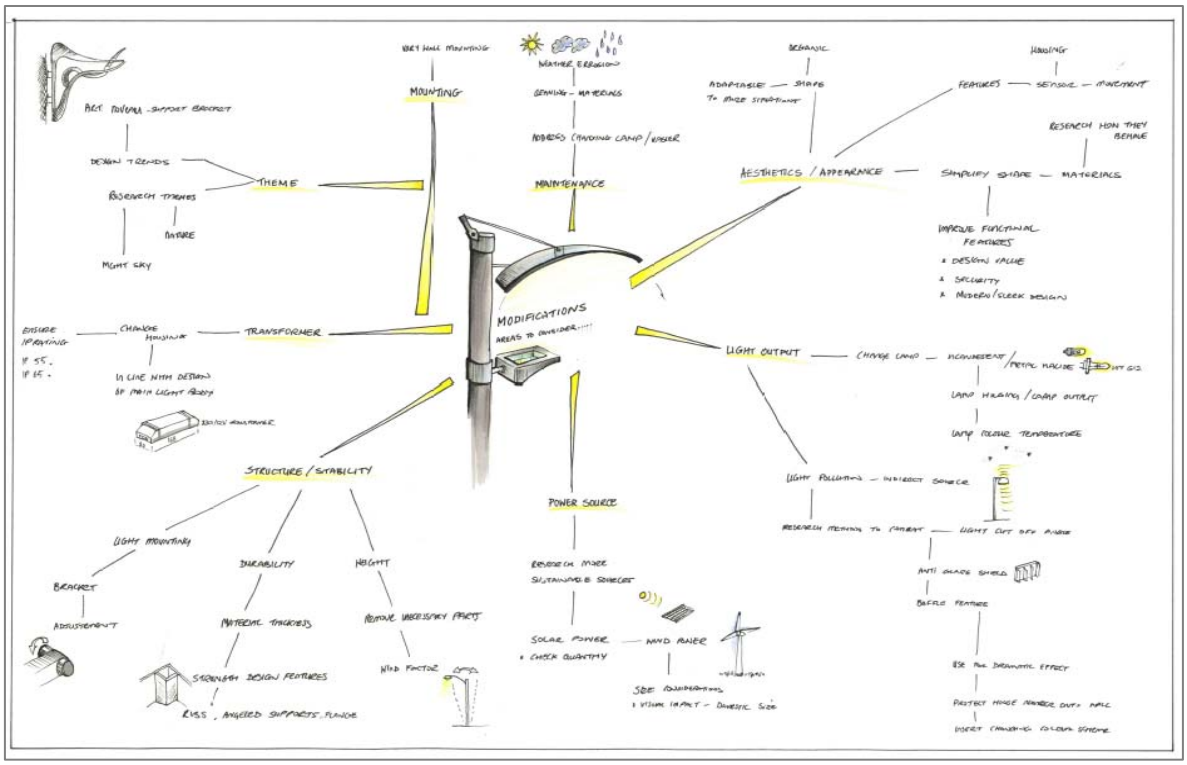
Companies modify their product ranges continuously to keep up with market trends and to meet their user's changing needs.

How should I decide which areas of the design to modify?

There are numerous approaches to modifying an existing design. The first approach should be to focus on your observations of the design from outputs 1 & 2. Other possible approaches are as follows:

- Create a Mind Map or Scatter Diagram of areas to explore.
  - From this quick visual exercise you might discover 3-4 keys areas that require further modification. (For example you might focus on the features, the power source, and user feedback).

- The example below shows a mind map which identifies the key areas to modify with an exterior light design. The key is to use the mind map as a visual tool to condense all your knowledge of the subject onto a single sheet.



- Create a list of questions as a guide to research the area further……Possible questions
  - Is the design fit for its purpose?
  - Does the design meet its user's needs?
  - List all functional features from your exploration. Are all existing features used? Can you add /remove features?
  - Is the design aesthetically pleasing?
  - Is the design adaptable to a range of situations / environments?
  - Is the design sustainable and environmentally friendly?
  - Are the chosen materials and finishes suitable?
  - Is the design durable and easy to maintain? Are all components accessible?
  - Are there any safety features in need of improvement?
  - Can the existing technology be improved?

- Create a detailed list of the design's strengths and weaknesses

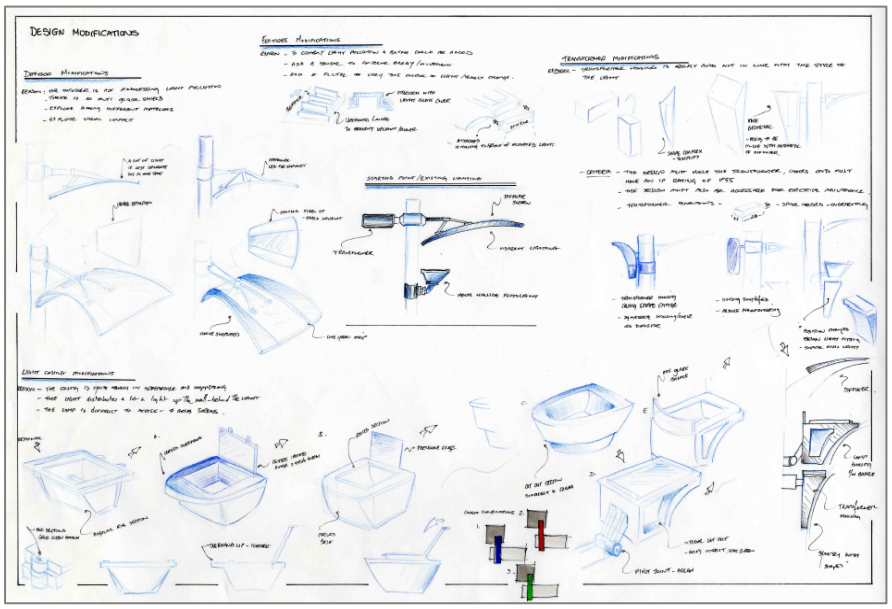
How many modifications do I need?

You are encouraged to explore between 4 to 5 design modifications. Each modification should be justified. Your annotations should communicate why this change is either necessary or valid. Altering the product's colour is not considered a modification unless there is a valid reason which impacts the design success.

How should I present my ideas for design modifications?

How you layout you sheet will depend on your individual graphic style and the depth of information you want to communicate. The design can be modified using a range of techniques from freehand sketches and annotations to photographs. Your modification sheet should convey the progression of your ideas as they lead to a final solution. You should ensure that you clearly detail all of the feature changes and your thought process.

Modification Design Ideas Sheet



Final Modified Design

Should all design modifications be justified?

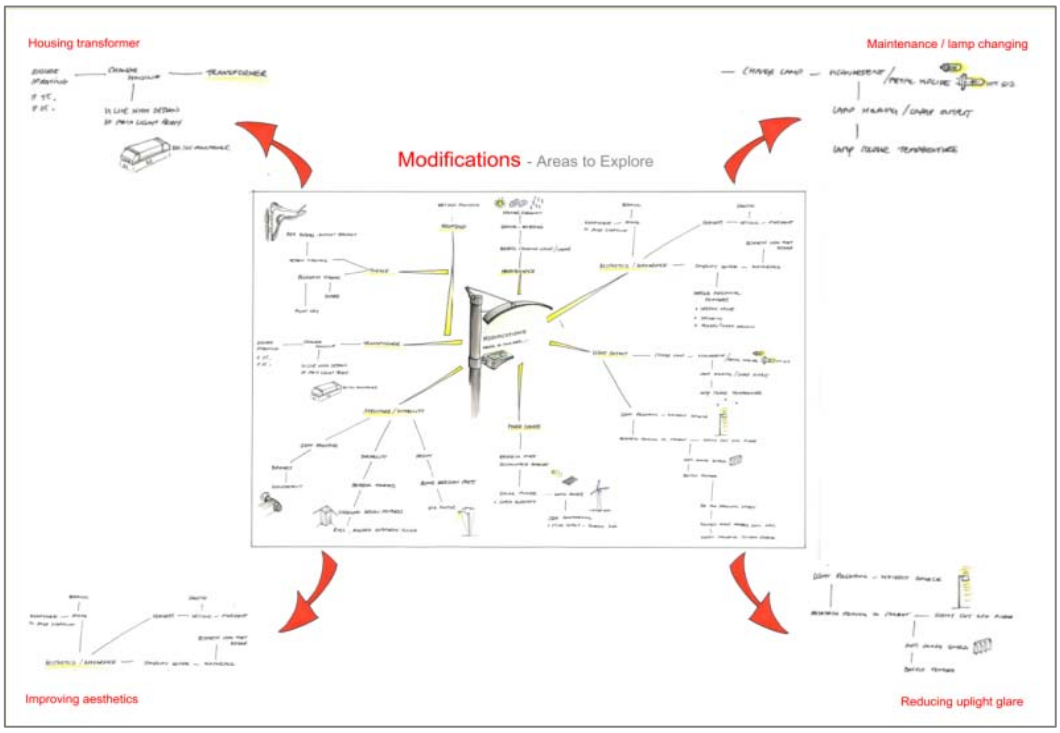
Yes, it is very important that you specify your reasons for each design modification. List why this change is necessary and how the improved version will add to the design's function or aesthetics etc. Your decisions and thought progression must be clearly communicated.

Can I complete additional research if I need to explore an area for modification?

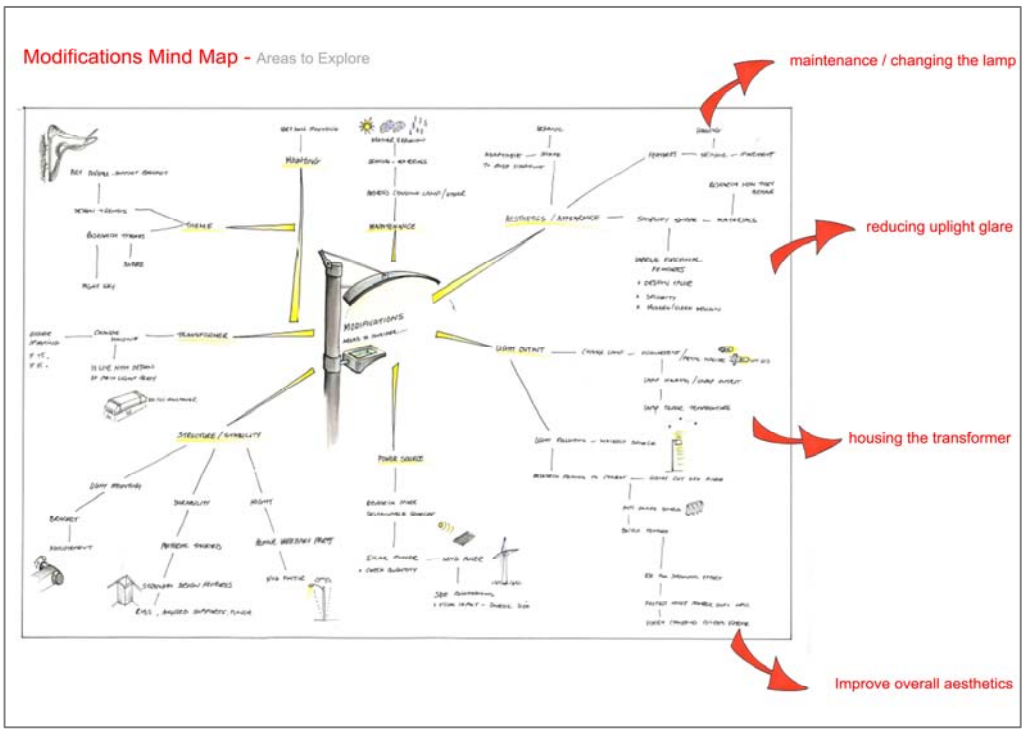
Of course, to modify the existing design it might be necessary to research new advances in technology, in this case for example, alternative power sources. Ensure that you record all research gained and document this in your decisions.

When I have all the modifications and research completed how do I condense the information?

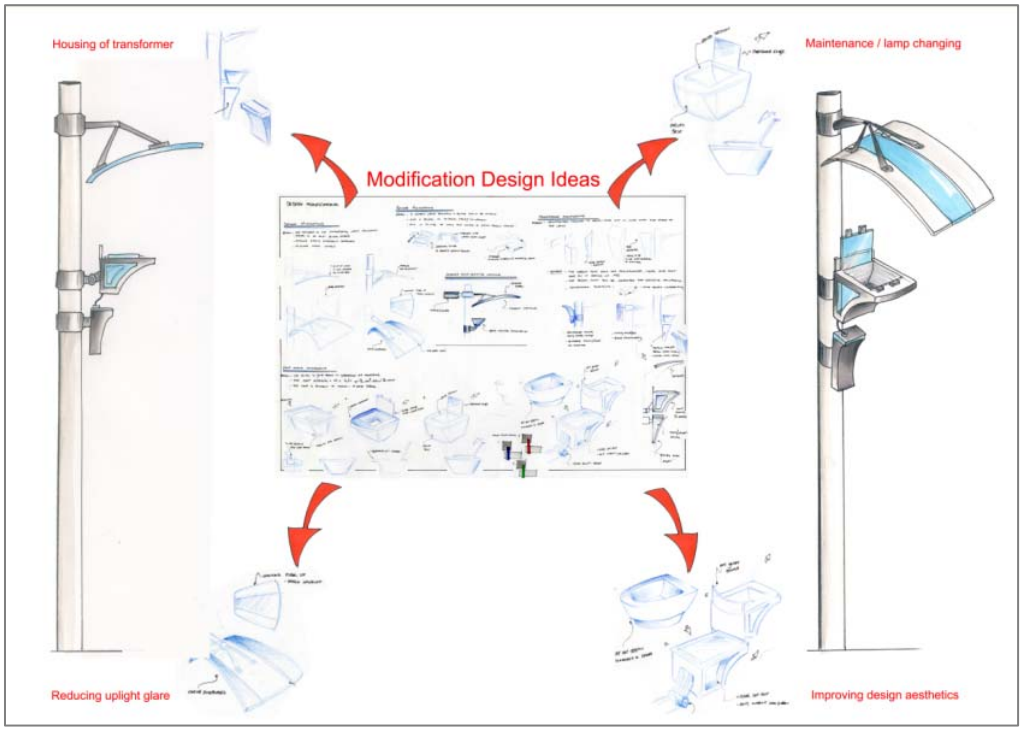
This is your opportunity to communicate all your knowledge on the chosen theme and your design skills. Be creative and individual with your sheet layout. Think about different graphic materials, papers and editing programmes. You may need to complete several preparatory sheets which then lead to your final sheet layout. The examples below show two different layout sheets for both the mind map and the design modifications.



Sheet 1 Layout Option 1 - Centre Mind Map showing all areas which were explored. The outside space shows four chosen areas for modification and sketches. * *A lot of blank areas on the sheet*

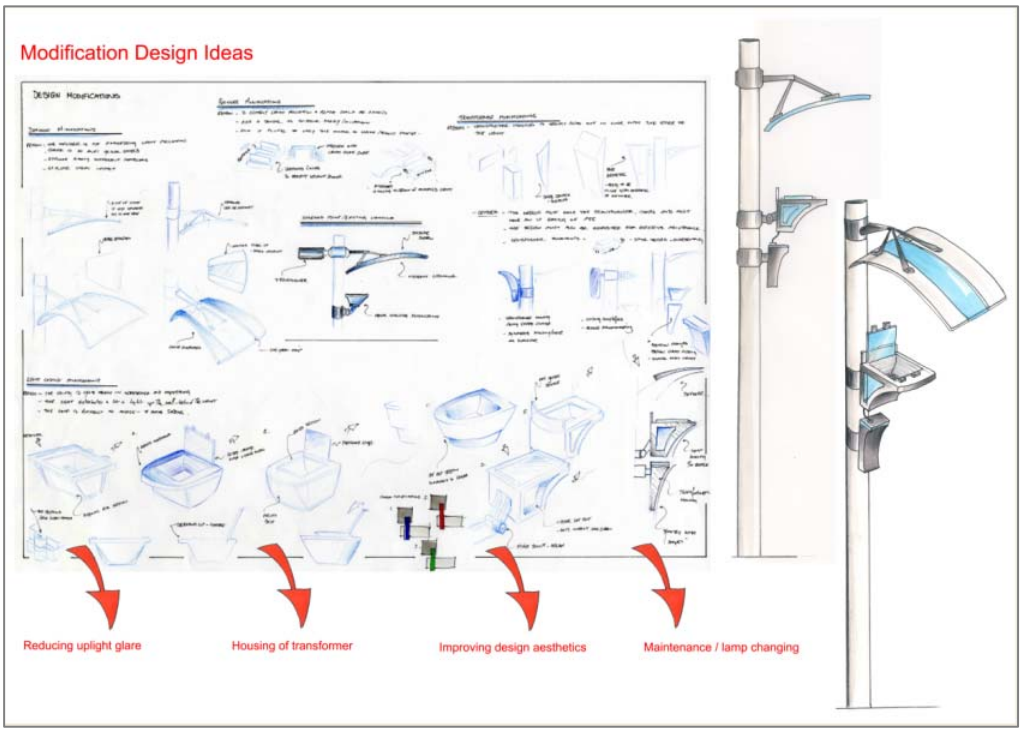


Sheet 1 Layout Option 2 - Enlarged Mind Map showing all areas explored. The outside space showing four chosen areas for modification. * *Better use of white space*



Sheet 2 Layout Option 1 - Reduced Modification ideas sheet in centre. Four modified features sketched on outside. The final modified design positioned at the sides. * *Difficult to read the modifications and decisions made.*

Sheet 2 Layout Option 2 - Enlarged Modification Ideas sheet. Four modified areas highlighted at the bottom. Final modified ideas to one side. **Clearer Communication*



Modifications Checklist

- Ensure all decisions are communicated and detailed evaluative annotation has been used.
- Be creative and individual with your presentation.
- Conclusions – What did you want to achieve on each sheet? What have you learned? What decisions have you made? How can you use this information to influence the next stage!

What is a Concept Design?

A concept design is a completely new design, inspired by investigative research. As with the Design Modification option, the information gained through exploration in Output 1 and 2 should directly influence your Concept Design. For example if you have learned about the functional criteria for exterior lighting then these factors should be evident in your concept design.

If you choose the Concept Design option, is it worth the same marks as the Design Modification Option?

Yes, both options require you to submit the same number of sheets and offer equal marks.
Students at Higher level are expected to produce two to four A3 sheets for this output. At Ordinary level one to two sheets are expected.

I want to choose the Concept Design option, where should I start?

The key to creating an interesting concept design is preparation. You need to find visual material to inspire a creative final idea, rather than stating; "It's a good design, because I like it". It is easier to make a design decision when you have created personal boundaries. The following are suggested starting points;

- Choose a **Theme** to inspire your thinking.
  - (Nature, Art Period, Film, Sport, Music)
- Choose a **Target Market.**
  - Often it is easier to design when you have a target group of people in mind. It helps you to assess the user's needs, what styles would interest them, the places the design would be used and their budget.
- Choose a **Message** you would like to convey.
- Create a list of **Key Words**/ Quotation to set a tone.
  - Natural, Green, Organic, Simple, Elegant, Soft, Garden, Lush, Eco, Pure.
- Choose a **Location / Environment.**
  - The solution therefore should fit within a specific location / surroundings.
- Create a **Mood Board.**
  - A mood board is a visual tool which may help at the design stage. It is used in industry to set a tone for a project. For example if you want to create a natural, soft theme you might collect a range of images, colours, textures and key terms and arrange them on a page to communicate the direction you want to take.

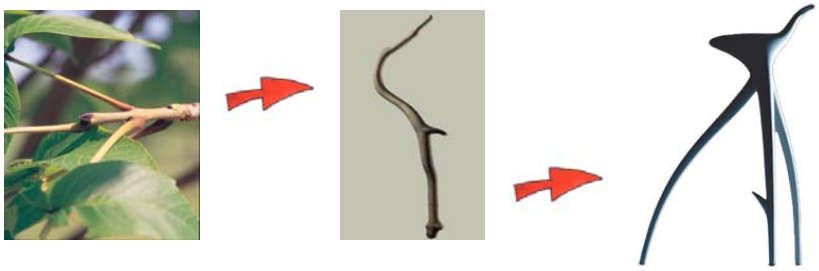
The Mood Board sets the tone and direction for the project. A range of images for an exterior light concept have been collected. The message conveyed is that the concept design will be simple in shape, geometric and inspired by nature.

Remember creating a mood board is only one approach to researching a theme.

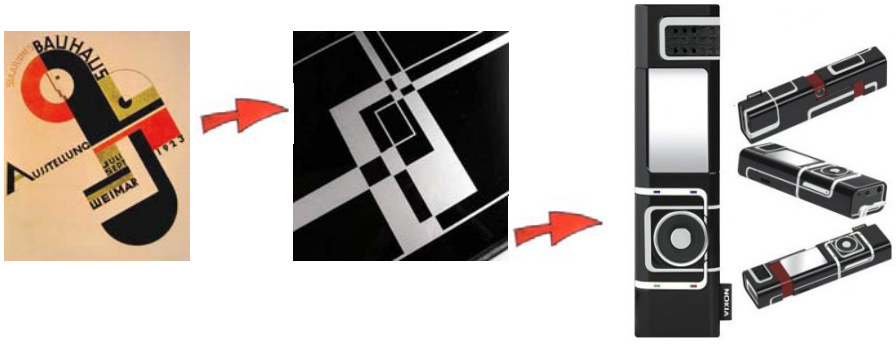
How do you find inspirational research material?

Inspirational material is all around you, from the items in the classroom to your individual thinking and experiences. Some of the most successful designs are those which are clever, simplistic and address the user's needs. Inspirational material is something which basically interests you in some way. The material can be collected from your own environment, interviews, photographs, books, magazines, and the Internet.

Nature may have provided the inspiration for this stool.



The Nokia 7280 collection is inspired by the geometric patterns of the 1920s Art Deco designs. Influences such as flow, movement, colour, geometry and bold graphics were typical of this period.



When I decide on a theme, do I record the images I've collected?

Yes, the idea is to create a visual story which communicates your design thinking and progression. One approach is to create an image board. This is basically a visual tool to use when designing. The images are laid out in a clear graphical format, with notes and sketches if necessary.

The image board below follows the chosen theme of *Carnivorous Plants*. The designer was inspired by the line, shape and elegance of the plants. The images are presented on a black sheet, using white colouring pencil to record any observations. Often it is only when we look at something from a different angle that we notice something interesting and new!

I have an idea already; do I still need to find inspirational material?

While it is good to have a visual theme in mind it not advisable to fix on a specific idea too soon. One approach might be to take this idea as a starting point and then use your creativity to develop this further. You might possibly take the idea and then recreate it for a different target market or adapt it for a different situation. Often the most interesting concept idea comes from rethinking the design completely.

I have researched my chosen theme and I am ready to start designing, should I write an individual design statement?

Writing a short design statement can be a good idea as it gives you boundaries to design within and something to refer to if you are having difficulty creating ideas.

Example:

"Following research, I am going to design an exterior street light for a public space. The design will be organic in style and reflect the shape of my chosen theme, Carnivorous Plants. The design will house a cfl bulb, an electric transformer and will be structurally stable".

How can I communicate my design and progression of ideas?

This is very much about your individual style of sketching and the flow of ideas. There is no definitive way to present your ideas. You have to find a technique that suits your presentation and strengths. Designing and its communication is a practical skill and must be practised.

Should all design ideas be justified?

Yes, it is important that you communicate the thought process which led to your concept design. List the decisions made and how your inspirational material has influenced the design idea.

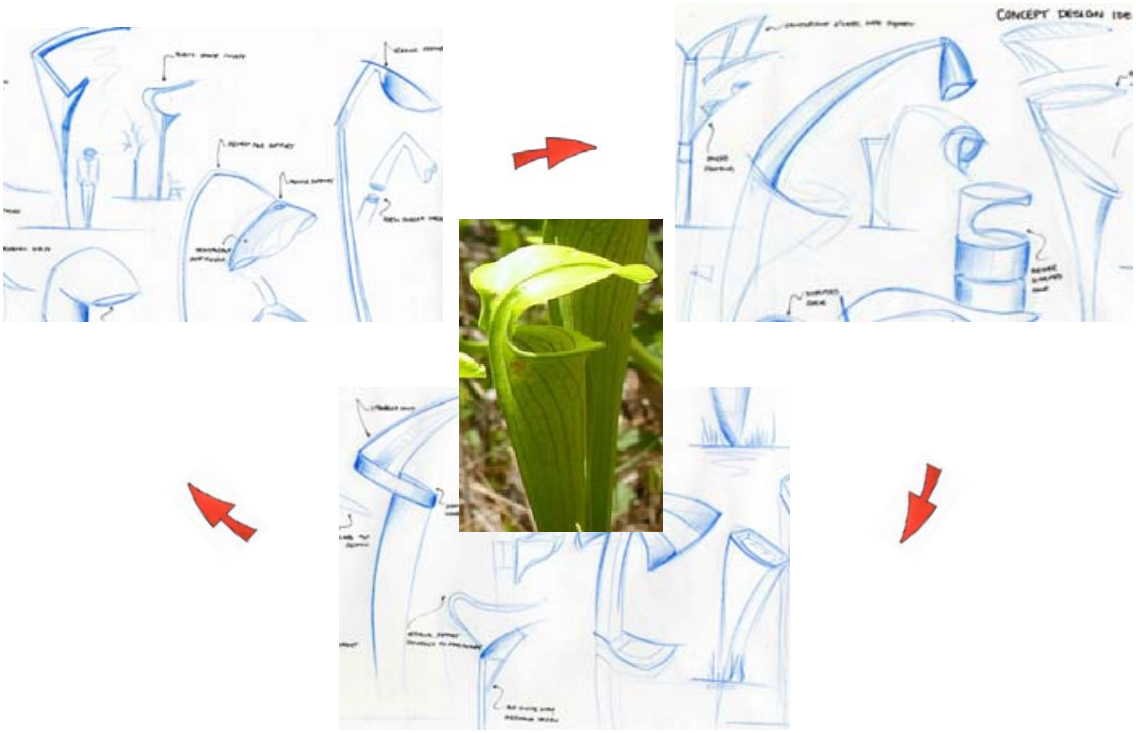
Do I have to think about how the design works?

Creating a new concept design is not just about styling. This is where your understanding of the product area from Output 1 and 2 directly influences your design ideas.

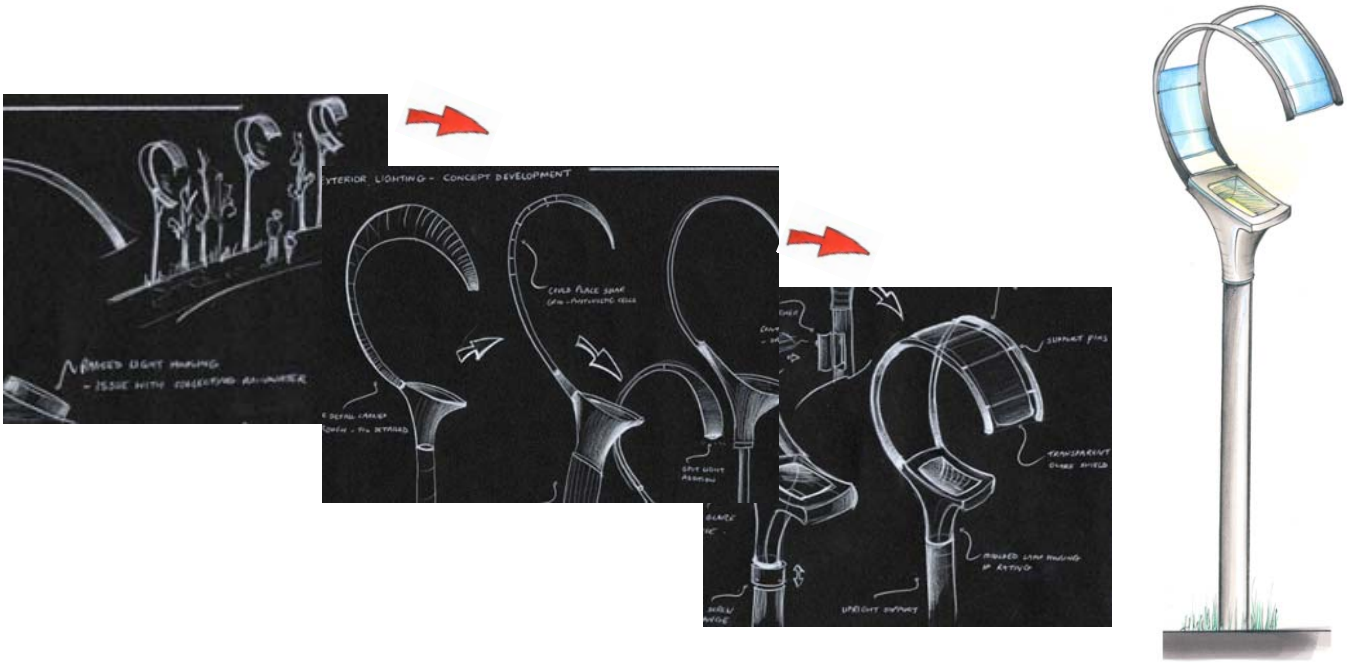
When designing, how can I use the inspirational material to influence my ideas?

The key is not to copy the inspiration material directly but to use this to inspire and influence your design idea. The research collected is a visual tool. Try to look more at the line, shape and tone of the design and think what it is that interests you. Then take these elements and add your own creativity. Refer to all your research particularly when making design decisions. If you have decided on a target user, a theme, or a location, keep all this in mind and check that your ideas meet your criteria.

The example below shows the thought process behind an idea for the exterior light project with the Mood board and *Carnivorous Plant* theme Image board, as inspirational material. Two A3 sheets were used to explore the design stage. The first is a Concept Design and the second is a Concept Development.



Note: The sheet is full of quick design sketches and annotation. There is no need to create highly finished sketches at this stage as you are just exploring a range of possible solutions. The student might need to add a conclusion to show what they have learned from the process.



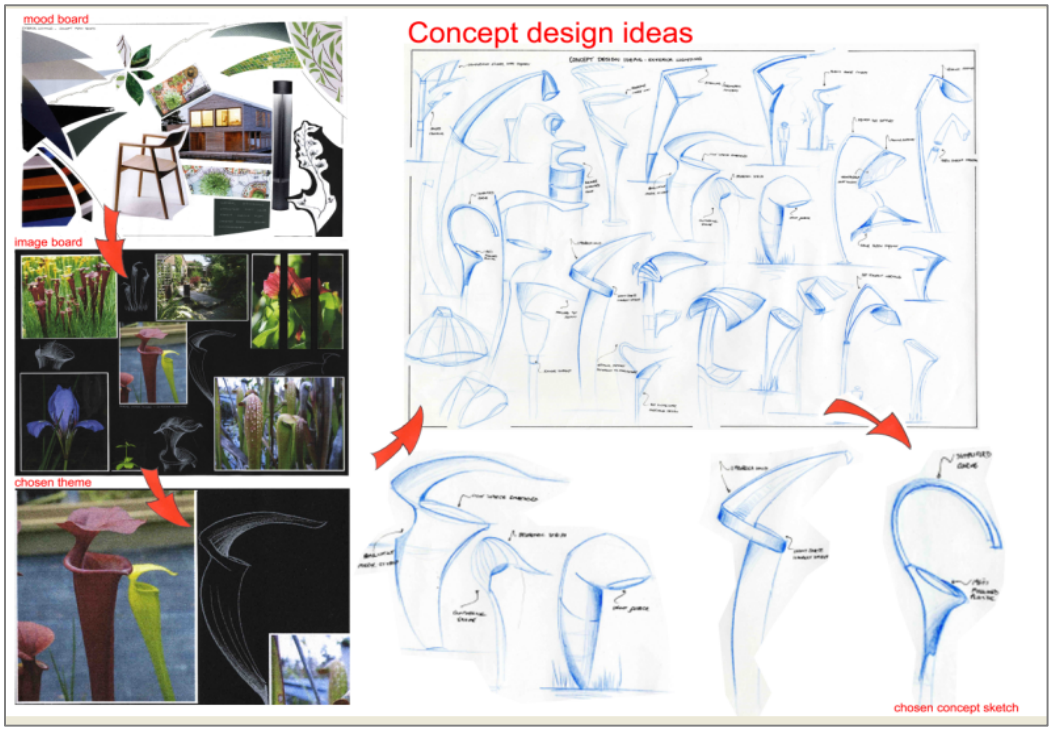
Note: This sheet takes the strongest concept design from the ideas sheet and develops that design a stage further. The objective is to visually show your thought process and progression until you reach a final concept design.

When I have the research and concept design sheets completed how do I condense all of the information?

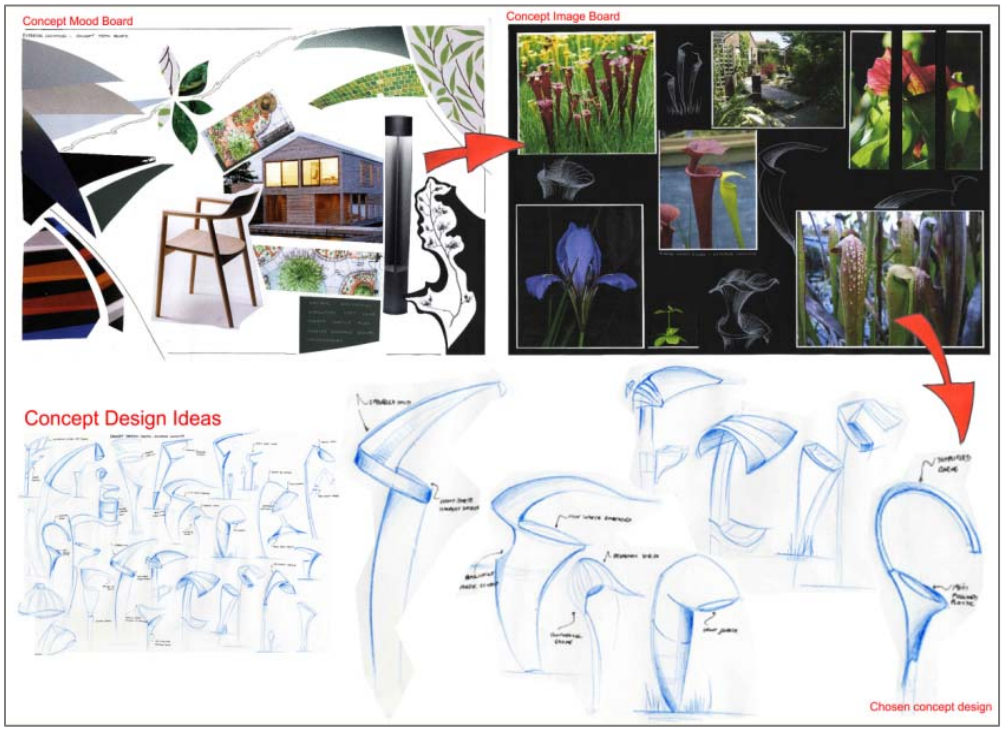
At this point you have created a range of research material and several design sheets to reach a final concept design.

This is your opportunity to communicate all your knowledge on the chosen theme and your design skills. Be creative and individual with your sheet layout. Think about different graphic materials, papers and editing programmes. You may need to complete several preparatory sheets which then lead to your final sheet layout.

The examples below show two different layout options for the first A3 final Design Concept sheet.

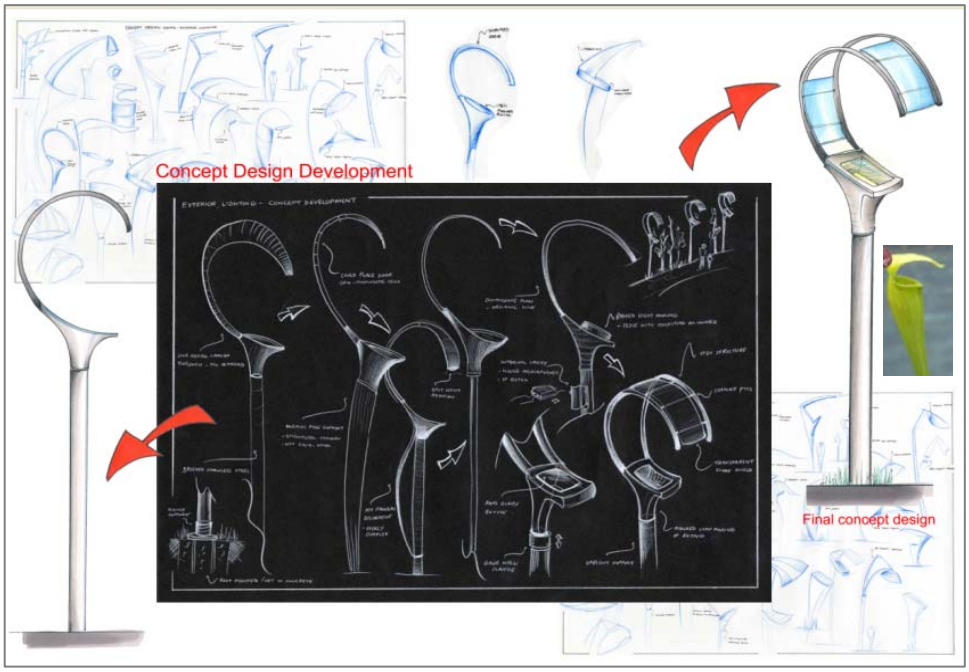


Sheet 1 Layout Option 1 - Centre scanned sketch concept designs. Mood Board, Image Board, Main Image to the left. Strongest design ideas enlarged at base. **Shows good progression of ideas but no sheet conclusion.*

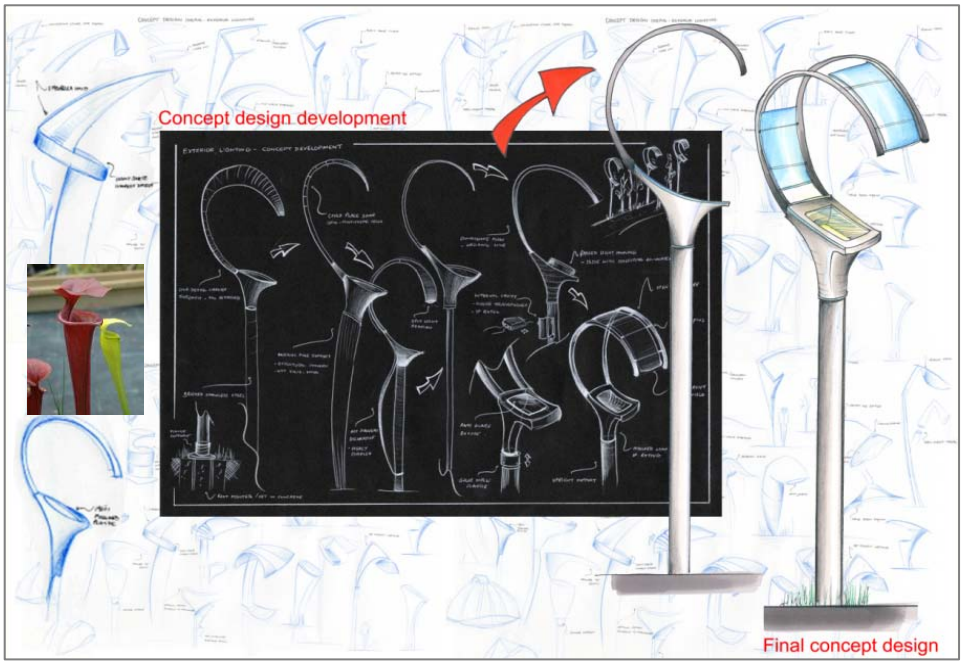


Sheet 1 Layout Option 2 - Top Mood Board, Image Board. Arrows used to show progression. Strongest design ideas enlarged at base. * *Slightly cluttered layout and no sheet conclusion.*

The examples below show two different layout options for the second A3 final Concept Design sheet.



Sheet 2 Layout Option 1 - Centre scanned development sketch. Faded sketches as background image. Final concept design in two views. * Shows good progression of ideas but visually difficult to follow.



Sheet 2 Layout Option 1 - Background faded sketches. Centre development sheet, main enlarged sketch designs and final concept design * *Shows clear progression of ideas and easier to follow design thinking and progress.*

It is important to remember that marks are awarded through the entire project for *thought and reflection*. To complete this section ensure that your sheets show how you have taken information gained from Part (a) and used this to influence your decisions in Part (b).

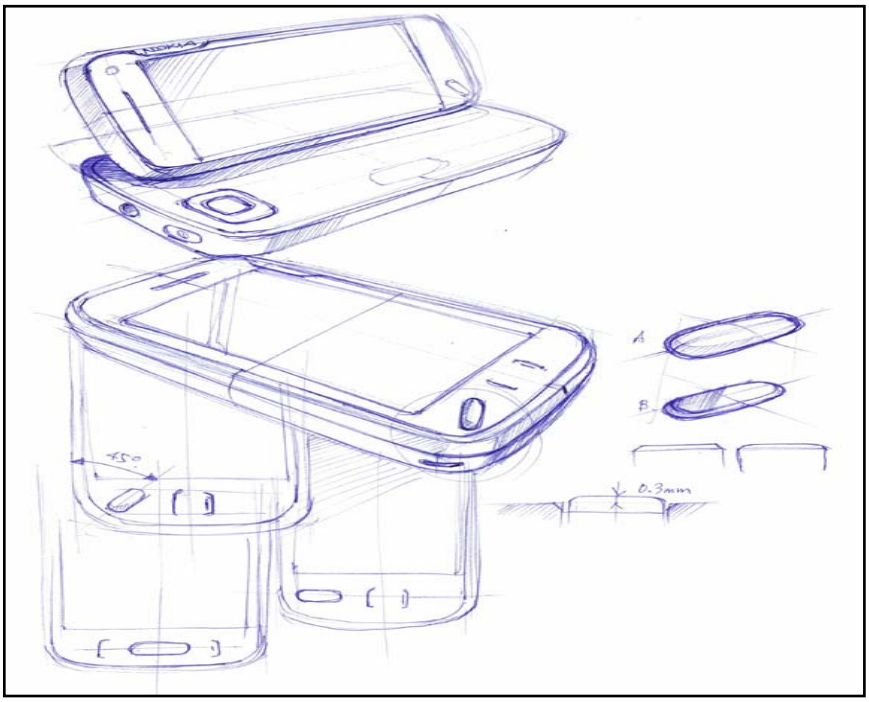
Output 8 – Detailed graphical representation of the Design Modification/Concept Design. This should include a rendered freehand presentation quality drawing in 3D format.

How many sheets do I need to produce?

Students at Higher level are expected to produce at least one A3 sheet for this output. The same is expected at Ordinary level. All drawing on this sheet must be sketched and all drawing submitted in this output must be the original freehand sketches.

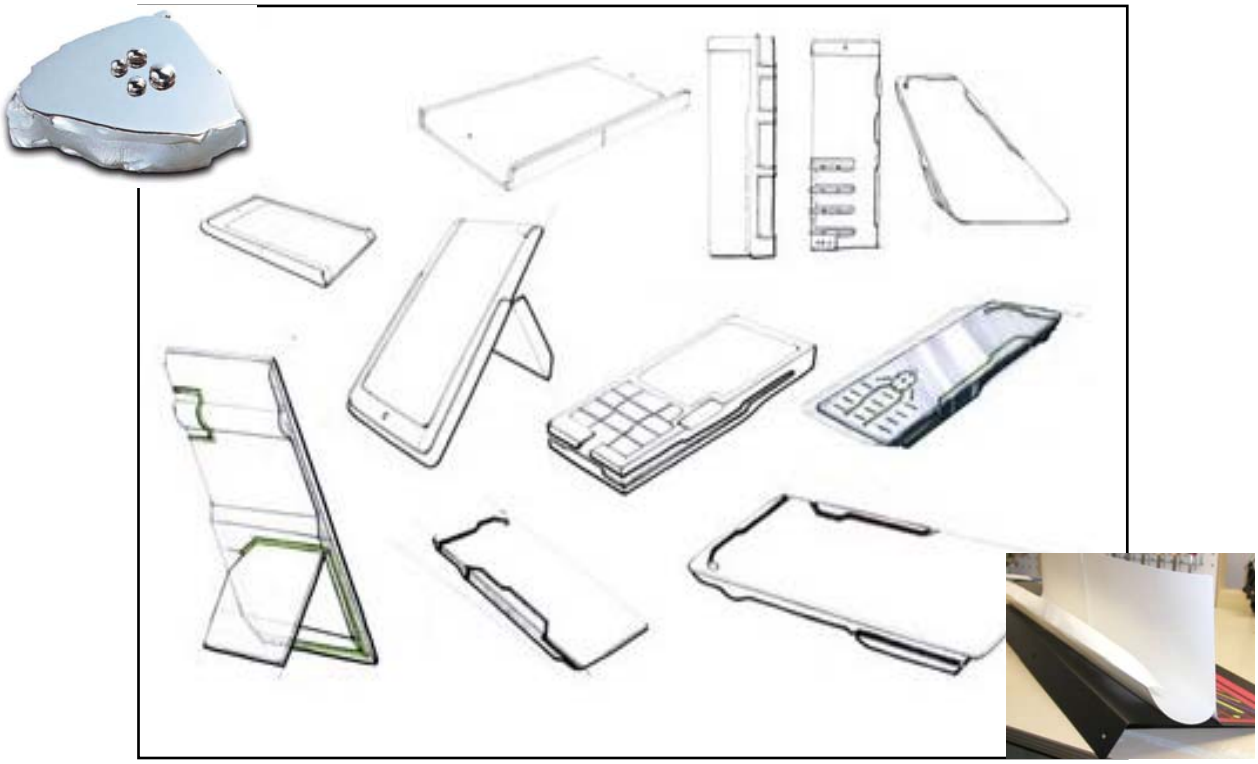
Design Modification(s) are changes or improvements to an existing design.

If you have chosen to make a modification(s) to an existing artefact, for example a mobile phone, then you must graphically represent this modification(s) and its relationship with the original artefact. In the example shown below, the chosen artefact in Part (A) of the assignment is a mobile phone. One of the key design elements of this mobile phone is the ability to have a sliding screen mechanism. The suggested modification centers on changing the sliding screen mechanism, so that the viewer will have a larger screen to view images, text messages and potentially aid individuals with sight impairments, but also have the same key functionality. The sketches shown below detail the modification, its sliding mechanism and its relationship with the physical form of the original mobile phone. It is up to each individual to decide on what views or details are used to graphically represent the object.



Concept Design is a completely new design, inspired by investigative research.

To satisfy this Output the individual must graphically represent their new concept design in the same way they represented the artefact sketched in Output 3. Use sketches, annotations, colour, textures etc. to try and demonstrate how your designs looks, how it works and the influences in its design. In the sheet shown below the concept phone is very thin, with built in peel back supports, the phone can also be integrated and used as a remote control using Bluetooth technology.



Output 9– CAD model and associated hardcopy outputs to include appropriately detailed orthographic, rendered pictorial and photorealistic views to communicate the modified/concept design.

What must be submitted to satisfy the requirements of this output?

The following CAD files must be submitted on the CD for assessment:

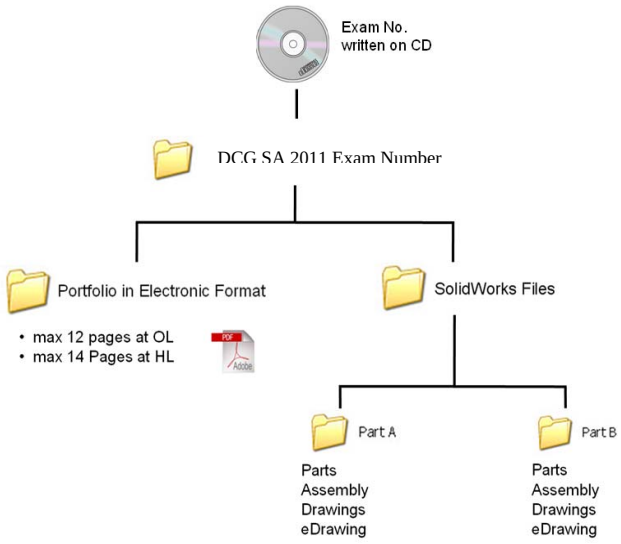
- Part file(s) for the modified artefact or concept design
- Assembly file for the modified artefact in Part (b)
- Solidworks drawings
  - Detailed orthographic views
  - A rendered pictorial view
  - Photorealistic view (Higher Level)
- An eDrawing of the assembly

In any year a candidate must decide to undertake either a design modification or a concept design.

Design Modification – File Management

If undertaking a modification to an existing artefact the student may be using some or all of the part files from part (a) of their assignment.

Only the part file(s) required should be copied from **SolidWorks Files/Part (a)** to **SolidWorks Files/Part (b)**.



This step is necessary as; any changes made to the part files due to the modified design would be reflected in the original CAD assembly.

It may be prudent to rename the part files in part (b) at this stage to avoid confusion with those related to part (a).

These files may then be edited, and in addition to any new files created, assembled to present the modified solution.

It is essential that the completed modified assembly located in Part (b) folder should only reference part files within the Part (b) folder, not those in Part (a).

Concept Design – File Management

All SolidWorks files relating to the concept design should be saved in **SolidWorks/Part (b)**

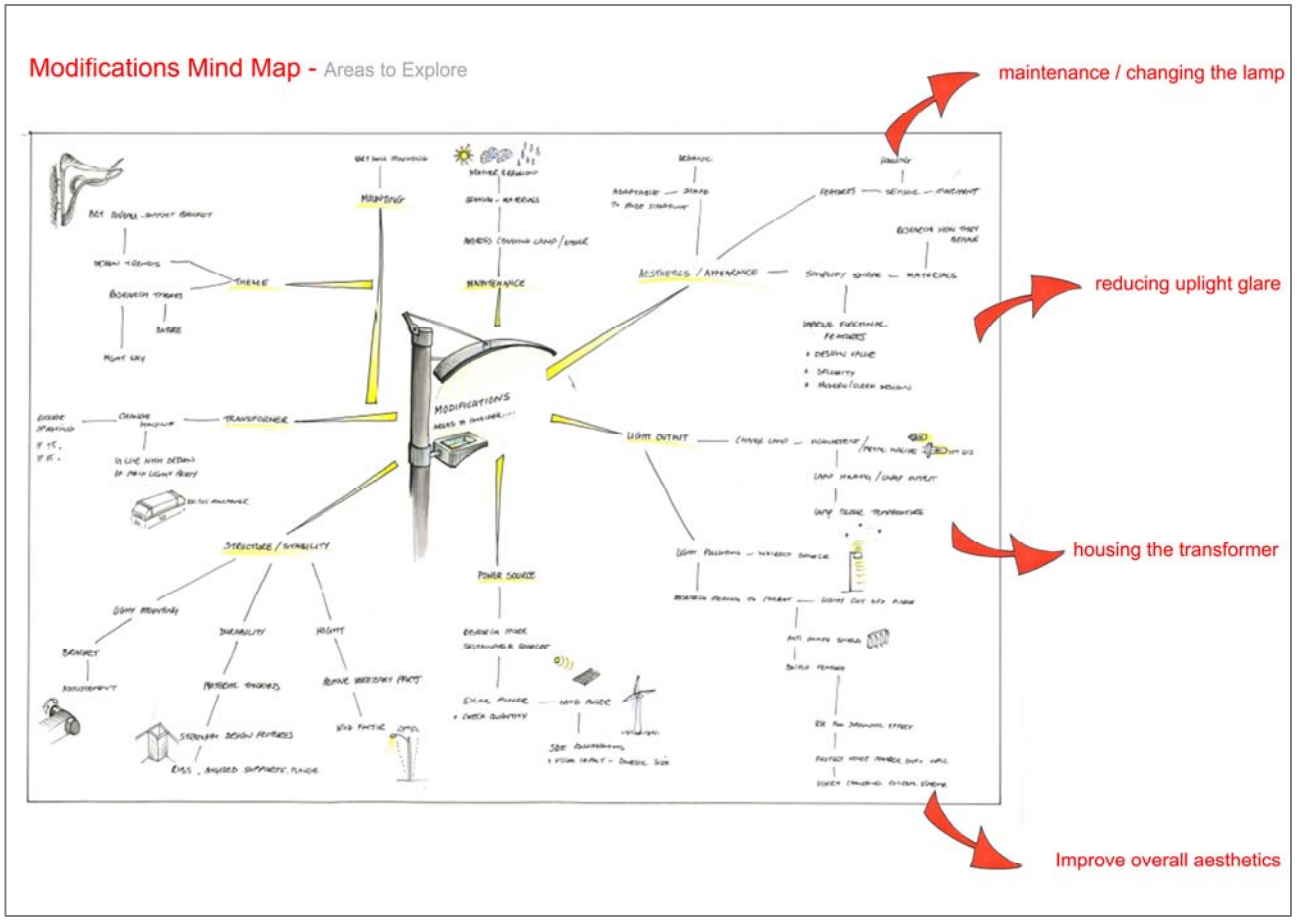
The modelling approach to the concept design should reflect good modelling practice along with reflecting the nature of the object being modelled.

Reflection and Thought Process

Marks for reflection and thought process are allocated under all sections through the assignment.

What is meant by the terms Reflection and Thought Process?

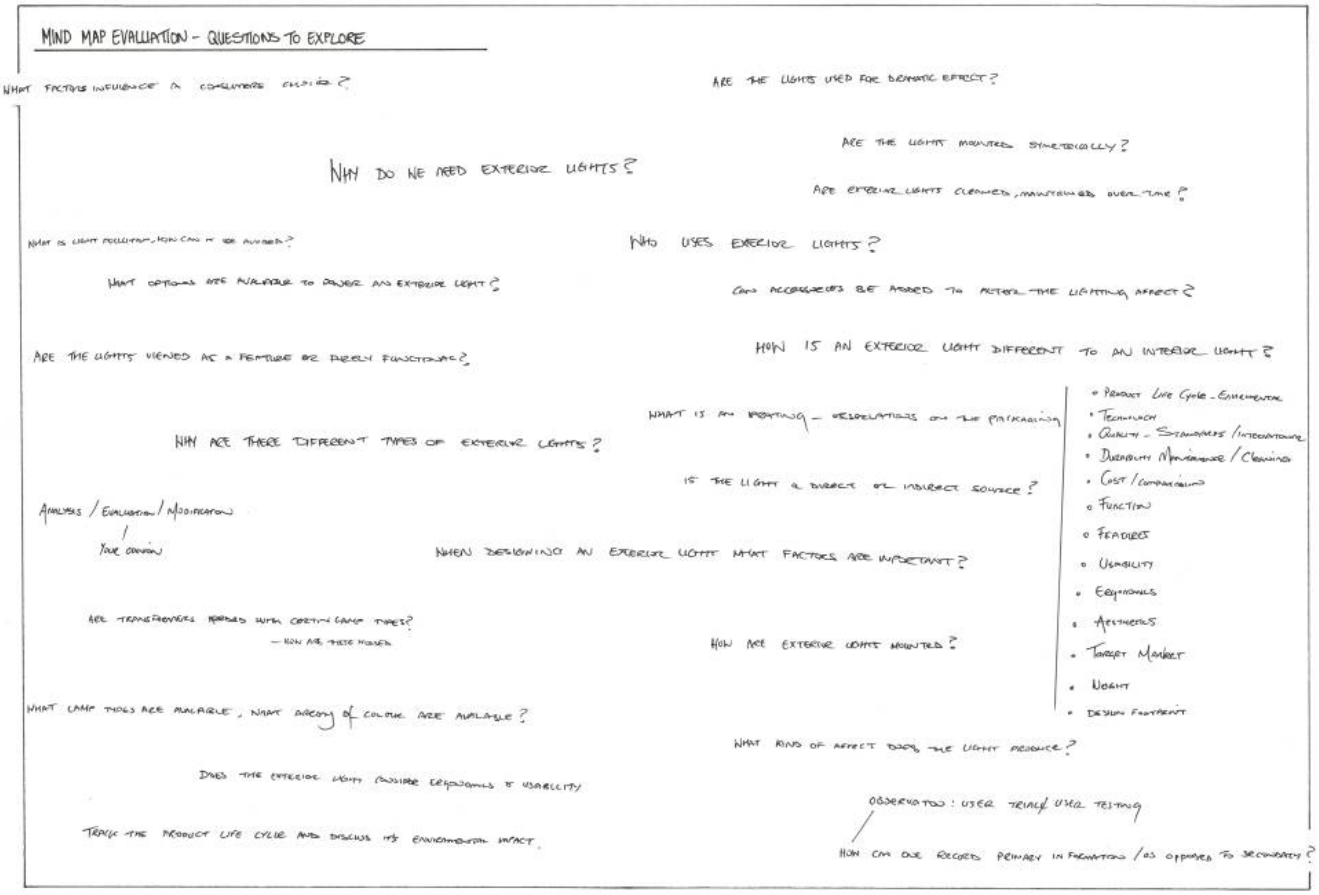
The student assignment should follow a logical progression. Each sheet should exhibit a reflective approach by outlining the design proposals and the reasons for them. This may take the form of relevant knowledge gathered, design proposals and decisions made. The reflection on each sheet should influence and guide what you are about to do in subsequent sheets as shown below. This is your thought process.



As discussed in Output 1, the design cycle is cyclical in nature. If a design idea is to reach its full potential the designer must explore and reflect continuously through out the design process. It is these reflective decisions and thought processes that we need to record and communicate, throughout the assignment. A key technique in making design decisions is to draw conclusions from each individual output.

How do I make decisions?

Decisions are about finding the best possible solution to the various problems or questions posed. Maybe you should start with a blank sheet of paper and write down every question you can think of relating to your assignment as shown below. Anything that provokes a thought or highlights questions, involves making a decision.



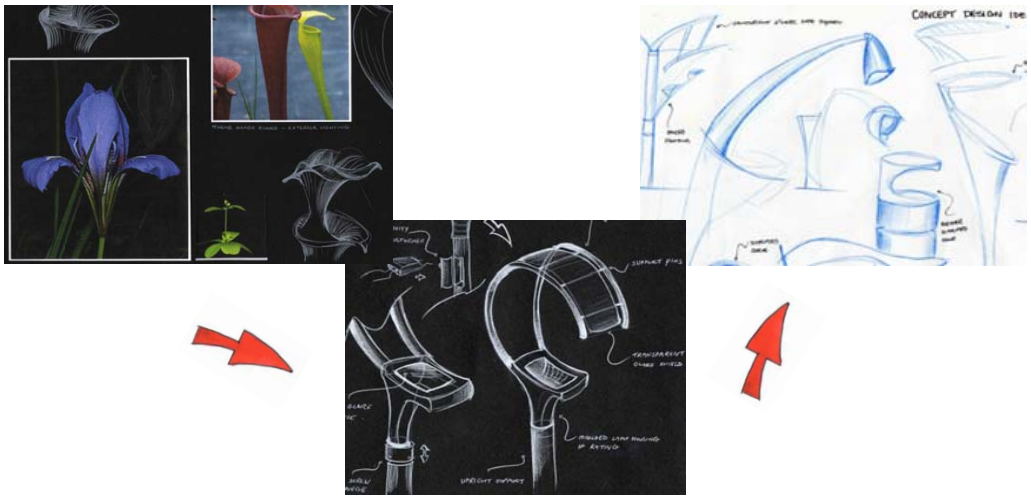
If we focus on the Compare and Contrast section in Output 2, two products to analyse must be chosen. This activity alone, involves making a multitude of decisions. For example: Why did you choose the two particular designs? What is it that you feel separates them from other designs? Is it that they are more attainable? Is it that they are aesthetically and functionally different?

Do I only make decisions at the end of an Output?

No, not at all, you are constantly making decisions. The key is to recognise when this happens and take a note of what you are thinking. Some decisions progress an idea to the next stage while others lead to abandoning an idea, as it is not in line with the project criteria.

For example, take the modification ideas sheet in Output 7. Here you are required to explore several

possible design modifications. Numerous decisions will be made while sketching the ideas. Some ideas may be too difficult to manufacture or are overly complex in their design. If this occurs these ideas may have to be revised or discarded completely and a fresh approach pursued. It is at this stage that you should record your thought process and decisions.



How can I record my decisions and thought process on my assignment sheets?

There are several techniques that may be used to record your decisions. Some of these are listed below:

- **Annotations**

  Annotations are short notes, observations or comments next to a design idea or a section of research. Annotations should reflect both the positive and negative aspects of your design and exploration. You should be constructive in your comments and take into account all your accumulated knowledge of the topic. Constructive annotation allows you to discard one idea and move onto the next.

  For example, *this design idea is an interesting shape but is not stable for an exterior light as the base design is too narrow. An additional support and a straighter shaft may increase the stability.*

- **Write a Sheet Intent at the start and a Sheet Conclusion at the end.**

  Sheet Intent: Before you start any Output list the key criteria you would like to achieve, or the aims of the particular sheet.

  For example: *Within Output 1, I aim to explore existing exterior lighting designs, the function requirements of an exterior light, the range of aesthetic designs and record my observations/discussions with target users.*

Sheet Conclusion: When you have finished an Output, draw on what you have learned, the insight gained and write a brief conclusion.
For example: *After completing this Output 1, I have learned that…I have decided to…. In the next sheet I will use this information to…..*

How can I insure that my decisions are clearly communicated?

Ensure your annotations are neatly presented and inline with your individual graphic style. You may decide to use a particular style of text, colour or a symbol, to highlight key decisions. Graphical arrows can also be used, to track your thought process over a sheet. The latter are suggestions only, the main criteria being that you are creative and consistent in your presentation.

I have collected all the research but I am finding it difficult to make decisions?

You need to be informed to make the right decision. It may be that you have collected all the research material but you need to spend time reading the information and understanding it. Following this, you could draft a list of questions to consider. There are several techniques to employ, some of which are listed below:

A useful technique is to use the **five W's** to draw conclusions/decisions from each section. This questioning process incorporates all aspects of the research topic. After each initial question, several new questions will arise.

- **Who** Who uses the artefact?.....Could it be adapted for other users?
- **What** What is the artefact designed to do?...Is it fit for its purpose? If not, why? If so, could it be improved to appeal to a wider market?
- **When** When is the artefact used? ....If there were other functions incorporated into the design, would it be used more often?
- **Where** Where is the artefact used? ….Can it be adapted to other environments?
- **Why** Why is the artefact needed?..... Are there features missing which would improve the function? Are there existing features which could be removed?

A guide to the **Student Assignment**

Design and Communication Graphics affords the student the opportunity to develop skills in graphical communication, creative problem solving, spatial visualisation, design capabilities, computer graphics and CAD modelling.

The Student Assignment provides the medium through which some or all of these skills may be both expressed and assessed.

The purpose of this document is to offer guidance to both teachers and students on possible approaches to successfully completing the DCG Student Assignment by drawing on the knowledge, experience and wisdom gained from the development of the Student Assignment process to date.

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