

Key Stage 4 Design & Technology: Pro/DESKTOP Exemplar Project

Suggested Year Group: Year 10

Project Title: Flat Pack



Brief:

To design a product (e.g. toy, furniture, game) using pieces cut from flat sheet. The product is to be modelled in Pro/DESKTOP to check the overall look and feel of the product and the pieces manufactured by profile cutting.

The product can also be packaged and include assembly instructions. A restriction on the size and thickness of the sheet material could be stipulated. The final product could be scaled down for manufacture.

Scheme overview:

Using Pro/DESKTOP, the students/students can be encouraged to:

- Experiment with a range of different 2D shapes
- Create 3D models
- Develop concept model(s) by assembly
- Create presentation views and experiment with a range of colours
- Transfer the parts to CNC driver software
- Arrange the parts economically for manufacture
- Use appropriate CNC machinery to manufacture the parts

Learning Objectives:

- to develop designing skills using Pro/DESKTOP solid modelling software
- to produce a simple, high quality product using computer-aided manufacturing
- to compare the advantages/disadvantages of using CAD/CAM
- to give students the ability to use virtual modelling in CAD to visualise and modify the appearance of products
- to enable students to manufacture, assemble and evaluate their chosen design
- to introduce students to the development of products for batch production with nesting of parts to minimise waste during manufacture
- to introduce the importance of tolerance, to get an good fit between parts

Learning Outcomes:

By the end of this project activity students will be able to:

- draw and edit 2D shapes
- assemble parts for evaluation and re-design
- explore a range of finishes to enhance models

- transfer models for CNC manufacture using appropriate software
- assemble the product and evaluate it
- discuss the advantages and disadvantages of CAD/CAM in designing and making
- produce assembly instructions

Software specific outcomes – students/students will be able to use some or all of the following features in Pro/DESKTOP:

- 2D sketching and editing
- Extrude profiles
- Using the browser and error correction
- Assembly of parts with mate, align, centre axes and orient
- Production of an “exploded” assembly by editing mate and align offsets
- Using the album to apply colours and textures
- Using engineering drawing to export DXF or export STL

Essential Vocabulary:

Sketch, edit, profile, extrude, part, component, assembly, alignment, exploded view, presentation view, profile, toolpath, offset, model, tolerance, fit

Resources:

1. Hardware:
 - A CNC modelling or routing machine
 - Laser cutter
2. Software:
 - Pro/DESKTOP
 - TechSoft 2D Design Tools or 3D GeoCam or Corel Draw or similar driver for Laser Cutter
3. Other resources:
 - Coloured card
 - Foam board
 - Images and examples of products (wooden toys, flat-pack furniture, games)
4. Tutorials:
 - Drawing and editing 2D profiles
 - Assembly of parts
 - Exploded views
 - Applying colours and textures in the album
 - Exporting DXF from the drawing interface to TechSoft 2D Design Tools or STL files to 3D GeoCam
 - Setting up the CNC machine
5. Useful websites:
 - www.techsoftuk.co.uk
 - www.boxford.co.uk/boxford/docs/products/3dcam_content.htm
 - www.wooden.co.uk (examples of toys)
 - www.alljigsawpuzzles.co.uk
 - www.smartpackkit.com.au/Content_Common/pg-Assembly-instructions-kit-cabinets-flatpack.seo
 - totem.ws/intro_e.html (Italian designer of slot-together furniture)
 - www.slotfurniture.com/how.html (UK furniture manufacturer)
 - www.thechipfactory.co.uk/pages/bwil/bwilfile.php (layout of pieces and design ideas)
 - news.bbc.co.uk/1/hi/technology/2238676.stm (the future of flat-pack?)
 - web.data.org.uk/data/secondary/ep_yr10_flatpack.php (school example)
 - <http://www.quartdepoil.com/> (French design company)
6. Suppliers of resources

Seawhite of Brighton Ltd. Star Road Trading Estate, Partridge Green, West Sussex RH13 8RA
 Phone: 01403 711633 Fax: 01403 711258
 Email: info@seawhite.co.uk Website: <http://www.seawhite.co.uk>
 Acrylic and other plastic sheet

Trylon, Unit J, Higham Business Park, Bury Close, Higham Ferrers, Northants, NN10 8HQ
Tel: 01933 411724 Fax: 01933 350357
email: info@trylon.co.uk Website: <http://www.trylon.co.uk>
Acrylic and other plastic sheet

Technology Supplies Ltd, Phoenix House, Tern Hill, Market Drayton, Shropshire, TF9 3PX
Tel: 01630 637300 Technical: 01630 637301 Fax: 01630 637302 Laser Enquiries 01630 637327
email: sales@technologysupplies.co.uk Website: www.technologysupplies.co.uk/home.htm
CNC machines and supplies

CadCam Technology Ltd, 5 Crocus Street, Nottingham, NG2 3DE
Tel: 0115 844 8050
Email: barryabson@aol.com Website: <http://www.cct-uk.com/html/education2.htm>
Laser Cutters

Hobart Lasers Limited, The Hopewell Centre, Hopewell Drive, Chatham, Kent, ME5 7DX
Tel: 0845 2601300 Fax: 0845 2601400
Email: sales@hobarts.com Website: www.hobarts.com
Laser Cutters

Suggested Introductory Lesson Activities (6 lessons):

- **Starter (10 min – whole class)**

Design stimulus:

Look at the work of designers and at existing flat pack products.

- **Starter (20 min – whole class)**

Generate ideas:

Use 4x4 method to produce four ideas in 4 minutes each.

Give each student a sheet of A4 paper. Ask them to draw a rectangle, about 6 cm by 8 cm, in the centre and then use vertical and horizontal lines to divide the area around the rectangle into four regions.

Allow 4 minutes for students to draw and annotate one of their design ideas in the centre space.

Ask them to pass their sheet to the next student in the group.

Allow them 1 minute to read the drawing they have just received and then 3 minutes to develop the idea in the top left-hand space on the sheet. Remind them to consider materials and construction.

After 4 minutes the sheets should be passed around to the next member of the group and the process is repeated, with students drawing in the top right-hand space.

This should continue until the sheet arrives back at the originator, complete with four developments of the initial idea.

The originator should then review the four developments and select or reject the suggestions.

(KS3 Strategy Materials: Module 4 Appendices and handouts (PDF))

- **Main Activity (50 minutes each)**

1. Develop and model ideas:

(a) Use Pro/DESKTOP to model 2D shapes, extrude them and save as parts.

Assemble parts. Evaluate designs visually against specification given.

(b) Use card or foam board to create and assemble shapes envisaged in drawings

3. Manufacture designs: Use CNC

Transfer designs to CNC software and arrange to minimise use of material.

Manufacture on CNC from sheet material (depending on number and type of CNC machines this may have to be a demonstration and then the rest of the manufacture done by the technician or outside lesson time).

4. Assemble designs:

Assemble the parts.

Evaluate against criteria.

Compare with card model.

5. Write the Instructions:

Disassemble the model in Pro/DESKTOP by exploding the assembly (change the offset values). Hide parts if necessary. Export the screenshots to instructions pages.

- **Plenary (15 min – group work)**

The foam/cardboard models can be photographed and annotation can show the development. Can others recognise the design influence?

List the advantages and disadvantages for using CAD/CAM.

Assessment: Key Stage 4 Criteria covered:

Developing, planning and communicating ideas

Students should be taught to:

- design for manufacturing in quantity;
- match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product;
- use graphic techniques and ICT, including computer-aided design (CAD), to generate, develop, model and communicate design proposals [for example, using CAD software to generate accurate drawings and part drawings to help with manufacturing].

Working with tools, equipment, materials and components to produce quality products

Students should be taught to:

- select and use tools, equipment and processes effectively and safely to make products that match a specification;
- use a range of industrial applications when working with familiar materials and processes;
- manufacture single products and products in quantity, applying quality assurance techniques;
- use computer-aided manufacture (CAM) in single item production and in batch or volume production [for example, using vinyl cutters, embroiderers, knitting machines, engravers, milling machines, lathes];
- simulate production and assembly lines, including the use of ICT.

Evaluating processes and products

Students should be taught to:

- ensure that their products are of a suitable quality for intended users [for example, how well products meet a range of considerations such as moral, cultural and environmental] and suggest modifications that would improve their performance if necessary;
- recognise the difference between quality of design and quality of manufacture, and use essential criteria to judge the quality of other people's products.

Knowledge and understanding of materials and components

Students should be taught:

- how materials are cut, shaped and formed to specified tolerances;
- how materials are prepared for manufacture and how pre-manufactured standard components are used;
- that to achieve the optimum use of materials and components, they need to take into account the relationships between material, form and intended manufacturing processes.

Awarding Body Criteria covered

Selected from 'A' grade coursework criteria for AQA Resistant Materials as relevant to this task

Designing:

- used one or more of their proposals and relevant knowledge of techniques, manufacturing and working characteristics to develop a detailed and coherent design solution;

- selected and skilfully used a wide range of communication, graphical and ICT skills which have helped to clarify their thinking and are sufficient to convey ideas to themselves and others effectively and precisely;

- provided evidence that they have considered and taken account of relevant issues, industrial practices and systems and control.

Making:

- recorded and justified the need for any changes or adaptations;

used appropriate materials, components, equipment and processes (including CAM)
consistently correctly, skilfully and safely;
made a complete product of high quality..

Gallery:



Quart de Poil



Slot Furniture

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Daniel White, Kingsbridge Community College
Slot Furniture Slough, Berkshire, SL3 6DF
Quart de Poil 21 rue de Bièvre - 75005 Paris

Author: John Myerson

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