
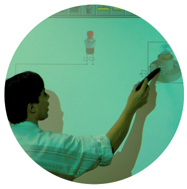


Building Bulletin 81

Design and Technology Accommodation in Secondary Schools

A Design Guide

department for
education and skills
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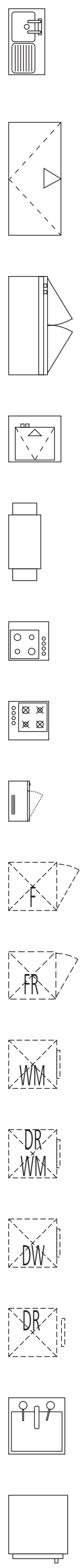
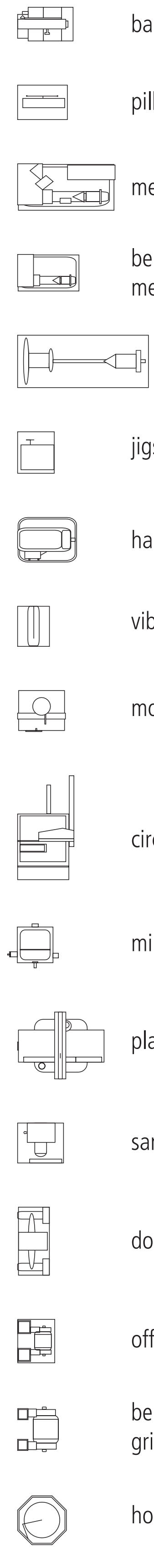
Symbols

Food equipment

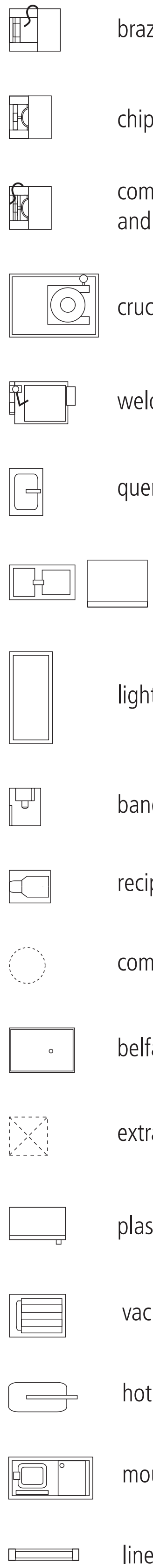


- domestic sink
- chest freezer
- industrial fridge
- blast chiller
- tunnel oven
- electric cooker
- gas cooker
- microwave oven
- fridge
- freezer
- washing machine
- washing machine with drier above
- dishwasher
- drier
- hand wash sink
- oven

Resistant materials machines and equipment



- bandsaw
- pillar drill
- metal lathe
- bench-mounted metal lathe
- wood lathe
- jigsaw
- hacksaw
- vibrasaw
- morticer
- circular saw
- milling machine
- planer/thicknesser
- sanding machine (linisher)
- double buffer
- off-hand grinding machine
- bench-mounted grinding machine
- horizontal grindstone



- brazing hearth
- chip forge
- combined chip forge and brazing hearth
- crucible furnace
- welding bench
- quenching tank
- dip-coating equipment
- light box
- bandfacer
- reciprocating saw
- compressor
- belfast sink
- extraction unit
- plastics oven
- vacuum former
- hot-wire cutter
- moulding bench
- line-bending machine

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A Design Guide

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Contents

Introduction

This document offers guidance to anyone involved with the briefing and design processes for design and technology accommodation. It is aimed at teachers, governors, local education authority advisers and building professionals, and is relevant to both new construction and the adaptation of existing buildings.

The document supersedes the previous edition of Building Bulletin 81, *Design and Technology Accommodation in Secondary Schools*.[1] While much of the original detailed guidance remains, it has been totally revised in both layout and content. The design is intended to be more accessible, and the content has been updated to reflect current thinking on secondary-school design and on secondary education itself, including issues around ICT and inclusion.

Design and technology is essentially a practical subject involving pupils in a wide and varying range of activities that can be divided into four key areas: researching; designing; planning and making; testing and evaluating. Products are made in a wide range of materials including wood, metal, plastics and textiles (often in combination) and food. Computers are used extensively for researching, designing and testing products, and presenting ideas.

The breadth and diversity of the subject is reflected in the need for a wide range of space types and the fact that there are many different ways of achieving a successful learning environment. This revised document aims to inform and inspire creative solutions rather than prescribe a single approach. It contains a new section on the link between activities and facilities, as well as more case studies of real schools showing the wide variety of approaches to accommodating the subject.

An increase in capital funding and the Building Schools for the Future initiative[2] provide an opportunity to develop suitable and attractive accommodation for design and technology that can inspire staff and stimulate pupils' learning. The accommodation brief should be considered in the context of the whole school's development plan and the resources that are available. The design solution must be flexible and adaptable enough to take account of both current and future needs, to ensure that value for money is achieved.

Notes

1. Published by the Stationery Office in 1996.
2. Capital funding will increase to more than £5bn in 2005–06. The BSF programme aims to renew all secondary schools over ten to fifteen years from 2003, assuming continuing funding support.

The information in this publication begins with a broad outline of accommodation requirements, followed by more detailed guidance. Issues associated with provision for vocational courses and for students with special needs are covered, where appropriate, throughout the document. More detailed investigation and guidance on both these subjects is being worked on currently in the Department. The sections in this document are summarised below:

Section 1. Planning for design and technology looks at the link between activities and facilities, how to calculate the number and size of spaces required and key planning points.

Section 2. Learning spaces provides guidance on planning individual timetabled and untimetabled spaces, using diagrammatic and real layout plans to illustrate.

Section 3. Non-teaching support spaces discusses the areas supporting the learning spaces, and includes advice on storage.

Section 4. Furniture, finishes and fittings has detailed guidance on furniture, including the safe working distances around tables and benches. It also discusses surface finishes, and how to use furniture to create a successful learning environment.

Section 5. Machines and equipment has information on individual machines and their servicing, as well as on safety and planning, including safe distances around machines and equipment.

Section 6. Services and environmental design outlines the key points of servicing a design and technology space to provide a safe and comfortable working environment.

Section 7. Cost guidance looks at the cost of building and equipping design and technology accommodation, with a worked case-study example.

There is also an extensive appendix on the main health and safety regulations relevant to design and technology.

Finally, readers may also want to look at the companion website 'Design and technology accommodation in secondary schools':
www.teachernet.gov.uk/designandtechnology/

1

This section provides an introductory framework for the more detailed guidance in other sections. It looks at the types of facilities that are needed to accommodate and facilitate design and technology activities, and how these translate into a range of spaces. It also sets down key planning principles that can be used as a guide when designing or adapting accommodation. The information here is intended to take readers 'back to basics' and encourage innovative design solutions that help to move the subject forward from its craft heritage to its design and technology future.

Planning for design and technology

Activities and facilities

Design and technology is essentially a practical subject. It involves pupils in researching, designing, testing and evaluating products as well as in making them. Pupils undertake various activities: product analysis; focused practical tasks that develop a range of techniques, skills and knowledge; and design-and-make assignments in different contexts. Computers are used extensively for researching, designing and testing products, and for presenting ideas. Products are made in a wide range of materials, including wood, metal, plastics and textiles (often in combination), as well as food. Pupils use a range of hand and machine tools and work with a variety of computer-controlled machines. They learn about and make use of a variety of control systems including electronics, mechanics and pneumatics. Pupils also learn about design and technology in the wider world, including processes and materials, and the cost and time involved in manufacture.

In design and technology lessons, pupils work individually and in teams of varying sizes. They take part in whole-class sessions for discussion, presentation and evaluation, often using an interactive whiteboard. Some activities involve an outside speaker who may work with more than one class group at a time. A range of courses, including vocational ones, is available for 14–19-year-olds.

There are four key aspects to design and technology activities:

- Researching
- Designing
- Planning and making
- Testing and evaluating

These activities do not take place in any strict order, and often run concurrently. For example, a pupil may make, test and evaluate a prototype, then refine their design (possibly carrying out further research) and then return to making once more.

The four key aspects of design and technology are described further overleaf.

Researching

Researching involves pupils both in independent investigative activities and direct teaching. Pupils carry out research individually, in small groups, or as a whole class (often using an interactive whiteboard). Activities include whole-class presentation and discussion, researching on the Internet, reading, writing, sketching and analysing existing products.

Designing

Pupils develop their ideas in a variety of ways, which may include sketching, computer graphics, and making and experimenting with materials and models. They discuss and analyse their ideas as they progress, and record them to form part of a 'story' of how their product develops.

Planning and making

This most practical stage of a project involves pupils planning and making in a range of materials and using a number of different processes[3]. Traditional and computer-controlled machines are used. Access to specialist facilities is needed.

Testing and evaluating

Pupils test and evaluate their products as they progress, and adjust their designs as needed. This may involve practical work, such as applying a load to a product to test its strength, using computers to analyse performance and log data, or seeking the views of peers and teachers through discussion and presentation in small or whole-class groups. Completed projects are usually presented as a report or design portfolio, but pupils may also make use of the latest presentation technologies to show their work to 'clients' and to explain it to the whole class or group.

Some of the activities described above, particularly those in the research and evaluation phases, require facilities that are the same irrespective of the specialist area or materials a pupil is working in. For example, clean tables to sketch or write at when developing an idea are needed whether pupils are considering food or a resistant-material product. Figure 1.1 lists the facilities that are needed to accommodate these general activities.

Other activities, particularly designing and making, and to some extent testing, require access to specialist facilities such as woodworking machinery or sewing machines. Figure 1.2 shows the range of these facilities against the main areas of specialist activity. Pupils may need access to more than one type of specialist facility for a project (e.g. designing and constructing an electronically controlled toy made from wood and fabric). Specialist

Note

3. Some of these processes are outlined in the machine descriptions in Section 5.

facilities that may be needed as part of testing and evaluating the results of any activity are shown at the end of the table. The notes column in each table highlights issues that could have space implications.

These tables link facilities, not rooms, to types of activity; it is not intended that each activity should have a separate space. Researching and designing, for example, can take place in a specialist space alongside making facilities, or in a shared resource area, or both.

FIGURE 1.1

General facilities associated with design and technology activities

Activity	Facility	Notes
Researching, designing, testing and evaluating	Clean areas with networked computers (up to half class at any one time), with occasional need for 1:1 computer access	Wireless laptops provide greater flexibility and would allow whole-class activity
		Computers attached to CAM machines could be used if available, given suitable software and adequate working space at the computer
	Clean area with tables for sketching, reading, writing and laying out products for evaluation	Facility could be multi-functional but sketching and writing require smooth surface
	Area for whole class or small group to gather for discussion	Tables not always needed – this affects area requirement. Pupils may stand for short sessions
		An interactive whiteboard, data projector, OHP or video player will be used. May be occasions when more than one group gathering (e.g. to hear outside speaker)
	Place for 2D and 3D display of existing good products to analyse and for inspiration	Position where seen frequently by pupils. Particularly in areas where design takes place and in shared resource areas
		Display will be rotated – consider effect on storage needs
	Storage space associated with all the above facilities	See Section 3 for more information on storage

FIGURE 1.2

Specialist facilities associated with design and technology activities

Activity	Facility [4]	Notes
All activities	Space to store materials, resources, prototypes, and final products	Products need to be stored securely, whilst in progress and when completed
Designing and making with resistant materials	Area for group gathering for practical demonstration (e.g. use of a machine)	Machine to be located to ensure safety and visibility to (possibly whole-class) group
	Area for working at workbenches with hand and power tools	Adequate space required around benches
	Floor-standing and bench-mounted machines for working with wood, metal and plastics (traditional and CAD/CAM)	Adequate space required around machines One line of floor-standing machines easier to supervise Electrical safety system needed (see Sections 5 and 6) Consider options for locating CAD/CAM machines, bearing in mind noise, dust and space requirements
	Equipment for working with plastics	Good ventilation needed
	Heat-treatment equipment	Minimum brazing hearth and casting equipment Position away from circulation areas. Local exhaust ventilation (LEV) will prevent location against windows Consider how gas bottles are stored
Designing and making with electronics and control systems	Area for working at benches with access to low-voltage power and possibly pneumatics	Low voltage can be provided in serviced tables or by portable power packs
	Area for working at workbench(es) with hand and power tools	Adequate space required around benches
	Facility to make circuit boards (PCB unit for etching or CAD/CAM for engraving)	Printed circuit board (PCB) unit needs good ventilation
	Area for working at computers, minimum half a class at one time with occasional need for 1:1 computer access	Laptops save space and allow 1:1 computer access. Battery-operated laptops allow work in a variety of places, which frees up layout possibilities
	Bench-mounted machines for working in wood, metal and plastics	Adequate space required around machines
Designing and making with food	Area for cooking and preparing food, with domestic, industrial and catering equipment	Adequate space required around cookers and sinks for safe working. Good ventilation required Cookers, sinks and worktops should be at the correct height

4. Pupils should have access to a sink with hot and cold water close to all specialist facilities.

(continued...)

Activity	Facility	Notes
	Area for group gathering for demonstration	Consider one or two cooking bays doubling as demonstration areas for flexibility, including industrial and catering equipment for a variety of cooking demos Consider visibility
	Somewhere where cooked food can be cooled after each lesson	Must be away from activity and secure Food-preparation area could be used (see Section 3)
Designing and making with textiles	Area where up to half class can cut out fabric	Some may need large surface area
	Work surface for working with sewing and knitting machines including CAD/CAM	Some equipment can be in a cupboard or a storeroom when not in use, releasing work surface
	Work surface for traditional equipment such as weaving looms	Equipment can be in a cupboard or a storeroom when not in use, releasing work surface
	Space for ironing fabric and garments during making	Allow safe distances around ironing board Avoid trailing leads
	Work surface with sink for fabric testing	May need occasional access to science laboratory with fume cupboard for health and safety reasons
	Plenty of free floor area for dressmaking dummies	Dummies which can hold work in progress may be put in stores or used as classroom display
	Area where garments can be tried on in privacy	Most economical solution is to use storeroom (if large enough)
	Occasional printing facility, including large deep sink and suitable printing surface, for screen-printing, use of dyes and batik	Can set up temporarily or share facility with art room Centrally located services allow e.g. batik printing on central tables (usually more spacious than perimeter benching)
Designing and making with graphics products	Area for working at computers, minimum a quarter of the class at one time with occasional need for 1:1 computer access	Laptops save space and allow 1:1 computer access. A large screen is desirable for graphic work
	Equipment for working with plastics	Good ventilation needed
	CAD/CAM facility	LEV needed
	Technical-drawing facility	Use general facility but allow space to store drawing boards if no specialist tables (see Section 4)
Testing and evaluating in all specialist areas	Access to specialist materials and equipment for testing products	When tasting food, somewhere with good lighting away from cooking smells is needed
	Clear floor space	May be needed for large and moving products, structural tests, etc.

Pupils may occasionally need to use facilities outside school. This is most likely on vocational courses when pupils may visit a college or workplace. There may also be virtual links allowing teaching groups to view industrial processes taking place off-site. Video conferencing can take place in any teaching area, provided there is room for the whole group to sit at tables for sketching, note-taking, etc.

Types of space

The way in which the facilities described in Figures 1.1 and 1.2 are translated into the exact number, size and type of spaces to be provided in a design and technology department will have to be determined by analysis of the school's needs – its present and future curriculum, pupil numbers and particular ways of teaching. This will involve discussion between teachers, advisers and building designers. Broadly speaking, the facilities provided will include timetabled teaching spaces, untimetabled learning/resource areas and non-teaching support spaces. These are described further below.

Timetabled teaching spaces

The types of timetabled spaces will vary depending on pupil numbers and the way in which the curriculum is delivered. The key is to provide facilities that will match the activities taking place now or in the future, bearing in mind the need to allow for flexibility. Types of space tend to divide broadly into the following categories, reflecting the different specialist facilities required:

- **Resistant materials:** equipped for working with wood, metal and plastics, sometimes with a bias towards working with either wood or metal, or equipped for a vocational course
- **Electronics and control systems:** for smaller-scale work, e.g. making and learning about electronic products and pneumatic control systems
- **Food:** specially equipped for working with food, sometimes with a bias towards a vocational course
- **Textiles:** specially equipped for working with textiles by hand and using machines in various ways

- **Graphic products:** equipped for working on 2D and 3D products including computer graphics

There is great variation within and overlap between these categories (with the exception of food areas for health and safety reasons). A resistant-materials area, for example, can vary from a metal-biased engineering space to a multi-purpose space that includes facilities for small-scale working with wood, metal, plastics, electronic components and pneumatics. Schools may teach some electronics and/or control systems alongside resistant materials.

Photo: Gill Greany

The size and focus of a school can affect the range of spaces provided. For example, in some schools there may be a space equipped specifically for graphic–products activities. Or there may be two or more resistant-materials spaces, each furnished and equipped to provide for a different emphasis (one centred on product design and computer-controlled manufacture, and another on engineering, for example). Where there are two or more food rooms, one may have a bias towards product development and another towards manufacturing, with food-production runs. For a small design and technology department there will be more overlap between facilities within the department (e.g. resistant materials sharing space with electronics and control systems), or between departments (e.g. textiles and art areas).

Photo: Gill Greany

The way in which CAD/CAM (computer-aided design/computer-aided manufacture) machines are distributed varies too. They may be:

- Located in a dedicated room
- Used alongside traditional machines in main teaching spaces
- Housed in a separate space with other resources (see 'Learning/resource areas' below)
- Kept on trolleys and moved between spaces as they are needed

Post-16 students generally use the same specialist facilities as younger pupils but they may have a dedicated space which may be partly timetabled. Untimetabled shared resource areas (see below) can double as post-16 study areas, with access to books, journals and ICT, but no practical or workshop facilities.

In some schools, a group of design and technology spaces is conceived of as a unitary resource where pupils move between spaces using equipment as required. The implications for this approach are discussed in some of the case studies.

See the case studies throughout this document for a range of design approaches to timetabled teaching spaces.

Learning resource areas

These areas allow pupils to learn away from the main specialist areas. They may be used as support facilities during timetabled time, or used independently during pupils' free time. In order to benefit everyone, they should be centrally located, easy to reach and easy to supervise indirectly (see 'Key planning principles' below). The most typical spaces are:

- **A shared ICT-resource area:** many research, design and evaluation activities require ICT facilities as well as clean table space. While some facilities can be provided alongside specialist equipment and furniture in each specialist area, it is desirable to provide a central resource as well. It can be bookable for part of the time and needs to provide ICT facilities for at least half and sometimes a whole class group.

- **A shared design-resource area:** a flexible space with loose tables, display space, journals and books for reference. This and the ICT resource area are valuable for post-16 pupils to use in their untimetabled time. As with the ICT resource, the design-resource area may need to accommodate a whole class plus teacher. ICT- and design-resource areas are often combined into a single space with a computer: pupil ratio of 1:2. If such an area is large enough for a whole class it can be partly timetabled as a graphics studio

- **A display area:** where pupils' own work and that of professional designers can be displayed for information and inspiration. This is often combined with a central design-resource area

- **A CAD/CAM area:** some schools may prefer to house some of their CAD/CAM machines in a separate room, which should be visible to and easily accessed by pupils. This may be in order to insulate learning areas from the noise of the machines (or their extraction), or to separate the computers from dust or humidity in the main teaching area. Schools without a specialist technician are unlikely to provide such a space. CAD/CAM machines may also be housed in a shared resource area where they are more widely accessible and where computers can be used for designing when they are not running the machinery. See also 'CAD/CAM room', in Section 2.

- **An external project area:** a covered external area can be used for building large-scale structures and testing products where more space is needed. It may also be a place where particularly messy or dirty activities take place or where large products can be constructed. The possibility of noisy activities disturbing other departments should be considered when locating such an area.

Non-teaching support spaces

These spaces provide essential support, freeing up the main spaces for teaching and learning activities. They include:

- Storerooms for teaching resources, specialist materials and equipment, and pupils' work. The area requirement for the last of these can be considerable
- An area where staff can safely prepare resistant materials for pupils' use and also maintain tools and equipment
- A room where staff can prepare food ingredients in advance of lessons. This area can also cater for some of the room's storage requirements. Laundry facilities also need to be provided, here or in the teaching space or in a separate laundry area
- A departmental staff base where teaching and non-teaching staff can exchange ideas and prepare work. Secure storage will be necessary

Number of spaces

In order to assess the overall number of timetabled specialist spaces needed, the proportion of pupils' time to be spent in design and technology and the availability of teachers will both need to be identified, for the present and, as far as possible, for the future. Account should be taken of all courses likely to make use of the spaces, including vocational courses such as engineering, manufacturing and catering. Engineering and manufacturing courses are likely to involve the use of electronics and control systems facilities as well as those for resistant materials.

Figure 1.3 shows the number of timetabled teaching spaces generated by three curriculum models for different school sizes (see the DfES 'School buildings' website,[5] for guidance on curriculum analysis). The models reflect a breadth of school-types within the 11 to 18 age range. Each model reflects a different total number of periods per week. Model 1 has the smallest percentage of curriculum time devoted to design and technology; it assumes that half of KS 4 pupils study design and technology and that no specialist vocational courses are offered. Models 2 and 3 show higher percentages of curriculum time. Model 3 may reflect a school which specialises in design and technology, and where all KS 4 pupils follow a design and technology course.

Note

5. www.teachernet.gov.uk/curriculumanalysis

FIGURE 1.3

Curriculum planning: number of spaces for 3 models

	Form entry	4	6	6	8	8
	Age range	11–16yrs	11–16yrs	11–18yrs	11–16yrs	11–18yrs
	No on roll	600	900	1100	1200	1540
MODEL 1	Periods	25	25	25	25	25
	Max Grp size	20	20	20	20	20
8% KS 3	D&T periods KS 3	36	54	54	72	72
8% KS 4	D&T periods KS 4	12	18	18	24	24
(50% participation	D&T periods Post-16			8		24
no vocational course)	Total periods	48	72	80	96	120
	Number spaces (calculated)	1.9	2.88	3.2	3.84	4.8
	Number spaces (rounded)	3	4	4	5	6
	Frequency of use	63%	72%	80%	77%	80%
MODEL 2	Periods	30	30	30	30	30
	Max Grp size	18	18	18	18	18
10% KS 3	D&T periods KS 3	63	90	90	126	126
10% KS 4	D&T periods KS 4	36	48	48	66	66
(70% participation	D&T periods Post-16			12		24
including 10% doing	Total periods	99	138	150	192	216
vocational courses)	Number spaces (calculated)	3.3	4.6	5	6.4	7.2
	Number spaces (rounded)	4	6	6	8	9
	Frequency of use	83%	77%	83%	80%	80%
	Periods	40	40	40	40	40
MODEL 3	Max Grp size	18	18	18	18	18
	D&T periods KS 3	84	120	120	168	168
10% KS 3	D&T periods KS 4	64	96	96	128	128
10% KS 4	D&T periods Post-16			16		40
(All take D&T including	Total periods	148	216	232	296	336
20% doing vocational	Number spaces (calculated)	3.7	5.4	5.8	7.4	8.4
courses)	Number spaces (rounded)	5	7	7	9	10
	Frequency of use	74%	77%	83%	82%	84%

Figure 1.3 also shows the average frequency of use for each space (the amount of time it is used compared to the total time it is available). Where rounding up to the nearest whole number results in a frequency of use above 85%, the next highest number of rooms is shown. The number of spaces should fit the need as closely as possible to ensure an efficient use of space. However, since each of these spaces has a specialist function and because some time is needed for room maintenance, it may be difficult to organise the school timetable to achieve an average use of the spaces of more than 85%.

If, however, the figure for average use falls below about 60%, it is advisable to consider equipping a space for more than one specialist function. This is particularly applicable to smaller schools, although the extent to which it can take place will be limited by considerations of safety and hygiene. Food technology, for example, cannot be combined easily with other specialisms for health and safety reasons. The number of spaces will need to be at least three if a broad range of facilities is to be provided. Spaces are likely to be bigger in a small department to ensure a suitable range of facilities is available (see 'Size of spaces' below).

There should be at least one storeroom for each timetabled space. The number of untimetabled learning-resource areas depends on the size and type of timetabled spaces provided and on the school's particular approach.

Size of spaces

The size of a teaching space will depend on the range of activities taking place in it and the maximum group size likely to be accommodated. The graph in Figure 1.4 shows a series of zones (G to J) which represent recommended area ranges for secondary-school teaching spaces according to group size. Typical zones for each specialism are suggested alongside the graph. Figure 1.5 shows the area ranges for zones G to J for typical group sizes, as generated by the graph. The areas include all working space but exclude full-height storage, walk-in stores and (in open-plan areas) circulation routes.

FIGURE 1.4

Recommended area ranges for design and technology teaching spaces

In the formulae, G is the KS 3 or KS 4 group size. For example, a space in zone H for 20 pupils would range from 83m^2 ((3.2x20)+19) to 95m^2 (3.6 x 20) +23).

Typical zones

Textiles	H
Graphic Products	H
Electronics and control systems	H
Food	I
Resistant materials	J

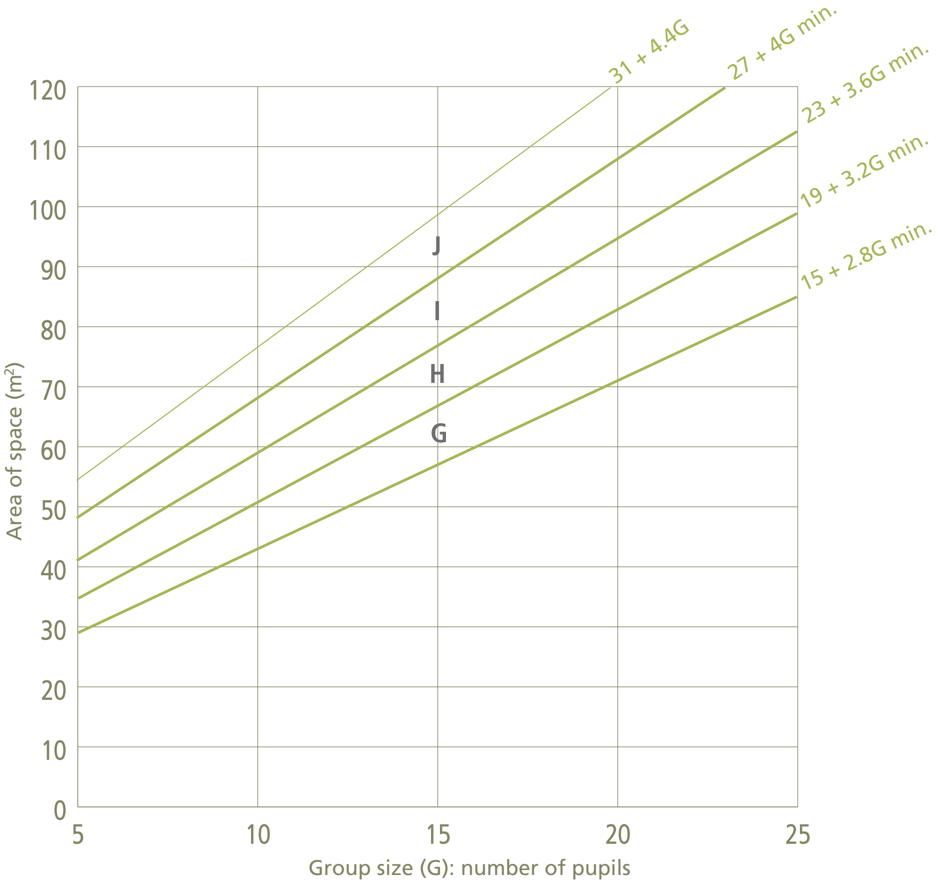


FIGURE 1.5

Table showing area ranges for typical group sizes for zones G, H, I, and J

Group size	18	19	20	21	22
Zone	Area range ⁄ m^2				
G	65–77	68–80	71–83	74–86	77–89
H	77–88	80–91	83–95	86–99	89–102
I	88–99	91–103	95–107	99–111	102–115
J	99–110	103–115	107–119	111–123	115–128

The area bands support a typical range of specialist activities together with associated general activities such as writing, sketching and presentation. However, the range and combination of specialist activities varies between schools. The range of equipment may be enhanced to meet curriculum need in spaces used by post-16 students and this may result in areas at the top end of the area range. Further explanation of areas is given below. The relationship between activity and area is described in more detail in Section 2 where case-study examples are shown.

Resistant materials (zone J)

An area in the middle part of zone J would allow for a range of designing and making activities including CAD/CAM and some heat-treatment facilities. A space of this size would also allow for a clean design area for part of the group to work away from the practical area. It would not necessarily be reliant on a shared resource area but such a space is still desirable.

An area in the middle part of zone I would allow for limited CAD/CAM facilities but would not allow for a clean design area alongside a full range of making activities. However, it could be acceptable if design and CAD/CAM facilities were available in shared areas (see 'Learning resource areas', Section 2). Design work could take place on multi-benches.

An area in the upper part of zone J would allow for additional facilities, e.g. more heat-treatment equipment. This area may be more applicable for a space that is used for vocational engineering courses. Such an area may also be needed in a school with only one resistant-materials space and no separate design-resource area.

Food technology (zone I)

An area in the middle part of zone I would accommodate a range of designing and making activities in domestic and commercial contexts. It allows for a cooker-to-pupil ratio of 1:2. It doesn't allow for a dedicated ICT resource area (see 'Food Technology', Section 2) away from the main practical area, so that easy access to a shared ICT design area would be needed.

An area in the middle part of zone H would also provide for a range of activities but with fewer cookers (a ratio of 1:2.5).

Neither of these areas would allow for a dedicated resource area where pupils could use computers or taste food away from the main practical area. If such an area were provided, it would need to be in the top part of zone J, for one cooker between two students, or the top part of zone I for fewer cookers.

These areas assume a peninsular arrangement of benching similar to that shown in Figure 2.16. If benching and equipment is arranged around the perimeter only, the area may need to be bigger if the same range of facilities are to be accommodated.

Electronics and control systems (zone H)

An area in the middle of zone H would allow for a range of designing and making activities, including circuit assembly, CAD/CAM and construction. There would be sufficient free floor space for construction work with materials, robotics testing, etc.

An area in the middle of zone G would allow for a good range of activities but not for a practical area: it would be suitable where adjacent resistant-materials spaces could be used for practical activities when necessary.

An area in the middle part of zone I would accommodate more equipment for making (including CAD/CAM machines), and might be appropriate in a multi-functional space such as that shown in Electronics and control systems case study 4.

Textiles (zone H)

An area in the lower part of zone H would allow for a range of designing and making activities including ICT and CAD/CAM. It would allow for sewing machines to be used either along a perimeter bench or on central design tables (if services are available). Sufficient free floor space would remain for loose equipment such as an ironing board or tailor's dummy.

An area in the upper part of zone G would allow for a range of activities, but a reduced level of equipment and reduced opportunities for fabric printing.

An area in the middle part of zone H would allow a wider range of equipment, e.g. CAD/CAM. Such an area would increase flexibility in the layout, allowing sewing machines to be used on tables at right angles to the perimeter benching, for example.

Graphic products (zone H)

An area in the lower part of zone H would provide for a good range of designing and making activities, with a desktop computer ratio of 1:2.5 (including the use of CAD/CAM equipment).

An area in the middle of zone G would be suitable if there were fewer making facilities.

An area in the middle of zone H would allow for more desktop computers (at a ratio of 1:2). A space of this size is seen less often.

Storage space

It is very important to provide enough storage space to support the teaching areas. Figure 1.6 gives a guide to the area that each specialist facility may require for the storage of materials, equipment and student work. These figures are supplementary to the suggested teaching areas in Figure 1.5.

Type of space	Storage area per work-place [6]
Textiles technology	0.4–0.5m^2
Graphic products	0.35–0.45m^2
Electronics and control systems	0.5–0.6m^2
Food technology	0.5–0.6m^2 (excluding preparation)
Resistant materials	0.6–0.8m^2 (excluding preparation)

FIGURE 1.6

Recommended storage areas per work-place for various types of timetabled space

Note

6. The number of work-places in a space should equal the maximum number of pupils likely to use the space.

Photo: Gill Greany

The areas are given per work-place because the number of pupils being taught affects the quantity of materials used and thus the storage area required. Factors that can affect storage-area requirements include:

- **Size of department:** small departments may need more area per work-place because a basic level of resources will still be required; a larger department may need less area per workplace due to the economy of scale
- **Range of activities:** a multi-purpose space may need access to a greater variety of materials
- **Nature of pupils' work:** the size of pupils' products and the extent to which work is kept in the school will also influence the area required. (It is important to consider both the school's policy and awarding bodies' requirements concerning pupils taking finished work home)
- **Additional uses:** any community use may require additional and separate storage

A preparation area for resistant materials should be a minimum of $30m^2$, whatever the department's size, to accommodate a work area with a typical range of machinery. Storage of materials, which is often combined with this, would need additional area as shown in Figure 1.6.

Key planning principles

Design and technology is a single subject involving a variety of activities which in turn require a range of specialist facilities. In a new building, therefore, design and technology spaces should be grouped together, so that pupils can access equipment and materials from different spaces as their work dictates, thus making optimal use of a range of facilities and strengthening departmental identity. Ideally the design and technology suite should be on the ground floor with easy access for the delivery of materials.

The diagrammatic plan in Figure 1.7 illustrates some of the key points to consider when planning design and technology accommodation, whether new or using existing space:

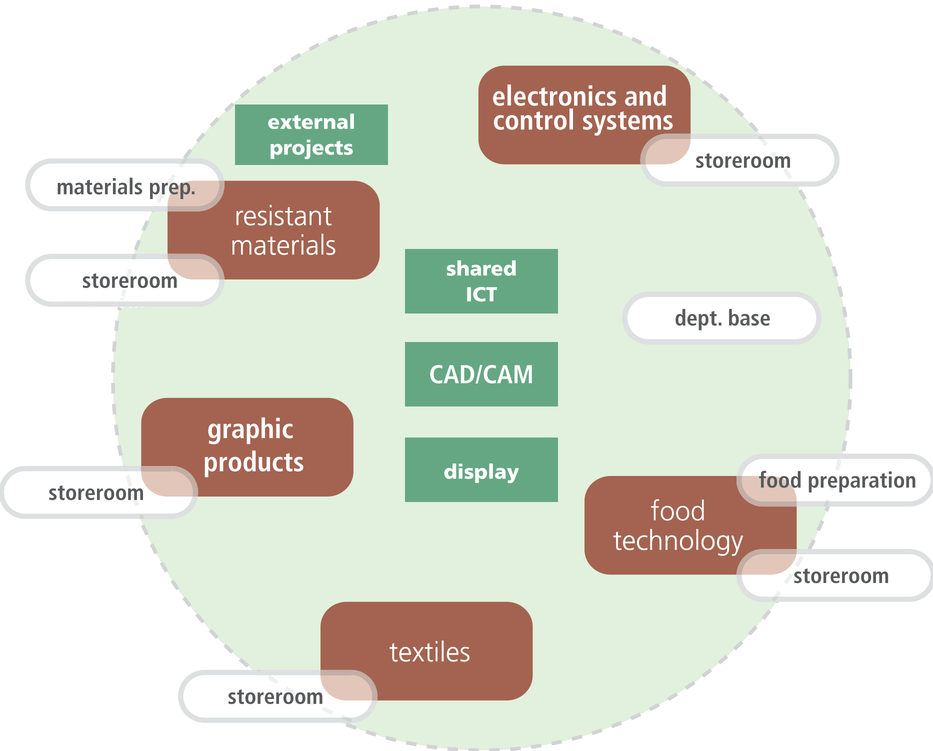


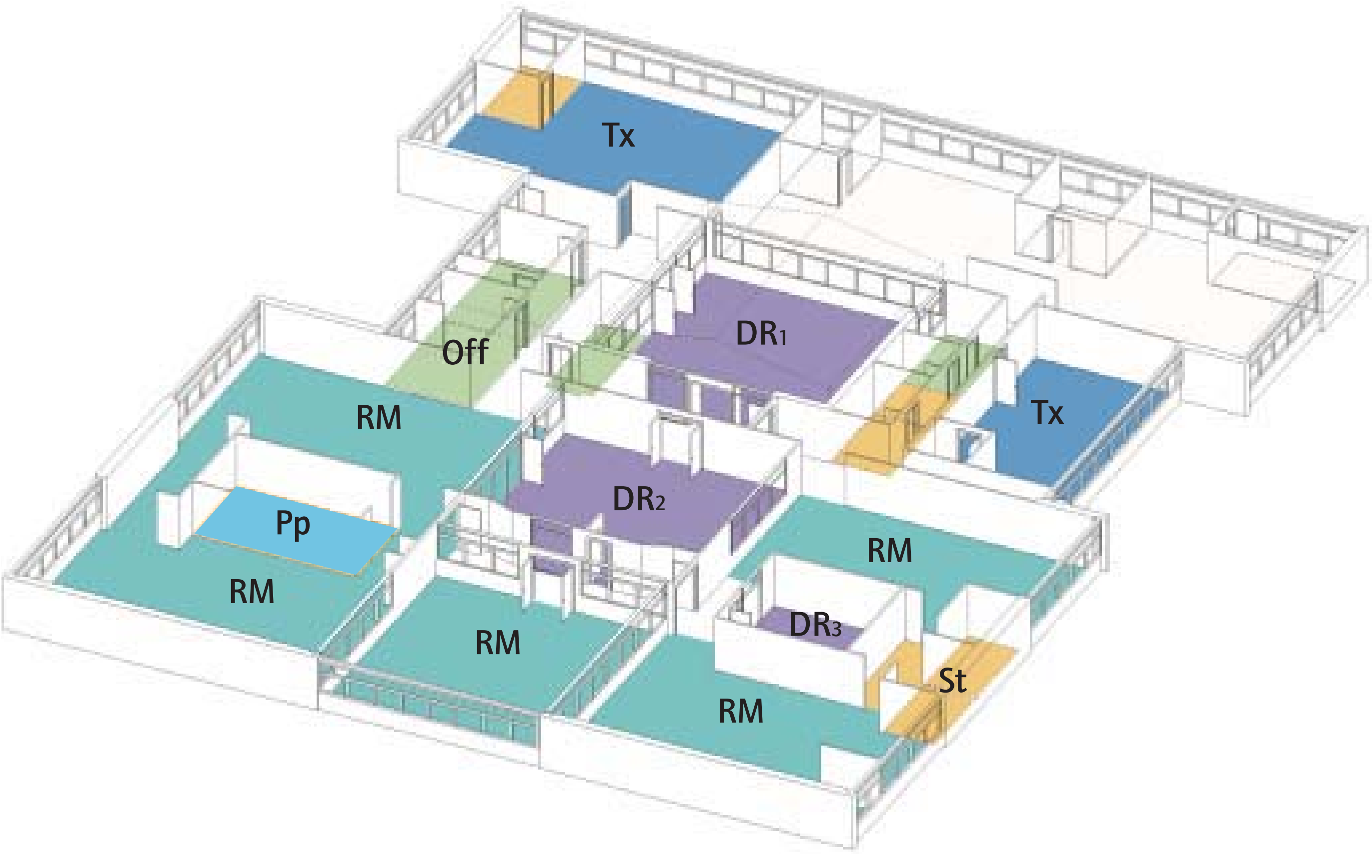
FIGURE 1.7
Diagrammatic plan of a design and technology suite

- Spaces for related activities are located closely together to enable pupils to move between them in order to make full use of available equipment.
- The materials-preparation room is positioned for the convenient delivery of materials from outside, and so that technicians have easy access to workshops.
- The food-preparation room is immediately adjacent to the food-technology spaces for the technician’s convenience and for reasons of hygiene.
- The shared ICT/design area is centrally located, easily accessible to all pupils and visible from surrounding spaces.
- The departmental base is centrally positioned next to the ICT/design area for ease of access and to enable partial supervision.
- Related departments such as science or art and design are nearby, maximising opportunities for sharing equipment.
- The shared CAD/CAM facility is located for easy access by all pupils and staff in the suite. It could be part of the central resources area or in a separate room.

Planning Case Study 1

Figure 1.8 shows an example of a suite of design and technology spaces in a large 11–18 secondary school with 1,650 pupils. This is a large department with nine spaces, seven of which are grouped together in a suite around two shared untimetabled areas. A small, centrally located CAD/CAM room has network links with the whole department and also with local primary schools, allowing younger pupils to have their designs manufactured by the department (this room is described in Section 2). Food technology rooms are close by. Key points about the arrangement are as follows:

- There are five resistant-materials spaces, each with a different emphasis: engineering (the school teaches a vocational engineering course); multi-materials with electronics; two multi-materials; woodworking.
- The resistant-materials engineering room is equipped with heat-treatment equipment and mainly metalworking machines (pupils use the central design area for sketching etc.).
- The resistant-materials room with woodworking machines is also used for adult evening classes.
- The central ICT resource area is bookable by staff for whole-class sessions as well as being available to all students outside booked time. It is a key area for sixth-form students (see detailed description in Section 2).
- The second shared area is a multi-purpose space used for whole-class briefing sessions, individual design work and special projects (sometimes involving visiting teachers). Loose tables can be moved aside to provide a clear space and the high ceiling makes this an ideal space for large-scale projects (see detailed description in Section 2).
- The CAD/CAM room can be reached by all pupils and is used by post-16 students out of lesson time. In this location pupils are not disturbed by the noise of machines. A CAD/CAM technician is based here, monitoring the machines at work.
- Extensive glazing provides views between teaching areas.
- The departmental staff base is central to the suite.
- The materials-preparation room accommodates three technicians.



Key

DR_1	**: multi-purpose resource**
DR_2	**: ICT resource**
DR_3	**: CAD/CAM resource**

FIGURE 1.8

Planning case study 1

Planning Case Study 2

Figure 1.9 shows part of a design and technology department in a 900-place 11–16 school. The department has six timetabled spaces, five of them in a suite. A recent refurbishment of the food and textiles areas has created a group of three timetabled spaces sharing an ICT resource area. Ideally the school would like a large resource space in the courtyard shared between the whole department with enough computers for a whole class to have 1:1 access. Key points to note about the food and textiles suite are as follows (the food-room layout is described in detail in Section 2):

- All three refurbished spaces open onto the central area.
- The central area, providing ICT facilities and display, is used informally by all three spaces both during and between lessons.
- The central area can be booked for whole-group presentations or discussion, and the electronic whiteboard is particularly useful for this.
- In the central area there is a combination of computers (one between two pupils), loose tables and resources such as books and journals for research and design activities.
- The staff office is easily reached, and internal glazing allows informal supervision of the adjacent food room and central area. The ICT area is used for staff meetings.
- Storerooms next to food-technology rooms allow easy access from both main and shared areas.
- Alternative entrances to food-technology rooms avoid cross-circulation through the shared area.

Photo: Briony King

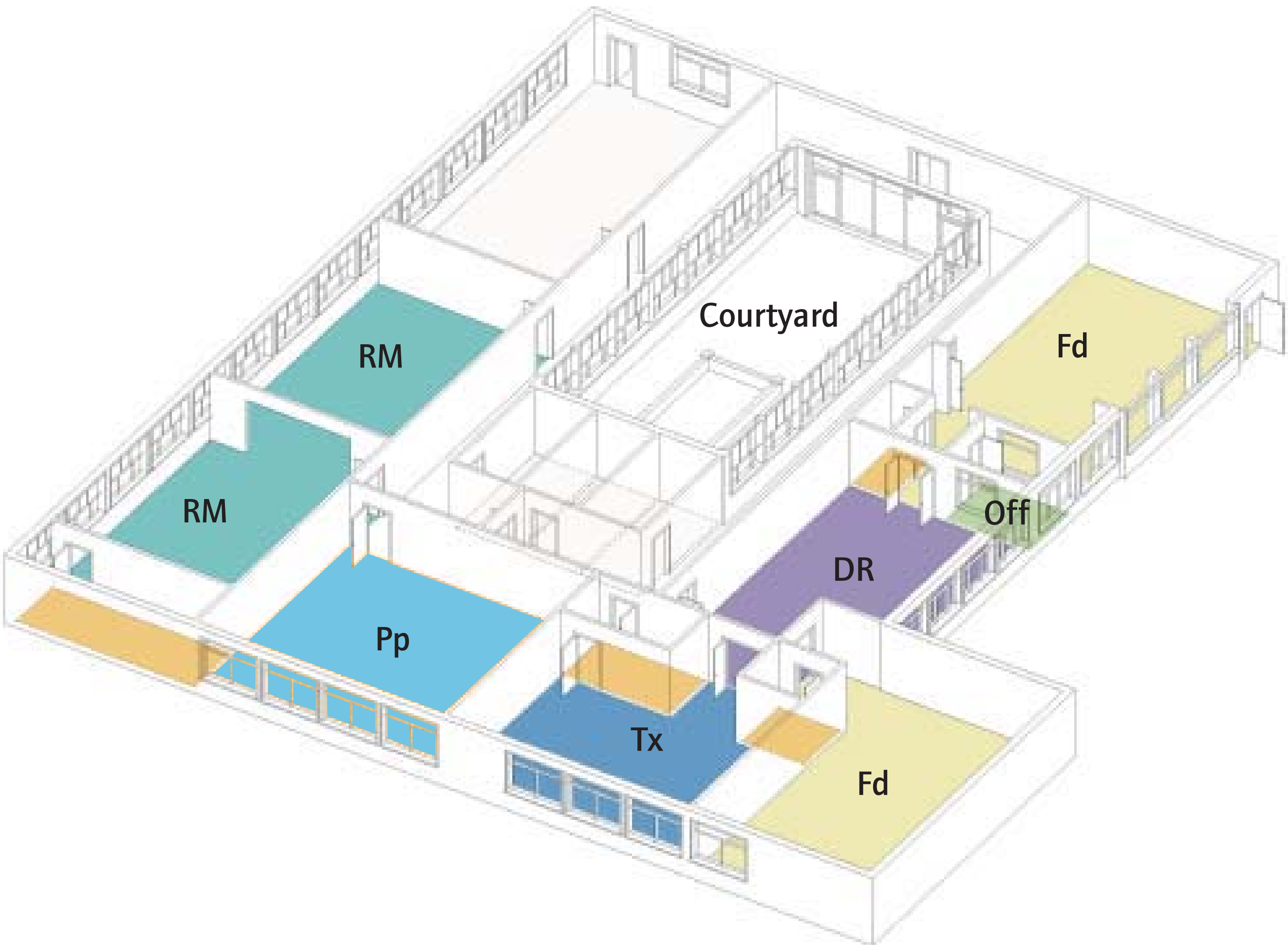


FIGURE 1.9

Planning case study 2

Planning Case Study 3

Figure 1.10 shows part of a design and technology suite in a new 11–16 school for 1,000 pupils. The unusual layout of this department requires a certain teaching strategy, as well as staff who cooperate effectively and can work with the visual and audio links between spaces. It is also essential that the central area is properly supervised by teaching staff.

There are seven design and technology spaces in total. Four of these are grouped together in a suite:

- Textiles technology
- Graphic products/general design
- Electronics and control systems
- Resistant materials

Two food-technology rooms and a second textiles-technology space are located elsewhere. Two non-timetabled ICT ‘pods’ (one in the suite and one shared between the two food-technology rooms) support the department. The resistant-materials space is untimetabled but bookable and acts as a resource for the surrounding spaces. Key points to note about this arrangement are:

- The central resistant-materials area is manned by a full-time technician for health and safety reasons. Teachers in surrounding spaces also have good views of the area.

- Sliding folding partitions allow the three spaces adjoining the resistant-materials space to be enclosed for whole-class discussion or presentation and opened up for independent working.

- It can be difficult to achieve an acceptable acoustic environment in such an open-plan suite, but staff have generally not experienced problems.

- Ideally there would be more storage space.

- There is a special-needs unit on the school site. Adjustable furniture allows pupils based at the unit to share many of the specialist facilities.

- Because the systems and control area is an internal space, daylight levels are inadequate.

- Extensive use of internal glazing creates a sense of openness but limits opportunities for display.

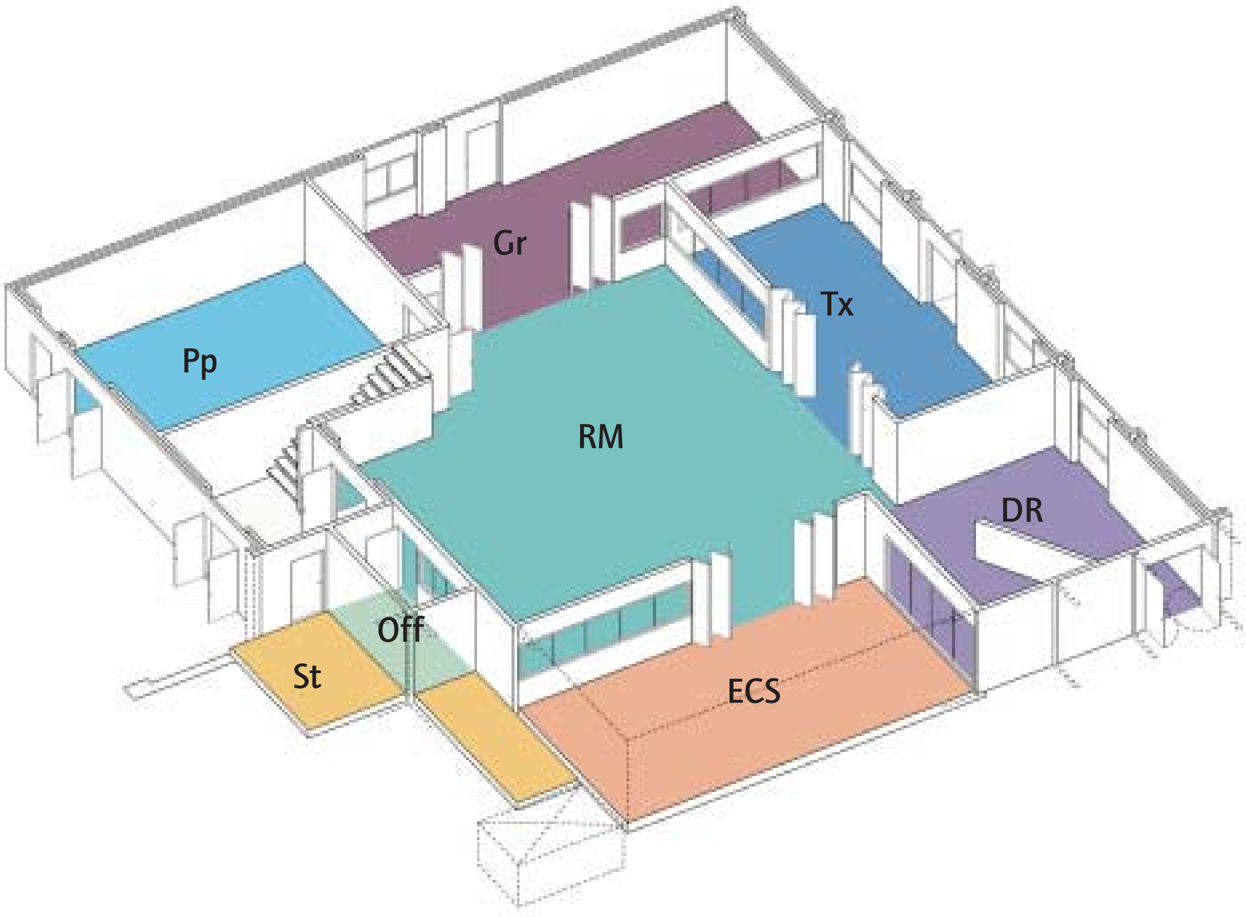


FIGURE 1.10
Planning case study 3

2

This section describes in detail the various types of timetabled and untimetabled design and technology learning space. Diagrammatic plans provide guidance on the planning of individual spaces, and case studies show different ways in which the facilities outlined can be translated into spaces. More detail on the furniture and equipment described here can be found in Section 4.

Learning spaces

Timetabled spaces

General considerations

A timetabled design and technology space should be flexible enough to accommodate specialist making activities alongside designing and evaluating activities. The furniture and equipment layout should enable pupils who are at different stages of a project to pursue various activities.

Furniture and equipment (F&E) layouts can be used to test the suitability of a building design proposal and to prepare budget costs. It is worthwhile preparing layouts for every teaching space early on in the design process. This section shows room layouts in two ways:

- Diagrammatic layouts showing the key principles of organising a space for a particular specialist area

- Case studies with detailed furniture and equipment layouts taken from real schools, and chosen to illustrate a range of approaches

For simplicity, both types of layout are shown grouped under a main specialist area of activity (e.g. electronics and control systems), but in reality there will be many overlaps between these specialist areas. As such it is important that room layouts are derived from the activities taking place in the individual school concerned (see 'Activities and facilities' in Section 1).

The diagrammatic layouts are based on the planning strategy outlined below and illustrated in Figure 2.1 with adjustments made to suit specialist activities (the zones of colour indicate types of furniture and equipment – serviced, loose, etc.). The strategy is intended to yield a space with the flexibility to accommodate a broad range of activities in safety and comfort, and its main principles are as follows:

- The centre of the space is free of fixed furniture and equipment, allowing loose furniture to be rearranged to suit activities.

- Fixed work surfaces are kept to a minimum and located mainly around the perimeter, with limited peninsular benching where appropriate. This maximises the area available for rearrangement.

- There are movable serviced tables at the perimeter where appropriate (to house, for example, CAD/CAM equipment).
- A focus area for whole-group discussion and presentation with sufficient area for pupils to gather (some sitting, others standing) is positioned close to the room's entrance and away from fixed furniture and machines to give flexibility. The area includes an interactive whiteboard at 90° to the window wall, minimising reflection and glare.
- There is a local resource zone close to the teaching focus, comprising a serviced work surface with storage below and display above, and space for a teacher's table or resources trolley.
- There is sufficient distance around tables, benches and machines to allow for safe circulation and use of furniture and equipment (see Sections 4 and 5).
- A storage facility for pupils' coats and bags (see 'Coat and bag storage' in Section 4) is located next to the room entrance and close to the teaching focus, enabling pupils to deposit coats and bags as they enter the room. It is essential in practical areas that coats and bags brought to a lesson do not cause an obstruction.
- There is direct access to storerooms. Avoiding full-height storage furniture in the main space maximises working area. Mobile units for local storage under benching make most effective use of the space.
- A free-standing, adjustable-height table is provided with sufficient space around it to allow wheelchair access.

The preceding principles are assumed throughout the examples and case studies which follow.

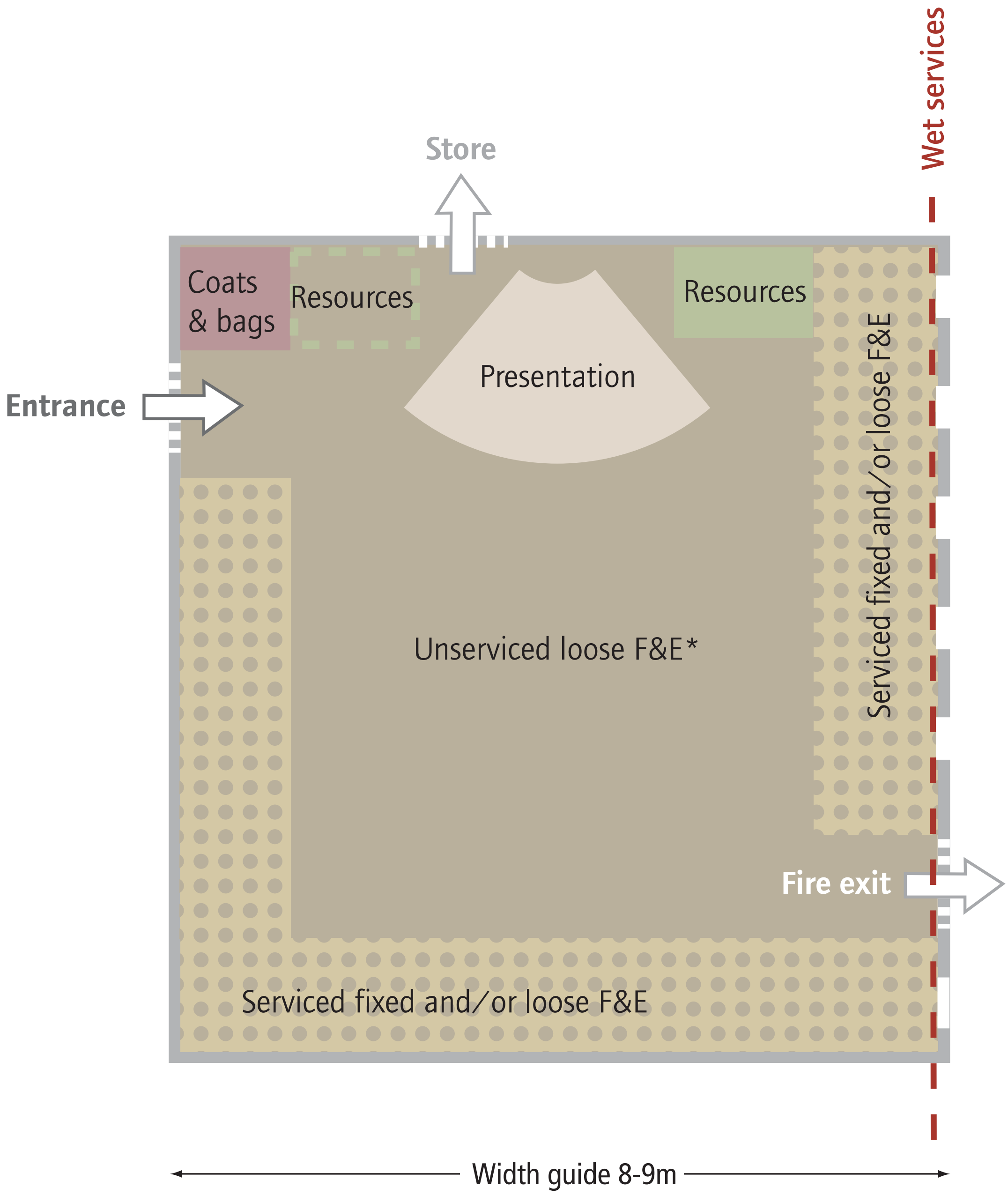


FIGURE 2.1

Generic layout

* May be serviced by flexible service outlets in floor or ceiling

Photo: David Prest

In any design and technology space, there should be a generous amount of wall-mounted display space (two- and three-dimensional). However, the need for such display space has to be balanced with the desire to provide glazing giving views into adjacent spaces.

Figure 2.1 and the other diagrammatic plans in this section are based on the following servicing strategy:

- Fixed services are located primarily along perimeter walls, to service perimeter benching and tables. In some cases services are assumed to run into peninsular benching.
- There is a primary run of wet services along the external wall to allow for straightforward relocation of partitions in the future.
- There is servicing from above to a ceiling-mounted data projector.

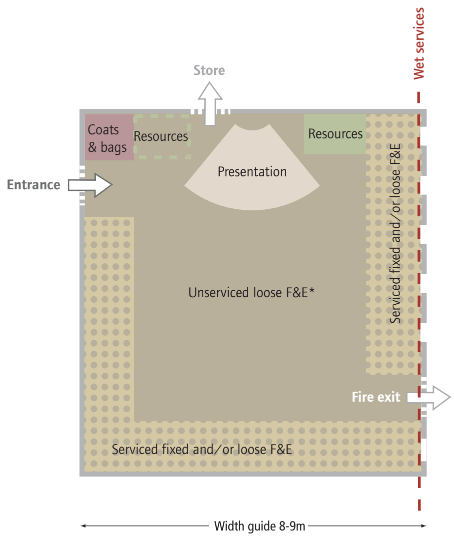


FIGURE 2.1

Generic Layout

* May be serviced by flexible service outlets in floor or ceiling

If equipment (such as a sewing machine) is to be used in the centre of the space, it is important to avoid trailing leads. Providing additional servicing in the centre of the room avoids this and allows a wide range of portable equipment to be used at central tables (see Section 6 for ways of arranging servicing). However, central servicing must be appropriate to school use and should not reduce the flexibility of the furniture layout. Battery power is valuable for some equipment (e.g. laptop computers).

The shape of a space will affect the layout. A regular shape without indentations is generally easier to organise and more adaptable in the longer term. A narrow room can be difficult to plan, particularly where large items of equipment and furniture are involved. A width of 8–9 metres is recommended. A proportion of between 1:1 and 1:1.4 will generally allow for a variety of furniture and equipment arrangements. However, a 1:1 proportion is normally only suitable for smaller spaces because large square rooms are too deep, resulting in an unusable central area.

The modern classroom layout should be capable of constant change. To ensure a dynamic lesson, teachers should be able to teach in a variety of ways, using a variety of methods and from a number of different positions. All walls could be classed as teaching walls, offering the opportunity for inspiration and information. Each wall surface could have the potential for projecting images throughout a lesson as an inspirational backdrop. This could influence the colour and finish of the walls and the storage and display systems used. Some schools may prefer a mobile interactive whiteboard for flexibility.

The diagrammatic plans of specialist spaces which follow are all based on the planning and servicing strategies outlined above. The same colour-coding is used, showing how the specialist-space diagrams are derived from the planning strategy. More detail of the perimeter-servicing strategy that relates to each specialist area is given, with an indication of the effect of providing central servicing in addition. Alongside the diagrammatic plans are equipment lists, assumed for the purposes of the layout. These are illustrative only and a school's equipment schedules must be referred to in a real project.

This room is described on p.51

Resistant materials

Figure 2.2 shows how the planning and servicing strategy described above can be applied to a resistant-materials room equipped for a broad range of designing and making activities. The layout is based on the two illustrative equipment lists alongside, one of which has a bias towards product design and the other towards engineering, with heat-treatment equipment. This is a fairly self-contained space with integral CAD/CAM facilities and a design area. It doesn't assume an additional resource area although such a space shared with other areas could provide additional ICT facilities and the opportunity for a whole class to do research activities at the same time (see 'Central resource area' below). The plan follows the general principles of Figure 2.1, and the table below explains the layout.

Key to resistant materials generic layout

Layout incorporates...	which will allow for...	Points to note
pedestal machines along the external wall (a)	good lighting and a single sight-line for ease of supervision	allow safe distances around machines working area separate from circulation space
heat treatment equipment (engineering)	experiencing heat treatment processes	provide appropriate finishes position against wall with safe distances around equipment LEV needed
loose multi-benches (b)	the use of hand and battery-powered tools designing on paper or with battery powered ICT	allow adequate space between benches some designs of multi-bench allow pupils to sit comfortably at them
loose design tables at a ratio of 1:5 (c)	pupils to work in 'clean' zone away from multi-benches	pupils can also design at multi-benches
bench-mounted machines, to supplement their larger pedestal counterparts (d)	3D designing and making with a wide range of materials	consider distances around side benching a full range of pedestal machines would be space consuming adjustable benching can allow use by disabled pupils
small CAD/CAM equipment on relocatable serviced tables away from design/presentation area (e)	3D designing and making creation of production runs	mobile tables allow machines to be shared consider means of minimising noise LEV needed
protective aprons storage near to coats and bags storage		locate near to coats and bags storage

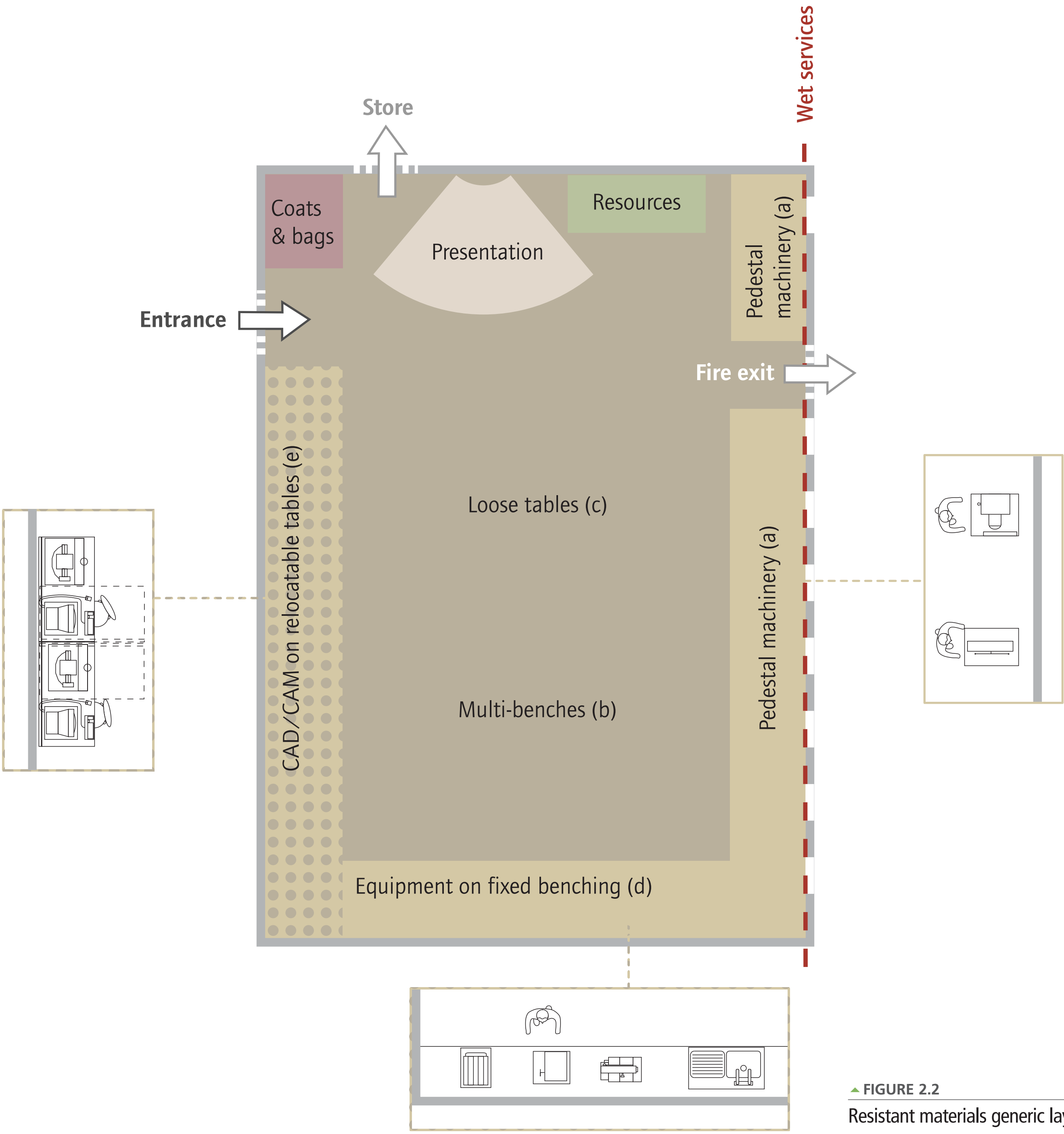


FIGURE 2.2

Resistant materials generic layout

Resistant materials (Product)	
1 bandsaw	1 hot wire cutter
1 linisher	1 strip heater
2 drills	1 vibrasaw
1 wood lathe	1 SS sink
1 polisher	4 CAD/CAM engravers
1 CNC router	6 desktop PCs
1 vacuum former	1 electronic whiteboard
1 jigsaw	
1 oven	
1 dip–coating machine	

Resistant materials (Engineering)	
1 crucible furnace	1 bench–mounted vacuum former
1 moulding bench	1 bench drill
1 brazing hearth	1 bench–mounted jigsaw
1 metal lathe	1 plastics trolley
1 linisher	1 SS sink
2 drills	3 desktop PCs
1 polisher	1 electronic whiteboard
1 large CNC mill	
1 large CNC lathe	
1 bench–mounted bandsaw	

For more information… ▸ Safe distances around furniture: Section 4 ▸ Safe distances around machines: Section 5 ▸ Ventilation and acoustics: Section 6

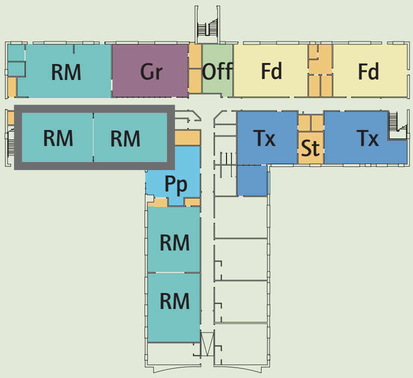


FIGURE 2.3
Resistant materials case study 1 key plan

Key data

Age range	: 11–18
NOR	: 1350
Max. group size	: 22
D&T dept.	: 10 spaces
Room areas	: $111m^2$+$102m^2$
Storage areas	: $13m^2$+$3.5m^2$

Resistant materials Case Study 1
Linked CAD/CAM and 'traditional' spaces

The pair of resistant-materials spaces shown here is divided by sliding folding doors, allowing the spaces to be used independently or together with free movement between the two. One space is equipped with 'traditional' machines and the other with CAD/CAM equipment. This pair of spaces is one of two in a large new design and technology department which is part of a major redevelopment in a large school. The department, which is particularly well equipped with CAD/CAM machines, comprises: one resistant materials space with engineering bias, two traditional resistant-materials spaces and two resistant-materials spaces (CAD/CAM) (these four resistant-materials spaces form two linked pairs), two food spaces, two textiles spaces and one graphic-products space (see key plan).

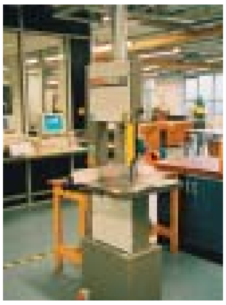
The 'traditional' resistant materials room is 111 m^2, which for 22 pupils is in the upper part of Zone I on the graph in Figure 1.4. This area allows for a good range of activities to take place, including general design activities, with adequate circulation space to ensure a safe working environment. A space of this size would be likely to suit a range of courses including vocational ones, but this would need to be tested by doing room layouts for the relevant furniture and equipment specification. In a department where all design activity takes place in an adjacent shared resource area the space could be smaller.

General points to note about the spaces are given here (captions on the plans provide more detail):

- Two-person workbenches provide a vice position for half a class at any one time. If four-person multi-benches were used there would be a vice for each pupil.
- Design tables in the 'traditional' space are used for individual sketching or writing and for group presentation and discussion. When a whole class is sketching or writing pupils use either drawing boards on workbenches or facilities in nearby rooms.
- Stores are immediately accessible from each space. An additional store is to be provided for GCSE project work.
- The range of floor-standing machines gives students experience of working in wood, metal and plastics.
- Adjustable chairs in the CAD/CAM area ensure comfortable working conditions when using computers.

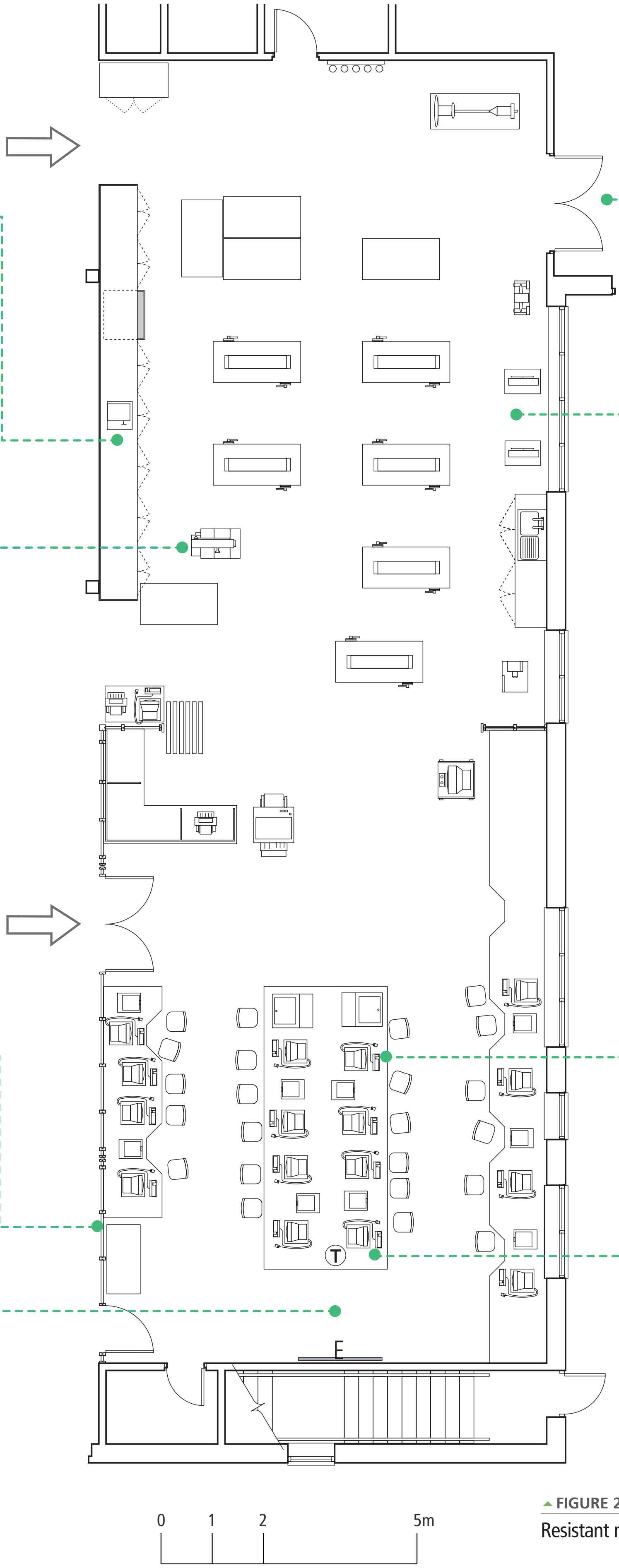
Bench-mounted machines supplement floor-mounted machines.

A bandsaw in this position has to be well supervised with good extraction.



Glazing in partitions provides views to adjacent spaces.

Free space allows pupils to gather for discussion.



Access to the adjacent preparation room is useful for staff.

Machines are arranged in a line for ease of supervision.

There are sufficient CAM machines for one between two pupils; adjacent computers (one per pupil) can be used for researching and designing as well as programming machines.

The teacher's computer is close to the interactive whiteboard.

FIGURE 2.4

Resistant materials case study 1 layout

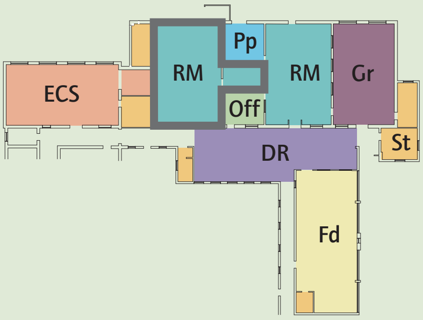


FIGURE 2.5
Resistant materials case study 2 key plan

Resistant materials Case Study 2

A multi-functional space with access to a resource area

This resistant-materials room is one of five (two resistant materials, one electronics and control systems, one graphics and one food) which have recently been adapted to form a suite sharing a central ICT resource area (see key plan). Glazing provides views from this space into the central area and adjacent staff base.

This area is in the middle part of zone H in Figure 1.4. It allows for a range of activities including general design work and making with metal, wood and plastics. However, the circulation space around machines and workbenches is less than ideal. An area in zone I would allow for more movement space and more CAD/CAM equipment. Pupils benefit from having the resource area adjacent which can house PCs and CAD/CAM equipment.

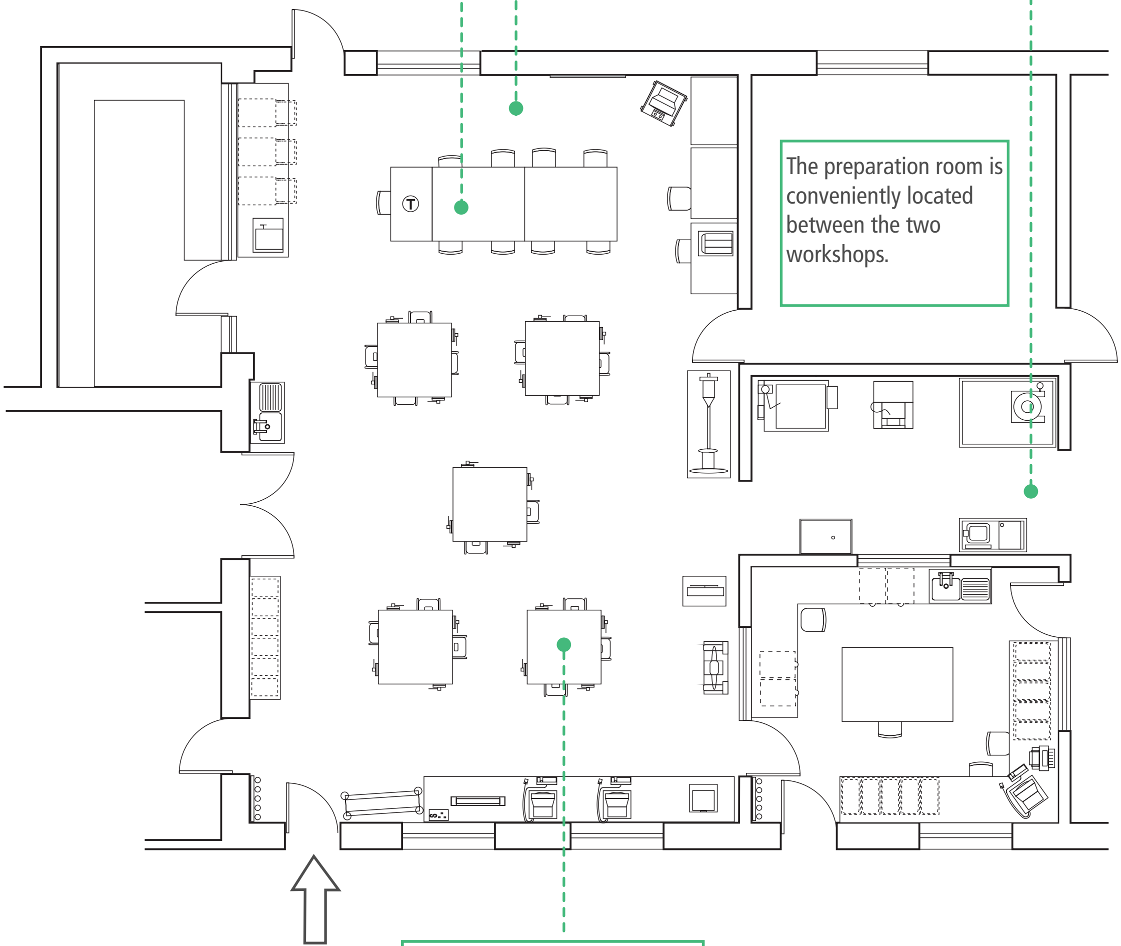
Key data

Age range	: 11–18
NOR	: 1150
Max. group size	: 22
D&T dept.	: 5 spaces
Room area	: 95m^2
Storage area	: 22m^2

Tables allow pupils easy access to a clean surface for design and research activities.

Pupils also gather here close to the whiteboard for discussion and presentation, moving the furniture when necessary.

The heat-treatment area is accessible from both resistant-material spaces. Activities can be supervised from the adjacent staff base.



Five multi-benches allow 20 pupils to use vices at the same time.

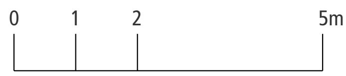


FIGURE 2.6

Resistant materials case study 2 layout

Electronics and control systems

Figure 2.7 reflects a dedicated area for working with electronics and control systems which includes facilities for small-scale making associated with these activities. The table below explains the layout.

Key to electronics and control systems generic layout

Layout incorporates...	which will allow for...	Points to note
loose design tables at a ratio of 1:5 (a)	designing, planning, research and evaluation	tables should be light enough to move around but sturdy enough for heavy use
multi-bench in the central area (b)	the use of hand and battery-powered tools	allow adequate space around bench
free floor space	testing buggies and robots (move loose tables aside)	required more in control than other spaces
small bench-mounted machines and equipment (c)	small-scale making circuit-board assembly	consider distances around side benching
relocatable tables for the whole class, with a range of dry services such as LV, compressed air and data (d)	researching, designing and report writing using ICT small-scale making and assembly the table layout to be changed if required	furniture can carry services laptops take up less area
small scale CAD/CAM equipment on relocatable serviced tables away from presentation area to lessen disturbance (e)	designing and making creation of CAD/CAM production runs	consider means of minimising noise LEV needed

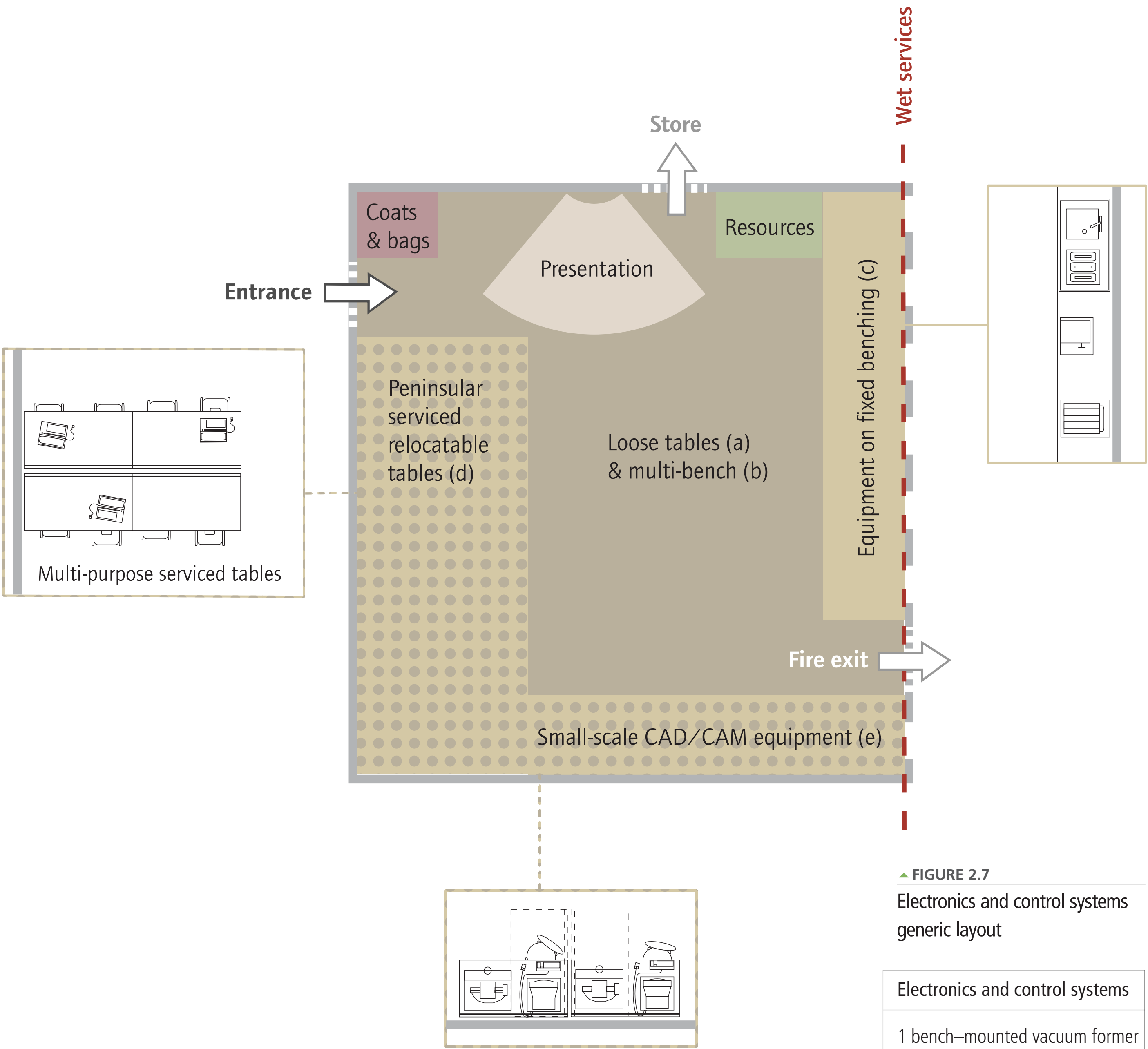


FIGURE 2.7
Electronics and control systems generic layout

Electronics and control systems
1 bench–mounted vacuum former 1 bench–mounted sander 1 bench–mounted drill 1 bench–mounted jigsaw 1 acid etching tank unit 1 belfast sink 1 desktop CNC milling machine 1 CAD/CAM plotter and cutter 1 CAD/CAM engraver 3 desktop PCs 1 laptop trolley 1 electronic whiteboard

For more information… ▸ Furniture design: Section 4 ▸ Safe distances around furniture: Section 4
▸ Ventilation and acoustics: Section 6

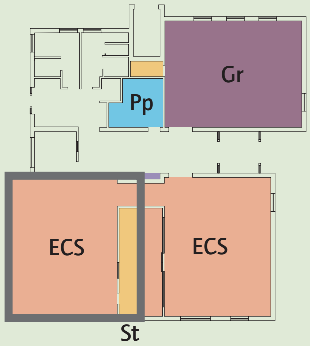


FIGURE 2.8
Electronics and control systems case study 1 key plan

Key data

Age range	**: 11–16**
NOR	**: 750**
Max. group size	**: 21**
D&T dept.	**: 5.5 spaces**
Room area	**: 88m²**
Storage area	**: 13m²**

Electronics and control systems Case Study 1

A space with an electronics emphasis

This space, specially equipped for electronics, is one of five spaces in the design and technology department. Other spaces are dedicated to resistant materials, food, graphic products, control technology and textiles (the last space is shared with art). This department has a particular interest in electronics and control technology and, unusually, has one space for each specialism (the control space is described in case study 2 below). This case-study school also appears in Section 7 (Cost).

The space is furnished and equipped to accommodate a range of practical and other activities. Teachers and the design team worked closely together on the room layout. In a typical lesson pupils have an introductory session, then divide into three groups using the three zones in the room – ICT, serviced benching (e.g. for circuit testing) and a making area. The computer: pupil ratio is 1:3 (or 1:1 when working in three activity groups). Coats and bags are stored elsewhere in the department. The adjacent walk-in store is long and narrow, a shape that can become congested if not well organised though in this example it is used very effectively. Local storage includes tray units under the teacher's table.

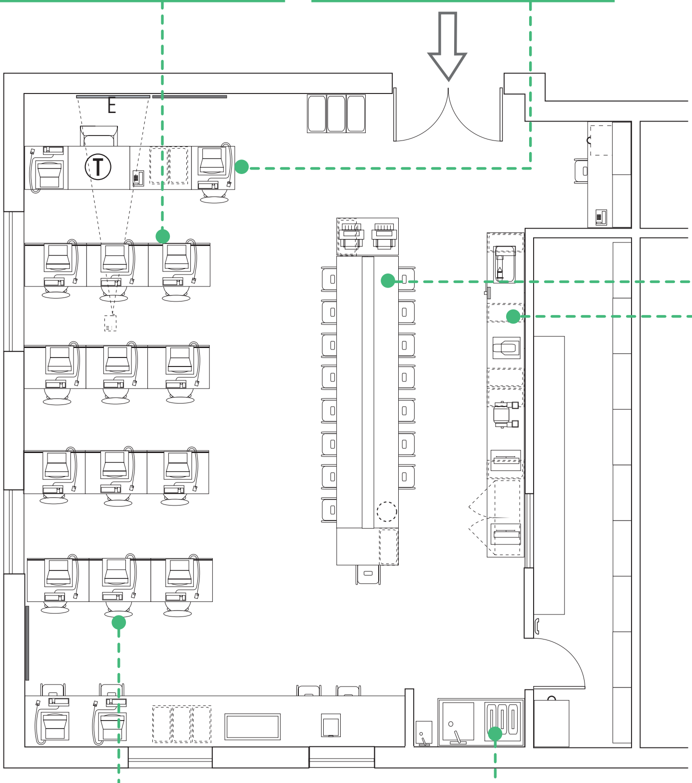
The area (excluding the storeroom) is in the lower part of zone H on the graph in Figure 1.4, and allows a wide range of activities to take place. The working space around the computer area is a little congested but this could be alleviated in the future by replacing desktop computers with laptops. An area in the middle part of zone H would be needed (assuming laptops) if coats and bags were brought into the room, or if CAD/CAM facilities were included, or if a multi-bench were provided. A space with all these facilities which retained desktop computers would need a bigger area, in the upper part of zone H.

The layout of this space varies from the generic plan on page 49 in that it does not feature multi-functional tables for writing, sketching, computer work (with laptops) and electronic or pneumatic work.

The whole class sits here for presentation or discussion sessions. Adjustable chairs allow pupils to sit comfortably and alter their seated position to suit their needs.

The school has found that a bigger gathering space at the front of the room for discussion and evaluation would have been useful: viewing the whiteboard from rows of computer tables is less than ideal.

Serviced benching allows at least one of the three activity groups to do practical electronic work, including soldering. (A fixed bench may reduce the flexibility of a space.)



Bench-mounted machines for making small products (wall cupboards above are useful for storage and display).

Loose computer tables allow rearrangement in the future, and putting CPUs below the tables increases the available table space.

An etching tank with extraction fitted above is provided for producing circuit boards.

FIGURE 2.9

Electronics and control systems case study 1 layout

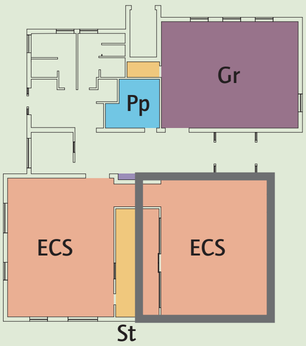


FIGURE2.10
Electronics and control systems case study 2 key plan

Key data	
Age range	: 11–16
NOR	: 750
Max. group size	: 21
D&T dept.	: 5.5 spaces
Room area	: 88m^2
Storage area	: 2.5m^2

Electronics and control systems Case Study 2

A space with an emphasis on control and CAD/CAM

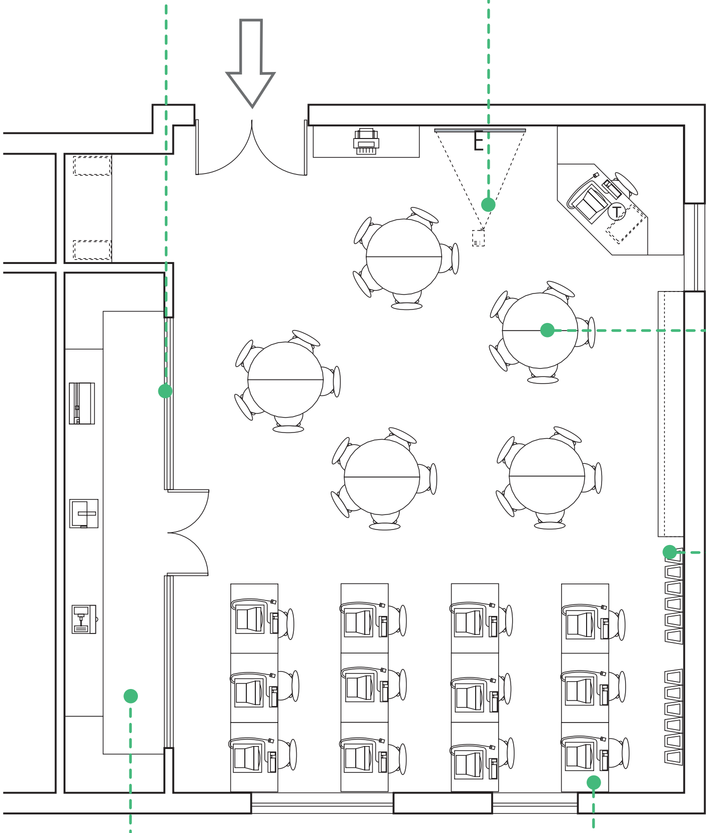
This space, specially equipped for control technology, is in the same school as case study 1. The space has two zones: a flexible discussion/presentation area and a computer area. The discussion area can be cleared, and the wide corridor outside the room can also be used, when pupils are doing robotics experiments or using large construction kits. CAD/CAM machines are housed in an adjacent bay, and pupils also use manual machines in adjacent spaces when necessary. The school would ideally like to have a second door from the corridor into the CAD/CAM bay so that the technician and other pupils could enter without passing through the main space. A storeroom adjacent to the space would be a beneficial addition to the local room storage; coats and bags are kept outside the learning space.

The area (excluding the CAD/CAM bay), is in the lower part of zone H on the graph in Figure 1.4. It already allows pupils to work in a comfortable flexible environment, but if laptops replaced desktop computers there would be more space for writing and sketching. An area in the middle of zone H would be needed if coats and bags were brought into the room, making facilities were included and some CAD/CAM equipment were provided in the main space.

Glazed screen provides some sound insulation while allowing pupils to see machines in action.

A video camera allows teachers to project a magnified image of very small items on to the electronic whiteboard.

Loose tables can be rearranged to suit activities.



Shelves with trays and component bins for small items.

A wider CAD/CAM bay would improve working space around machines.

Twelve desktop computers with adjustable chairs are used for designing and researching.

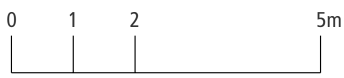


FIGURE 2.11

Electronics and control systems case study 2 layout

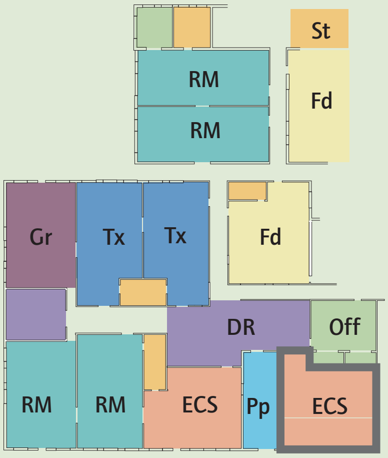


FIGURE 2.12
Electronics and control systems case study 3 key plan

Key data

Age range	: 11–18
NOR	: 1500
Max. group size	: 22
D&T dept.	: 11 spaces
Room area	: $95m^2$
Storage area	: $0m^2$

Electronics and control systems Case Study 3

An electronics space with a CAD/CAM emphasis

This electronics and control systems suite is in a school which specialises in technology and has strong links with local industry. The department provides eleven spaces: four resistant materials, two textiles, one graphic products, one resistant materials with electronics, one electronics and control systems and two food. Eight of the rooms are grouped together in a suite and share a central ICT-resource area (see Figure 2.35).

This space, which was designed to simulate industry, is divided into two by a three-quarter-height glazed screen. On one side is a whole-group teaching space with serviced tables, eleven PCs and three plotters, allowing it to be used for both design and practical work. On the other side is a bay housing CAM machines.

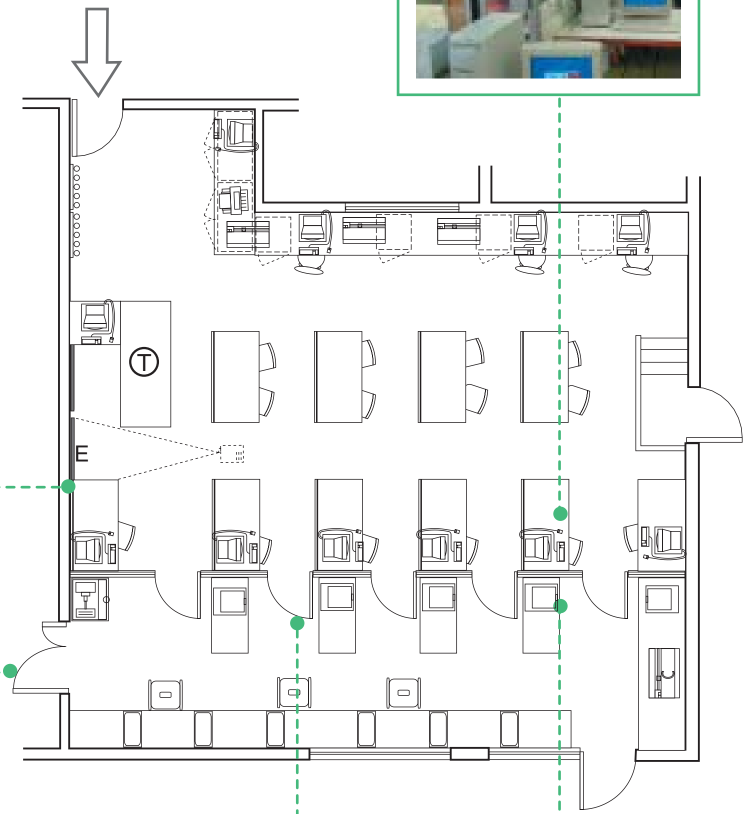
The room is considered very successful by staff and pupils, although a wider CAM bay and a full-height partition (to provide better acoustic separation) would improve the provision. There is a lack of storage space.

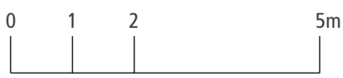
The area (including the CAM bay) is in the middle of zone H in the graph in Figure 1.4.

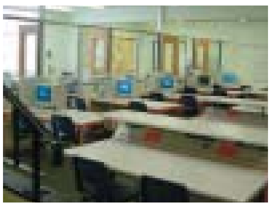
PCs used to control CAM machines on the other side of the screen.

An electronic whiteboard linked to the teacher's PC is invaluable for whole-class presentations.

A door from the prep room allows the technician to maintain machines (or check progress).







Doors positioned to allow pupils to reach their machines easily.

Seven machines (five engraving machines, one stencil cutter and a large CAM milling machine) which can be put on trolleys and taken to other spaces, increasing flexibility.

FIGURE 2.13

Electronics and control systems case study 3 layout

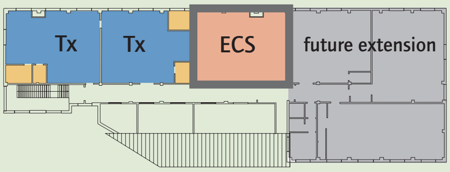


FIGURE 2.14
Electronics and control systems case study 4 key plan

Key data

Age range	: 11–18
NOR	: 1400
Max. group size	: 21
D&T dept.	: 9 spaces
Room area	: 98m^2
Storage area	: 7m^2

Electronics and control systems Case Study 4

A multi-purpose space with a high level of making

This electronics and control-systems space is one of nine in the department (three resistant materials, two electronics and control systems, one graphic products, two textiles and one food). The school is currently extending the main suite to bring all the design and technology spaces together and to add a further two spaces (a second food room and a second electronics and control-systems space). The extension is indicated by the grey area in the key plan. The textiles room in this school is discussed in textiles case study 1.

This space differs from the other electronics and control systems examples described because it provides more making facilities, which can be shared by pupils in the adjacent space.

The area is at the top of zone H. Working closely with their furniture supplier the school ensured that the room provided a multi-functional area for the design, construction and assembly of electrical, electronic, mechanical and pneumatic components. The area around machines and the clear floor space available for testing buggies, etc. could be increased if laptops are introduced in the future.

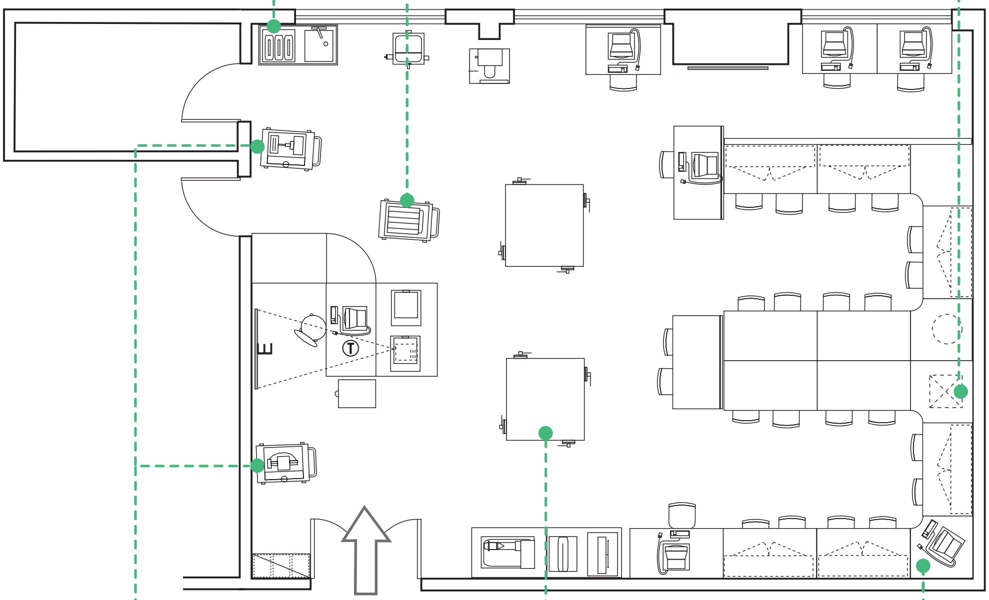
Key points of the layout are given below; further detail is shown on the plan:

- There are sufficient serviced bench positions to allow a whole group to assemble and experiment with PCBs, etc.
- Six PCs (there are plans to add more) allow some students to use software as part of the design-and-make process.
- Both small, manually operated machines and CAD/CAM are provided: a sander, saw, drill and lathe allow students a full range of making facilities and ensure that the room is totally multi-functional.
- Two whiteboard positions allow a number of activities to take place concurrently.
- There are enough clean flat surfaces for a whole group to do design work (drawing boards are also provided).
- Because some machines have less than the recommended distance around them, staff have to ensure that adjacent machines are not used at the same time.

A PCB station allows pupils to etch their own circuit boards.

A vacuum former is particularly useful for making plastic housings. As it is on a trolley it can be transferred to other rooms when necessary.

Extraction pumps which remove soldering fumes are fitted into benches.



Two CAD/CAM machines on trolleys allow students to make casings, moulds and mechanisms for products.

Two multi-benches are sufficient for work with hand tools, although not enough for a resistant-materials class.

Benches provide low-voltage supply and compressed air for pneumatics.

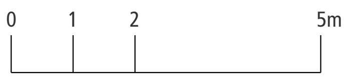


FIGURE 2.15

Electronics and control systems case study 4 layout

Food technology

The diagrammatic plan in Figure 2.16 represents an area accommodating a variety of food-related activities including food preparation in commercial and domestic contexts, food testing and consumer evaluation. This diagram is based on a partly peninsular arrangement, and other solutions are shown in the case studies. An ICT-resource bay where pupils work away from food-preparation areas is indicated by the dotted line (this would be suitable for a food space in an isolated location, where use cannot be made of a shared departmental resource area).

Key to food technology generic layout

Layout incorporates...	which will allow for...	Points to note
serviced fixed peninsular benching with domestic catering facilities (a)	food preparation one bay to double as a demonstration area	allow adequate space around food-preparation areas minimum fixed benching allows flexibility
loose commercial catering tables and relocatable commercial catering units with flexible servicing cables (b)	food preparation units to be moved for demonstration purposes or for simulating manufacturing runs	allow enough space for pupils to gather and for equipment to be positioned safely
loose tables, sufficient for the whole class (c)	additional practical work surface alongside peninsular benching researching, designing incl. using ICT layouts for whole-class discussion	tables must be movable, but sturdy enough for heavy use
fridges for ingredients near entrance and, if possible, the prep room (d)	quick access when pupils leave or pick up food the food technician to oversee food storage	two fridges allow separate storage for cooked and raw food
direct access to preparation room (e)	more readily available teacher and pupil support	room may double as a laundry area
an ICT-resource area (shown dotted) positioned near the entrance (f)	quiet food tasting with minimum distraction access by pupils not involved in the main lesson food testing and photography	tasting can be at general tables in main area as a whole class or group activity
coats and bags area away from the food preparation areas (g)	a more hygienic food preparation space	coats etc. could go in a bay directly off the teaching space
apron and hat storage area near coats and bags	hygienic storage of food-preparation clothing	

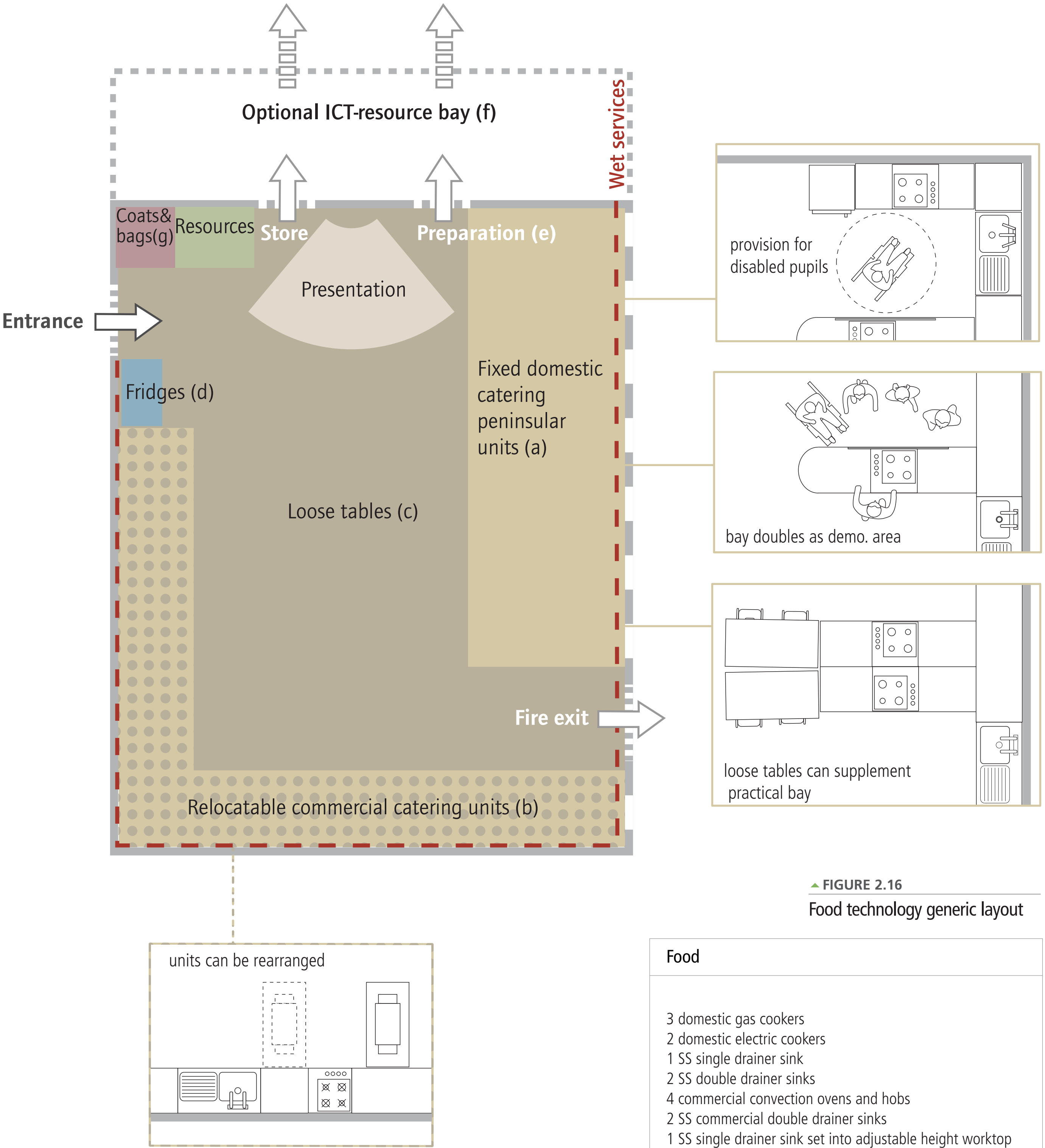


FIGURE 2.16

Food technology generic layout

Food
3 domestic gas cookers 2 domestic electric cookers 1 SS single drainer sink 2 SS double drainer sinks 4 commercial convection ovens and hobs 2 SS commercial double drainer sinks 1 SS single drainer sink set into adjustable height worktop 1 domestic electric hob inset into adjustable height worktop 1 domestic wall oven inset into open carcass unit 2 larder fridges 3 microwaves 2 combination oven/microwaves 1 SS hand wash basin 1 laptop trolley 1 electronic whiteboard

For more information… ▸ **Furniture design**: Section 4 ▸ **Safe distances around equipment**: Section 5

FIGURE 2.17
Food technology case study 1 key plan

Key data

Age range	: 11–16
NOR	: 900
Max. group size	: 22
D&T dept.	: 6 spaces
Room area	: $86m^2$
Storage area	: $4m^2$

Photo: Briony King

Food technology Case Study 1

A peninsular layout with access to a resource area

This is one of two food rooms sharing an ICT resource area (see Figure 1.9 for a plan of the suite). The peninsular arrangement creates more bench surface than a perimeter-only arrangement and allows one cooker per two pupils to be provided. However the increased fixed benching reduces the flexibility of the space. Extensive glazing creates an attractive atmosphere, but heat gain can be a problem in warm weather. Small opening windows and roof-light extraction are inadequate to counter this.

The area is in the upper part of zone G in the graph in Figure 1.4, and below the area recommended in this document. However the pupils do have the benefit of the adjacent ICT facility for ICT-based research, design and evaluation activities. This area allows for a range of practical and non-practical activities with a cooker:pupil ratio of 1:2. If the space between benching in the bays (which is less than ideal) were increased the area would be in zone H. More space would also be needed if some of the domestic cookers were replaced with commercial versions but this would have the advantage of broadening pupils' experience.

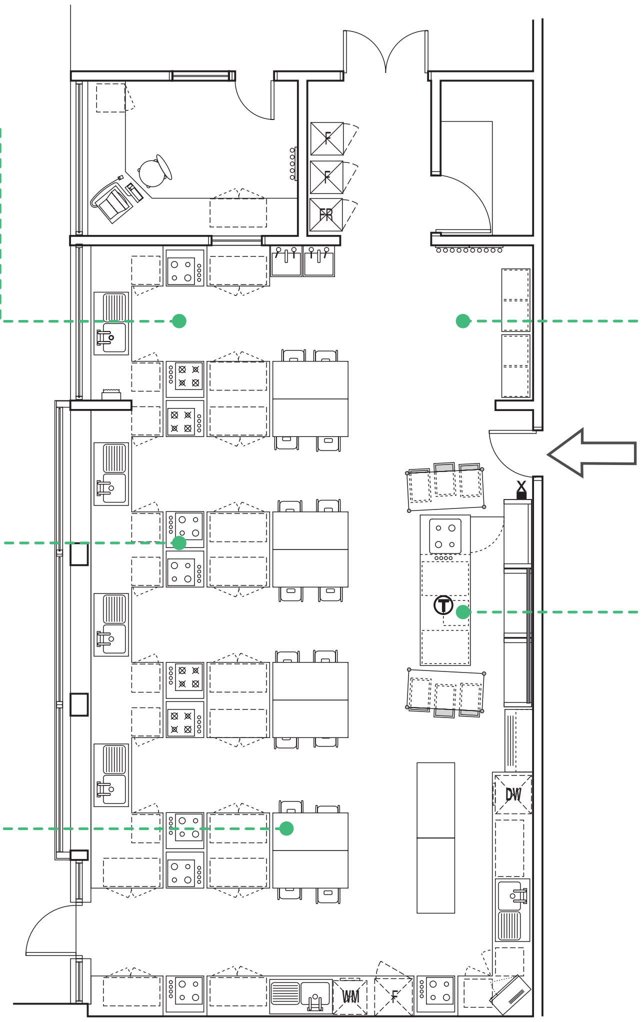
Key points to note about the layout are given below; captions on the plan provide more detail:

- Pupils can gather around the teacher's table for demonstrations (an overhead mirror or video camera would give pupils a better view from a distance).
- Fridges and freezers are positioned close to the room entrance so that pupils can leave fresh ingredients on the day of their lesson without causing too much disruption.
- Cooked meals are left on trolleys to cool before being collected by pupils.
- Washbasins are provided for personal hygiene reasons.
- A washing machine and tumble dryer are used for cleaning dishcloths, teacloths, etc.
- Under-bench cupboards provide local storage for most equipment; a walk-in store easily reached from the main space houses electrical equipment which is less regularly used.

The practical bays provide working areas for up to four pupils, though the space between the units is less than ideal.

Cookers are positioned with a fixed work surface on either side (see 'Food technology equipment' in Section 5).

Loose tables, the same height as peninsular benching and with stainless-steel surfaces and braked castors, can be used alongside the practical bays or arranged to face the whiteboard.



Bag-storage units and coat hooks are near the entrance and away from the main activity area.

The teacher's table with electric hob and fridge provides a demonstration bench and resource base (loose trolleys alongside contain resources needed for the lesson).

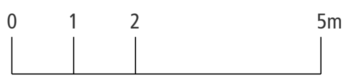


FIGURE 2.18

Food technology case study 1 layout

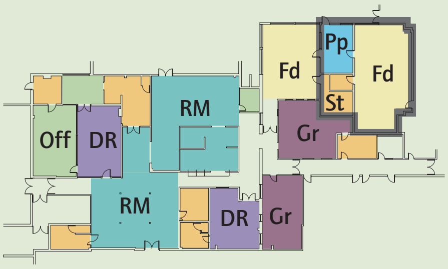


FIGURE 2.19

Food technology case study 2 key plan

Key data

Age range	: 14–19
NOR	: 1900
Max. group size	: 22
D&T dept.	: 10 spaces
Room area	: 85m^2
Storage area	: 5m^2

Food technology Case Study 2

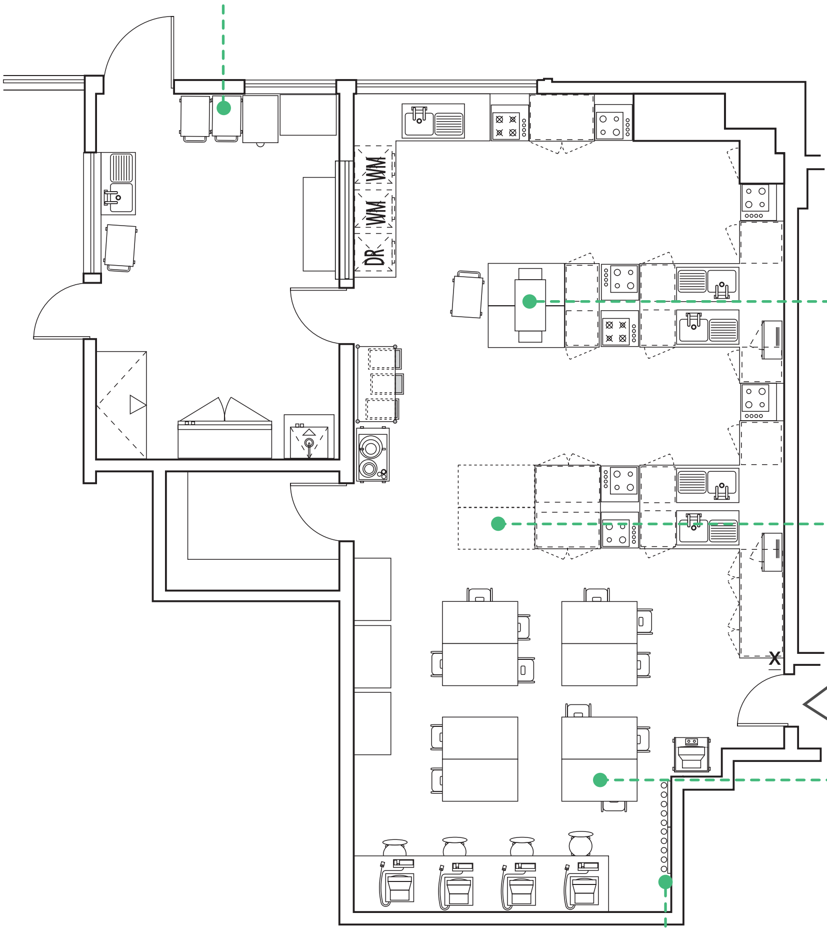
A multi-functional space with an integral resource area

This is one of a pair of food rooms in a design and technology suite which benefits from a shared central ICT-resource area. The room illustrated here has domestic-style kitchen bays whereas the adjacent food room houses stainless-steel commercial catering units. The rooms are divided by a shared preparation area which is supervised by a full-time food technician (see description in 'Food preparation area', Section 3). A peninsular layout in just over half the space provides the food-preparation facilities for the pupils, and the cooker:pupil ratio is 1:3. A run of computers, located in the 'free' area for easy access, is used for data processing and digital photography. The nearby ICT-resource area is used when a whole group needs to use computers. The walk-in store is easily reached. Cupboard units above and below the worktop provide additional storage for food-preparation equipment.

The area falls in the upper part of zone G on the graph in Figure 1.4, which is below the area range recommended in Section 1. Although separating the practical area from the non-practical means that only half the space may be used for food preparation, this does have advantages in terms of hygiene and management.

Trolleys are used extensively to bring resources from the prep area and store (notional parking position shown).

A tunnel oven increases the variety of cookers.



Loose tables can be moved to form long production runs providing flexibility.

Loose tables allow a variety of arrangements for design, evaluation and testing activities.

Bags and coats storage is near to the entrance and away from the practical area.

FIGURE 2.20

Food technology case study 2 layout

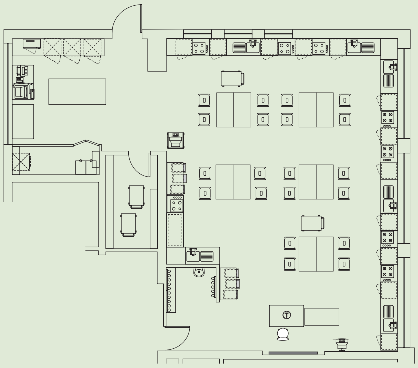


FIGURE 2.21

Food technology case study 3 alternative room layout

Key data

Age range	: 11–16
NOR	: 600
Max. group size	: 22
D&T dept.	: 3 spaces
Room area	: 100m^2
Storage area	: 9m^2

Food technology Case Study 3

A perimeter layout with a resource bay

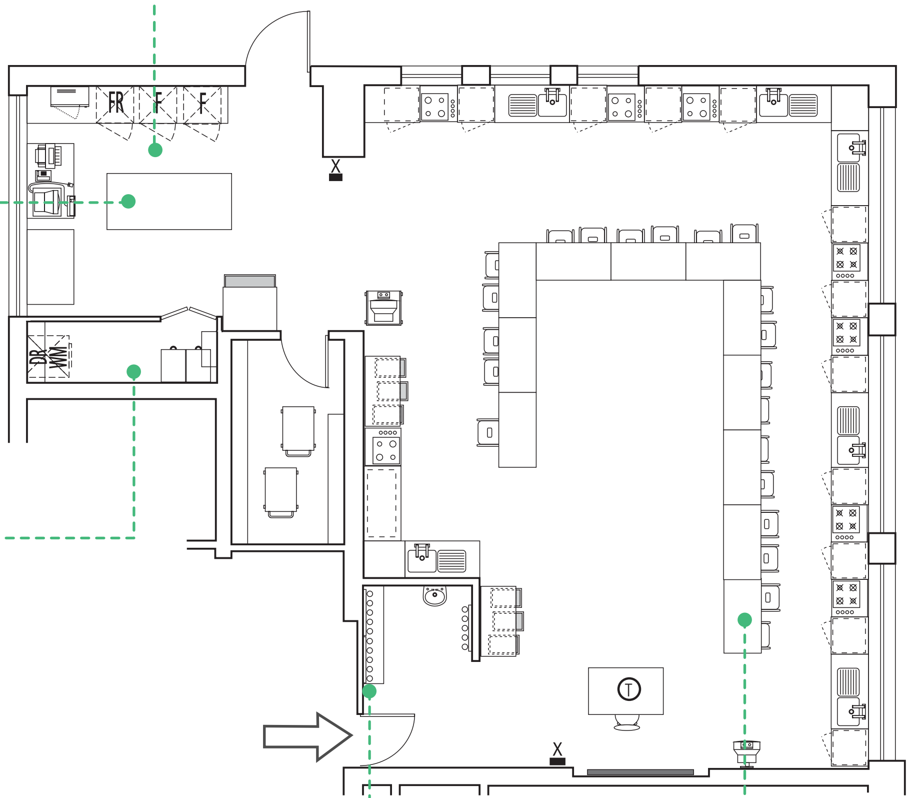
This is the only food room in a small department with three spaces: food, resistant materials and textiles. The room has recently been refurbished, and a bay formerly laid out as a model flat has been converted into a design and resource area away from the main practical area. A key difference between this layout and the previous two examples is that all serviced benching is arranged around the perimeter. All other tables are the same height as perimeter benching, and are loose, providing flexibility. The pupil:cooker ratio is 3:1. The teacher moves a table perpendicular to the perimeter bench for practical demonstrations. This arrangement is adequate but not ideal.

The area (excluding the coats and bags lobby but including the 18m^2 resource area) is in the upper part of zone H on the graph in Figure 1.4. The perimeter arrangement takes up less space than the peninsular layout shown in Figure 2.18 but provides a shorter run of work surface, which means fewer cookers (eight rather than 11).

This area is used for research and design work, food testing, cooling completed dishes and for group meetings. Fridges, freezers and washing machine are also housed here.

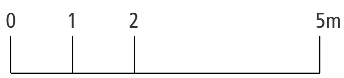
The large table is useful for pupils to gather around for evaluation.

A walk-in store for equipment and cupboards for paperwork are easily accessed from the resources area.



Coats and bags are stored close to the entrance and separate from food-preparation areas.

Loose tables, here shown arranged for whole-group discussion, can be moved to suit activities (see figure 2.21).



▲ **FIGURE 2.22**

Food technology case study 3 layout

Textiles

Figure 2.23 reflects a textiles area used for a variety of designing and making activities. Pupils may use sewing and knitting machines, work with fabrics by hand and test and evaluate fabrics. Computer-controlled machines give pupils the opportunity to design and make products with CAD/CAM equipment. The table below explains the layout.

Key to textiles generic layout

Layout incorporates...	which will allow for.....	points to note.....
fixed perimeter benching housing sewing machines at a ratio of 1:4 (a)	3D designing and making using sewing machines, including CAD/CAM	specialist furniture can incorporate machines storage
fixed perimeter benching with a deep sink with high splash back (b)	fabric printing and dyeing and general cleaning fabric-testing equipment	a corner position away from sewing machines is advisable
loose tables for the whole class in a variety of plan sizes and heights (c)	researching etc. using battery-powered ICT various group activities, e.g. fabric cutting printing, if an appropriate table-cover is used	laptops take up less area than desktops allow sufficient distance between tables tables must be light enough to move around but sturdy enough for heavy use
free floor area	fabric cutting and/or tailor's dummies for garment construction area for ironing	tailor's dummies may be left out as inspirational display, or stored
desktop computers on relocatable tables (d)	researching and designing	supplementing laptops on central tables
fabric display in resources zone (e)	pupil inspiration and awareness of materials	specialist systems can be used for hanging fabrics
access to store which doubles as a changing room (f)		must be lockable from the inside but with override

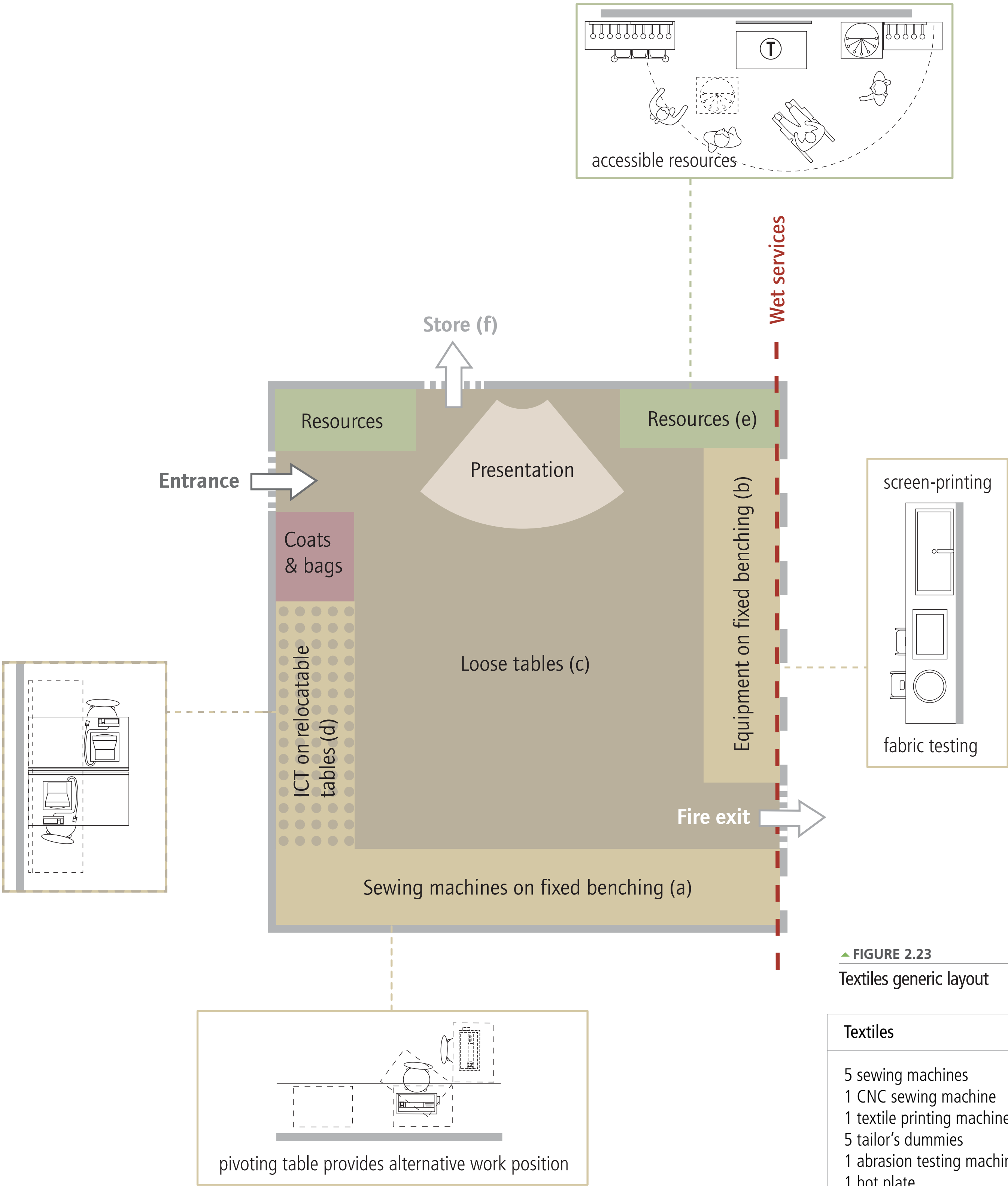


FIGURE 2.23

Textiles generic layout

Textiles
5 sewing machines 1 CNC sewing machine 1 textile printing machine 5 tailor's dummies 1 abrasion testing machine 1 hot plate 1 screenwash sink 2 ironing boards 3 desktop PCs 1 laptop trolley 1 electronic whiteboard

For more information… ▸ **Furniture design**: Section 4 ▸ **Safe distances around furniture**: Section 4

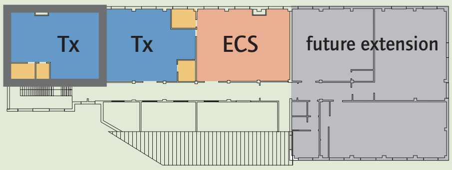


FIGURE 2.24
Textiles case study 1 key plan (upper floor)

Key data

Age range	: 11–18
NOR	: 1400
Max. group size	: 21
D&T dept.	: 9 spaces
Room area	: 91m^2
Storage area	: 11m^2

Textiles Case Study 1

A large multi-functional space

This textiles space is one of nine design and technology spaces in a technology college, six of which (three resistant materials, one electronics and control systems, one graphics and one textiles) are grouped in a suite (see key plan). These are supported by an ICT-resource area, a departmental staff base and a preparation room. A food room, a second textiles room and a second electronics and control systems space are grouped together elsewhere. The electronics and control-systems space is shown in electronics and control systems case study 4.

The textiles space shown here accommodates a range of activities, including designing, printing and the construction of garments. Staff teach both conventional skills (including sewing techniques making use of tailor's dummies) and ICT-based skills. All tables (including those at the perimeter) are loose, providing flexibility. Teachers feel central servicing would give them more flexibility, allowing pupils to do activities such as batik on central tables and allowing staff to demonstrate sewing-machine techniques more easily.

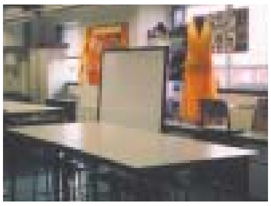
The area is in the middle of zone H in the graph in Figure 1.4. It provides for a wide range of activities including screen-printing. An area in the upper part of zone H would be more appropriate if an extensive amount of screen-printing were to take place or if post-16 students were to work alongside younger pupils.

Key points to note about the space are given here; further detail is given on the plan:

- Glazing alongside the door gives staff a good view of pupils arriving.
- The original carpet flooring has been replaced by vinyl as thread and pins were getting caught in the pile. Vinyl allows pupils to cut patterns or fabric (particularly long lengths) on the floor.
- There is plenty of free floor space allowing loose equipment such as tailor's dummies to be brought into the space.
- There are two storerooms; one doubles as a changing area. Garments in progress are kept on a mobile coat-rail and wheeled into the room when needed.

Tray units contain all the folders from one class which can be distributed easily at the beginning of a lesson.

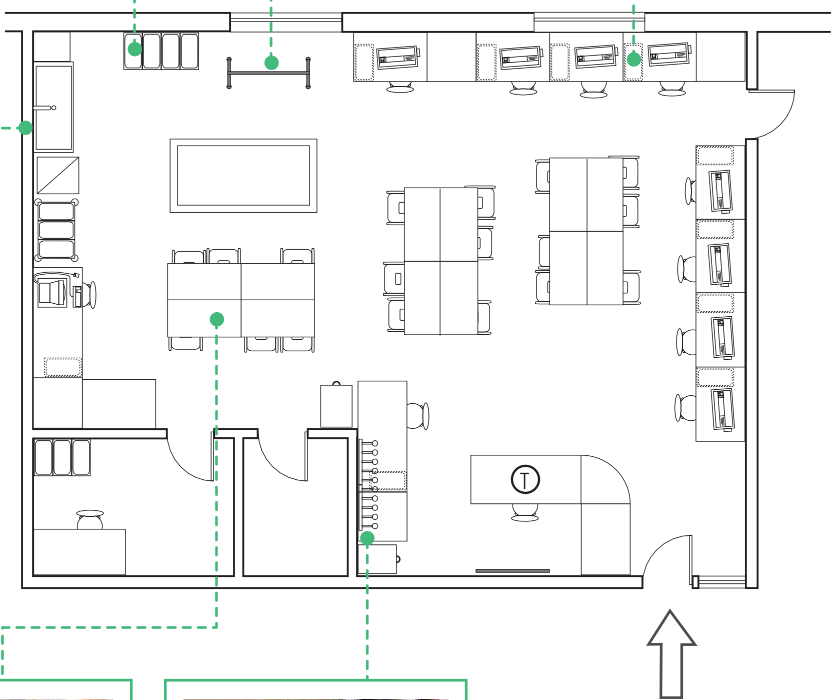
A mobile whiteboard gives teachers the flexibility to move the teaching focus to wherever it is needed.



Eight sewing machines which can be stored underneath in pedestal cupboards.

photos: Alison Wadsworth

The messy-printing area (table and wide stainless-steel sink) is away from the cleaner areas.



Tables of various sizes are used for sketching, discussion and some types of printing (one large table has a rubber mat stored nearby to allow it to be used for screen-printing).

Hooks hold fabric samples mounted on small hangers.

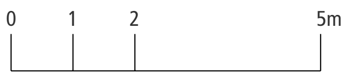


FIGURE 2.25

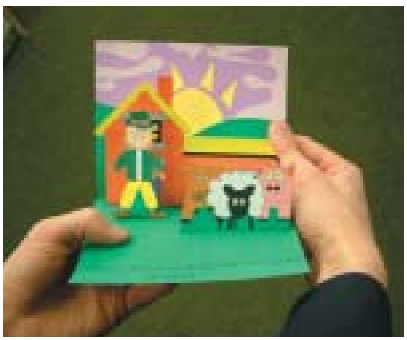
Textiles case study 1 layout

Graphic products

Figure 2.26 represents a graphic-products area equipped for a wide range of activities, including making three-dimensional products and using CAD/CAM equipment.

Key to graphic products generic layout

Layout incorporates...	which will allow for...	Points to note
loose tables - sufficient for a whole class (a)	researching, designing and drawing in a variety of media including electronic (battery-powered laptops) formal technical drawing, on loose drawing boards.	tables must be light enough to move around but sturdy enough for heavy use laptops take up less area than desktops proprietary drawing tables are available but can be inflexible
desktop computers at a ratio of 1:8 on relocatable tables (b)	researching and designing	relocatable tables can also house plotters and scanners
serviced fixed perimeter bench housing light making equipment (c)	making 3D graphical products in plastic and card	consider distances around side benching
CAD/CAM equipment on relocatable tables away from presentation area (d)	making and prototyping small scale 2D and 3D graphical products	consider means of minimising noise LEV needed



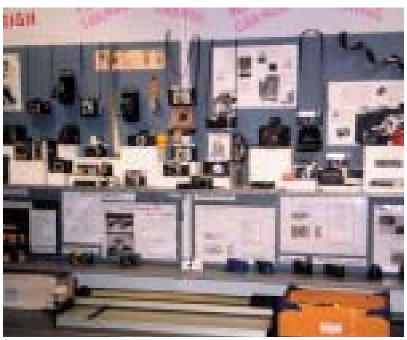


Photo: Alison Wadsworth

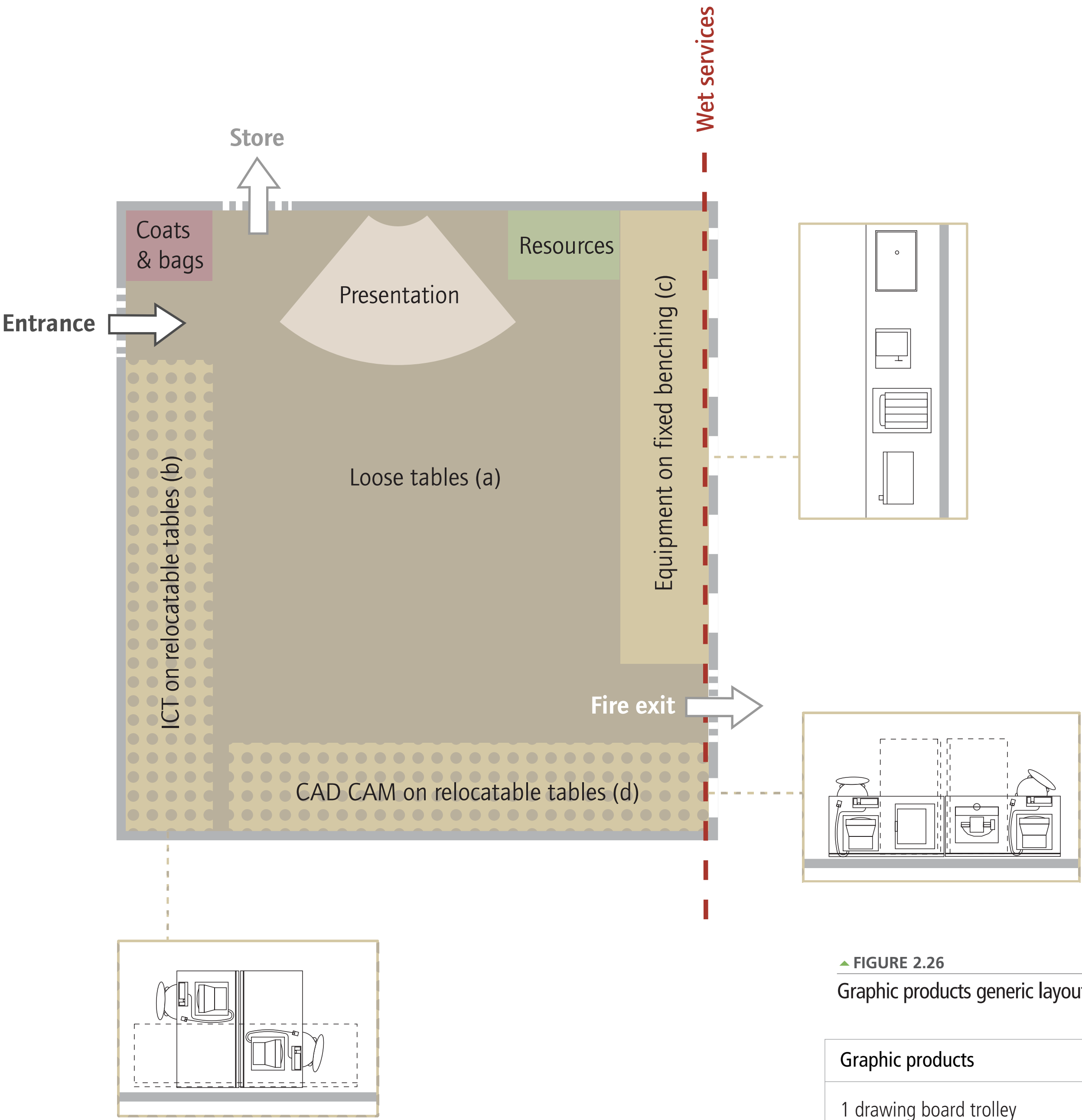
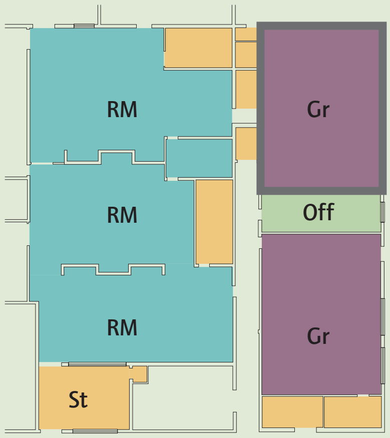


FIGURE 2.26
Graphic products generic layout

Graphic products
1 drawing board trolley 1 light box 1 plastics trolley 1 jigsaw 1 bench–mounted vacuum former 1 belfast sink 1 CAD/CAM plotter and cutter 1 scanner 1 CAD/CAM engraver 9 desktop PCs 1 laptop trolley 2 electronic whiteboards

For more information… ▸ Furniture design: Section 4 ▸ Safe distances around furniture: Section 4 ▸ Ventilation and acoustics: Section 6



▲ FIGURE 2.27

Graphic products case study key plan

Key data

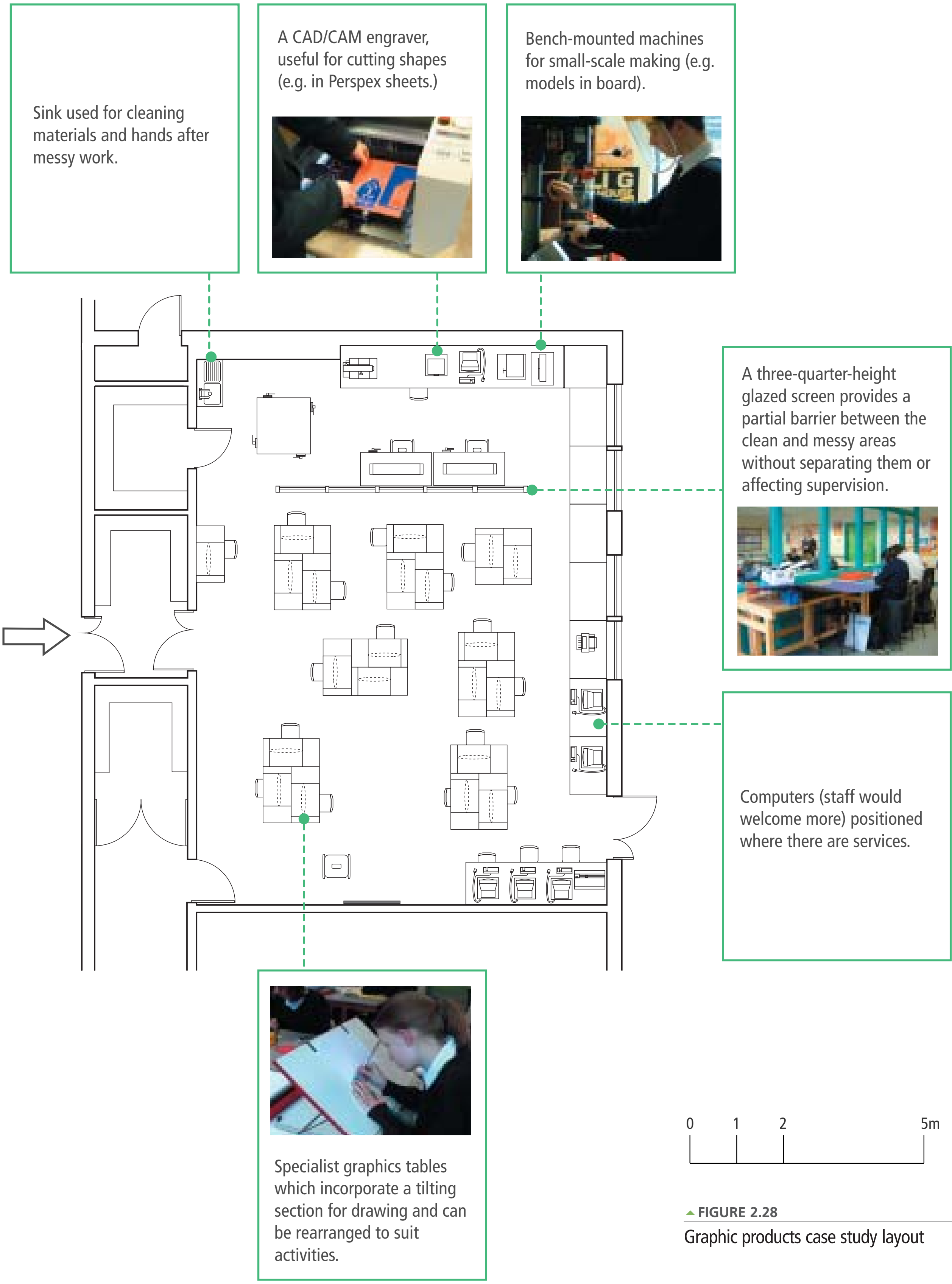
Age range	: 13–18
NOR	: 1350
Max. group size	: 22
D&T dept.	: 8 spaces
Room area	: 105m^2
Storage area	: 13m^2

Graphic products Case Study 1

A large multi-functional space with a making area

This recently refurbished graphics room is one of eight design and technology spaces in the school. The graphics and resistant-materials rooms are grouped together in a suite. Food and textiles are elsewhere. This space provides a range of facilities for researching, designing and making. Compressed air and low-voltage supplies on the perimeter bench allow the space to be used for electronics and control technology if required. Pupils sit at tables in the main space for whole-class discussion or presentations and disperse to work individually or in small groups using sketching tables, computers or equipment in the making area. Two stores open directly off the space; one houses materials and the other houses projects in progress and finished work.

The area, which is in the lower part of zone I on the graph in Figure 1.4, provides for a full range of facilities including a making area with a multi-bench. An area in the lower part of zone H would be appropriate for a space with more limited making facilities.



▲ **FIGURE 2.28**

Graphic products case study layout

Learning resource areas

The type and size of learning/resource areas varies greatly between schools. A few of the more common spaces are described here.

Central resource area

This is a particularly useful space which provides a shared departmental facility for research, design and evaluation activities. It can be used for independent working during or between timetabled lessons, as well as for whole-group discussion or presentation, given appropriate furniture and space. This may be valuable, for example, when a class wants to gather away from machinery and equipment. It may be bookable for whole-class sessions.

A resources area may be ICT-based, and provide the departmental ICT facility, or be a more general design and display area, supplementing local design areas. It may house an electronic whiteboard which is unavailable in other spaces. The central resource area may also include a CAD/CAM resource (see 'CAD/CAM room' below for a discussion on alternative locations and case study 3 for an example of CAD/CAM in a resource area). A resource area can act as a focal point for the department and two- and three-dimensional display is an important feature. Case-study examples are shown below.

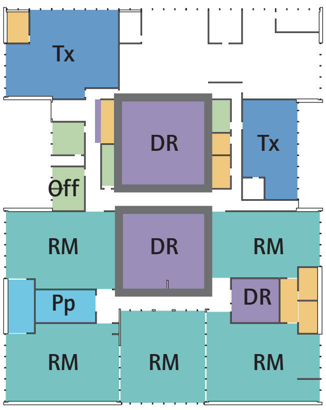


FIGURE 2.29
Resource areas case study key plan

Resource areas Case Study 1

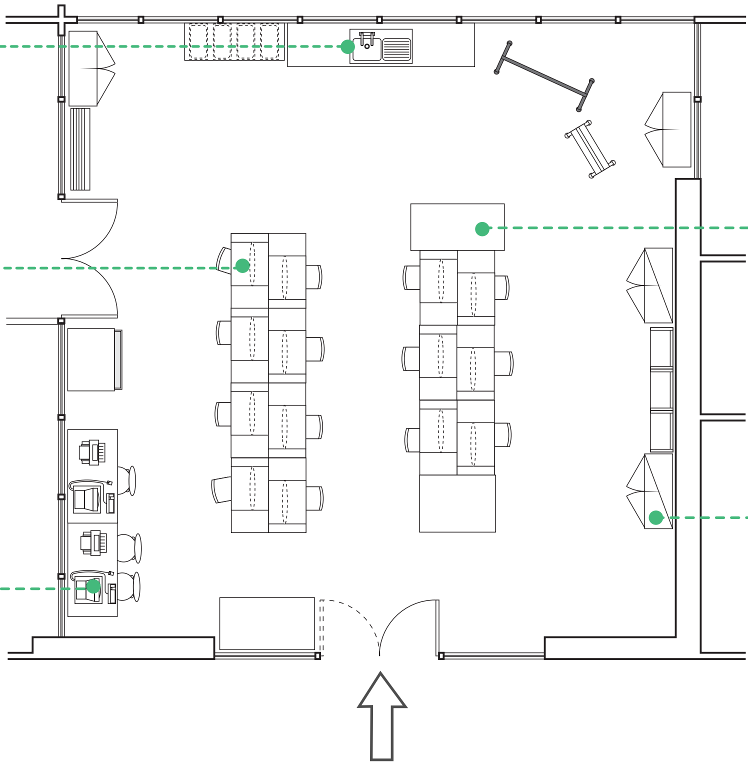
A multi-purpose space and an ICT resource

Figures 2.30 and 2.31 show two untimetabled design areas in a 1,650-place 11–18 school. Both spaces are centrally positioned in the design and technology suite allowing pupils to make maximum use of the facilities. One space is primarily an ICT base while the other is more multi-purpose. The ICT base, which is large enough to house a class of 20, is bookable for part of the time but otherwise freely available. The other space is partly timetabled for graphics courses and can be booked for external speakers to work with a group. Both spaces are designed to be flexible; loose tables rather than fixed benching allow staff to rearrange furniture to suit activities.

A sink is useful when doing graphics work or model-making.

600mm x 1800mm drawing board tables give a comfortable work surface for design work.

A networked desktop computer.



Tables can be arranged in various ways and cleared to the side for large-scale projects.

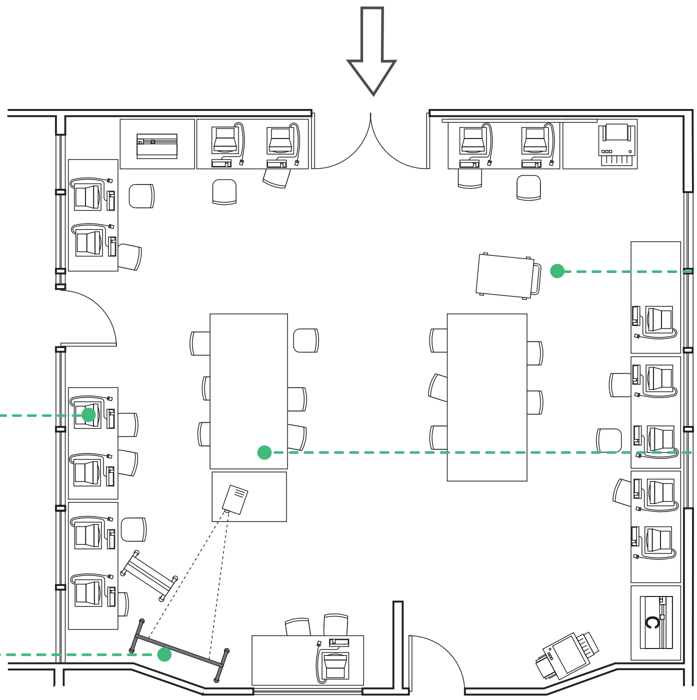
Cupboards (some with tray units), shelving and an A1 plan chest provide local storage and display surface.

FIGURE 2.30

Multi-purpose space layout

Sixteen desktop computers at a ratio of 1 per 1.25 pupils.

The mobile whiteboard can be moved to suit activities.



Trolleys bring resources close to where they are needed.

Large central tables for group discussion and presentation as well as individual design and research work.

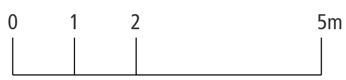


FIGURE 2.31

ICT resource layout

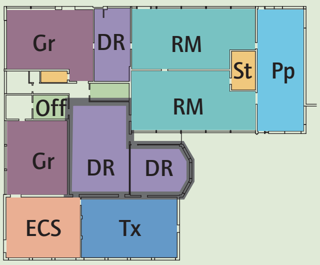


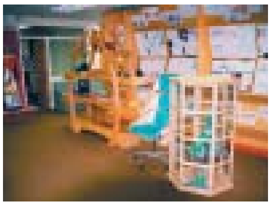
FIGURE 2.32
Resource areas case study 2 key plan

Resource areas Case Study 2

An ICT resource and a post-16 studio

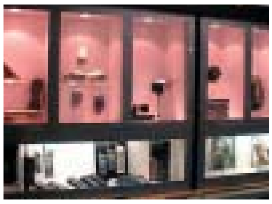
Figure 2.33 shows two central resource areas in a school with 1,430 11–16 year-olds and 265 post-16 students. There are ten timetabled spaces in the department (three resistant materials, two textiles, two food, one electronics and control systems, two graphic products) but only six in the suite. One of the central-resource areas is a shared ICT-resources area which is untimetabled but bookable by surrounding classes. Twenty-four desktop computers allow a whole group to work here at the same time. The second resource area is a post-16 studio which is timetabled 25% of the time for design and technology courses. It is also used in untimetabled time by students working on projects where specialist equipment is not required. Glazing between the two spaces allows some daylight into the ICT area and makes the sixth-form studio visible and inspirational to younger pupils. Post-16 students use computers in the ICT area but also have access to two desktop computers in their studio. Both resources areas can be reached directly from surrounding spaces and they are close to the entrance to the block.

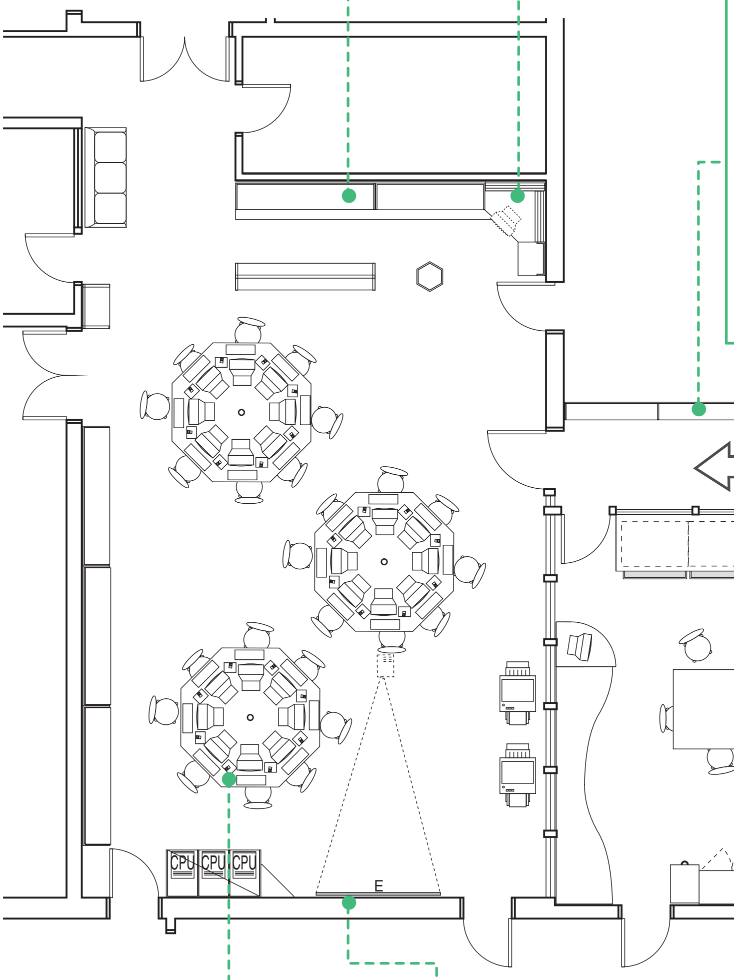
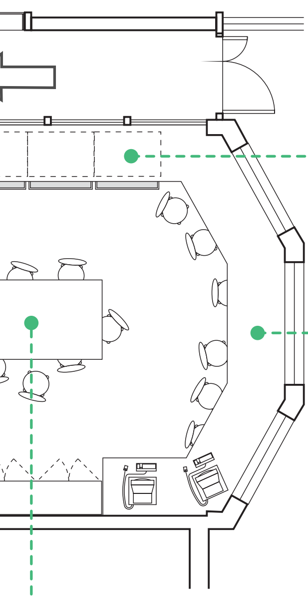
A display wall for pupils' and professionals' work.



Three-dimensional display area and TV screen.

Interesting and informative display, visible as pupils enter the suite.

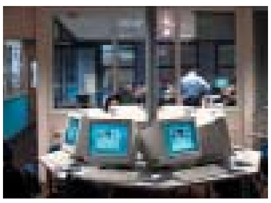


Deep drawers below house A1 card and paper.

900 mm deep fixed perimeter benching provides good working space for computers or graphics work. Loose A3 drawing boards are available.

Table for group discussion and presentation.



Octagonal tables allow for group working but do create unused triangular space.

An electronic whiteboard for group presentation or discussion. Pupils gather around here on chairs if necessary.

0 1 2 5m

FIGURE 2.33

Resource areas case study 2 – 2 Layouts

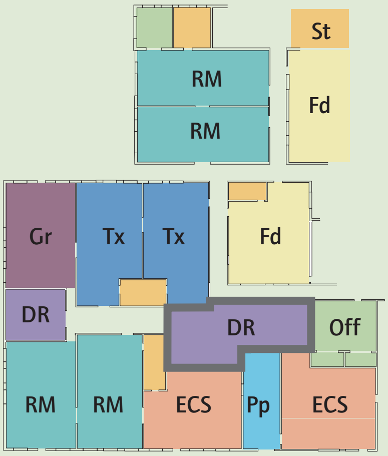


FIGURE 2.34
Resource areas case study 3 key plan

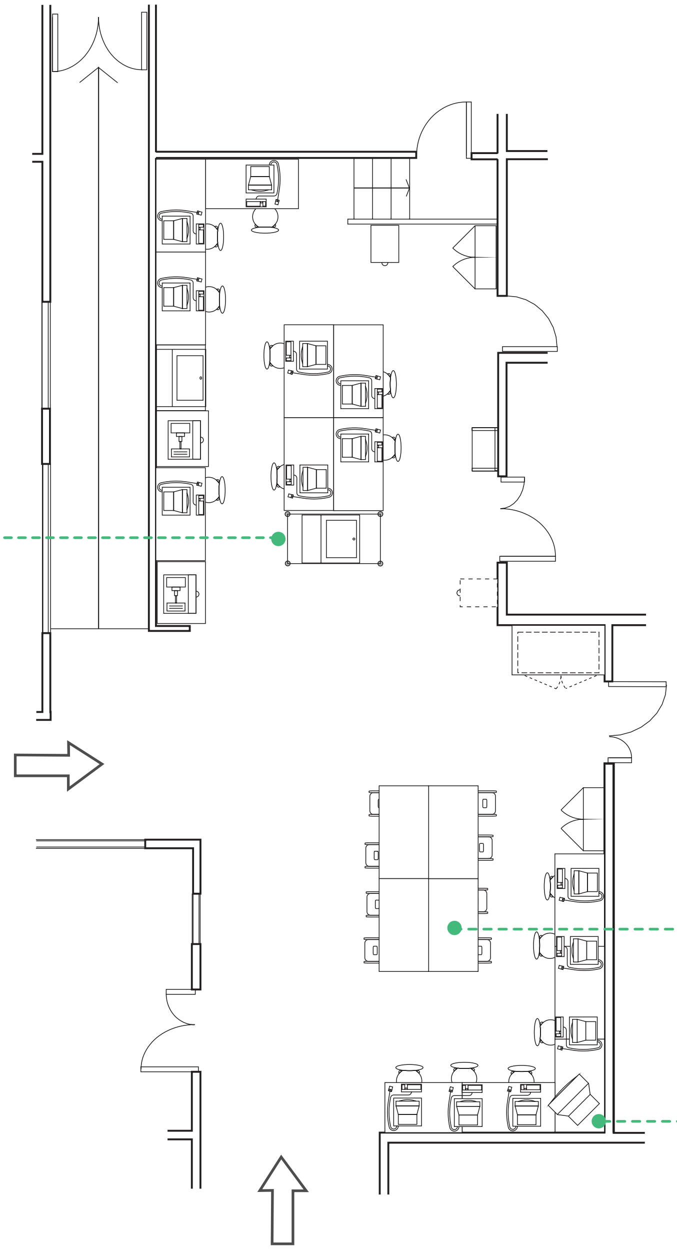
Resource areas Case Study 3

A resource area housing ICT and CAD/CAM

Figure 2.35 shows an ICT-resource area in a 1,500 place 11–18 school (the electronics and control systems technology suite of this school is illustrated in Figure 2.13). There are 11 design and technology spaces in total and seven of them open directly off the resource area (see key plan).

As this space is centrally located, it is easily reached and well used by pupils. It can be indirectly supervised from surrounding teaching spaces and the adjacent departmental staff base. It is a well lit space with high ceilings making it a pleasant learning environment. The space is generally untimetabled and used for independent learning by pupils of all ages. It can also be booked for whole-group presentation or discussion sessions.

Four CAD/CAM machines (mill, lathe, router and stencil cutter) easily available and visible to all. Pupils and staff do not find noise a problem, possibly because the machines are enclosed in boxes.



Loose tables for designing and researching.

A television and video player used for presentations.

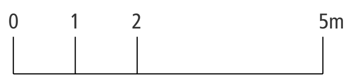


FIGURE 2.35

Resource areas case study 3 layout

CAD/CAM resource area

The way in which CAD/CAM machines are located varies. In some schools the equipment is an integral part of the timetabled teaching area, sitting alongside traditional machines. In others the equipment is grouped together in a separate room, either centrally located or adjacent to a timetabled space (normally divided by a glazed screen so that staff can supervise activities and pupils can observe machines working). The latter is likely to be more common in an existing school where timetabled spaces are not large enough to accommodate additional machines. An example of this approach is shown below. A third option is to locate machines in a shared central resource area where they are visible and accessible to all. Examples of locating CAD/CAM are shown in:

Figure 2.11 (a CAD/CAM bay opening off a robotics space)

Figure 2.13 (a CAD/CAM bay adjacent to an electronics and control-systems room)

Figure 2.35 (CAD/CAM machines as part of a central ICT-resources area).

CAD/CAM Case Study 1

A dedicated resource room

Figure 2.37 shows a CAD/CAM room housing five CAD/CAM engravers (four small and one large) in a large design and technology suite (see key plan). Resource areas case study 1 described facilities in the same school. This school adapted its existing accommodation to provide a central CAD/CAM base which can be reached by pupils during and between lessons. It is supervised by a CAD/CAM technician (this arrangement would be difficult to manage otherwise).

Advantages of a separate CAD/CAM room:

- Keeping noisy machines away from timetabled spaces
- Allowing pupils to use machines at any time
- Making supervision and maintenance easier for one technician

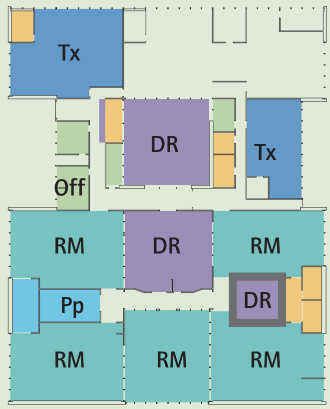
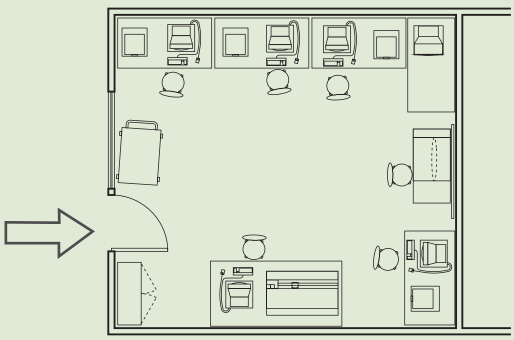


FIGURE 2.36
CAD/CAM case study key plan



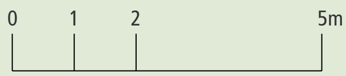


FIGURE 2.37
CAD/CAM case study layout

Photo: David Prest

3

This section describes the non-teaching spaces that support the main timetabled spaces in a design and technology department, including areas for the preparation of resistant materials and food, a departmental staff base and storage spaces. Guidance on the kinds of furniture used in these areas is given in Section 4.

Non-teaching support spaces


FIRST AID

Storage

It is very important to provide adequate storage space for design and technology. Recommended areas are given in Section 1 (Figure 1.6). Storage will be required for items of all shapes and sizes, from large manufactured boards to small electronic components, but there are five main categories of storage:

- **Teaching and display materials and equipment:** including paper (up to A2 size); textbooks and worksheets; CDs; TV and video/DVD recorder; data projector; A1 posters and items to inspire pupils

- **Pupils' portfolios:** for graphic work and sketch books kept for reference and possibly assessment purposes (up to A3 at KS 3 and up to A2 for 14–19 year olds)

- **Pupils' coats and bags:** (unless kept centrally in cloakrooms or lockers) and protective clothing and equipment (all pupils and staff need to use appropriate personal protective equipment (PPE) in specialist areas)

- **Specialist raw materials, tools and equipment:** as little as possible of any commodity should be in storage at any one time, as far as purchasing and curriculum requirements allow

- **Pupils' projects (in progress and completed), including prototypes:** if kept in the school (this needs to be established when calculating area needs)

Storage locations

The bulk of the storage will be in storerooms adjacent to learning spaces. There will also be local storage in teaching rooms and some storage in the departmental staff base (for example, textbooks).

Local storage in the teaching space (see the room layouts in Section 2 and guidance on storage furniture in Section 4) should be limited to those items that need to be immediately accessible, to avoid reducing the area available for learning or affecting the flexibility of the layout.

These may include:

- Some frequently used and inexpensive tools and equipment
- Items forming inspirational display (including pupils' completed projects and objects of interest)
- Protective clothing (such as aprons or goggles)
- First-aid equipment (which must be secure but easily accessible to both staff and pupils in case of an emergency)
- Fire extinguishers and blankets
- Coats and bags (if brought into the space)

The largest proportion of items will be kept in walk-in storerooms directly accessible from each of the specialist facilities, and providing security and accessibility. All walk-in stores should be deep enough (1.8m minimum) to allow equipment trolleys to be kept in the central part of the storeroom between shelving, without wasting space.

Pupils' work in progress is usually kept in a local storeroom for ease of access, but completed work may be put away in a central store (ideally still within the department). Projects will vary in size and shape, and will range from clothing to three-dimensional constructions. KS 4 and post-16 projects are likely to be larger. Projects should be kept safely and securely.

Specialist requirements

Particular storage needs are outlined below according to specialist area, although this advice is not meant to be comprehensive.

Resistant materials

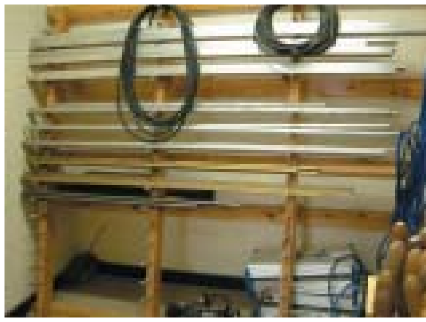
Items used in this area can take up considerable space and some have significant health and safety implications. BS 4163, Health and Safety for Design and Technology in Schools and Similar Establishments, provides useful guidance (see summary in Appendix).

Construction materials

Materials include:

- Wood in sheets and sections
- Plastic sheets and rods
- Metal sheets, bars, rods and tubes

These should be stored in an area separately designated and supplementary to the teaching area, usually in a walk-in store or the preparation room (see 'Materials preparation area', below). From the storage area there should be ready access to resistant-materials areas and to the outside to facilitate deliveries. Ideally timber and plastics should be kept in an unheated environment to maintain the condition of the material but if stored in the preparation room the space should be heated for the comfort of the technicians. Metal always has to be kept warm and dry. Plastics materials should be stored in cool dry conditions away from direct heat sources.



Care should be taken to ensure that items are stored securely and that they do not protrude so that they could present a risk to eyes, head or body. See 'Resistant-materials storage' in Section 4 for information on ways of storing resistant materials. High-level storage is not generally recommended but where it occurs it is essential to provide suitable access equipment

Hazardous substances

Certain substances, including chemicals, flammable liquids, liquefied petroleum gas (LPG), acetylene and oxygen, have to be carefully stored in accordance with COSHH regulations (see References). Reference should also be made to the Management of Health and Safety at Work regulations and the DSEAR (Dangerous Substances and Explosive Atmospheres regulations). The storage requirements for these substances are summarised here, but reference should be made to BS 4163, Health and Safety for Design and Technology in Schools and Similar Establishments, for more detailed guidance.

The total volume of highly flammable liquids, (including cellulose paint and thinners, methylated spirits, and petroleum-based adhesives) should not exceed 50 litres in any one work room and these substances must be kept in a fire-resisting, leak-proof cabinet. Larger quantities must be stored externally in a secure, purpose-built highly-flammable-liquids store, although storing large quantities is best avoided altogether because external stores tend to be underused and may be subject to vandalism.

Cylinders of liquefied petroleum gas (LPG) (e.g. for brazing) should be used and stored in accordance with LP Gas Association Code of Practice No 7, 2004.[10] They should be stored away from combustible and corrosive materials and oxygen cylinders in a well-ventilated position, preferably outdoors. LPG cylinders should not be stored below ground level or close to drains, cellars or basements.

The number of oxygen and acetylene cylinders (oxyacetylene is used for welding) should be kept to a minimum (they can explode violently if involved in a fire). They should be stored (even if empty) in a safe, well-ventilated place, preferably outside and away from combustible materials. Again, these cylinders should not be stored below ground level, or next to drains, basements or other low-lying places.

Sufficient storage area should be provided for forge fuel (coke for traditional forges has generally been superseded by gas ceramic-chip forges) and moulding sand.

Tools and machine accessories should be stored securely in a walk-in storeroom or lockable cupboard in the teaching area.

Food technology

The way in which materials and equipment are stored will vary between schools but there will usually be one store for equipment (pans and electrical equipment such as food processors) and one for a limited quantity of dry and 'shelf-stable' foods (e.g. bread, bottled foods and canned foods). Some equipment may also be stored locally in units in the teaching area. Any cleaning materials or chemicals used for food science must be stored separately from foodstuffs in a locked storeroom.

Food stores must be dry and well ventilated by means of a rodent-resistant grille in the door or wall. The temperature range within should be 10–15°C.

Perishable foods (e.g. fish, meat, dairy products and prepared fruits) will be stored in fridges or chiller units either in the main room (see food-technology plan in Section 2), storeroom or food-preparation room (see below). Sufficient capacity must be allowed for pupils' ingredients and finished food products to be kept during the school day. Freezer cabinets can also be located in the teaching space, storeroom or food-preparation area.

For further detail on food storage see BS 4163.

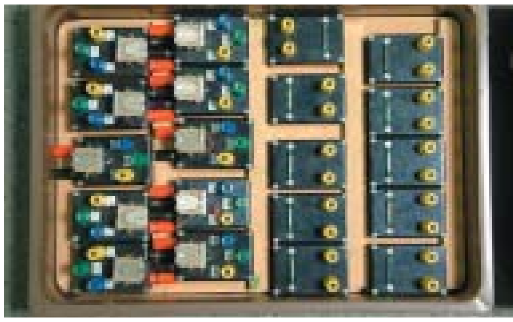
Notes

10. *Code of Practice 7: Storage of Full and Empty LPG Cylinders and Cartridges*, LP Gas Association, 2004

Textiles

Items to be stored will include rolls of fabric, small sewing accessories, tailor's dummies and weaving frames. Equipment such as sewing machines or over-locking machines is often kept on a trolley in the storeroom when not in use to release work surfaces for other activities. These items may also be put away under the bench (see options for this in 'Storage units' in Section 4). As a textiles storeroom often doubles as a changing room. adequate space must be allowed between shelving.

Electronics and control systems



Most items in this area will be small (e.g. electronic components, control-systems kits and making materials such as small sections of wood, metal and plastics). Chemicals for use in etching printed circuit boards may also need storing, in accordance with COSHH requirements.

Graphic products

Most materials used will be flat: paper, card, and small sheets of plastic. Building Bulletin 89, *Art Accommodation in Secondary Schools*, includes useful guidance on storing these materials.

Materials-preparation area

Whilst the preparation of construction materials sometimes takes place in a defined area of a workshop, it is desirable to have a separate room. It is often convenient if this room also acts as the main materials store and delivery point. This area is normally accessible only to members of staff because it usually houses dangerous machines, including a circular saw, planer and hacksaw. There will usually be a bandsaw in addition to that in teaching areas. Because of the size of the materials used in these machines, a large floor area is required, although mobile storage units can be housed here when preparation machines are not in use (see Section 5 for details about machines and space to allow for them, and the Appendix for relevant health and safety information).

Generic plan

Figure 3.1 shows an example of a preparation room which incorporates a materials store. The storage systems include separate racking for wood, metal and plastic as well as cupboards for tools and small components.

Particular points to note are as follows:

- There is enough storage space for the largest timber sections, manufactured boards, metal rods and tubes that are likely to be processed (the full-size sheets assumed here are shown dotted in Figure 3.1).

- Wood and metal are stored in distinct zones to avoid wood becoming contaminated by lubricants on the metal.

- External double doors allow for the delivery of construction material and an internal 'stable door' enables pupils to contact the technician without entering the prep room.

- There is an enclosed office for the technician which should be adequately ventilated and, for fire-safety reasons, have a window on to the main preparation space.

- An extraction unit serves the two woodworking machines (see 'Local exhaust ventilation' in Section 6 for more on dust extraction). This could also serve machines in adjacent teaching spaces.
- Trolleys give flexibility to the layout and facilitate the safe handling of materials. Resource trolleys, shown in their parked position, will be loaded with resources and wheeled into the adjoining workshop.
- Shelving is positioned carefully to avoid narrow gangways or obstructions that can hinder the manoeuvring of heavy loads.

The space of $54m^2$ shown here provides sufficient area for the kind of work undertaken by the technician, including administrative work, as well as for raw-materials storage. Storing materials in the preparation room means that they are next to the machines which will be used to process them. If materials are stored separately, the preparation-room area could be reduced to $30–35m^2$.

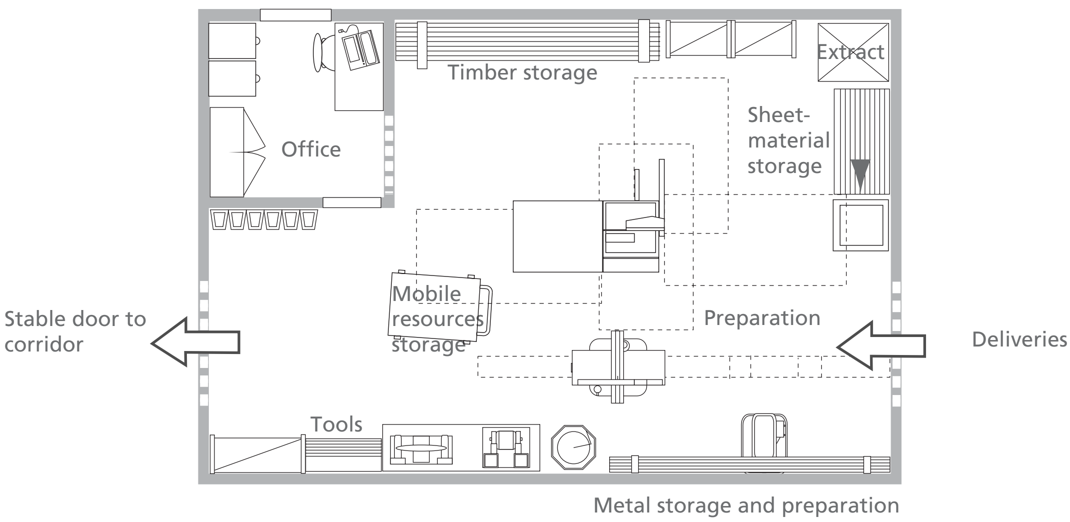


FIGURE 3.1
Preparation room (desk study)

Food-preparation area

It is desirable to have a separate clean space where a technician can prepare materials in advance of lessons. Pupils' completed dishes, which must be kept in a secure area, can also be left here away from the main teaching area. A preparation area should be immediately adjacent to the food-technology area(s) with good visibility between the two areas. Facilities usually include a serviced work surface with a sink and storage beneath. There should be space for parking trolleys between benching. Large-capacity fridges and freezers for storing pupils' food before lessons may also be kept in the food-preparation area but may be more conveniently situated in the main teaching space (near the entrance) for easy access by pupils. A washing machine and drier may be located here or in a separate laundry area; adequate ventilation should be ensured.

Food preparation Case Study 1

Figure 3.2 shows a preparation area which serves two food rooms in a 1,900 place 14–19 school. One of the food rooms is illustrated in Section 2 (Figure 2.20).

The food-preparation area of 34m^2 is supervised by a full-time technician who helps the teacher by, for example, weighing out ingredients prior to pupils' cooking or preparing foodstuffs for evaluation. Activities occur mainly at the perimeter of the room because the central area is often used as circulation to the adjacent food rooms. Whilst this restricts what can be done, there are significant advantages in direct access to each teaching space. Key points to note about the plan are that:

- Resources for lessons are prepared by the technician, loaded onto trolleys and wheeled into the classrooms. There is plenty of free floor area for parking trolleys.

- The internal wall between the food room and the prep room contains a window with inset glass shelves. This allows the technician to display resources such as a selection of food mixers so that pupils are familiar with the items before they even use them. Imaginative displays of resources can often instil enthusiasm amongst pupils.

- A large fridge next to the door allows pupils to store their ingredients prior to lessons and their finished products (once cool) after the lesson. Ideally there should be two fridges, one for raw food and one for cooked food.
- A blast chiller (which quickly and safely cools cooked products so that they may be refrigerated immediately) sits next to the fridge for efficiency. A vacuum packer (also next to the fridge) seals products in plastic containers, allowing pupils to package their finished products before refrigerating them.
- This space is also used for photographing pupils' completed dishes. A white screen is set up on the table.

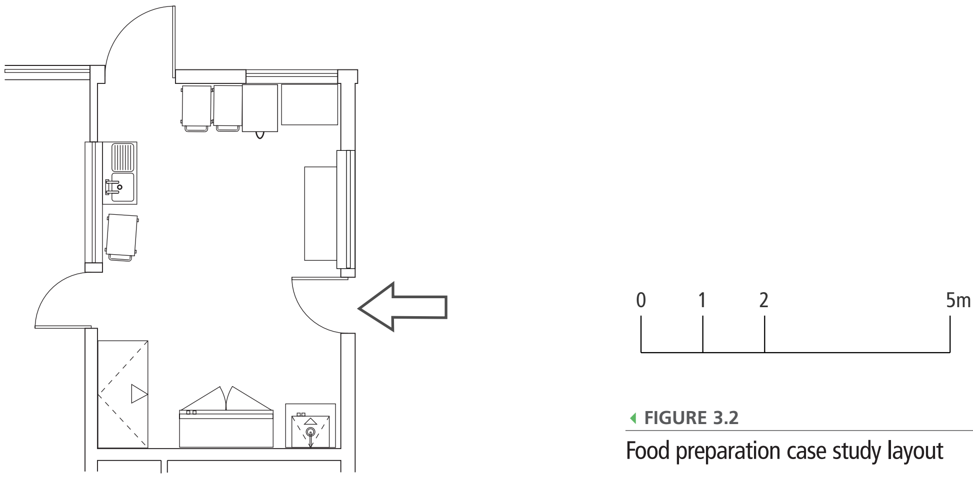


FIGURE 3.2
Food preparation case study layout

Staff base

A departmental base allows staff from a number of different specialisms to meet and work together. Facilities should include:

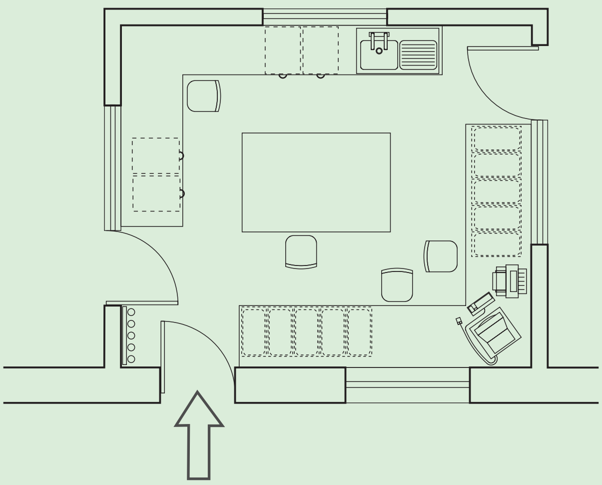
- Work space for each full-time member of design and technology staff
- At least one networked desktop computer and the facility to connect up laptops
- Shelf space for keeping reference books and papers
- Display boards for notices
- Secure storage for pupils' records, etc. (e.g. a lockable filing cabinet)
- A telephone
- A place (with or without a table) where staff can gather for discussion

There may also be soft seating and facilities for making refreshments (a sink, worktop and fridge), depending on the school's policy on staff social spaces (i.e. whether central or dispersed).

Staff base Case Study 1

Figure 3.3 shows an example of a departmental base which combines work and social facilities. Key points to note about the plan are given below:

- Glazing allows staff to see into adjacent workshops, the shared design area and the heat-treatment bay.
- A sink is useful when making refreshments.
- The computer is used for work planning and stock control.
- Under-bench storage units house teaching materials.
- Departmental meetings can be held at the central table.



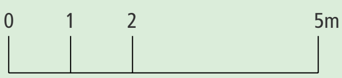


FIGURE 3.3
Staff base, case study layout

4

This section is divided into three parts. The first part describes the type of furniture that is appropriate for design and technology activities. The second provides guidance on finishes and fittings. The third part shows how to use the information to create an attractive and flexible design and technology space.

Furniture, finishes and fittings

Design and manufacture: WW.Modcons and Emmerich (Berlon) Ltd. Photo: Lauren Shear / Design Council

Furniture

All spaces in design and technology need to provide facilities for general research and design activities as well as material-specific specialist activities. A basic range of furniture alongside specialist furniture will provide for these wide-ranging activities.[11] Furniture needs to be robust and suitable for the activities taking place. It should also be comfortable to use and be chosen to maximise flexibility both within and between learning spaces.

Flexibility

Furniture can help to create a flexible environment in a number of ways. Providing each space in a design and technology suite with the same basic furniture allows them to be more interchangeable and the suite as a whole to have a more coherent feel. Also, if specialist furniture is versatile enough to perform a number of functions it can help to create an efficient space which provides for a number of activities at any one time (e.g. a multi-bench with an open frame and linoleum top which can be used for working with materials but also allows pupils to sit comfortably and draw at it).

Ergonomics

Ergonomics is the study of the environment in which people live and work and the equipment which they use. It is concerned with people's well-being and with their safety and comfort. Sufficient working distance around furniture (see 'Tables and benches' below) and machines (see Section 5), the position of emergency-stop switches and the sensible zoning of activities within a classroom (see Section 2) are all ergonomic issues which should be considered when looking at design and technology accommodation. Furniture has a number of ergonomic aspects and some of these are looked at in detail in the descriptions of individual furniture types below.

Furniture should be designed and used to ensure pupils and staff can work comfortably and safely. Dimensions are a particularly important ergonomic consideration; inappropriately sized furniture can affect the comfort and concentration of pupils and lead to back and neck pain in later life.[12] Sufficient leg-clearance under tables, adjustable chairs for use with

Notes

11. DfEE *Furniture and Equipment in Schools: A Purchasing Guide* gives detailed guidance on all issues of furniture procurement and must be read in conjunction with this section (see References).

12. The proposed website on www.teachernet.gov.uk/fande will give advice on appropriate furniture sizes for pupils based on a number of factors including age, Key Stage and stature. It will feature advice on fitted furniture such as shelving for use by teachers and pupils.


Photo: Osborne School

computers and the design of table underframes are just some of the ergonomic considerations when choosing furniture for schools.

The height of a work surface is an ergonomic consideration which has both comfort and safety implications. If a bench is too high it may prevent a pupil from operating a machine correctly or turning it off safely in an emergency. Before determining the height of a work surface, it is important to know what activities will take place at it, as well as the height range of users. Recommended heights for various furniture types are usually cross-referenced to pupils' ages. It must be noted, however, that these are often general recommendations and in certain extreme cases (such as a particularly short pupil) a variety of sizes of furniture may need to be provided. Adjustable furniture may also be considered, to cater for the range of pupil sizes and activities.

At least one specialist adjustable workbench or table should be provided in each area to allow disabled pupils to do general and practical work. This table may need to be shaped to allow pupils support to operate a machine. Specialist advice must be sought on this issue.

The width and depth, or plan size, of furniture is an ergonomic consideration which is often overlooked. Pupils should be able to sit comfortably side by side and carry out a variety of activities comfortably using a range of resources. This is a particular issue for computer use (see 'Specialist tables' below). The whole range of activities which may be carried out in a particular room should therefore be identified.

Ergonomics should also be borne in mind when designing storage areas. To ensure safe manual handling, a user should be able to see and assess the weight of a stored item easily. For this reason shelves should not be too deep or too high. The heaviest loads should in any case be stored at waist height where removal is safest. Adjustable shelving allows a variety of arrangements (see 'Shelving systems' below).


Photo: Counties Furniture Group

Furniture types

Tables and benches

There are several different kinds of tables and benches which may be fixed or loose. The following paragraphs look at the range, separating them into five types:

- Basic tables
- Specialist tables
- Perimeter benching
- Trolleys
- Multi-benches

Guidance is also given on materials, and on the safe working distances around tables and benches. While there are times when specialist tables or benches are required, it should be borne in mind that the more specific a function an item of furniture can perform, the less flexible it will be.

Basic tables

Basic tables are used mainly in design-resource areas for general non-ICT work, and also in practical areas where activities are 'light' duty – for example for design work. These tables are generally at sitting height (standing-height tables usually require the stability given by a more robust frame, see below) and are generally a modular 1200 x 600mm or 1500 x 750mm in plan.

Specialist tables

Specialist tables, also known as 'heavy-duty' tables, are similar to basic tables but are more robust in construction (the frame is usually made from a larger section of steel in a thicker gauge) and can contain services. They are used as computer tables or for practical work. Specialist tables are available with various shapes of fully welded metal underframes (see Figure 4.1). The cantilevered underframe or 'C' frame shown is particularly popular if tables are to be put together to form a long run, as pupils can sit more easily at the front of the table without the restrictions caused by table legs (see 'Perimeter benching' below). Storage units may be rolled underneath and located against the bottom of the frame.

FIGURE 4.1
Specialist table underframes: standard four-legged frame, 'I' frame and cantilever 'C' frame

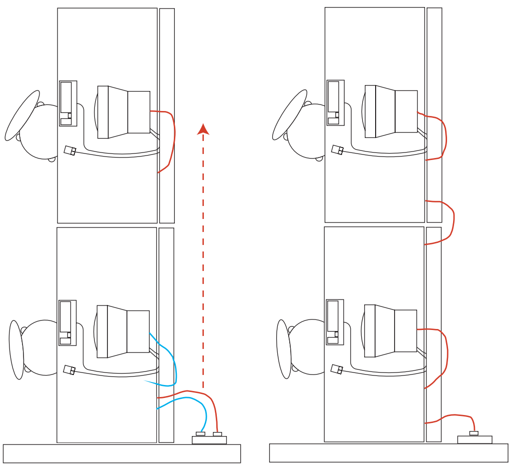


FIGURE 4.2
Daisy chains and wire management taken from *Furniture and Equipment in Schools: A Purchasing Guide*

Specialist tables can incorporate built-in services trunking. One example, often called a 'technology' table may be useful for electronics or control-systems work as it can provide a full range of relocatable services in the centre of the room without the need to run them through the floor or ceiling. These tables can be 'daisy-chained', or linked together and serviced from perimeter service outlets. However, the number of tables that can be linked in this way will depend on the power capacity of the socket outlet. A 'heavy-duty' table may also incorporate a cable tray for wire management, making it useful as a computer table. Figure 4.2 illustrates the function of the wire-managed and the daisy-chained table types.

Four table sizes are recommended for design and technology specialist activities: 1200 x 600mm (a standard general teaching table size), 1500 x 750mm and 1800 x 750 and 1800 x 900mm. These sizes allow for a variety of activities. Larger plan sizes are more comfortable for large group gatherings and can be useful for certain activities where a large unbroken surface is preferable, such as cutting long lengths of fabric. However, these tables are more difficult to move and they offer fewer options for layouts which reduces flexibility. Two heights are generally recommended; 710mm (for sitting activities) or 900mm (for standing activities). However, there is an argument for a slightly lower standing height table of 850mm in food spaces to account for the range of activities in food preparation, many of which require a downward force.

The plan dimensions of a table are particularly important where computers are used. A depth of at least 750mm is needed to allow the keyboard to be placed in front of the monitor and for pupils to sit at least 450mm away from the screen. This depth may be reduced with the introduction of flat screens and laptops. Figure 4.3 shows the recommended widths of table for different user situations; this should allow sufficient space for pupils who are left or right handed to use a mouse.

Tables are available which allow the monitor to be located and serviced through the frame. However the tables are invariably hard-wired to each other or to the wall which does reduce flexibility. Some table systems allow the screen to sit within the desk when not in use; this is an excellent way of saving space, particularly in areas such as graphics where ICT usage may be a whole-class activity for some of the time. The tables should be capable of housing a variety of computer models.

Computer workstations must provide adequate clearance for pupils to change the position of their thighs, knees, lower legs and feet. Allowing for a working height of 710mm, the work surface and front rails should have a total thickness no more than 75mm to enable thigh clearance. Adjustable chairs should also be considered (see 'Seating' below) as they help to ensure that a pupil sits at the optimum height in relation to the screen, although particularly short pupils will need the additional help of a footrest.

Some computer tables offer a variety of shelf attachments. However, if the table is the size recommended in Figure 4.3 then there should be no need for additional shelves unless room needs to be made for a printer. Monitor shelves can often lead to the monitor being too high in relation to the user's eye level, which may result in neck pain. Some computer tables incorporate shelves just below the bench for items such as keyboards; this can, however, reduce the knee-room available unless the bench is higher than that recommended.

A table that can be adjusted to enable a disabled pupil to do general research and design work, both on paper and on a computer, should be provided. In some cases one table (e.g. a specialist serviced table) could also be used for their making activities. This table should have a mechanism for height adjustment which is discreet and easy to operate. Some pupils may need a specially shaped table-top for support, and in some cases it may be beneficial for the pupil to have their own top attached to their wheelchair – provision for storing a number of these tops should therefore be made. It may be necessary to modify furniture and equipment for a pupil's particular needs, and professional advice must be sought on this matter.

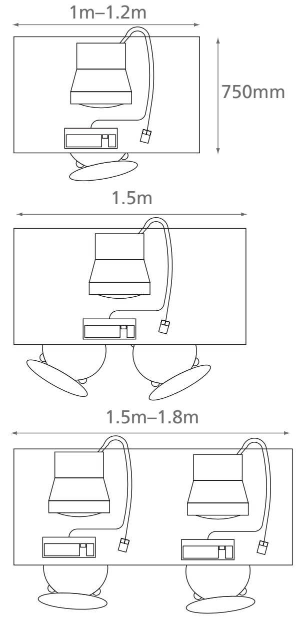


FIGURE 4.3
Recommended widths for ICT

Perimeter benching

Perimeter benching (including peninsular benching) usually contains most of the room's services as well as providing additional working area. Perimeter benching is usually installed at standing height unless activities dictate otherwise (e.g. in textiles rooms where sewing machines are used). ICT equipment should ideally be positioned on sitting- rather than standing-height benching, although the latter can be useful for short periods of working, particularly when using laptops. Benching for standing to work with ICT should ideally be higher than a bench accommodating machinery.

A minimum depth for benching incorporating desktop computers `is at least 750mm. When wall-mounted trunking (usually around 50mm deep) is used along the back of the benching, then an overall depth of at least 800mm should ideally be assumed. This also takes into account the need to tidy away wires from the worktop, generally under the bench in a 'trough' or tray. Both flat screens and laptops require less space.

Perimeter benching can be made up of a series of independent standing-height specialist tables clamped to each other for stability rather than to the wall. This system allows the classroom to be rearranged relatively quickly without affecting the fabric of the building. Tables with castors (or trolleys, see below) can also be used, making relocation easier and quicker.

Note

See also 'Bench-mounted machines' page 126

An adjustable work surface may be needed at the perimeter to accommodate a disabled pupil. The independent standing-height table described above, with an additional height-adjustment mechanism, could be used and could accommodate a bench-mounted machine and a vice for working with resistant materials if the appropriate work-surface material is used. Some schools may choose to house all their bench-mounted machines on individual adjustable tables, as this allows both able-bodied and disabled children to use the full range comfortably, whilst also enabling the room layout to be rearranged if necessary. In a food room there should be a specialist adjustable bench with hob and sink inset (see also 'Food technology equipment' in Section 5).

Photo: Brionney King

Trolleys

Tables with braked castors are sometimes referred to as trolleys. They can have the same specification as specialist tables and form part of the design and technology department's specialist tables range, although not all frame shapes are suitable. Castors must be the appropriate size for the height and loaded weight of the trolley. Mounting lightweight CAD/CAM machines on trolleys allows them to be relocated to other design and technology spaces if required or to create temporary manufacturing runs. Ensure that the height of the work surface takes into account the size of the castors.

Photo: Lauren Shear/Design Council

Multi-benches

Multi-benches are heavy-duty tables with metal or, more usually, wooden frames. They can be used to work with wood, metals and plastics, with some incorporating hinged flaps for engineering activities. The standard solid wood top can have a loose oil-resistant board added for working with metal. Vices are available which may be changed easily for use with a variety of materials.

Multi-benches can have cupboard units beneath them for storing tools and other resources. However, open benches which allow pupils to tuck their knees underneath and therefore sit more comfortably will often be preferable, particularly if there are no other drawing facilities in the workshop. Open benches are also lighter and easier to move in order to rearrange the workshop layout, although a bench must be robust enough to withstand the highly practical nature of many workshop activities. A new bench design suitable for product-design workshops has been developed, which allows pupils to design on a smooth wipe-clean surface but is still sufficiently heavy-duty to allow 'light' making with hand tools and the use of portable vices when necessary.

The optimum height for a workbench is around 850mm. This takes into account the height of vices, the types of tools and materials used and the downward force often required when using hand tools. Some multi-benches contain a central well for storing hand tools. This does, however, present problems for doing flat design work larger than A3. Benches are usually two- or four-person, the latter being more economical for space.

Adjustable-height multi-benches suitable for disabled pupils are available which can be operated electrically or manually. When choosing such a bench, the emphasis must be on the need to adjust it as quickly, unobtrusively and easily as possible.

Table and benching materials

Basic tables, specialist tables and perimeter benching all generally have plastic-laminate work surfaces over a manufactured-board core and are edged either in solid wood, plastic strip or the core material itself. The edge material should be strong and well bonded because these tables may be subjected to a good deal of heavy use. Solid laminate (a series of paper laminates glued together to form a dense material) can also be used; here the worktop material also forms the edge. This material is particularly useful where mild-strength chemicals are used (e.g. in electronics) or on benching in a workshop where a sudden impact could cause the core material of laminated board to crumble. Whatever material is chosen, tables for use with computers should have a low-reflectance finish to prevent problems with glare. With increasing use of laptops, some of which may be wireless, schools should consider applying this requirement to all tables

In food rooms, surfaces should be easily washable, water- and heat-resistant and, if fixed, fully sealed to avoid water penetration. Laminated upstands should also be well sealed and preferably post-formed in order to avoid water attack on edges where two glued laminate surfaces meet. Deeply scratched surfaces can harbour dirt and bacteria so stainless steel, which is hard and therefore difficult to scratch deeply, is often used in commercial catering facilities. Its use may therefore be considered throughout school food rooms for both perimeter benching and loose tables.

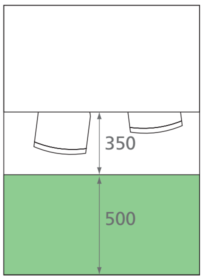


FIGURE 4.4
Distance between tables (mm)

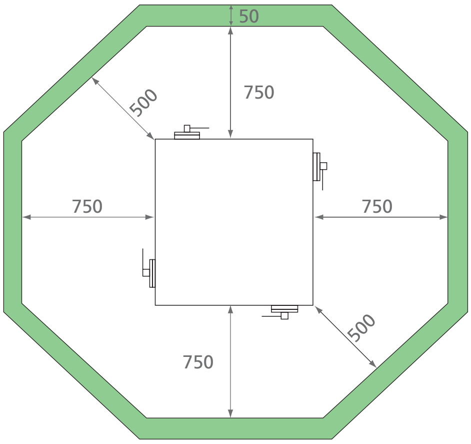


FIGURE 4.5
Distance between multi-benches (mm)

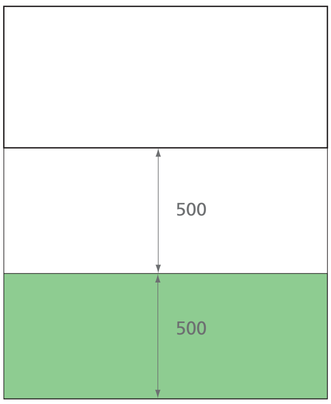


FIGURE 4.6
Distance in front of perimeter benching (mm)

Distances around tables and benches

Figures 4.4-4.6 give a guide to the distances that should be allowed around tables, multi-benches and perimeter benching. These dimensions, in conjunction with the distances around machines given in Section 5, can be used when planning a room layout to help ensure comfortable and safe working conditions. However, it is important to note that adequate distances are not the only safety consideration. Room shape and size are amongst the other things to think about, and the activities carried out also need to be considered.

The tinted areas in Figure 4.4 allow for an overlap of 500mm between adjacent items of furniture. This overlap must only be used between tables. The distances shown should be increased between long runs of tabling or where there is a high level of circulation. The diagrams show recommended distances of 850mm around a general-design table or a computer table. Therefore two tables back to back would need 1200mm between them (2 x 850mm – 500mm).

Figure 4.5 shows distances around a four-person multi-bench, with a tinted overlap area of 50mm where two benches are positioned next to each other. A distance of 750mm is allowed around each side of the four-person workbench. Therefore the space needed between the four-person multi-benches would be 1450mm (2 x 750mm – 50mm).

Figure 4.6 shows the distance required in front of perimeter benching; a zone of 500mm will allow space to be shared with tables.

Seating

Three types of seating are desirable to suit the diverse nature of design and technology: stackable chairs, stools and adjustable chairs. Stackable moulded-plastic or laminated wooden chairs are useful as they are inexpensive, relatively easy to clean and lightweight. It is important to check the comfort of these chairs, however, because some are more suitable than others. When used with loose tables they should be easily movable to allow an area to be set up for group activities.

Stools are generally used with standing-height tables. Ergonomically designed moulded-plastic or wooden seats are preferable to flat seats as they are more comfortable. Stools with back rests are more comfortable over a long period although they allow less freedom of movement for pupils and are harder to store under tables when not in use. The height of stools prevents pupils resting their feet on the floor which restricts postural change, though footrests help overcome this problem to some extent.

The ability to adjust seat height is particularly advantageous when computers are being used. Fully adjustable chairs (both seat and back) enable pupils to align themselves correctly in relation to the computer screen and to rest their wrists comfortably at the keyboard. A swivel seat is particularly useful in rooms where computers are placed on the perimeter as pupils can easily turn to face the centre of the room for occasional class discussions or directions from the teacher. Adjustable-height chairs should be able to accommodate all sizes of pupil, but if particularly short pupils are unable to rest their feet flat on the floor footrests should be provided.

Storage

Storage in any department is an important issue, but in design and technology the wide range of materials which need storing demands that furniture choice must be carefully considered. Restricting storage-unit types allows spaces to be interchangeable, but equipment must be stored in the safest and most appropriate way possible. This section identifies four types of storage:

- Storage units
- Shelving systems
- Resistant-materials storage
- Coat and bag storage

Storage units

A range of storage units that are mutually compatible (in terms of plan size, available components and style) allows spaces to be used efficiently and flexibly and resources to be shared.

Mobile cupboard and tray units have the advantage that they can be moved to where they are needed. For space efficiency, units can be kept undeperimeter worktop and then moved to the centre of the room when pupils need better access to particular resources or if pupils wish to sit at the worktop. However, space must be allowed in areas where mobile furniture is to be ‘parked’. The use of trays across the suite allows resources to be transported more easily from unit to unit. Under-bench cupboards with doors are preferable to avoid resources spilling out into circulation routes and causing tripping hazards.

Static units, which should be from the same range as the mobile ones, include tall cupboards (which are good for high-volume storage, particularly if storeroom space is tight), low cupboards, tray units and plan chests. These lower units can provide additional work surface, display area and space division.

Tray units are most suitable for use under perimeter work surfaces as the trays can be pulled out and resources inside them more easily viewed. Doors for storage units should ideally open to 270°; where possible they can be folded back to sit by the side of the carcass unit to prevent obstructions and tripping, particularly where they are against circulation routes. Like tables, the surface of the cupboard top must be robust and edges well sealed. Horizontal edges of doors should also be well sealed to prevent water ingress.

Resource trolleys are particularly useful for storing and transporting small amounts of equipment and materials. They may contain plastic trays which can also be used in cupboard units in the teaching spaces, storerooms and preparation areas. When planning layouts it must be remembered that a trolley needs a parking space in both teaching and storage rooms.

In food rooms, carousel fittings make the most use of corner-cupboard units, especially in peninsular layouts. Some schools prefer not to use cupboard units in their food rooms in favour of open tables; this assumes all resources are kept in the storeroom and wheeled in on trolleys. This is particularly true for commercial-catering layouts which are generally made up of a series of open units to enable layout changes. Open units also allow for easier cleaning and a more centralised approach to storage. This system is often more successful with schools which have a food technician.

Photo: David Prest

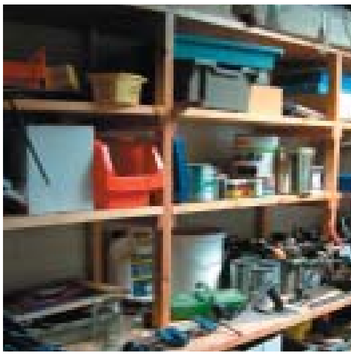
Some storage units may double for display – those with glass doors, for example. In some cases storage/display units may need to be lockable to protect valuable or potentially dangerous items.

Occasionally specialist storage units may be required for specific items of equipment. Sewing machines can be effectively stored in mobile units pivoted at one point under side benching to enable them to be wheeled out at 90°. Half of the unit is open underneath, which allows the operator to sit at it to use the sewing machine. The unit can be swung back under the side bench when not in use, to save space (see figure 2.23).

Shelving systems

There are many types of shelving system that can be used to store teaching materials and equipment and pupils' projects in storerooms (occasionally they may be used in classrooms). The four main options, which vary in the flexibility they afford, are:

- **Purpose-built fixed timber batten:** this shelving can reduce flexibility but allows shelves to fit accurately into a storeroom
- **Adjustable-height timber shelving:** this shelving can be free-standing, though is more usually fixed back to the wall. Relocatable pegs allow shelves to be adjusted, providing greater flexibility than with fixed-batten shelving
- **Top-hung storage:** this system is suitable for both storerooms and classrooms. It incorporates a wall-mounted shaped metal section from which droppers and shelves may hang at any point. This system may not be suitable in conjunction with very lightweight walls
- **Cantilevered brackets:** in fixed metal droppers. An adjustable system which is also suitable for storeroom and classroom use and which enables shelving to clip in at various heights



To ensure safe manual-handling operation the user should be able to see and assess the weight of a stored item easily. For this reason the shelf should not be so deep as to prevent this. The heaviest loads should, in any case, be stored at waist height (usually around 1000–1100mm) where removal is easiest and safest. High-level storage of heavy items should be avoided . Adjustable shelving allows shelves to be positioned at the optimum height for the weight they are storing and the height of the person who is working in the area. The angle of reach should be taken into account when determining the height of shelves directly above cupboards.

To allow resources to be organised effectively in food rooms and stores, shelves should be no deeper than 200mm for small ingredients and 350mm for large tins and electrical items. Shelves should never be positioned over a cooker.

Some schools prefer to put all their resources in storerooms with no storage furniture in classrooms. It is worth remembering however that shelving systems provide opportunities for three-dimensional display of more interesting resources.

Resistant-materials storage

There are many ways of storing raw materials in storerooms or preparation areas, for example:

- Metal rods and timber planks should ideally be stored horizontally against a wall on a series of metal brackets and secured with safety chains. They should not be allowed to protrude into circulation or work areas.
- Sheet materials, e.g. manufactured wooden boards, metals and plastics are ideally stacked vertically in a variety of racking systems.
- Steel tubes and rods can be stored vertically in tall, sturdy drums or boxes if suitably secured.

The location of materials, particularly those with sharp edges, must be carefully considered, and they should never be placed near to doorways. Adequate space must be allowed to remove materials easily and safely from their racks or units (see also 'Storage' in Section 3).

Coat and bag storage

This is an important consideration with both health and safety and planning implications and should be considered early on in a project. Some schools provide lockers for pupils' books with storage for their coats only in classrooms; some provide lockers large enough to store coats and bags so that storage in classrooms is only required for resources needed for the lesson in progress. If pupils' coats and/or bags are to be brought into the teaching spaces then they must not cause an obstruction and there should be some means of storing them near the room entrance. Schools may wish to consider housing two smaller storage units in different parts of the classroom to avoid congestion. Having more than one coats-and-bags zone does make spaces more difficult to organise, however.

Free-standing units are the most flexible approach, allowing for rearrangement of the room. In food areas coats should be stored away from the food-preparation area with storage for aprons nearby. Units which contain a series of open, box-like shelves encourage a more organised environment, particularly if it is only bags which require storing. It is important that each compartment is big enough so that bags do not overflow onto the floor.

Finishes and fittings

Flooring

Flooring choice must be based on a sound knowledge of the learning environment to ensure it is fit for purpose. It is important to know, for example, the kind of activities that will be undertaken; what substances will be used (e.g. oil, grease, etc.); whether the space contains water or is susceptible to condensation; the noise levels in the area; the substructure of the floor, etc.

Generally the following characteristics are important when specifying flooring for a design and technology space:

- Safety performance, including slip-resistance
- Strength and resistance to wear
- Chemical resistance
- Resistance to static
- Hygiene
- Appearance
- Cost (both initial capital cost and maintenance cost)
- Maintenance
- Acoustic properties
- Flammability

Slip-resistance is a particularly important consideration in highly practical areas such as resistant-materials and food spaces, and it applies to both 'wet' and 'dry' rooms. Water, lubricants and dust (e.g. wood dust) can all make a floor slippery. Often flooring relies on a rough surface to ensure slip resistance; this is often at odds with the need to clean the floor. The manufacturer's recommended cleaning method should always be followed and proprietary cleaning products used. In certain circumstances using inappropriate cleaning methods may damage the surface finish. As with all areas of building maintenance, a good level of housekeeping should be kept up and spillages quickly cleared away to prevent accidents and damage to the floor itself. Preventative measures are preferable, including adequate cleaning regimes, measures to reduce the likelihood of spills and matwells in external doorways to prevent mud and dirt entering the building.

The level of slip-resistance of a floor will be reduced by an uneven substructure which may lead to excessive wear in certain places. Uneven floors may also lead to tripping, or slipping if water spillages create pools. These considerations are of particular concern in an existing space.

A floor's resistance to wear depends on a number of factors including the amount and type of traffic in the room, the maintenance it receives, the activities going on in the room and the loads imposed on it. The fact that things may be moved from room to room should be taken into account. For example, heavy machinery may be wheeled around on trolleys.

The use of anti-static flooring is recommended, particularly in areas with a high level of electronic and electric components. Legislation does not cover flammability of flooring,[13] but floor finishes can contribute to the spread of a fire and the degree of fire-resistance should therefore be identified. A fire-resistant material such as quarry tiles must be used in heat-treatment areas.

Long-term maintenance costs should be borne in mind; the initial low cost of flooring can soon be offset by excessive time spent cleaning.

It is important to establish with the relevant people at an early stage, and by consultation with the manufacturers if necessary, whether fixed furniture and equipment should be installed before or after flooring is fitted.

Typical flooring types are outlined below.

Vinyl

Vinyl is available in sheet or tile form. It is waterproof, and impervious to oil, fat and domestic chemicals. It is a relatively soft material and can be cut fairly easily, making it vulnerable to metal legs without plastic end-caps on stools and chairs. Thicker vinyls provide more sound absorption.

Sheet vinyl is relatively easy to lay but joints must be well sealed to ensure that water or other liquids cannot permeate to the underside. Vinyl tiles have the advantage that they can be replaced easily if damaged, but they can curl, tear or de-bond more easily.

Slip-resistant versions are available, often with small particles of metal embedded into them. The texture of this finish can make this flooring more difficult to clean than standard vinyls and it is important that the most appropriate cleaning method is used following the manufacturer's recommendations. Good maintenance will help to ensure flooring retains its safety characteristics.

Note

13. The provisions set down in Approved Document Part B of the Building Regulations concerning internal fire-spread do not apply to flooring materials because it is considered that these surfaces are not significantly involved in a fire at the early stages.

Linoleum

Linoleum is made from renewable ingredients and natural raw materials, which makes it a more sustainable resource. It is available in both sheet and tile form. Linoleum is finished with anti-static agents and offers resistance to most common chemicals. The material is soft and therefore offers some acoustic benefits. A wide range of colours and new cutting techniques allow for numerous inlays and floor patterns, some of which can help pupils with visual impairments.

Carpet

Carpet may be appropriate in non-practical areas such as resource areas and can help improve the acoustic quality of a space. An anti-static carpet may be necessary where there is a high level of ICT as a build up of static in the floor can affect electronic and electrical components. Dense-fibre carpets are the most durable and a slight pattern shows less staining. A carpet which resists water absorption will allow it to be specified in some 'wet' areas (but not food preparation areas).

Ceramic floor tiles

Ceramic floor tiles are available in a variety of sizes and shapes and can have a patterned relief which can generally stop them being slippery but does make them more difficult to clean. Specialist skirting tiles may be useful where floors are washed frequently. However, tiles are hard, making them noisy, less comfortable for teachers who stand on them all day and unrelenting to delicate objects which may be dropped on the floor. Larger tiles are more likely to crack, particularly on an uneven floor. Tiles can be grouted with a non-slip filling; smaller tiles, with a greater proportion of grouting, will therefore be more advantageous. Quarry tiles are stronger than other ceramic tiles, very hard-wearing and easy to maintain, but textured, slip-resistant varieties must be used in design and technology areas. Quarry tiles are usually unglazed, and will therefore stain with oils and fats.

Other flooring

Rubber flooring is hard-wearing and warm. A variety of relief patterns give it a non-slip quality but as with all flooring which relies on a relief pattern to ensure slip-resistance, dirt can build up around the patterns, so appropriate cleaning is essential. Sheets come in limited sizes and as more than one may be required in a room, it is essential that joints are correctly sealed to prevent water ingress.

Sealed wooden flooring is durable and less hard than ceramic tiles but as frequent wetting causes swelling and warping proper maintenance is essential.

If concrete floors are left bare in workshops they must be sealed; even plain tap water can degrade concrete after a certain amount of time. Unsealed concrete will shed dust over a period of time which then in turn acts as an abrasive coating to create more dust – again this can be avoided by sealing the concrete. Plain concrete floors do little to contribute to an attractive working environment.

Walls, windows and doors

In food rooms, where a good level of hygiene is required, the walls must have a washable surface. Splash-backs behind food preparation areas may be made of stainless steel, perspex, solid laminate or aluminium sheet. However splash-backs behind hobs must be heat resistant. If they have visible fixings then it must be possible to clean them easily. Tiles are less effective because bacteria can be harboured in the grouting although larger tiles with less grout do reduce this problem.

Wall surfaces in heat-treatment areas should be finished in a matt, fire-resistant material.

Dado rails prevent damage to walls at chair and table height. Solid laminate is an ideal material to use as it requires little machining. The cost of rails may be offset by savings on decoration costs.

Some form of daylight and sunlight control will be needed in most spaces to ensure good visibility of the electronic whiteboard and/or computer screens.

Photo: Briony King

Blinds – vertical, horizontal or roller – are frequently used for this purpose. Because all three types of blind are susceptible to damage, it is important to specify high-quality durable fittings and install them in a way that minimises the chance of damage occurring. For safety and to avoid damage, pull cords should be tidied away and a mechanism for doing this should be provided on the wall. Horizontal aluminium blinds are the most controllable but do gather dirt. Metal slats on south-facing rooms can heat up and act like radiant panels. Vertical blinds are cheaper and easier to clean but are more delicate and offer less controllability. Roller blinds provide some lighting control but this cannot be combined with a view out for pupils. Ensure that both vertical and roller blinds are waterproofed for wet areas, particularly food rooms. It should be possible to secure blinds so that they do not blow against hot burners (it is not advisable, however, to position cookers in front of windows).

One-and-a-half-leaf doors are advisable in resistant-materials teaching and storage areas where large objects may be brought into the room (the half-leaf can be closed most of the time). In areas which surround a central resource area, one-and-a-half-leaf or double doors allow spaces to be opened up and used as a suite. Vision panels in doors are particularly valuable in practical parts of design and technology areas where maximum supervision is needed. Consider vision panels at a lower level for wheelchair users, perhaps with a centre line around 1000–1200mm.

Colour and texture

The key considerations when choosing room surface colours are the need to maximise light levels, visibility, maintenance and psychological effect. Colour can affect behaviour and mood. For example, passive cool colours, such as blue-green, light green and beige, are thought to aid concentration while bright colours can be disturbing or over stimulating to some people. Generally speaking neutral colours provide the most flexible background for a learning space and colour can be provided in displays. The following key points are worth considering:[14]

- Glossy finishes can be glaring and should not be used on the horizontal surfaces of furniture, particularly for use with ICT.
- Dark colours reflect much less light than pale colours and can make a space feel smaller. They should therefore be avoided on walls and ceilings (which should be white), though pale floor colours are impractical.
- Bright colours and strong patterns should be avoided on horizontal working surfaces as they can be distracting.
- Highly contrasting patterns and colour combinations can be disturbing to some pupils and should be avoided.
- Contrasting tones and shades (for example on door frames) can help those with visual impairment orientate themselves.

Note

14. DFEE: *Furniture and Equipment in Schools: A Purchasing Guide* gives detailed guidance on colour (see References).

Making the best use of a space

The following suggestions are intended to help teachers make the most of their environment to create a flexible and effective space.

Flexibility

- Furniture can be used to subdivide an area without creating permanent barriers. For example, a 'clean' research and design area can be defined in a resistant-materials space by cupboards containing appropriate resources.

- Furniture can create temporary discrete workstations to create a 'studio' style atmosphere in areas such as post-16 students' resource bases.

- Group discussion does not always have to focus around the main whiteboard. Informal exchanges of ideas can happen in a number of ways and providing additional vertical surfaces for writing/drawing can encourage pupils to express their ideas in a spontaneous way. Examples include using blackboard paint on a wall, using whiteboard material for tall cupboard doors or having mobile flip charts, whiteboards or interactive whiteboards available to share.

Display

- Dynamic displays can be created by putting wall displays (e.g. posters or pupils' design drawings) on a wall behind a shelf display of associated three-dimensional objects.

- Shopfitting display units can sometimes be useful, for example free-standing units providing display on all four sides (some units could be glazed and lockable). Units with castors can be moved to where display is needed, such as next to a group of tables, as an inspirational resource. A variety of fixings which fit on to standard wall uprights, including holders for rolls of paper or fabric, are also useful.

- In a textiles room, fabrics can be stored where they double as display. A number of shopfitting systems are available for this purpose. Alternatively fabric can simply be hung or draped from a series of pegs or dowels.

- Wall shelves above benching are useful for display but neither shelves nor cupboards should be positioned over a cooker.

- If the height of a room is sufficient (e.g. above 3m) consider using the ceiling area for display. Items such as kites and large three-dimensional constructions can have a dramatic and stimulating effect.

- Coloured lines and labels on the wall (or banners hung from the ceiling) can be used to denote activity areas, so that pupils know what is on offer. This is particularly useful in workshops where younger pupils will not necessarily recognise all the equipment and what it does.

- In all spaces there should be some means to display products, for example in electronics a display of electrical goods can provide a stimulating background as well as being used as part of discussion sessions. Mobile display units can be useful, allowing pupils to gather around.

- Glass shelves in front of internal glazing act both as storage and as a way of introducing pupils to items of equipment.

- The backs of storage units (if visible) can be used for two-dimensional display, and the tops of units for three-dimensional display.

- Interactive whiteboards can offer display opportunities, showing slides to offer stimulation and inspiration for pupils.

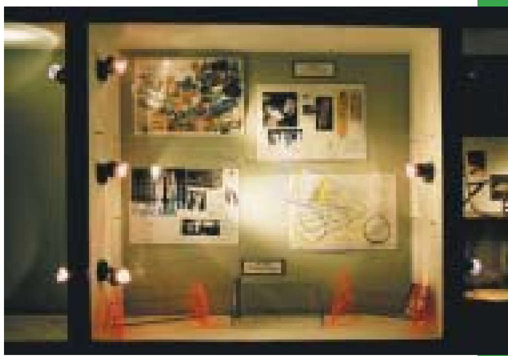


Photo: Alison Wadsworth

5

This section gives a brief description of the equipment featured in the room layouts throughout this volume. Key planning and health and safety issues are also outlined. This section should be read in conjunction with Section 6, 'Services', which gives more detailed information on switches, lighting, installation, ventilation and extraction. BS 4163, Health and Safety for Design and Technology in Schools and Similar Establishments, must also be referred to. Accompanying the descriptions of floor-mounted machinery and equipment are space-allocation drawings.

Machines and equipment

Planning points for floor- and bench-mounted machines

There are some key planning issues which relate to all machines regardless of their function:

- The floor in the area where the machine is sited should be level, non-slip and well maintained.
- Machines should be positioned in one long run as far as possible, to give the teacher a single sight line for supervision.
- Machines should be situated in good natural light – particularly important for precision machines.
- Consideration must be given to the most appropriate machines to position adjacent to fire exits; those which do not require large pieces of material to be clamped to them will not block exits in an emergency.
- Positioning machines against a circulation route (a route between the machines and multi-benches for example, as in Figure 5.1) allows the operator the greatest distance to move away from an accident. Allowing circulation behind the machines does, however, require good workshop management and teachers may choose to make pupils aware of safe workshop practice by marking out the circulation route using chevron tape.
- Wherever possible multi-benches rather than design tables should be put next to machinery runs. Pupils doing similar work on multi-benches are less likely to distract pupils using machines, and benches provide useful supplementary work surface for machine operators.
- There should be sufficient space around any machine to allow safe use of the machine and to prevent the operator from being accidentally pushed by passers-by.

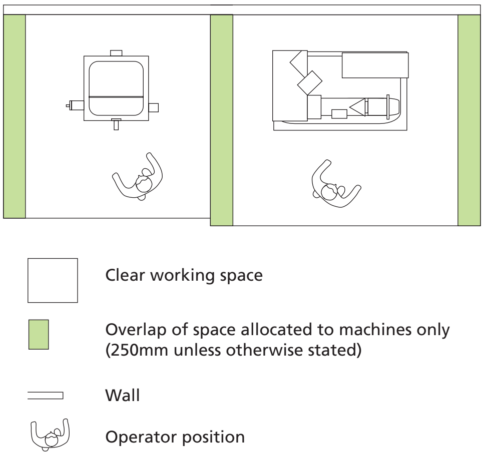


FIGURE 5.1
Key diagram showing overlap

The space-allocation diagrams for machines give a guide to the working areas required. Figure 5.1 illustrates how the diagrams are used. However, these dimensions alone will not ensure safety, and consideration must be given to:

- The materials being used
- Working practices
- The number of people working at or circulating near to the machines
- The location of the machines
- The size and layout of the workshop as a whole (see BS 4163 for details)

No sizes are given on the machine drawings: the dimensions refer only to the space around the machine.

Floor-mounted machinery

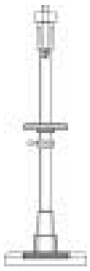
In the space allocation diagrams below, the dimensions each side of the machine represent a clear working space. However, where machines are next to one another, dimensions can be overlapped (as indicated by shaded zone on diagram). Distances in front of machines are assumed to adjoin circulation routes – it would be inadvisable to position the user against a wall or fixed structure. A 200mm space has been allowed at the back of the machine for cleaning and maintenance purposes unless otherwise stated. The dimensions around the preparation machines are shown to overlap completely. This is based on the assumption that only one machine in the preparation area will be in use at any one time and that there is less likelihood of misuse by the operator than in the workshop.

All these machines should be firmly fixed to the floor.

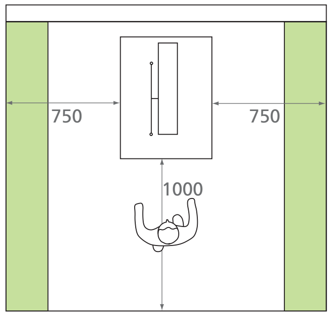
Floor-mounted woodworking machinery

An isolator switch should be provided on or within two metres of all these machines. They should also be on a no-volt release RCD circuit.

Pillar drilling machine



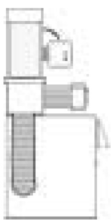
This machine is generally one of the most heavily used in a workshop and, where space allows, it is preferable to provide two – one for wood and plastics and one for metal. Alternatively, one drill can be used for all materials simply by changing the drill bit and the speed of the machine, though this must be carefully managed. Large pieces of material may require drilling so space around the machine should be provided for this. If the material is not clamped tightly onto the table during the drilling operation it could spin round with the drill bit. Providing sufficient clear space around the machine will reduce the likelihood of a serious accident if this should happen. A foot- or knee-operated stop button must be fitted on the drill as an additional safety feature. Low-voltage task lighting is also needed. The machine should be securely bolted to the floor.



▲ **FIGURE 5.2**

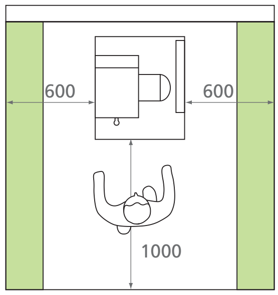
Pillar drilling machine

Sanding machine (linisher)



Sanding machines are available in two basic forms: a rotating disc or a continuous moving horizontal or vertical belt (linisher). The vertical position is generally considered a safer option.

The sanding machine is suitable to place adjacent to a fire exit as the material being sanded is not clamped to the machine and would not therefore obstruct the fire exit in the case of an emergency. A foot- or knee-operated stop button should be fitted on the linisher as an additional safety feature. Separate local exhaust ventilation (LEV) should be provided for sanding machines, due to the risk of fire or explosion from fine dust particles. Some machines, particularly linishers, may have LEV built into the machines.

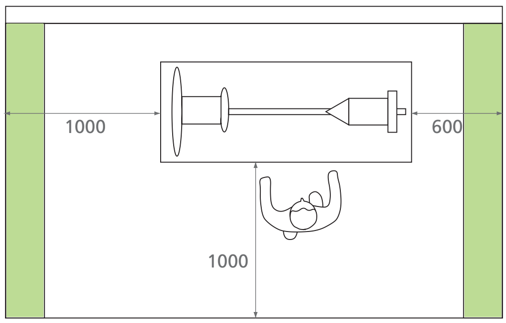


▲ **FIGURE 5.3**

Sanding machine

Wood lathe

A wood lathe rotates a piece of timber whilst a chisel or scraper is offered up to the wood at various positions in order to 'turn' the material down and shape it, for example into a bowl or a table leg. Ideally the lathe should be placed at the end of a run of machines away from the major traffic of the workshop, and positioned within a teacher's clear line of vision. Wood lathes can be placed parallel to a wall or preferably (if there is room) at an angle of 15° to the wall. This gives the operator greater protection from the circulation route. Many lathes have an additional face-plate facility (for bowl turning) attached to the end of the



▲ **FIGURE 5.4**

Wood lathe

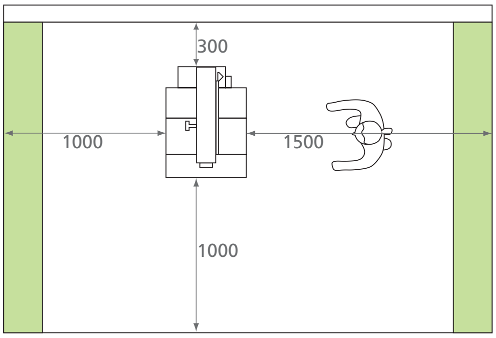


FIGURE 5.5
Bandsaw

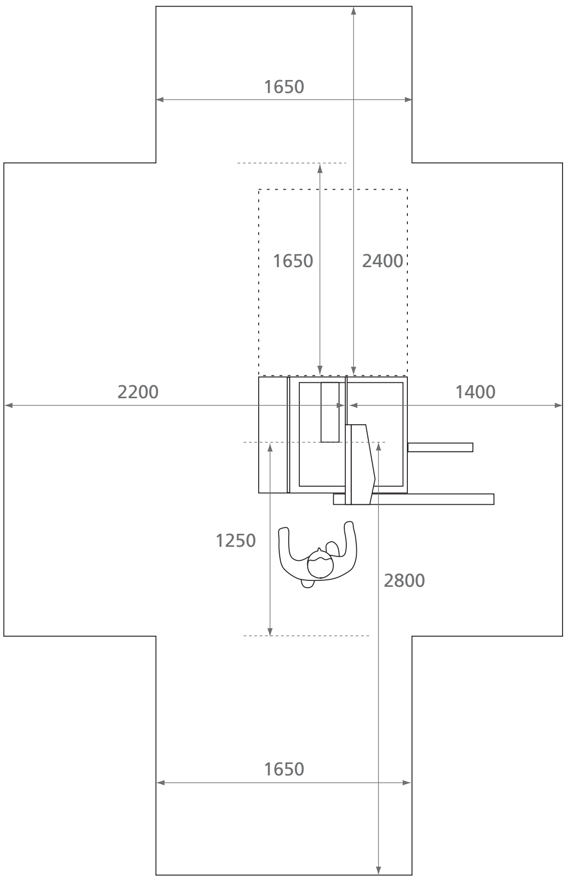
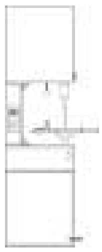


FIGURE 5.6
Circular saw

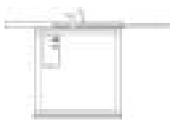
machine. In this case the extra operator position must be considered when planning the workshop. Due to the precise nature of woodturning this machine requires a good level of natural light and low-voltage task lighting. LEV above the lathe is not normally required but a COSHH risk assessment should be carried out to evaluate the likely risk to health from inhalation of wood dust. The amount of dust given off during operation may be minimised by the use of well-maintained tools.

Bandsaw



A bandsaw, which cuts plastic, timber and sometimes metal, can be very useful in smaller schools where space does not allow for a circular saw. This machine may be used by older, responsible pupils under the direct supervision of a competent person who has received recognised training. The machine would ideally be sited in the preparation room but as it is frequently required during lessons many schools site them in workshops. There should be sufficient floor area to allow long lengths of wood to be taken through it, although if this is rarely necessary the circular saw could be used and the space around the bandsaw slightly reduced. A foot- or knee-operated stop button should be installed on this machine. A key-operated switch should be provided to lock off the machine when not in use. LEV should be provided on the bandsaw; where this is linked to a central extraction unit, it is useful to position the bandsaw as near to it as possible in order to reduce the length of ducting (see 'Services', Section 6).

Circular saw

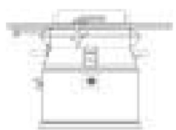


The circular saw has a large rotary blade which can cut down large sheets of manufactured board and timber. The saw must only be used by a technician or teacher who has received recognised training and under no circumstances by pupils; therefore it should be kept in a separate area away from pupils (preferably a preparation room where the user will not become distracted during operation and where it cannot be accessed by pupils).

Some sheet material used with a circular saw requires a substantial amount of space at saw-table level for operation. A take-off table should always be used when large sheets are being processed, as the saw table itself is generally inadequate to support full-size sheets. The distance between the blade and the back of the saw table or take-off table must be no less than 1200mm. Schools with limited space may find a small saw model with a portable side or extension table (for handling wider sheets) more suitable. A circular saw should be fitted with a key-operated isolator switch and a foot- or knee-operated stop button should be fitted as an additional safety feature.

LEV must be provided for this machine (some rigidly constructed exhaust units will sit adjacent to the machine and provide a take-off table surface as well). Where a circular saw has to be used in a workshop, it must not be easily accessible to pupils and there should be sufficient space not to necessitate feeding materials into circulation or pupil work areas. There are also implications for noise (See 'Acoustics' in Section 6).

Planer/thicknesser



Planer/thicknesser machines have two main functions: to produce true planed faces on sawn timber (planer) and to reduce a piece of timber to a specific, pre-set thickness (thicknesser). These machines can help reduce the cost of materials enabling the buying-in of raw timber (cheaper than ready planed) and the recycling of timber which requires reducing or surface finishing. It is essential, however, that such material is free of any additional components such as screws or nails. Some schools may use a planing machine only, although this does restrict the use of raw timber as it is more difficult to ensure exact thicknesses.

The planer/thicknesser should be used only by a technician or teacher who has received recognised training and under no circumstances by pupils. Ideally it will be housed in a separate area (preferably a preparation room) free from distraction during operation and where it cannot be accessed by pupils. Consideration must be given to the length of material going through or over it – timber planks often come in 2.4m lengths so that at least this amount will be needed on both in- and out-feed. The machine should be fitted with a key-operated isolator switch and a foot- or knee-operated stop button should be fitted as an additional safety feature. The planer/thicknesser should ideally be sited next to the circular saw where it can share LEV. Planer/thicknessers are noisy machines (see 'Acoustics' in Section 6).

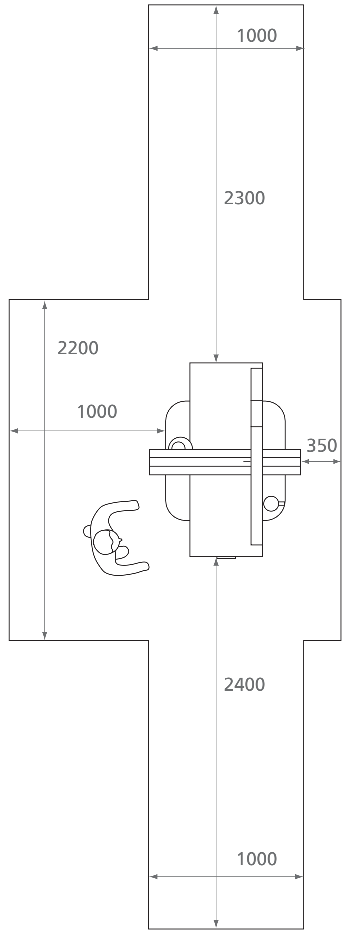
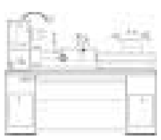


FIGURE 5.7
Planer/thicknesser

Floor-mounted metalworking machinery

Metal lathe



A metal lathe rotates metal or plastic rod or irregular-shaped material while a tool cuts into the material at a pre-set position. It is mainly used to produce flat, cylindrical and conical forms. As with a wood lathe, a metal lathe may be placed either parallel to the wall or

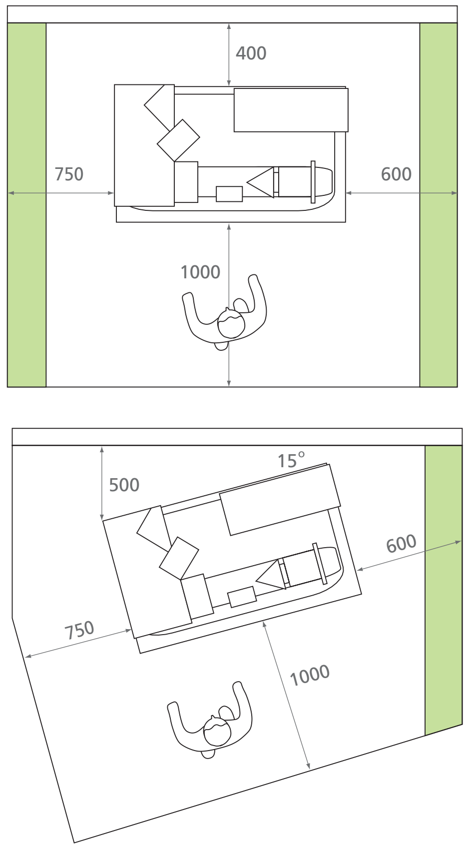


FIGURE 5.8
Metal lathe

at an angle to it, the latter position being helpful for demonstrating the working of the lathe to pupils gathered around the machine. The lathe is a precision machine and should be placed in a position with a good level of natural light, though additional low-voltage task lighting is usually built into the machine. Metal may need to be fed into the chuck through the head-stock on the operator's left-hand side for certain operations and this should be borne in mind when determining the space around this machine. Lubricating fluid usually needs to be used when the machine is in operation, so it is a good idea to keep it away from areas where pupils are producing finished artwork or design sheets.

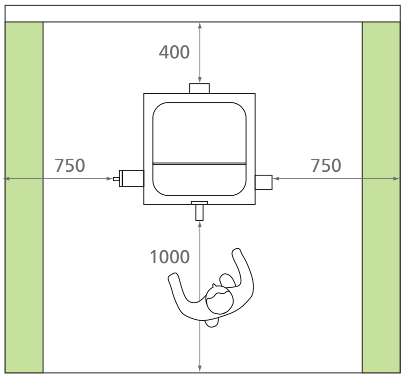
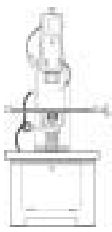


FIGURE 5.9
Milling machine

Milling machine



This machine is used to make slots, grooves or flat surfaces. Using a pre-set rotating cutter position a milling machine accurately removes the surface from a piece of metal placed on a traversing bed.

The moving bed on this machine means that its position must be carefully planned. The moving table should not be within 500mm of any fixed structure. As a precision machine it is best sited adjacent to its counterpart – the metal lathe. Lubricating fluid usually needs to be used when the machine is in operation, it is therefore a good idea to keep it away from areas where pupils are producing finished artwork or design sheets.

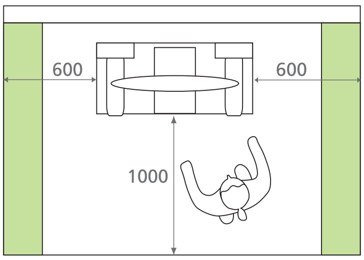


FIGURE 5.10
Double-buffing machine

Double-buffing machine

This machine polishes metal or plastic which is held against rotating mops. Like the linisher this is an appropriate machine to position adjacent to a fire exit. The rotating shafts upon which the mops sit should not be exposed: they require adequate guards. If the machine is to be used frequently, LEV is recommended. Some manufacturers now make buffers with in-built extraction to collect particles from the mops and fumes from the polish applied during the buffing process. The buffer is generally a less dangerous machine than others and can be located at the end of a machine run adjacent to another activity zone.

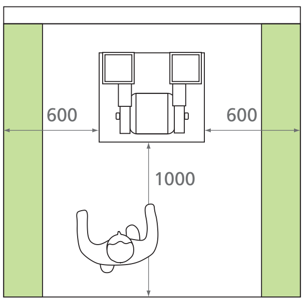
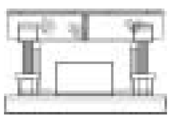


FIGURE 5.11
Off-hand grinding machine

Off-hand grinding machine



Most grinders have two rotating disks of grindstone about 15mm in thickness. They are generally used by teachers and technicians for maintaining drills and lathe bits. Pupils may use this machine when adequate supervision and instruction is given, but it is generally most ideally sited in a preparation area.

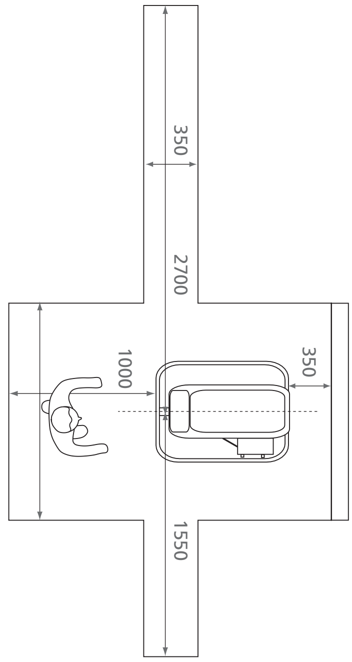
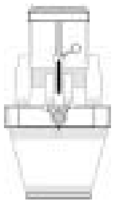


FIGURE 5.12
Hacksaw

Hacksaw



Usually located in the preparation area, this machine will cut metal bars and large tubes. The saw blade moves slowly back and forth whilst the metal remains clamped. A mobile stand may be needed to support the metal, particularly when cutting to size the standard three-metre lengths of metal which are often delivered to schools. Space must be provided around the machine in order to cut the metal at various points along its length. For ease of access to the materials used in the machine and to save space, a hacksaw is generally best sited next to or beneath metal-rod or tube storage. If it is beneath the storage racking, the maximum height of the machine when it is in operation must be considered.

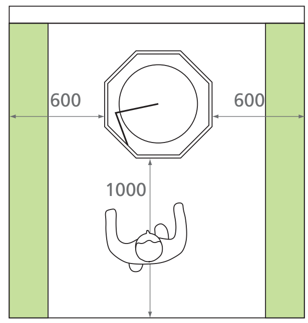


FIGURE 5.13
Horizontal grindstone

Horizontal grindstone

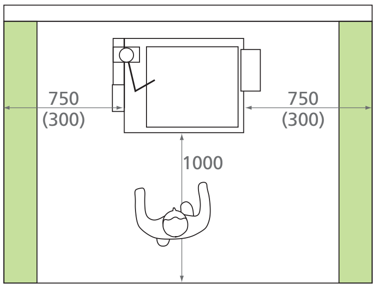
This machine will sharpen tools such as chisels on a rotating circular flatbed of grindstone. It is not necessary in teaching areas and is best sited in the preparation area away from main circulation areas.

Hot-metal equipment

Careful consideration must be given to the siting of all hot-metal equipment because of the dangerous nature of the activities associated with it. Where there is more than one piece of equipment they are best located together and any equipment should be positioned with good supervision in mind and kept free of oil, grease and dirt. LEV for fumes should be provided for all hot metal equipment. The floor should be fire-resistant and slip-resistant. An adjacent work surface on which to leave hot metal to cool should be provided. Gas solenoid protection should be provided in the main gas supply in case an electricity failure disrupts the air supply.

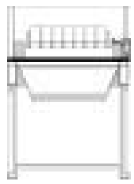
Heat-treatment processes may either be grouped together (which may be a useful way of maximising services, flooring and anti-glare surfaces) or there may be one or two machines sited within the main run of pedestal machines. A school must carefully consider which equipment will best suit its teaching needs.

There should always be clear access to an emergency exit and an appropriate fire extinguisher or blanket should be immediately available. Fire detectors and fire alarms should be fitted.



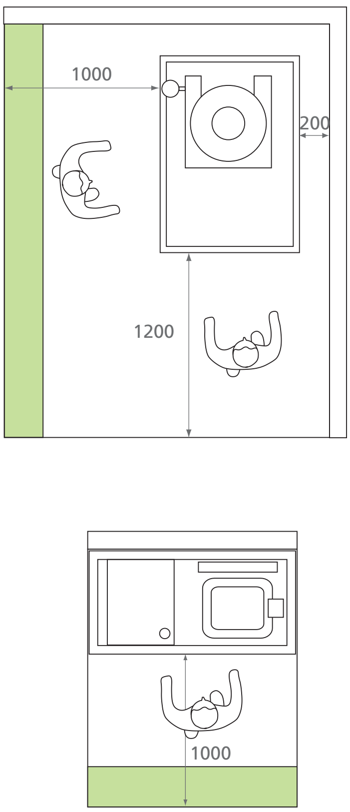
▲ FIGURE 5.14
Welding bench

Welding bench



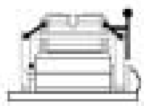
Welding is usually serviced by a torch burning oxygen and acetylene gas stored in cylinders. When not in use, oxygen and acetylene cylinders not directly connected to a welding bench must be stored chained to an upright trolley in an area agreed with the fire officer. If the gases are piped to the bench from an external store, this must be of fire-resistant construction with access from the outside only. Gas cylinders, whether in use or not, must always be housed in a well-ventilated area.

Electric arc welding including metal-inert gas (MIG), metal-active gas (MAG) and tungsten-inert gas (TIG) requires specific shielding facilities in order to avoid flash blindness. Some LEAs have a policy that excludes electric arc welding. A flame-resistant curtain around the bench is necessary to protect other pupils from seeing the arc and from sparks emitted during arc welding.



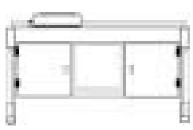
▲ FIGURE 5.15
Crucible furnace and moulding bench

Crucible furnace and moulding bench



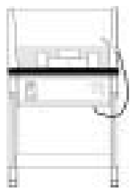
A crucible furnace is a casting facility in which metal is melted in a pot (the crucible) inside a furnace before being poured into a mould, usually constructed from sand. A sand tray beneath where molten metal is poured contains any spillage.

The furnace must be kept well away from water, as contact can cause the molten aluminium- or zinc-based alloys used in the furnace to explode. For this reason it is best to keep the furnace away from windows in case of leaks. Placing the furnace in the corner of a room reduces the likelihood of distraction from neighbouring activities and in the event of an explosion, limits the damage primarily to walls. Casting will always be demonstrated or supervised closely by a teacher who is competent and has received recognised training. There should always be sufficient space available for pupils to observe the procedures in safety; manipulating and pouring a crucible of molten metal requires considerable space. The pouring area should be designed so as to contain any spills of molten metal safely. LEV is required for fumes.



A moulding bench may be used in conjunction with the furnace. The bench consists of a deep tray of sand inset into a bench top in which a mould can be constructed. The deep tray has a cover over it to prevent the sand drying out. As pupils will fill the mould with sand and lift it from the bench, the surface should be no higher than 800–850mm. The bench should ideally be placed near to the furnace to enable pupils to construct a mould and take it over to the furnace where the molten metal can be poured directly into it.

Brazing hearth



This is a popular appliance for hot-metal working, including jewellery making. The hearth enables pupils to join two pieces of metal together with spelter or silver solder heated by a gas torch supplied from either the mains or a liquefied petroleum gas (LPG) bottle. Double units are also available for schools (taking up less floor area than two separate hearths and generally proving less expensive). A water trough or low-level sink for quenching hot metal should be provided near to the hearth.

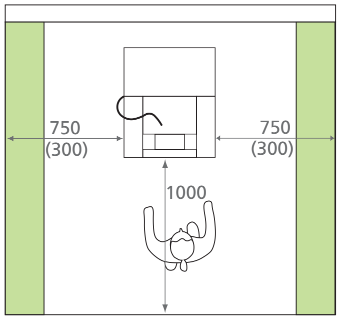
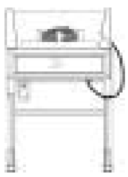


FIGURE 5.16

Brazing hearth

Ceramic-chip forge



This is used to heat metal to red heat in order to manipulate it. The heat is generated by gas burners and is passed through a layer of ceramic chips. The hot metal is usually shaped on an anvil and space should be allocated near the chip forge for this purpose. A trough or low-level sink for quenching hot metal and a rack for associated tools should be provided nearby.

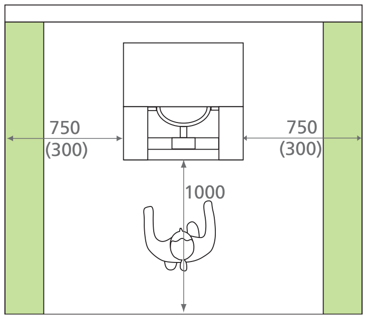


FIGURE 5.17

Ceramic-chip forge

Combined brazing hearth/ceramic-chip forge

A combined unit with an interchangeable work surface which allows both brazing and forging is particularly useful in small schools. A space-saving double unit with a separate hearth and a forge is also available.

Pickling bench

A pickling bench allows pupils to clean metal after heat treatment. A tank containing dilute acid and a sink is inset into the bench, which should ideally be no higher than 850-900mm to allow for safe use by smaller pupils. The acid cleans or 'pickles' the metal and the sink provides running water for rinsing. The pickling bench should be sited in a well ventilated area. The acid bath should come with a protective cover to prevent splashes. A large dilution trap is often provided so that the bench can be plumbed into mains drainage. A COSHH risk assessment[15] should be carried out for fumes.

Note

15. See HSG 97, *A Step by Step Guide to COSHH Assessments* (revised edition), HSE Books, 2004.

Bench-mounted machines

The information on the function of pedestal machinery also applies to bench-mounted machines. The general considerations governing guards, LEV, safety switching and braking for a pedestal machine are also the same. The area required at the side of the machine may, however, be smaller than that needed by its pedestal counterparts as the material used will not generally be as large. Electrical leads to bench-mounted equipment should be enclosed in a suitable protective conduit; they should not trail across the benching as this may present a safety hazard.

All bench-mounted machines should be connected to the electrical supply through a suitable fused switch disconnector clearly labelled with the machine that it controls. A no-volt release or similar device should be provided to prevent automatic restarting after the mains power has been cut. These machines should not be connected using a standard 13-amp plug and socket. Space should be allowed for the operator at the front of the bench (see Figure 4.6).

The depth, height and construction of the bench is an important consideration. If the emergency-stop buttons for the whole room are set on the wall above the bench, the work surface should be no more than 600mm deep to enable pupils and staff to reach the switches quickly in an emergency (see 'Electricity' in Section 6 for more information on emergency-stop buttons). Given the significant height of some bench-mounted machines, the bench should be no more than 850mm high to enable safe use of equipment by younger pupils. An additional safety measure for all machines is an emergency-stop button clearly accessible to the operator which can be used in the case of emergencies. These switches should be provided for bench-mounted machinery on the rail beneath the bench top or on the floor slightly under the bench so as not to be a tripping hazard. This does, however, assume that the machinery is fixed to the bench. Bandsaws must always be securely fixed to the bench.

Plastics equipment

Plastics give off toxic fumes when overheated, but a built-in thermostat to control the temperature of the equipment will reduce the risk of this occurring. Equipment should always be sited in a well ventilated part of the workshop, for example near a window.

There is a wide variation in the size of plastics equipment and schools must consider the space available in the workshop when deciding which items of equipment to purchase. There should always be sufficient space around the equipment for safe and effective working.

A vacuum former uses atmospheric pressure to press plastic sheet over a mould to form a three-dimensional impression. Formers vary in size depending on the size of mould used, from a bench-mounted model to a larger floor-standing model on castors. Some have lids which slide backwards and hence they need to be positioned away from the wall when in use. This should be borne in mind when choosing a suitable position for the machine.

A line-bending machine uses an enclosed heating element to heat sheet plastic sufficiently for it to be bent accurately by a pivoted bed. Machine sizes are available to suit the size of plastic sheet to be used.

A hot-wire cutter cuts expanded polystyrene by melting it with a heated tensioned wire. It is particularly important that the machine is sited in a well ventilated area as the melting polystyrene gives off fumes. Some larger models may require LEV.

Plastic-coating equipment

An oven (which can be used for other general plastics activities) heats metal, which is then placed in a fluidising bed of powder. When the powdered plastic is blown onto the hot metal it fuses in place and coats the metal in plastic. These units are available in various sizes: some are bench-mounted, others are considerably larger. A well ventilated room is normally adequate for this process, although some types of plastic powder require LEV.

CAD/CAM equipment

Computer-controlled equipment enables a pupil to produce an item, or multiples of an item, through a fast, high-precision manufacturing process. The software which runs the machine is often also a design package (either two- or three-dimensional), allowing pupils to design, make and adapt products using the same computer.

The CAD/CAM items described below may be sited in resistant-materials, textiles, electronics and control-systems and graphics areas, or located in a shared resource area. CAD/CAM equipment is often placed on mobile trolleys and can be pulled away from the wall for demonstration purposes. Larger machines may need to be bolted to the floor; a distance of 1m from the wall must be allowed to allow for maintenance access. CAD/CAM are often 'clean' machines and for this reason some machines are more appropriately placed in teaching zones next to the electronic whiteboard and discussion area. However, it should be borne in mind that many of these machines are noisy when in use.

Stencil cutter

This versatile piece of equipment, which is available in a variety of sizes, is traditionally used by the signwriting industry to produce vinyl signs and letters. In the school situation it may also be used to score and cut card and other thin sheet materials. It has applications in all materials areas.

Engraving machines

These are widely used in schools for small-scale milling or routing. The bed size is usually in the A4 to A3 range and the machine may be used to cut thin sheet material such as wood and plastic of up to 5mm in thickness. These machines are often used to engrave printed circuit boards rather than using the more messy etching systems. Most engraving machines will only work when a protective interlocking cover is in place. The fine dust produced should be extracted at source.

Laser cutters

Increasingly schools are purchasing laser cutters which although expensive are quick and easy to use. Laser cutters may be used to cut most flat materials such as wood, paper, card, plastic and textiles. Some materials give off toxic fumes when heated which must be extracted at source.

Computerised sewing machines

Sewing, embroidery, knitting and weaving machines may all be computer controlled. Most of them are portable but it is advantageous to position the machines near their manual counterparts as the same materials will be used in both types of machine.

Heavier CNC (computer numerically controlled) machinery

This is usually located in the more specialised manufacturing rooms, and may include the machines described below.

CNC router

An efficient cutter of flat images with some limited capacity to produce three-dimensional work. A router works at a fast spindle-speed and is suitable for cutting wood, composites and plastic materials. Machine sizes vary from 600 x 300mm to 2 x 1m for larger-scale furniture work. LEV is necessary, as is a safety interlock in the protective cover.

CNC milling machine

This is used for the two- and three-dimensional machining of a variety of materials, including wood, plastic and metal. Safety considerations are the same as for a manual milling machine. COSHH assessment will be needed to ascertain if LEV is required when working with plastics and wood.

CNC lathe

A CNC lathe is used to machine a variety of materials including wood, plastic and metal into three-dimensional forms. Sizes and safety considerations are the same as for manually controlled lathes.

It is worth noting that CAD/CAM equipment is developing at an ever-increasing rate, with new technologies constantly influencing both the theory and practice of design and technology teaching. Good examples of this are the relatively new rapid-prototyping techniques such as stereo lithography and laminated-object manufacture. Both of these are widely used in industry but they are not yet generally an economic proposition in schools, although some schools have established links with industrial rapid-prototyping centres to which they can email their designs and watch them being produced via video-conferencing links.

Miscellaneous

Printed circuit board (PCB) unit

This unit combines all the processes involved in producing circuit boards (developing, etching and washing), housing a separate tank for each process. A PCB unit usually contains a sink with hot and cold water supply which can be used for other workshop activities requiring water. Most units require a power supply to allow for agitation of the etchant. It is important that these units are fixed and stable.

Guillotine and shears

A guillotine cuts metal sheets. While smaller models can be used by pupils, larger guillotines should only be used by a member of staff and are best situated in a preparation area, away from doorways. Some bench-mounted models cut, bend and punch small sheets of metal. Shears also cut sheet metal but are only suitable for simple cuts. Both shears and guillotine must be lockable and positioned away from major circulation routes.

Food-technology equipment

Food rooms should ideally have a number of cooker types to allow pupils a range of experiences. Some schools may choose to provide both domestic and commercial catering facilities as shown in Figure 2.16. A range of gas, electric and halogen-style cookers should be provided. Ideally there should also be a range of different wall ovens. This allows hobs to be separate which increases layout possibilities. A separate hob and oven also allows easier access for wheelchair users, although there should be clearance for the wheelchair under both appliances. It is also preferable for the hob to be set within an adjustable-height bench. Ideally, a teacher should be able to demonstrate cooking techniques on both a gas and electric hob, so both types should be provided in an area where pupils can gather (see Figure 2.16).


Photo: Osborne School

Cookers should not be positioned directly in front of a window; if this is unavoidable then blinds set within a frame must be provided to ensure visibility of lit hobs (see 'Walls, windows and doors' in Section 4). Notice or display boards should not be sited above cookers. Electric cookers should be permanently wired into the room, with an isolator that is clearly labelled to identify the appliance being supplied. Gas cookers should have a chain fitted so that the cookers cannot be pulled out of position and the flexible gas connection strained. As a safety feature some schools may wish to provide induction hobs which only heat up when a metal pan touches the element.

Fridges should be large enough to store the ingredients and products of at least one class (see 'Food technology' in Section 3). Free-standing larder fridges are ideal. Alternatively, several under-bench ones should be provided.

A provision of one sink (with double drainer) to four pupils is usually assumed. Some schools like double-bowl sinks to keep food preparation separate from washing-up, and this should be checked at an early stage as it may affect layout and space requirements. Stainless steel is generally easy to clean and affordable. There should be at least one dedicated washbasin in each food room for washing hands.

Stainless-steel commercial units are generally free-standing or relocatable. A series of loose tables can be put together to form a run of side benching. Schools sometimes prefer tables with open under-frames, as under-bench cupboard units are often difficult to clean and manage.

Commercial catering cookers (sometimes called ranges) have four or six burners with ovens incorporated (schools could consider stacked convection ovens to make the best use of space). These can often be on flexible cable which allows teachers to pull them away from the walls so that pupils can gather around for a demonstration.

Food in a tunnel oven travels along a moving bed under a heated element. These are very useful for creating production runs for manufacturing activities.

Blast chillers blow cold air onto heated food to safely and quickly cool it down before it is put in the fridge. For this reason they are best sited next to the technician's base (if appropriate) and the fridge. A vacuum packer seals food into plastic trays with plastic covers to make ready-meals. This should be located close to the fridge and the technician's area. All these items of equipment can sit on standard side benching and can be run by standard power supply. Central service outlets would increase the flexible use of these items of equipment.

Figure 5.18 shows recommended safe working areas around sinks and cookers in food-preparation areas. These dimensions take into account the need for extra safety around cookers, including space required when taking something from the oven. The shaded area shows an overlap of 250mm, which is applicable if benching is back-to-back (e.g. in a peninsular arrangement). This means that in a bay arrangement there would be 1750mm between benches (2 x 1000mm – 250mm). It is assumed that the area between the cooker and the sink is never used as a main circulation route.

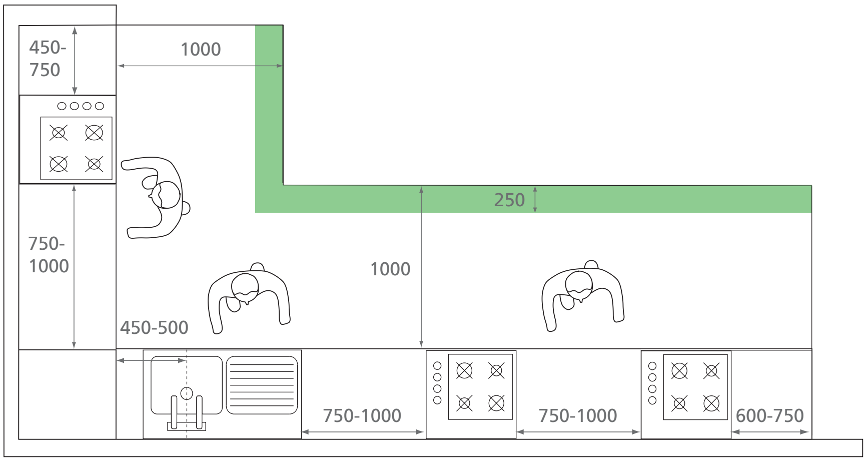


FIGURE 5.18
Distance between cookers

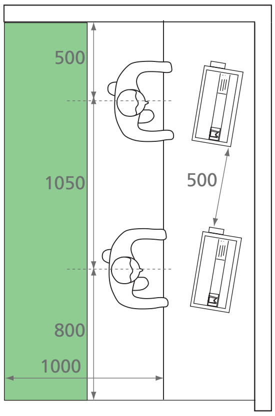
Textile equipment

A range of sewing-machine models should ideally be provided to give pupils a range of experiences. Some may be run from the computer (see above) as will some embroidery machines and fabric-printers. Manual sewing machines will run by standard power supply and should be provided in a separately zoned area where pupils will not be distracted (these machines may cause injuries if incorrectly used). Where large projects are being constructed it may be preferable to have units which may be positioned at 90° to the wall to allow fabric to fall more easily.

Overlockers are also required and should be sited in the same area as sewing machines. These machines work in a similar way to sewing machines to lock the edge of fabric to prevent it from fraying. Again, the potential for accidents means they should be sited in a defined area where pupils will not become distracted.

Figure 5.19 shows recommended distances around sewing machines on a perimeter bench. The diagram shows a bench in a corner, but the principles can be applied to other situations, such as freestanding tables. The shaded area shows an overlap of 500mm, which is applicable if benching is back-to-back (for example, in a peninsular arrangement). The 800mm dimension shows the recommended distance from the centre of a sewing machine placed at the end of a run of benching to the end of the bench.

Photo: Gill Greany



▲ FIGURE 5.19

Distance between sewing machines

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The design, installation, commissioning, operation and maintenance of services must comply with statutory requirements. Note should be taken of the relevant documents listed in this section and the References. The Appendix gives further detail of some of the regulations mentioned in this section.

It is advisable to produce elevations detailing the services provision on walls at an early stage in the planning of a design and technology space. In this way the positions of pipework, drainage, electrical trunking and heat-emitters can be coordinated with the heights and locations of window sills, furniture, fittings and equipment (see 'Perimeter benching' in Section 4). The effect that future adaptations may have on the service installation should be borne in mind at the design stage.

Services and environmental design

Services

Electricity

General

New fixed installations and alterations should conform to the Electricity at Work Regulations 1989 and to BS 7671 (see References). BS 4163 provides comprehensive guidance on the design and maintenance of electrical systems in design and technology areas, including references to relevant regulations and guidance. This section provides a brief overview.

All electrical equipment should be of an appropriate Index of Protection (IP) rating. For example, if there is a risk of water and/or solids ingress, the equipment should have a rating of at least IP 44. For details of specifications, and of tests to verify degrees of protection, reference should be made to BS EN 60529.

Whole-room controls

Each work area containing fixed electrical equipment (e.g. a resistant-materials room or a preparation area) should have a lockable single-switch disconnector, ideally near the main entrance to the space, or adjacent to the teaching focus or whiteboard, and easily accessible to the teacher. This should control all the electrical-power circuits but not lighting or circuits serving ICT equipment or equipment which is designed to remove a hazard (such as a fume-extraction system). There are no recommendations to have an overall main switch for food-technology rooms.

Each work area containing fixed electrical equipment should also have an emergency-stop system which switches off all circuits supplied via the switch-disconnector in an emergency. The emergency-stop buttons must be readily accessible to the teacher and positioned at a height of 1.5m to ensure clearance of machines and benching; there may be several emergency-stop buttons located at intervals around the room. In view of the increasing use of portable CAM machines, hand power tools and other portable equipment, it is recommended that the emergency-stop system control all socket outlets too, except those serving ICT equipment.

The reset switch should be key-operated to ensure that only authorised persons can reset the power. The contactor in the stop circuit should also provide under-volt release.

Critical circuits specifically installed to remove hazards (e.g. fume extractor) and fan, lighting and alarm circuits should not be controlled by the emergency system.

Controls for fixed equipment

All fixed equipment should be controlled by an isolating switch located either on the equipment or within two metres of the normal operating position, and accessible to the operator. For certain machines, e.g. circular saws or bandsaws, the switch should be lockable. All machines and equipment should have mechanically protected cabling (i.e. armour-flex cable).

Most machines also require individual emergency-stop buttons, controllable via knee or foot (see Section 5). Further details can be found in BS 4163.

Electrical supplies for food-technology equipment

Cookers in food rooms should be wired from local isolators. There should be a 13-amp supply for gas cookers to supply clocks and timers. Microwave and combination ovens can be connected via a 13-amp plug. All electrical equipment should be of an appropriate IP rating.

Supplies to commercial-sized fridges and freezers should be on dedicated circuits.

Electrical supplies for ICT equipment

Where required, local computer network servers should be supplied through an individual dedicated supply that cannot be switched off unintentionally. Sufficient socket outlets should be provided to minimise the use of adapters or extension leads to computers and peripheral equipment.

Consider high-integrity earthing for circuits serving IT equipment, as required by BS 7671, for new work.

Residual-current devices (RCDs)

The need for protection, additional to the overload protection provided to comply with BS 7671, should always be considered. For example, residual-current devices (RCDs) cut off the power supply to the room in the case of a fault in the circuit. Any equipment designed to remove a hazard should not be included on an RCD-protected circuit. Where electrical experiments are being carried out, a higher standard of protection can be achieved by the additional use of 1:1 isolating transformers.

In all areas of high risk from electrical hazards, the use of RCDs rated at 10mA (milliamps) should be considered.

Because there is unavoidable earth leakage current from the power supply circuits of computers, they may cause nuisance tripping of residual current devices.

Low-voltage supplies

Extra-low voltage for practical work can be provided either by portable transformers providing a range of voltages or by bench-mounted trunking systems (see 'Perimeter benching' in Section 4). 230-volt AC electrical systems in furniture have particular requirements regarding the number of socket outlets, connected loads, fuse protection, shock protection, earthing, etc.

Structured data cabling (network cabling)

Structured data cabling is a fundamental part of the services installation of a modern design and technology facility. The type of cabling (e.g. category 5e or category 6) should be carefully chosen, and installed and commissioned in accordance with industry standards. A Patch panel should be provided for a local server with connections for wireless network hubs and final data points.

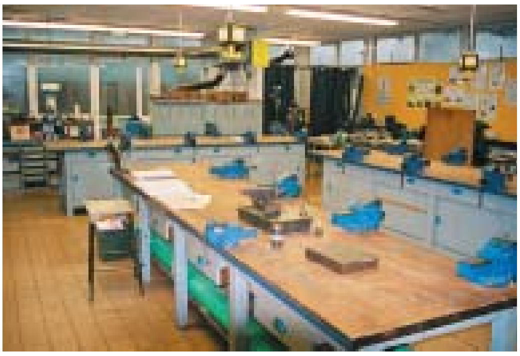
Electric arc welding

Electric arc welding equipment must have a properly earthed transformer. A separate earth lead from the workpiece to the mains earth should be fitted.

Portable equipment

If mains-powered portable equipment is to be used at loose tables in the centre of the space, it should be serviced from overhead via hanging sockets in order to minimize the use of extension leads and the possibility of tripping. Floor sockets may be considered but they can present significant hazards: paper clips, liquid and dust can enter them, leads can constitute tripping hazards or become trapped. It is also not possible to fit a transformer plug into a floor box.

Where portable equipment is provided, details of potential benching layouts together with the electrical loading of each supply point must be assessed



during the early stages of the development to ensure the potential loading of circuits is fully considered. Only portable equipment rated at less than 13 amps should be fitted with a normal BS 1363 plug top.

Socket outlets that will be used for mains-powered portable equipment (indoors or outdoors) should be protected by an RCD with a trip rating of 30 mA or less, conforming to BS EN 61008-1, BS EN 61009-1 or BS 7288.

All socket outlets should be positioned away from sinks to reduce the risk that electrically powered equipment is placed in water. In food-technology rooms, socket outlets should be positioned to ensure that an electrical cable attached to a piece of equipment doesn't have to cross a hot cooking surface.

Electrical supplies and SVGA cabling will be required for interactive whiteboards and ceiling-mounted projectors

Gas and air supplies

Mains gas

Mains gas is used to service cookers in food spaces and for heat treatment (for example a chip forge) in resistant-materials areas. Wherever mains gas is supplied, there must be some way of readily isolating and restoring the gas supply to each room. The principal isolating gas tap should be easily accessible, but not readily accessible to pupils. To prove that all downstream isolation valves are in a closed position prior to the restoration of gas supplies after a shut-down, a weep by pass pressure-proving system can be employed in large installations.

The automatic weep by pass pressure-proving system will facilitate safe daily isolation and restoration of the gas service and also automatic interlocking to ventilation systems and fire alarms where they are required. However, consideration will need to be given where the fire-alarm bells are used for other purposes such as for class-change.

Specialist advice should be taken before fitting leak-sensing controls, emergency shut-off valves, or ventilation-control or fire-alarm interlocks to gas supplies as they should not be fitted to some equipment.

Advice on gas installations is given in the publications IGE/UP/11[16] and BS 4163 (see References).

Note

16. *Gas Installations for Educational Establishments,* UP11, Institution of Gas Engineers and managers, 2004.

Bottled gas

Cylinders of oxygen and acetylene gas must be stored and handled with care. When not in use they must be stored in an area agreed with the fire officer. If the gases are piped to the bench from an external store, this must be of fire-resistant construction with access from the outside only. Gas bottles, whether in use or not, must always be housed in a well ventilated area, that must not be below ground level.

Liquefied petroleum gas (LPG) is sometimes used for brazing and should be supplied by hard pipe from cylinders located outside the building in the open air. These must be separate from oxygen cylinders and any combustible materials. It is essential to follow all safety precautions when using bottled gases and the fire-prevention officer must be consulted at an early stage. Refer to BS 4163 for more detailed guidance.

Compressed-air supplies

Compressed air (used in pneumatic work) can be supplied locally by a portable unit with flexible pipework or it can be piped from a fixed remote unit. The main dangers from using compressed air are:

- An airline being directed at a part of the body
- Excessive working pressures
- Air receivers installed in cramped, inaccessible and poorly ventilated areas
- Home-made air (or steam) receivers or those which have not had regular inspections; these can explode at high pressure

All compressors should be kept out of the reach of pupils and regular maintenance and testing by a competent engineer are essential. The Pressure Systems Safety Regulations 2000 apply to mobile and fixed compressed-air systems. BS 4163 (see Appendix) provides guidance. Noise from compressors needs to be considered.

Water

Pupils need ready access to hot and cold water from all design and technology spaces and ideally within the space itself. In food rooms there must be hot, cold and drinking water. Sinks should be fitted with bottle traps, and wherever weak solutions of acid are used, wastepipes should be able to withstand the corrosive effect. Food-technology rooms should be fitted with at least one dedicated basin for hand washing.

In food rooms, it is good practice to provide all taps for washing-up with water at a supply temperature of 60°C – this higher temperature than is suitable for normal hand-washing is needed to remove grease and helps to kill bacteria. However, at wash-hand basins, blended supplies should be provided.

The Water Supply (Water Fittings) Regulations 1999 (see *Water Regulations Guide* at www.wras.co.uk) require backflow prevention to be fitted to water supplies to equipment such as domestic clothes- and dish-washing machines which will contain a category 3 fluid (one which can cause contamination of the water supplies in cases of back syphonage). Workshop areas may house equipment which contains fluid categories 4 or 5, for which more stringent backflow prevention is required. These requirements are retrospectively enforceable under the Water Industry Act, 1999.

Environmental design

Environmental standards including heating, ventilation, lighting and acoustics are covered in the publications listed in the References. The following summarises the main requirements.

Ventilation

The ventilation of all design and technology spaces must be designed to provide adequate ventilation for the occupants. It should also dilute fumes (e.g. from paint spraying) and water vapour and vapourised fats generated by cooking in food rooms. Dust extraction will be required from woodworking machines.

Where flueless gas appliances such as cookers are installed, adequate ventilation is required to safeguard against the possibility of incomplete combustion producing carbon monoxide.

The provision of oxygen detectors or carbon-monoxide detectors should be considered, to warn occupants of dangerous incomplete combustion which can occur if the ventilation is insufficient for combustion or if the cookers are badly maintained. Because of the high ventilation rates required in such spaces, pre-heating of the ventilation air should be considered. Guidance is available in BS 6173 on air supplies required to support combustion where cookers are installed.

The Education (School Premises) Regulations 1999 give ventilation rates which allow for occupancy of teaching spaces. These require that 'controllable ventilation should be provided at a minimum rate of three litres of fresh air per person per second for each of the maximum number of persons the area will accommodate', and that 'the spaces should be capable of being ventilated at a minimum rate of eight litres of fresh air per second for each of the usual number of people in the space'.

The Workplace (Health, Safety and Welfare Regulations) 1992: Approved Code of Practice and Guidance' , L24, 1996 also applies during occupation.

The guidance states that the fresh air supply rate should not normally fall below five to eight litres per second per occupant (regulation 6, page 9). Factors to be considered include the floor area per person, the processes and equipment involved, and whether the work is strenuous.

The risk assessments produced by CLEAPSS (the Consortium of Local Education Authorities for the Provision of Science Services) for pollutants assume at least three air changes per hour in spaces of average size. If in design and technology workshops the ceiling height is low a higher ventilation rate will be required to achieve the same air-change rate.

Ventilation should be achieved by natural means wherever possible. However, some form of LEV is likely to be needed in certain situations (see below).

Some form of mechanical ventilation will be required in most food areas at least some of the time, to deal with the heat-gain and water vapour produced by cooking and other equipment, as well as solar gains (see Local exhaust ventilation below). Mixed-mode mechanical/natural ventilation systems rather than full mechanical ventilation systems will probably be the most economic solution. Heat recovery on local extract fans and on supply and extract systems may be helpful in winter to minimise ventilation heat losses. However, there will need to be bypass or separate arrangements for summer ventilation. Cleaning of grease from any heat-recovery systems must be considered during design. Food rooms should ideally be enclosed in order to prevent dust from contaminating food, particularly where resistant-materials spaces are nearby. Opening windows may need to have fly guards to prevent insect contamination.

Food stores, refrigerators and freezers must be maintained at the correct temperature. If refrigerators or freezers are kept in storerooms there must be sufficient ventilation so that the general conditions remain cool. Any ventilation and extraction systems should be designed by specialists to create appropriate conditions for comfort and health.

Local exhaust ventilation

Local exhaust ventilation (LEV) is needed to extract dust or fumes that pose a risk to the health and safety of users or affect their comfort. LEV may be necessary following a risk assessment carried out under COSHH (see Appendix). Typical situations where LEV may be needed (taken from BS 4163, see Appendix), are:

- Cooking appliances that give off steam, oil, grease, odour, heat and products of combustion

- Equipment for heat treatment, including for brazing, forging, welding, and soldering
- Woodworking machines, including for sawing, sanding, planing, and thicknessing
- Chemical processes, including acid pickling, plastics work, paint spraying, and engine exhaust emissions
- Working with adhesives
- Metalworking machines (grinding and polishing)
- Working with plastics and glass-reinforced plastics (GRP)

BS 4163 and HSG37 provide useful guidance on LEV and refer to further documents. Some key points include:

- Combustible dusts (e.g. fine particles of wood, plastics and some metal dusts) should be collected separately from those produced by processes where sparks are generated
- The local exhaust inlet should be sited as close as possible to the source of contaminant, and extraction should be to a place which will not cause harm.
- It is essential that air is brought into the space to compensate for air exhausted to the outside (note that make-up air may need to be heated in order to maintain adequate internal conditions).

CAD/CAM machines require their own extraction systems which can be very noisy, and since they are often left running during other class activities this can cause disturbance. Cookers in food rooms will need adequate extraction. This may be in the form of individual extraction hoods although these too can be noisy.

Where gas cooking appliances are used, the ventilation may be regarded as a 'power-operated flue' as described in the Gas Safety Regulations, and may need to be interlocked with the gas supply. BS 6173 provides further guidance. This type of ventilation may need to be provided at source in the way of LEV in accordance with COSHH requirements. The HSE guidance note on ventilation of kitchens in catering establishments gives good advice, some of which is applicable to food-technology rooms as well as school kitchens.[17]

Note

17. *Ventilation of Kitchens in Catering Establishments,* HSE Books, 2000.

Adequate combustion air as required by BS 6173 means that ventilation controls may need to be interlocked with gas supplies, e.g. on kitchen extract systems, unless an alternative means of reducing risk to a practicable level can be demonstrated by other suitable methods of working. Also, in some situations fire-alarm systems must be linked to extract fans, so that they are shut down in the event of a fire. Specialist advice on these matters will be required from a suitably qualified engineer.

Heating

An appropriate temperature must be maintained at all times, particularly in workshops and preparation areas because low temperatures and draughts can make it more difficult to handle materials or operate machinery, while high temperatures and inadequate ventilation may lead to fatigue. Temperature and humidity levels must also be appropriate to the materials stored in storerooms; for example, overheating or poor ventilation can damage timber stocks. Convector heaters should be avoided in dusty areas such as resistant-materials spaces as they blow out recirculated dust. Radiators can be a suitable solution.

Lighting

The quality of light is very important both for safety reasons and to contribute to the general atmosphere of a teaching space. Much can be achieved through the design of the building form, selection of luminaires (i.e. light fittings) and use of colour. Ideally, all teaching spaces should be lit by natural light, supplemented in deep rooms by electric light. It should be possible to control groups of luminaires separately, particularly those over the projection screen or whiteboard. Some form of daylight and sunlight control (such as blinds) will be needed in most spaces to ensure good visibility of the electronic whiteboard and any computer screens in the area.

Building Bulletin 87, *Guidelines for Environmental Design in Schools*,[18] recommends a level of 300 lux for general lighting in most teaching areas and 500 lux wherever visually demanding tasks, such as fine work with fabrics, are done. Good rendering of colours is important and lamps of CIE colour-rendering group 1B should be provided. Additional task lighting needs to be considered for machines in the resistant-material space and possibly for other activities such as circuit-board work. Directional lighting is recommended in display areas. If a lit display unit is enclosed, it will need to

Note

18. The revised version can be found at *www.teachernet.gov.uk/energy*

be designed to avoid the build-up of heat as this can be a fire hazard. Luminaires that are designed to minimise glare and reflection on the vertical plane should be used in areas where a number of computers are used (such as shared resource areas or graphics rooms). However, glare and reflection on the horizontal plane are usually equally important and the type of luminaire chosen should also minimise this type of glare. It is an advantage to be able to vary the lighting environment by providing, for example, separate controls to different parts of a space or dimming switches. Lighting controls such as daylight sensors can reduce running costs and are particularly suitable for storerooms.

Movement-sensing controls are best avoided in design and technology areas as it can be dangerous for the lights to switch off unexpectedly when people remain still.

The choice of luminaires is particularly important in workshop and preparation areas. Integral machine lighting should be fitted with deep reflectors to avoid glare from shiny surfaces. In certain circumstances some electric lamps, particularly mains-frequency fluorescent lights, can create a stroboscopic effect, making moving parts of machinery appear static. This can be overcome in various ways including using high-frequency control gear (see BS 4163). For this reason, and because of its better energy efficiency, high-frequency control gear should generally be specified as standard in design and technology spaces.

Emergency lighting is required for machine areas in order to provide illumination where machine parts may continue to move after the electricity supply has failed. Where it is required, emergency lighting should comply with BS 5266.

Subdued lighting should be provided for brazing and forging work areas as direct light might prevent a lit torch being seen. The walls in heat-treatment areas should be matt to avoid glare from reflections.

Sealed lighting units should be provided in dusty areas such as resistant-materials spaces to avoid dust build-up and to reduce maintenance costs.

In storage and preparation areas, lighting levels should be adequate for staff to see loads clearly and assess their weight before handling. Electric lighting should provide an even spread of light without deep shadows in order to minimise tripping hazards.

Building Regulations Approved Document L require lighting controls to be fitted in some instances although some lights should always remain uncontrolled.

Acoustics

Design and technology spaces should be designed to have a suitable acoustic environment for the health and safety of the occupants and for teaching. Consideration must be given to the noise level created by machinery (e.g. planers, compressors and dust-extraction units), and its effect on hearing, speech intelligibility and the audibility of warning sounds for safety purposes.

The noise produced by CAD/CAM machines should be taken into account when designing a space. A specially designed enclosure may be needed to prevent noise from CAD/CAM machines from disturbing other class activities. Where possible, steps should be taken to reduce noise generation at source.

Building Bulletin 93, *Acoustic Design of Schools*, contains performance standards for acoustics (indoor ambient-noise levels, sound insulation, reverberation, etc.) and guidance on how to achieve these standards.

Fire-alarm sounders and flashing beacons may be required in areas with high activity-noise levels and where students have impaired hearing.

Hazardous noise

High levels of noise can cause permanent hearing loss. The risk of hearing damage depends on the sound level and the length of exposure. Some impact-type sounds can cause hearing damage instantaneously (e.g. gunshots or heavy hammer blows on resonant objects).

The Noise at Work Regulations 1989 require an assessment of noise exposure to be carried out by a competent person. The regulations specify duties of employer and employee if the employee' s daily noise exposure reaches specific 'action levels'. Action levels describe a person's daily personal noise exposure, taking account of both noise level and exposure time. The first action level is 85 A-weighted decibels (dB(A)), the second is 90 dB(A), and the third peak action level is 140 dB(A). In school, only the teacher or technician is likely to have long enough exposure time to reach the first action level and even that may not be reached. Nevertheless, employers have a general duty under the regulations to reduce the risk of hearing damage to the lowest level reasonably practicable.

In 2006, the UK legislation will be changed as a result of a new European directive relating to noise at work, the Physical Agents (Noise) Directive, published in February 2003. The main changes to the legislation are a lowering of the action levels (e.g. the first action level will fall from 85 dB(A) to 80 dB(A)). An overview of the Noise at Work Regulations is included in Appendix 9 of Building Bulletin 93.

7

This section is divided into three parts. The first gives general guidance on the capital cost of providing design and technology accommodation in secondary schools, the second part looks at the cost and procurement of furniture and equipment and the third analyses a case-study example.

Cost guidance

General cost issues

New building versus adaptation or refurbishment

Constructing and fitting out a completely new design and technology facility in an existing school can cost between £1,500 and £1,700 per m^2 of gross floor area provided. These costs include building work, fixed and loose furniture and equipment, associated site works and professional fees, but exclude land-purchase costs and VAT. Factors influencing the cost include briefing requirements, standard of specification, site conditions, ease of access, the size of the project, and whether the building is single or multi-storey. Design and technology accommodation that is part of a whole new school may cost up to 5% less than this due to the economies of scale that can be achieved.

The costs of adapting and refurbishing existing buildings tend to be more variable. In the case of refurbishment requiring, for instance, only redecoration and a few extra service outlets, and where there is substantial reuse of existing furniture and equipment, the costs could be as little as 10% of the equivalent cost of new accommodation. In more complex projects, the costs can approach those of a new building.

Where, in an existing school, there is a choice between building a new facility and adapting or refurbishing existing accommodation, the latter will usually provide a more economic solution. As the overall gross floor area does not increase, the recurrent costs associated with new accommodation, e.g. heating, lighting, cleaning, maintenance, rates, etc., will be avoided (these could cost up to £50 per m^2 of gross floor area annually). In addition, the adaptation or refurbishment of an existing building may make it easier to create or maintain appropriate links between existing curriculum areas.

All projects, whether for new building, adaptation or refurbishment, should be considered in the context of a school's overall long-term building-development plan.

Temporary accommodation

Permanent construction is preferable to temporary accommodation for design and technology accommodation, for a number of reasons. It is often difficult to manage environmental-temperature control in temporary buildings. They need frequent maintenance, which increases running costs, and will have a shorter design-life. Security is an important issue with potentially very expensive equipment being accommodated. Temporary buildings may be less convenient if they are isolated from the rest of the design and technology department, making the sharing of resources and equipment more difficult.

Temporary buildings can, however, provide a cost-effective solution to a short-term accommodation need, e.g. during building work, or to accommodate a short-term peak in a school's roll. A typical six-month hire charge for a 100m^2 temporary building fully fitted and serviced for design and technology, inclusive of delivery, installation and removal, is £15,000–£20,000 (excluding VAT). If temporary accommodation is needed for more than around two years, outright purchase and installation is more economical, costing between £700 and £900 per m^2 (excluding VAT) for a building fully fitted with design and technology furniture and equipment. This is about 50% of the cost of equivalent new permanent accommodation.

Building consultants' fees

New building work, including extensions and substantial adaptations to existing accommodation, will normally be managed and supervised by professional building consultants, usually architects. Depending on the nature and scale of the work, there may also be other consultants, including building surveyors, quantity surveyors, structural engineers and mechanical and electrical engineers. The overall fee for these services will generally amount to between 10 and 15% of the value of the building contract, although higher fees may be payable in exceptional circumstances. The respective professional institutions will supply details of the services that can be provided as well as information on fees.

The value of the building contract on which a fee is assessed will usually include fixed furniture and fittings, e.g. shelving, benching and cupboards. Care should be taken to ensure that fees are not paid on the value of items which, whilst forming part of the main building contract, have been independently designed, procured and fixed by a specialist contractor. There may, however, be fees payable for any necessary coordination and liaison work between the project team and specialist contractors.

There will also be fees payable in respect of a planning supervisor, building regulations approval and planning permission. Site investigation work will also normally be required if building new accommodation.

Value Added Tax

Under current regulations most school building work will attract VAT at the standard rate. The exceptions are freestanding buildings and some types of extension project at schools which have charitable status, i.e. most voluntary-aided and foundation schools. In these cases the work can be zero-rated. Furniture, equipment and professional fees are standard-rated whatever the type of project. DfES grant aid will cover the additional burden of VAT where payable. In LEA school-building projects any VAT payable is recoverable by the local authority.

As VAT can have a considerable impact on the cost of a project, advice on its application should be sought from the local HM Customs and Excise Office at an early stage in the planning and design process.

Furniture and equipment

Furniture and equipment (F&E) for design and technology often forms a large percentage of the building costs due to the specialist nature of much of the equipment. ICT plays a large part in the cost, partly as machines are increasingly operated by computers and also because powerful computers with good resolution and large memories are required to run sophisticated software. Furniture is often more expensive as it has to be particularly robust and multi-functional to withstand the number of activities carried out in design and technology. Costs are usually expected to fall within £400–450 per m^2, including small equipment and consumables.

In some local education authorities, the procurement of furniture and equipment, fixed and/or loose, is managed by the authority's supplies organisation. Where this service is not provided, it may be necessary to employ the project architect or another agency to provide the procurement service. This can cost up to 6% of the value of the furniture and equipment supplied. In small projects this work is sometimes undertaken by the school itself.

Some F&E suppliers provide a 'turn-key' service for school building projects, i.e. they supply and fit all the furniture and equipment, and decorate the space. However this is less likely in a design and technology project owing to the wide range of F&E required for design and technology compared with, say, science. Those suppliers that do provide the service often buy in many of the items from other suppliers, resulting in schools paying more than they would by buying themselves. Another risk with the turn-key approach in a design and technology project is that a company's standard stock items are provided which may not always be appropriate to the particular needs of the department.

With some items of equipment, e.g. lathes, schools sometimes deal directly with the manufacturer. Some machinery can be purchased second-hand at specialist dealers and at auctions, although allowance will need to be made for the cost of any overhauling and safety checks. The health and safety implications of reuse will need to be considered as older furniture and equipment may no longer meet with current standards (see Appendix).

Cost analysis Case Study 1

Background

The case study is a new design and technology block for an 11–16 secondary school which has 750 pupils on roll. Group sizes are around 21 at KS 3 and 16–18 at KS 4. The school's particular strength is in electronics and control systems. Two of the spaces are described in Section 2.

The project

The new block is part of a major county-wide design and technology redevelopment programme. In this school, existing 1960s buildings that contain high-alumina cement are gradually being replaced. This new stand-alone block houses three design and technology spaces (graphics, control technology and electronics). The remaining design and technology spaces are in the existing buildings (resistant materials, food and textiles (shared with art)). Being self-contained allows the block to be let out to the community after hours (particularly the IT facilities).

Staff worked closely with the local-authority architect on the design of the new block. Although the overall size of the building was given, the teachers were involved in deciding positions of partitions and the individual room layouts. Each space has therefore been designed to suit the school's particular ways of working. The corridor is wider than average to allow for display and the floor is used to test robots and other control projects.

The building, which has a floor area of 414m^2, is a simple form using traditional materials. In addition to the three teaching spaces, there are supporting spaces for staff and storage, as well as toilets and a cloakroom because it is a stand-alone block. The main structure consists of concrete strip foundations, cavity walls in blockwork and facing bricks, timber-trussed rafters, concrete roof tiles, double-glazed timber windows and doors, and veneered internal doors. Finishes include painted plaster walls and isolated tiled splashbacks, carpet or vinyl flooring, and suspended ceiling throughout. Heating is via a gas-fired boiler and fan-convector radiators, and mechanical ventilation is provided throughout. Fire and security alarm systems are provided as extensions to the existing installation. The contract was procured through a two-stage selected-tender process, and the contract period was 22 weeks.

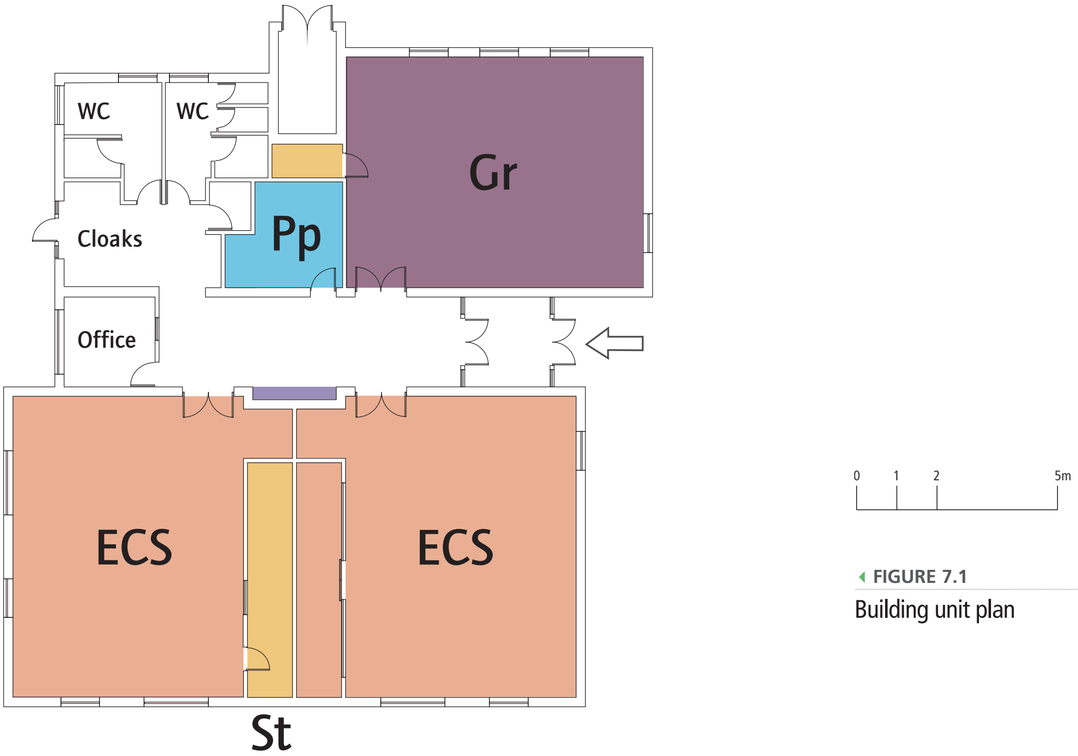


FIGURE 7.1
Building unit plan

Furniture and equipment

All furniture items were procured via a local-authority supplies company of which the school's own authority is a key member. All furniture procured from the supplies company is pre-tendered on behalf of its members. The company's in-house design team (which also designed much of the furniture procured) advised on layout and provision of furniture and drew up detailed cost schedules.

Orders were then placed either by the general contractor for fixed furniture, or by the school's local-authority property-services division for loose.

Each of the three teaching areas had fixed benching and shelving as well as a provision of loose furniture. Although the computer tables were essentially free-standing, the school opted to have them floor-fixed; this meant that as they were then classed as fixed furniture they were ordered via the general contractor. Specialist equipment was ordered and specified by the school itself.

Furniture provided included beech-faced chipboard side benching; computer chairs; adjustable shelving; composite material pin-up boards; under-bench cupboard units; heavy-duty serviced tables; bag-storage units; filing cabinets; and general tables. Interactive whiteboards are provided in all three technology spaces.

The cost

The tender sum was £428,425 in December 2000. The location factor for this region at that time was 0.92 (national average is 1.00). The table below gives the costs at price levels for the fourth quarter of 2003 with a standardised location factor. Costs increased by more than 21% between 2000 and 2003.

FIGURE 7.2
Cost data table

	£	cost/m^2
Substructure	43,387	105
Superstructure	201,096	486
Mechanical and electrical (M & E) services	178,290	431
Furniture	31,109	75
Equipment	28,394	69
External works	84,802	205
Total	**567,078**	**1,371**

The pie chart shows the percentage distribution of costs.

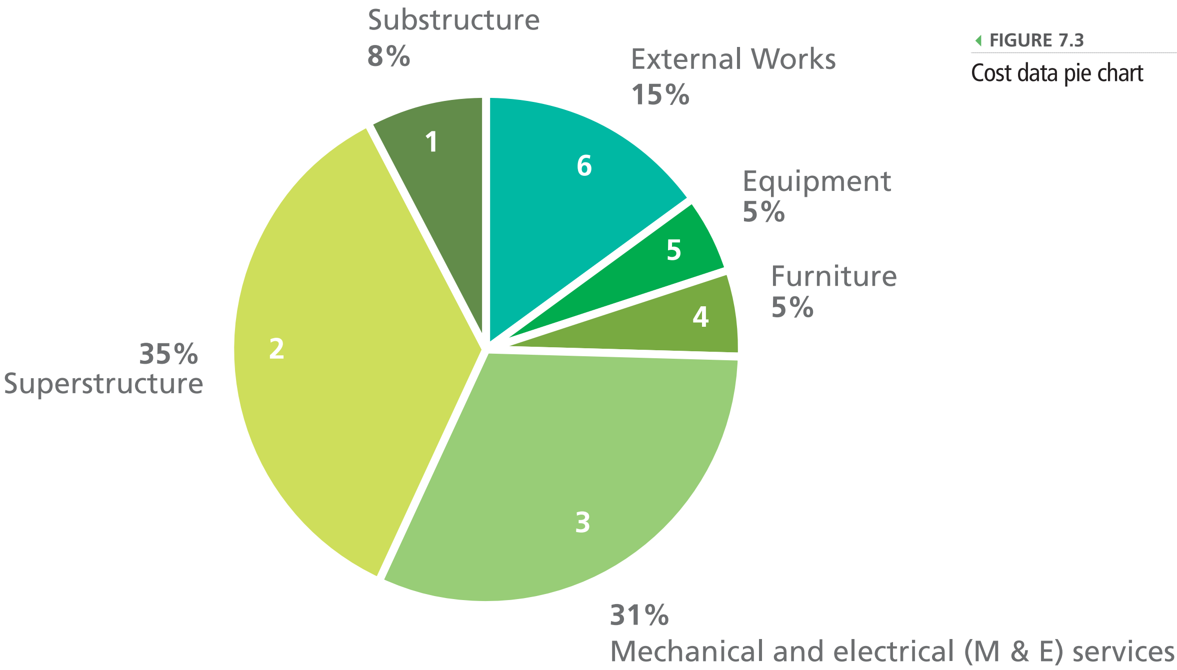


FIGURE 7.3
Cost data pie chart

Cost comment

The basic building cost at current prices (4Q 2003) is £1,022/m^2 after adjusting for location factor. This is slightly below the DfES's current guide cost for secondary schools and in part reflects the relatively simple design of the scheme.

The mechanical and electrical (M&E) installation is slightly more expensive than it would have been had the project involved general teaching accommodation because of the heavily serviced nature of the facility. The level of professional fees at 14% was typical for a project of this type; one would expect the fee percentage to reduce for larger schemes.

A total of £59,503 was spent on furniture and equipment, broken down as 37% on fixed furniture, 17% on loose furniture and 46% on equipment. These costs are, if anything, lower than might be expected. This may be because some specialist equipment (including ICT), was bought from a separate budget and therefore not included in these costings.

Appendix

This section summarises the major health and safety regulations and advisory codes of practice which have direct relevance to school design and technology accommodation. Advice on health and safety matters is also given earlier in the publication, and is cross-referenced here in brackets. For matters of detail it is advisable to refer to the source reference document.

Health and safety in design and technology

The health and safety system

If The Health and Safety Executive (HSE) consider it necessary to supplement existing health and safety arrangements they have three options for action:

- Regulations
- Approved codes of practice (ACoP)
- Guidance

Regulations are made, in most cases, under the Health and Safety at Work Etc. Act 1974 (HSWA) and deal with the workplace. These regulations (which include EU legislation) refer to 'employers' and 'employees'. In the case of schools, employers will be assumed to be the local education authority, school governing body or proprietor, and the employees, the teachers and support staff. Pupils are classed as a third party and may not be covered by the regulations, but are covered under the general requirements of the HSWA.

Approved codes of practice offer practical examples of good practice. They give advice on how to comply with the law. They have a 'special legal status' which means that if someone is prosecuted for a breach of health and safety law, and it is proved that they have not followed the relevant provisions of the approved code of practice, a court can find them at fault. However, compliance with the law can be shown in some other way other than through the approved code of practice.

The main purposes of guidance are to interpret the law, to help people comply with the law and to give technical advice. Guidance is not compulsory, but a person following the guidance will normally be doing enough to comply with the law.

BS 4163, Health and Safety for Design and Technology in Schools and Similar Establishments, Code of Practice, HSE, 2000

BS 4163 is the main approved code of practice covering design and technology in schools and colleges. It sets out clearly what a safe design and technology environment should be, and includes guidance on managing health and safety. The pertinent points from the other documents referred to in this appendix have been incorporated into this code of practice. Information that is particularly relevant to accommodation includes (relevant sections in this document are given in brackets):

General brief

Includes information on briefing by teachers to architects, and general planning, building and furniture considerations (see Sections 2, 4 and 5)

Storage

Makes reference to the storage requirements of hazardous materials, bulk materials and specific types of materials, e.g. plastics (see Sections 3 and 4)

The working environment

Covers such aspects as lighting, heating, ventilation, flooring and wall surfaces (see Section 6)

Services

Detailed information about main workshop switchgear, including electrical circuits, socket outlets and emergency switching devices (see Sections 5 and 6)

Machinery

Detailed recommendations on individual machines likely to be placed in a school workshop, highlighting requirements for ventilation, siting, controls, guarding and personal safety (see Sections 2, 5 and 6)

BS 4163 provides a comprehensive list of references to other useful publications including those from the Design and Technology Association (DATA) and the Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS).

The British Standard states that 'risk assessment is an important part of health and safety and all teachers should be aware of the Health and Safety Executive booklet " INDG 163: Five Steps to Risk Assessment" '.

Control of Substances Hazardous to Health Regulations 2002 (COSHH)

The COSHH regulations are one of the most important items of recent legislation affecting work premises in both the public and private sector, including schools. Employers are responsible for assessing the use of hazardous substances to ensure this is controlled without risk to health. Employees also have a responsibility to report potential problems and may be delegated the task of assessing potential risks in their particular specialist area. Areas of concern in art, design and technology are:

- Workshops
- Art and textiles rooms
- Food rooms

COSHH requirements fall into four categories:

- Assessment
- Prevention
- Control
- Management

Risk assessment is the crucial first step; schools must assess the risks associated with the storage and use of hazardous substances. This is covered in BS 4163 (see above), and CLEAPSS publishes *Model Risk Assessments for Design and Technology in Secondary Schools*, which covers all material areas, identifying hazards and their control. Forms of control include personal protective equipment (PPE) and local (extract) exhaust ventilation (LEV) installations (see Section 6), but where possible prevention is preferable to control.

The Food Safety Act 1990

This act contains specific requirements for food which is sold or supplied. The school kitchen is covered by the act but not necessarily the food teaching room. The act has implications for work in mini-enterprise projects and where activities are intended to mimic commercial catering. Some of the main points are listed here, but schools should check the legal position regarding food safety with their local Environmental Health Officer.

- The law will apply in a school food room if food is either sold or supplied to any person who is not the maker of the food product.

- If a school sells or supplies food it must register as a food business with its local authority and be liable to visits by an environmental health officer.

- For a school to be a registered food business it must sell or supply food items for a total of five or more days in any consecutive five-week period. This is a requirement of the Food Premises (Registration) Regulations 1991 (as amended).

- The main concerns of the Food Safety Act are the provision of safe food in a clean environment. Specific requirements, such as hand-wash basin provision, equipment requirements, including adequate refrigeration, suitable wash-down surfaces, both horizontal and vertical, the obligations on management and requirements for food handlers are laid down in regulations made under the act, viz. the Food Safety (General Food Hygiene) Regulations 1995 (as amended) and the Food Safety (Temperature Control) Regulations 1995 (as amended).

- When pupils make food for their own consumption in lessons this is considered to mirror domestic kitchen activity. These are therefore not subject to the requirements of the act. However if, for example, there is an outbreak of food poisoning in a food technology room, it is against the requierements of food law that the school is likely to be judged. It is good practice to instil in pupils an understanding of personal hygiene and safe food-handling techniques.

The Electricity at Work Regulations 1989

These regulations place a duty on employers to ensure that as far as possible all electrical equipment and installations are constructed and maintained so as to prevent danger.

For fixed installations BS 7671, *Requirements for Electrical Installations*, is the standard usually followed in this country for the design and construction of electrical installations. Its associated Guidance Note 3 on inspection and testing gives guidance on the maintenance of fixed installations. These publications are available from the Institution of Electrical Engineers (IEE).

Guidance on maintenance of appliances is available in HSE publication HSG107, *Maintaining Portable and Transportable Electrical Equipment*. Guidance is also available in IEE publication *Code of Practice for In-Service Inspection and Testing of Electrical Equipment*.

The Supply of Machinery (Safety) Regulations 1992

Since 1 January 1995, most machinery supplied in the UK has had to meet the health and safety requirements outlined in these regulations, which are aimed at the manufacturers of machinery. The regulations set out clear design criteria for compliance including:

- Lighting (see Section 6)
- Fire risks (see Section 6)
- Control devices (see Section 6)
- Noise emission (see Section 6)
- Guarding

Meeting the requirements of these regulations will ensure compliance with Section 6 of the HSWA which deals with the general safety of machinery in the workplace.

A CE marking on a machine indicates that the manufacturer has complied with relevant supply law and with all relevant essential health and safety requirements in the Supply of Machinery (Safety) Regulations. False certification by a manufacturer is a criminal offence. Schools should ensure that any machine they purchase has a CE mark. However, a CE mark is not a guarantee of safety, and end users should still make sure (as far as they can) that the machinery is safe and suitable for its intended task.

The Supply of Machinery (Safety) Regulations do not apply in general to second-hand or donated machinery. However, if the second-hand machine in question is substantially refurbished (i.e. the majority of components have been replaced), or its use is substantially different from that for which it was originally intended, it will be treated as a new machine for the purposes of the law, and will have to go through the CE-marking process.

The Workplace (Health, Safety and Welfare) Regulations 1992

These regulations apply to all workplaces including schools. The regulations cover aspects of health and safety in the workplace (replacing a number of old regulations), and set out the responsibilities of both employer and employee. Issues of direct relevance to design and technology include:

- Maintenance
- Environmental issues (see Section 6)
- Room dimensions (the $11m^3$ per employee recommended in the Approved Code of Practice does not apply to teaching areas)
- Workstation layout and furniture (see Sections 2 and 4)
- Free floor space and circulation routes (see Sections 2 and 5)

The Manual Handling Operations Regulations 1992 (as amended)[19]

These regulations seek to prevent injury to any part of the body during the process of manual handling at work. They stress employers' responsibility to ensure employees' health and safety through the avoidance of any manual-handling operation involving risk of injury. In the case of schools this would apply to all staff working in preparation areas, for example emptying dust containers (see Section 3).

The regulations give design guidance aimed at reducing the risk of injury during manual-handling operations. The considerations outlined are:

Note

19. The Guidance that goes with the manual handling regulations is currently being updated, mainly to take account of recent research findings. The revised guidance is due to be launched in 2004.

- Space allocation (see Sections 2 and 5)
- Flooring (see Section 4)
- Temperature (see Section 6)
- Ventilation (see Section 6)
- Lighting (see Section 6)
- Storage details (see Section 3)

An ergonomic approach to lifting and the use of mechanical or automated aids, e.g. wheeled trolleys, are both encouraged.

It is important that schools carry out risk assessments of manual handling taking place in design and technology areas. Refer to HSE leaflets[20] INDG 143, 'Getting to Grips with Manual Handling', which highlights the importance of risk assessment, and INDG 163, 'Five steps to Risk Assessment', which may prove useful when considering possible dangers in the classroom.

The Management of Health and Safety at Work Regulations 1999

These regulations set out general duties for employers concerning the management of health and safety for their employees. They cover four basic aspects of health and safety:

- Planning
- Organisation
- Control monitoring
- Review

The regulations have little direct relevance to the design of school buildings. However, certain management procedures may result in specific requirements for the design and layout of design and technology areas.

Note

20. Available on the HSE website.

The Personal Protective Equipment (PPE) at Work Regulations 1992 (as amended)

The regulations aim to ensure that employers provide adequate PPE for their employees. PPE is defined as any item which protects a person against any health and safety risk. It does not, however, cover any equipment which may be required as a direct result of COSHH regulations. Like COSHH, the PPE regulations regard prevention as an initial action. For example, suitable guarding to a machine is preferable to the operator wearing goggles when using the unguarded machine. PPE should always be regarded as the last resort to protect against risks to health and safety; safe systems of work should always be considered first.

Direct reference is made in the regulations to the accommodation of PPE, e.g. coat pegs for protective clothing (see Section 2).

The Health and Safety (Display Screen Equipment) Regulations 1992

These regulations set out the health and safety management duties of employers to employees who habitually work with display-screen equipment. The regulations require employers to:

- Identify what constitutes display-screen equipment
- Identify who is a user
- Assess workstations and reduce risks
- Ensure all workstations meet minimum requirements
- Plan for breaks and changes of activity
- Provide eye and eyesight tests
- Provide training and information

Other areas include the working environment and software.

Teachers would not normally be considered habitual users of IT, and the DSE directives do not directly relate to pupils as they would not be classed as habitual users of workstation equipment. However, it is vital that staff and pupils' health and safety[21] are looked after by the school and this document is a valuable source of reference when designing an environment (including workstations) where display-screen equipment is used. Issues covered include:

- Furniture (see Section 4)
- Lighting (see Section 6)
- Space
- Noise
- Heat and humidity (see Section 6)

An ergonomic approach is recommended, adjusting workstations to meet the workers' needs.

These regulations have been amended through the Health and Safety (Miscellaneous Amendments) Regulations 2002 to:

- Take account of a European court case which decided that the specified minimum requirements applied to all workstations (not just to those used by 'workers' as defined in the DSE Directive)
- Developments in technology since 1992, including laptops and non-keyboard input devices, e.g. the mouse
- Clarify the requirements for eye tests and training of new users

Two HSE documents provide guidance on this area:

- *Working with Display Screen Equipment: Guidance on Regulations* covers the legal and technical details of the regulations.
- *The Law on VDUs: An Easy Guide* offers step-by-step practical help in what to look for, how to manage risks and what actions to take if problems arise.

Both guides include a workstation checklist that can be used to carry out risk assessments.

The Provision and Use of Work Equipment Regulations 1998

The regulations' prime objective is to ensure that all work equipment provided for use at work meets various health and safety standards. 'Equipment' may include component parts of an item of machinery (see Supply of Machinery (Safety) Regulations 1992).

Note

21. These duties are highlighted in Section 3 of the Health and Safety at Work Act 1974.

The regulations set out a number of requirements that both equipment manufacturers and employers must meet. Issues covered include:

- Safe construction and design of equipment, its component parts and additional safety features (see Section 5)
- Suitability for purpose
- Conditions in which equipment is used, which will include suitable space allocation for that equipment (see Section 5)
- Inspection
- Training
- Dangerous parts of machinery (including guarding)
- Stop controls

The approved code of practice L114, Safe Use of Woodworking Machinery, is based on the Provision and Use of Work Equipment Regulations 1998.

References

General School Design

DfES Building Bulletin 98, *Briefing Framework for Secondary School Projects*, the Stationery Office, 2004.

The Education (School Premises) Regulations, The Stationery Office, 1999.

Storage

DfEE Building Bulletin 89, *Art Accommodation in Secondary Schools*, The Stationery Office, 1998 (see sections 2 and 3).

Getting to Grips with Manual Handling, INDG 143 Rev 1, HSE Books, 2000.

Manual Handling Operations Regulations 1992: Guidance on Regulations, L23, HSE Books, 1998.

Furniture

BS 5873, *Educational Furniture*, British Standards Institution, 1980_1998 (see Parts1_5).

DfEE, *Furniture and Equipment in Schools: A Purchasing Guide*, The Stationery Office, 2000.

Equipment

Health and Safety (Display Screen Equipment) Regulations 1992 SI1992/2792, The Stationery Office, 1992.

PUWER 1998 Provision and Use of Work Equipment Regulations 1998, Open Learning Guidance, The Stationery Office, 1999.

Safe Use of Machinery, PD5304, British Standards Institution, 2000.

Safe Use of Woodworking Machinery: Provision and Use of Work Equipment Regulations 1998 as Applied to Woodworking Machinery, L114, HSE Books, 1998.

Supply of Machinery (Safety) Regulations 1992, SI1992/3073, The Stationery Office, 1992.

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The Law on VDUs: An Easy Guide, HSG90, HSE, 2003.

Services and environmental design

An Introduction to Local Exhaust Ventilation, HSG37, HSE , 1993.

Approved Document L2 – Conservation of Fuel and Power in Buildings Other Than Dwellings: 2002 Edition, The Stationery Office, 2001.

BS 5266, Part 1 *Emergency Lighting. Code of Practice for the Emergency Lighting of Premises Other Than Cinemas and Certain Other Specified Premises Used for Entertainment,* British Standards Institution, 1999.

BS 5925, *Code of Practice for Ventilation Principles and Designing for Natural Ventilation*, British Standards Institution, 1991.

BS 6173, *Specification for Installation of Gas-fired Catering Appliances for Use in All Types of Catering Establishments (2nd and 3rd Family Gases)*, British Standards Institution, 2001.

References

BS 7288, *Specification for Socket Outlets Incorporating Residual Current Devices (SRCDs)*, British Standards Institution, 1990.

BS 7671, *Requirements for Electrical Installations. IEE Wiring Regulations*. 6th edition, British Standards Institution, 2001.

BS 8313, *Code of Practice for Accommodation of Building Services in Ducts*, British Standards Institution, 1997.

BS EN 60529, *Specification for Degrees of Protection Provided by Enclosures*, British Standards Institution, 1992.

BS EN 61008 part 1, *Specification for Residual Current Operated Circuit-breakers Without Integral Overcurrent Protection for Household and Similar Uses (RCCBs). General Rules*, British Standards Institution, 1995.

BS EN 61009 part 1, *Specification for Residual Current Operated Circuit-breakers With Integral Overcurrent Protection for Household and Similar Uses (RCCBs). General rules*, British Standards Institution, 1995

DfEE Building Bulletin 87, *Guidelines for Environmental Design in Schools*, see the latest version on www.teachernet.gov.uk/schoolbuildings.

DfEE Building Bulletin 90, *Lighting Design for Schools*, The Stationery Office, 1999.

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Electricity at Work Regulations 1989, The Stationery Office, 1989.

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Maintaining Portable and Transportable Electrical Equipment, HSG107, HSE , 1994.

Ventilation of Kitchens in Catering Establishments, HSE Books, 2000.

Water Industry Act, The Stationery Office, 1999.

Water Supply (Water Fittings) Regulations, The Stationery Office, 1999.

General health and safety

A Step by Step Guide to COSHH Assessments (Revised Edition), HSG 97, HSE Books, 2004.

BS 4163, *Health and Safety for Design and Technology in Schools and Similar Establishments*: Code of Practice, British Standards Institution, 2000.

Code of Practice 7 – Storage of Full and Empty LPG Cylinders and Cartridges, LP Gas Association, 2004.

Control of Substances Hazardous to Health, L5, HSE Books, 2002.
Note: Read in conjunction with 'A Step by Step Guide to COSHH Assessments listed above.

Dangerous Substances and Explosive Atmospheres Regulations 2002, The Stationery Office, 2002.

Five Steps to Risk Assessment, INDG 163 REV1, HSE Books, 1998.

Health and Safety at Work Act 1974, The Stationery Office, 1974.

Health and Safety Training Standards in Design and Technology, The Design and Technology Association, 2003.

Management of Health and Safety at Work Regulations 1999, SI1999/3242, The Stationery Office, 2000.

Model Risk Assessments for Design and Technology in Secondary Schools and Colleges (Revised), Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS), 2000.
Note: Available to members and associates only, contact CLEAPSS on 01895 251 496. A CD ROM with this publication and additional leaflets and information has also been published.

Personal Protective Equipment at Work: Guidance on Regulations Personal Protective Equipment at Work Regulations 1992, L25, HSE Books, 1992.

Risk Assessment in Secondary Schools and Colleges Design and Technology Teaching Environments: Health and Safety Guidance (Fully Revised Edition), The Design and Technology Association, 2003.

Work with Display Screen Equipment: Health and Safety (Display Screen Equipment) Regulations 1992 as Amended by the Health and Safety (Miscellaneous Amendments) Regulations 2002 – Guidance on Regulations, L26, HSE Books, 2003.

Workplace Health, Safety and Welfare Regulations 1992: Approved Code of Practice and Guidance, L24, HSE Books, 1996.

Food safety

Food Safety (Temperature Control) Regulations 1995 (as amended), SI 1995/2200, The Stationery Office, 1995.

Food Safety Act 1990, The Stationery Office, 1993.

Food Safety (General Food Hygiene) Regulations 1995 (as amended), SI 1995/1763, The Stationery Office, 1995.

Food Premises (Registration) Regulations 1991 (as amended), SI 1991/2825, The Stationery Office, 1991.

Websites

CLEAPSS (The Consortium of Local Education Authorities for the Provision of Science Services)

http://www.cleapss.org.uk

A nationwide subscription advisory service supporting science and technology teaching in schools. Provides practical advice on matters such as health and safety. At the time of writing all LEAs in England, Wales and Northern Ireland are members and hence all their officers and schools have free access to the services as do the vast majority of independent schools and colleges which are associate members.

The British Standards Institution

http://www.bsi-global.com

For access to British Standards publications including BS 4163, Health and Safety for Design and Technology in Schools and Similar.

The Design and Technology Association

http://www.data.org.uk

DATA provides a guidance service to staff on health and safety and risk assessments.

The Health and Safety Executive

http://www.hse.gov.uk

The HSE website has useful health and safety information and publications on topics including wood dust and Control of Substances Hazardous to Health (COSHH) procedures.

The National Association of Advisers and Inspectors in Design and Technology

http://www.naaidt.org.uk

The site provides a discussion forum for design and technology teachers and advisers. The NAAIDT also produces publications and organises training on health and safety matters.

TeacherNet

http://www.teachernet.gov.uk/schoolbuildings

For DfES design guidance including Building Bulletin 98, Briefing Framework for Secondary School Projects and Furniture and Equipment in Schools Projects.

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Furniture

- adjustable computer chair
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- adjustable drawing table
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- 4-person multi-bench
- 2-person multi-bench
- relocatable serviced table (with alternative position)
- mobile whiteboard
- mobile flipchart
- display point
- display shelf
- display cabinet/ storage
- whiteboard
- electronic whiteboard
- magazine rack
- teacher's table

Storage units

- filing cabinet
- filing cabinet below surface
- storage cupboard
- tall storage cupboard
- storage cupboard below surface
- tray storage
- tray storage below surface
- mobile tool storage
- drawing chest
- components bins
- general-purpose trolley
- coats and bags storage
- mobile tray unit
- tray trolley

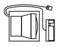
CAD/CAM equipment

- CAD/CAM plotter
- CAD/CAM plotter & cutter
- CAD/CAM milling machine
- CAD/CAM lathe
- CAD/CAM engraving machine (small)
- CAD/CAM engraving machine (large)
- CAD/CAM laser cutting machine

Textiles equipment

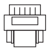
- ironing board
- sewing machine
- screen-printing table
- pegs for fabric
- screen-printing sink
- abrasion tester and electric ring
- textiles display carousel unit

ICT equipment

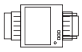
 computer workstation

CPU

 laptop

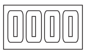
 desktop printer

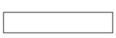
 scanner

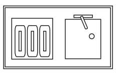
 photocopier

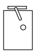
Electronics equipment

 soldering point

 etching tanks

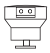
 serviced trunking

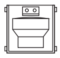
 PCB unit

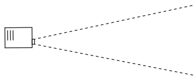
 eye-wash sink

AV equipment

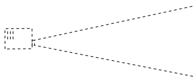
 T.V.

 Wall-mounted TV/video player

 TV/video trolley



Video/data projector (portable/table-mounted)



Video/data projector (ceiling-mounted)

Glossary of Acronyms

CAD/CAM – computer aided design/ computer aided manufacture
LEV – local exhaust ventilation
PPE – personal protective equipment
CNC – computer numerically controlled
PCB – printed circuit board
4Q – fourth quarter (in a year)

Colours

Colours for generic layouts

	Loose unserviced
	Fixed serviced
	Re-locatable serviced
	Resources
	Coats and bags
	Fridges
	Presentation

Colours for case study plans

	ECS	Electronics and control systems
	St	Store
	Fd	Food technology
	Off	Staff base
	RM	Resistant materials
	Pp	Preparation (RM, Fd, ECS)
	Tx	Textiles
	DR	Resources
	Gr	Graphic products



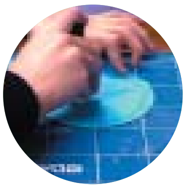


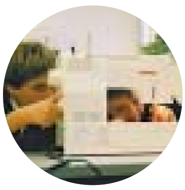


This bulletin provides guidance to anyone involved with the briefing and design process for design and technology accommodation. It supersedes the original Building Bulletin 81 (1996) having been updated to reflect current thinking on secondary school design and education. The guide includes information on: the link between activities and facilities, planning individual spaces, furniture and equipment, services and environmental design and cost.

Case study examples from real schools are used throughout the document reflecting the variety of ways in which design and technology activities can be accommodated.



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