

CAD/CAM IN SCHOOLS

WHAT IS CAD/CAM?

Computer Aided Design and Computer Aided Manufacture can be thought of as two separate processes.

CAD involves the creation of a design using a computer. Designs do not have to be in the traditional technical style, they may also be very graphical, such as the graphics for a new shop front, or in the form of 3D models, etc.

CAM involves using a computer to control the operation of a manufacturing tool. This may be a vinyl cutter, a sewing machine, a laser cutter, etc. (Early systems used only numerical data, hence CNC - Computer Numerical Control.)

In recent years CAD and CAM have converged with data from the CAD system automatically generating tool paths and operating machines directly. CAD/CAM has revolutionised industry, cutting time and costs, and improving accuracy. It has also allowed the development of products not possible using traditional manufacturing techniques.

2D OR 3D SOFTWARE?

We live in a 3D world and therefore creating designs in 3D is an important activity. However, many of the shapes and images we see and work with are 2D. True 3D design is an intellectually challenging activity (remember a computer screen is 2D, as is the mouse input - not that different to a pencil and paper!). Conceptually, often the simplest way of introducing the 3D product design is to start with fabrication, i.e., assembling a product, (such as a box) from cut out flat parts. Much CNC manufacturing in schools will necessarily be 2D, eg., cutting and routing, due to material cost and manufacturing times. In practice 3D and 2D data formats, structures, etc., are inherently very different, so it is difficult to make software work effectively in both.

Modela MDX-20E
Low cost light miller comes with
3D scanner head



We therefore tend to split 2D and 3D design activities by software type (eg., designing a bottle label is best done on 2D software, designing the bottle is probably best done on 3D software). However, there is a lot of overlap and images can often be transferred from 2D software to 3D and visa versa, to utilise the strengths of each type.

In practice in schools, it probably pays to concentrate on 2D design and 3D assembly for younger children, and to think of true 3D design as an activity for older, more able children.

CAD/CAM IN THE CURRICULUM?

CAD/CAM is no longer a "bolt on" activity if time and resources permit, it is now a core part of the Design and Technology process for all students. In fact in GCSE in the U.K. assessment, students can be penalised for not providing evidence of CAD/CAM activities. Even more importantly CAD/CAM enriches the knowledge and experience students receive from their D&T education.

WHAT CNC EQUIPMENT DO I NEED?

There are primarily six main types of CNC systems in use in schools: knife cutting systems, milling/routing systems, laser cutters, 3D printers, computerised embroidery systems and Image Transfer systems.



Stika SV-8E
A good starting point for
those on a low budget

Knife Cutting Systems

The simplest and cheapest access point to CAD/CAM is knife cutting. Text and simple designs can quickly be created by even the most inexperienced pupils. Vinyl signs, decals, and logos applied to products, will provide an instant enhancement to the quality of finish. Recent developments mean that these machines can also be used for print/cut activities. Designs can be printed out on a standard colour printer or an Image Transfer printer, then put into the cutter for cutting out. This means that designs can easily be made into professional quality full colour decals, logos, tags, labels, garment decoration, etc.

The low cost entry into cutting are the Roland **STIKA** machines. These are great for all schools at all levels (including primary).



CAMM 1 GX-24E
Our most popular
vinyl / card cutter

The standard cutter for secondary schools, however, is the **CAMM 1** (current model the **GX-24E**). These large, fast, powerful machines cut heavier materials such as card (great for full colour packaging for example).

Roland also supply a larger more specialist cutter with a built in print head (Roland **VersaCAMM**)

YOUR QUESTIONS ANSWERED



MDX-40E
Our most popular
miller / router

Millers / Routers

Milling and routing are key CNC activities. Miller/routers can be used for cutting out and profiling in sheet and block materials, and also for subtractive rapid prototyping of 3D objects. All schools should have some provision for this type of work.

The first choice for most schools is the Roland MDX-40E. This machine has a generous working envelope, easy setup and operation, the ability to cut a wide range of workshop materials and full 3D capability. With the additional options of a self-centering vice for producing full 3D objects, a rotary 4th axis for fully automatic production of 3D objects, and even a 3D scanner head, the MDX-40E is truly a great all rounder at an amazingly low price, and is one of the great workhorses of schools' CAD/CAM.

To get started in CNC milling, or for individual project work, the MODELA MDX-15E/20E and EGX-350E are ideal. MODELAs are designed primarily for 3D and the EGX-350E for engraving, but with enhancements, both make excellent light millers. It is worth noting that the EGX-350E has twice the bed size and four times the XY feedrate of an MDX-20E, for not much more cost.

For more ambitious users (or those with bigger budgets), the Roland MODELA PRO II MDX-540E is a large blisteringly fast servo driven machine. It is the state of the art for subtractive rapid prototyping, and must be the top choice for serious 3D design work.



EGX-350
Engraver

WHAT SOFTWARE DO I NEED?

2D Software

2D DESIGN has been created specifically to be used in schools. It is now accepted as the standard educational graphic design and draughting product, being in use in over 5000 U.K. schools. It is sophisticated yet easy to use. The ability to be user-configured means that it can be used through all years. The built-in drivers for CNC equipment mean that can be at the heart of the vast majority of CAD/CAM systems in use in schools. Roland recommend that the software is used as the core drawing program for the entire school. This will maximise students' exposure to it and hence reduce the Design and Technology teaching burden. A Student License allows pupils to use the software at home, radically increasing access times.

Version 2 of 2D Design greatly enhances the graphics capabilities of the software, with features such as bitmap support (loads bmp, jpeg, etc.), bitmap to vector conversion, graduated and pattern fills, clip paths, user definable fonts, etc. Most D&T departments will find that 2D Design V2 is the only piece of 2D CAD/CAM and graphics software that they will ever need.



MODELA PRO II
MDX-540E
Large, Powerful, Ultra High Speed miller /
router for the more demanding user

3D Software

All Roland's milling systems come complete with a suite of **free** software applications. For true 3D Design, Roland's **3D Engrave** is a good starting point. This allows simple shapes to be drawn then "popped up" into 3D. Shapes can be added and subtracted to build up complex shapes as desired.

For engineering and product design applications, programs such as **Pro Engineer, Solidworks etc** have a role to play for senior students. TechSoft's **Visual ToolPath** is an intuitive and user friendly way of machining 3D files directly. Alternatively, a graphic simulation of manufacturing may be run to check that the manufactured object will match the design, and to see what the surface finish will be like, etc. Usefully, an accurate estimate of machining times is given, so that the effects of different machining parameters and feedrates, etc., can be assessed before committing to machining.

WHAT ABOUT PRIMARY SCHOOLS?

It is important that children learn the principles of design drawing as young as possible. Therefore, a low cost simplified drawing program, Design Tools - Primary Design, has been created specifically for primary pupils. This also provides a natural path of progression as children move from Primary to Secondary, thus helping to bridge the divide in D&T. Of course the data is fully transferable so that students designing in primary schools can have their products manufactured in their secondary school. Many primary schools have already gone one step further and have bought their own STIKA - ideal for primary CAD/CAM.