Pearson BTEC Level _ Higher Nationals in Engineering (RQF)

Unit 23: Computer Aided Design and Manufacture

Unit Workbook 2

in a series of 2 for this unit

Learning Outcome 2, 3 & 4

Producing 3D Models, Manufacturing Simulations & Accurate Components using CAD/CAM

edexcel Approved Centre

Contents

INTRODUCTION

Produce 3D solid models of a component suitable for transfer into a CAM system.

1. *Solid modelling:*
    - Extrude, cut, fillet, chamfer, holes, sweep, revolve, lines, arcs, insert planes, properties of solid models e.g. mass, centre of gravity, surface area.
2. *Geometry manipulation:*
    - Mirror, rotate, copy, array, offset.
3. *Component drawing:*
    - Set-up template, orthographic and multi-view drawings, sections, scale, dimensions, drawing.
    - Attributes e.g. material, reference points, tolerances, finish.

Use CAM software to generate manufacturing simulations of a component.

1. *Insert solid model:*
    - Set-up, model feature and geometry identification, stock size, material.
2. *Manufacturing simulation:*
    - Operations, e.g. roughing and finishing, pockets, slots, profiling, holes, tool and work change positions, tool sizes and IDs, speeds and feeds, cutter path simulations, program editing.

Design and produce a dimensionally accurate component on a CNC machine using a CAD/CAM system.

1. *CNC machine types:*
    - Machining centres, turning centres, MCUs e.g. Fanuc, Siemens and Heidenhain.
2. *Data Transfer:*
    - Structured data between CAD and CAM software e.g. datum position and model orientation; file types e.g. SLDPRT, Parasolid, STL, IGES, DXF; transfer to CNC machine e.g. network, USB, ethernet.
3. *Inspection:*
    - Manual inspection e.g. using Vernier gauges, bore micrometres.
    - Automated inspection e.g. co-ordinate measuring machine (CMM), stages of inspection throughout manufacturing process.

GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

Purpose

Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

Theory

Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

Example

The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

Question

Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

Challenge

You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

Video

Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

1.1 Producing 3-D Models

1.1.1 Solid Modelling

Computer aided design is a highly specialised skill and requires powerful software to produce professional results. As a result, there is fierce competition amongst CAD software suppliers. As mentioned previously in this unit, there are several competing pieces of software suitable for professional use. All CAD software systems have the same aim, of producing a dimensionally accurate computer model, and thus, they all possess similar features.

Unless you already have access to suitable CAD software, speak to your course tutor for up-to-date links to free CAD software downloads.

For a free and simple-to-use starting point, 'Sketchup' is highly accessible and widely used. The very basics of any CAD software can be seen in 'Sketchup', for example to start modelling a simple block, it is usual to draw a 2D square and extrude this shape up or out to the desired height or width.
One can start drawing this 2D shape on any of the three axes within the software, this goes for any CAD software and is a basic foundation of their operation.

Challenge

Sign up to 'Sketchup Free' and/or TinkerCAD to start creating some 3D shapes, using as many different features as possible!

https://www.sketchup.com/
https://www.tinkercad.com

Once you are familiar with those basic systems or if you already have experience of using CAD, then download Autodesk Inventor or Fusion 360 (both student versions) or use Solidworks free trial to attempt some of the tutorials and your own original designs.

https://www.autodesk.co.uk/products/fusion-360/students-teachers-educators

https://my.solidworks.com/try-solidworks

Once you are registered with Autodesk, you will be permitted to view a selection of short course videos, these explain a variety of topics, from getting started to transition from another CAD system, through to assemblies and testing and validation.

A distinct advantage of Fusion 360 is that it also possesses CAM simulation capabilities, (these will be explored later in this workbook). There are some standard features with any CAD system, the 2D planes to draw shapes on, the extrude/pull, hole, sweep, revolve etc. and extensive tutorials are available on the respective software websites.

Challenge

1. Model the following solid part:

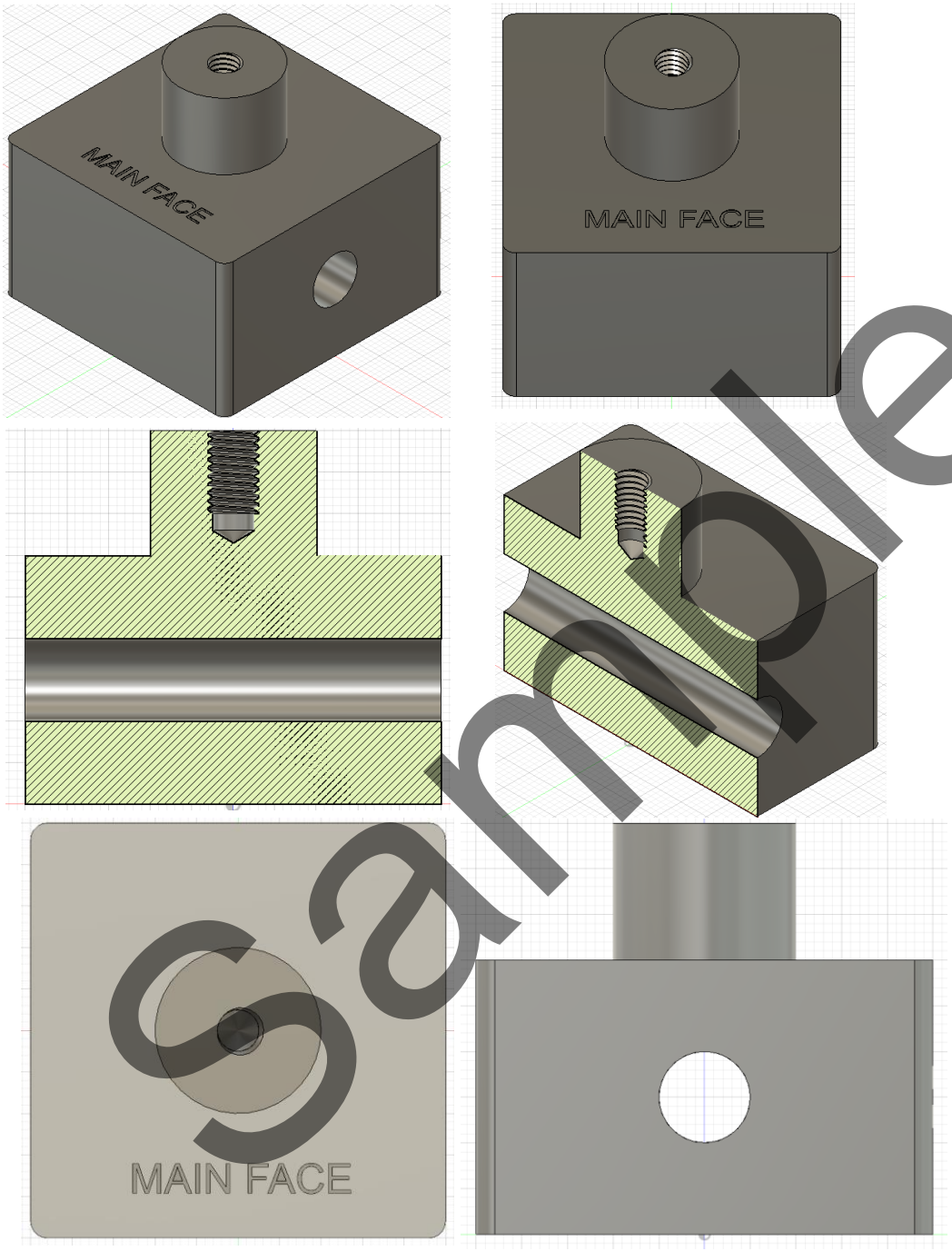

Figure 1.1: *Example Solid Model Block*

This part is a 50mm x 50mm square, 30mm high with 2mm radii at each corner. There is a 20mm diameter cylinder, 15mm high located centrally on the top face with an M6 partially threaded hole located concentrically on the cylinder top face (12mm depth, 10mm threaded). There is also a 10mm diameter plain hole through the side face, which goes through the entire part, this is located centrally on the side

face. Finally, there is text, 5mm high, reading 'MAIN FACE' on the top square face, etched 0.2mm deep, again located centrally and equidistant between the cylinder and the part edge.

2. Change the material of this part to 'PAEK Plastic', highlight its centre of mass and determine the surface area of the face labelled 'MAIN FACE'. (Surface area should be approximately 2150mm^2).
3. Mirror the cylinder and threaded hole so that they now protrude from the bottom of the part, if necessary, create a plane in the centre of the existing part.

The part should now appear as follows:

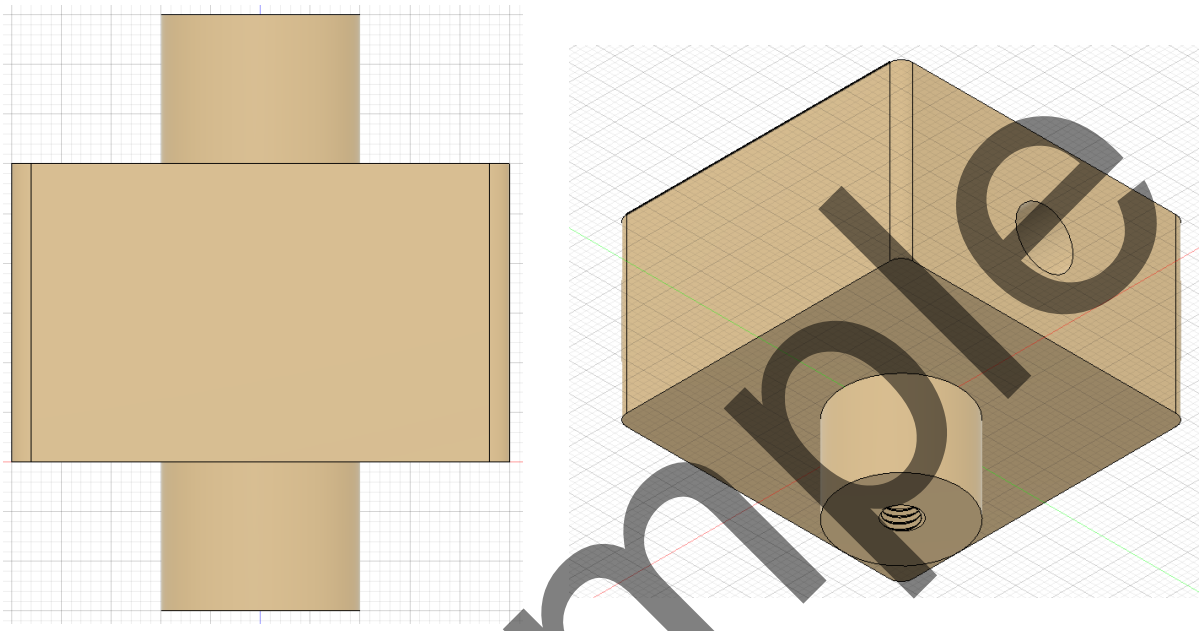

Figure 1.2: *Example Solid Model (Modified)*