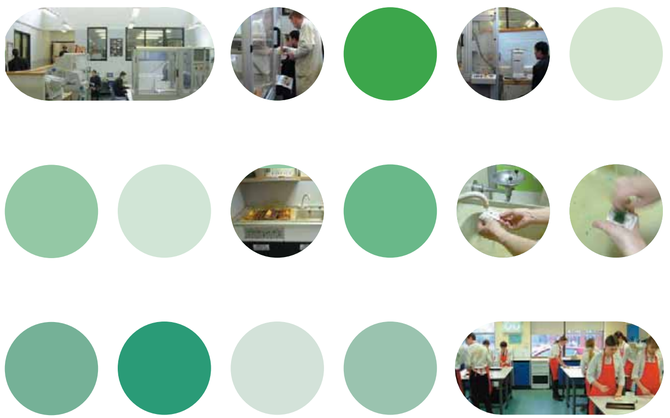
Building Bulletin 81

Design and Technology Accommodation in Secondary Schools

A Design Guide

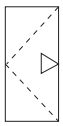
department for
education and skills
creating opportunity, releasing potential, achieving excellence

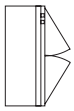


Symbols

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

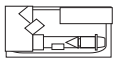

hand wash sink


oven

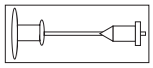
Resistant materials machines and equipment


bandsaw


pillar drill


metal lathe


bench-mounted
metal lathe

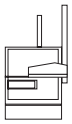

wood lathe


jigsaw

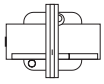

hacksaw


vibrasaw


morticer


circular saw


milling machine


planer/thicknesser


sanding machine (linisher)


double buffer


off-hand grinding machine

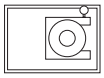

bench-mounted
grinding machine


horizontal grindstone


brazing hearth

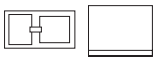

chip forge


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

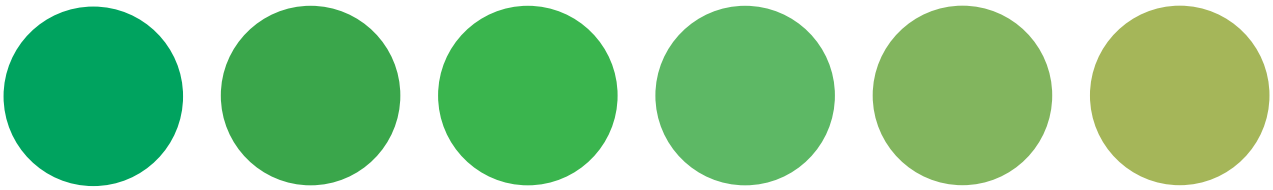
plastics oven

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.

1 Planning for design and technology

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 Age range No on roll	4 11–16yrs 600	6 11–16yrs 900	6 11–18yrs 1100	8 11–16yrs 1200	8 11–18yrs 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

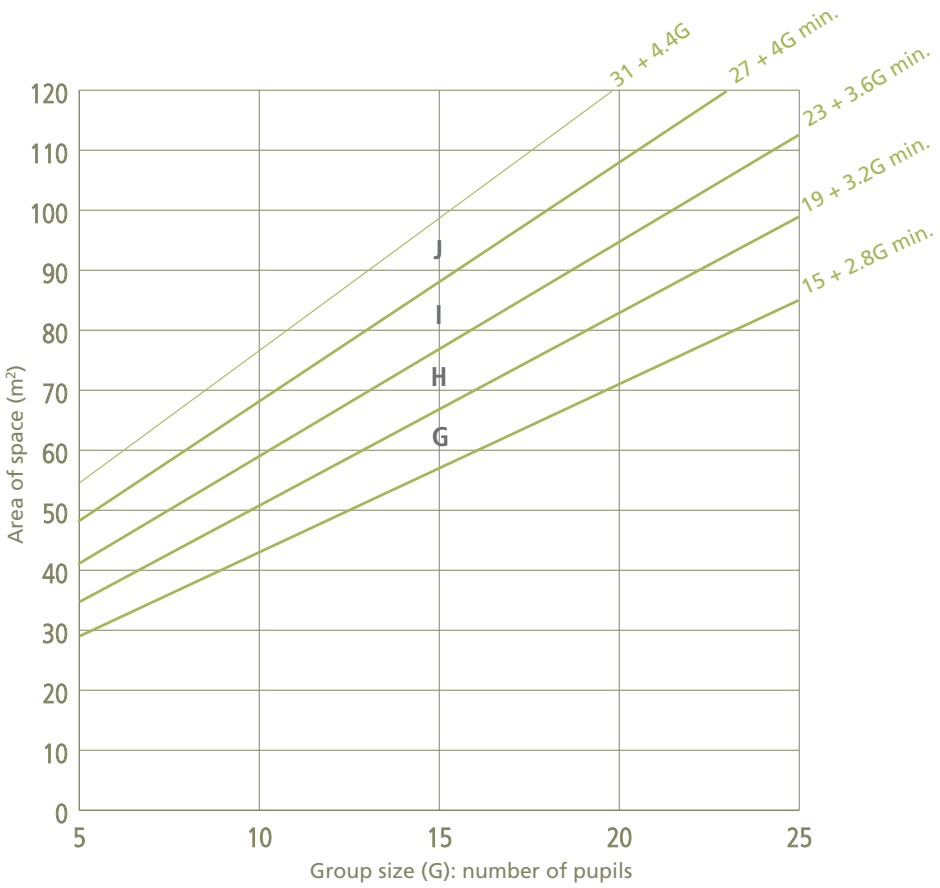


FIGURE 1.5

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:

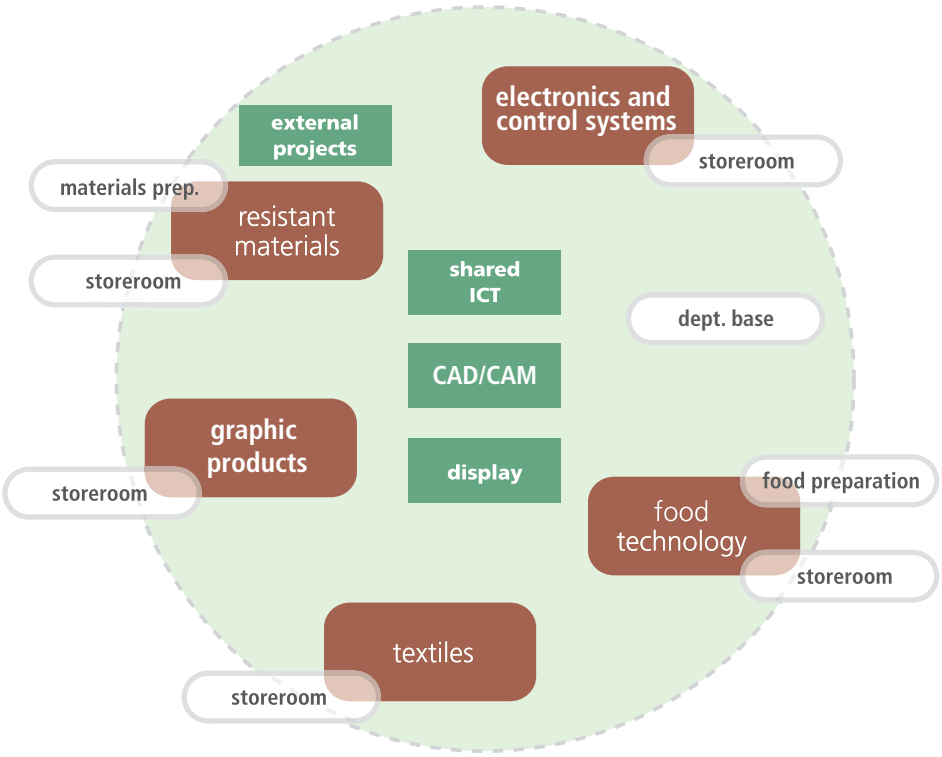


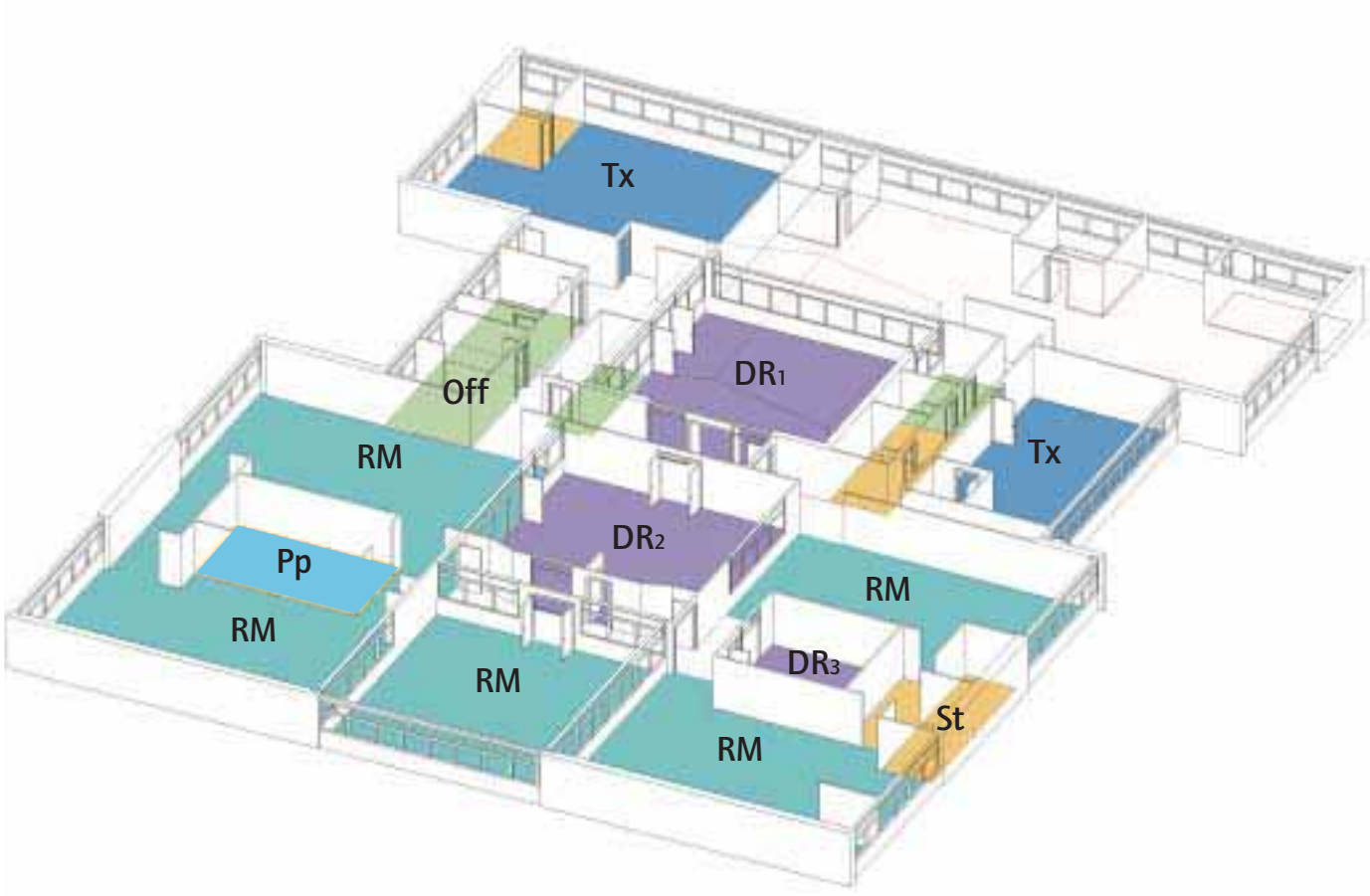
FIGURE 1.7
Diagrammatic plan of a design and technology suite

- 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

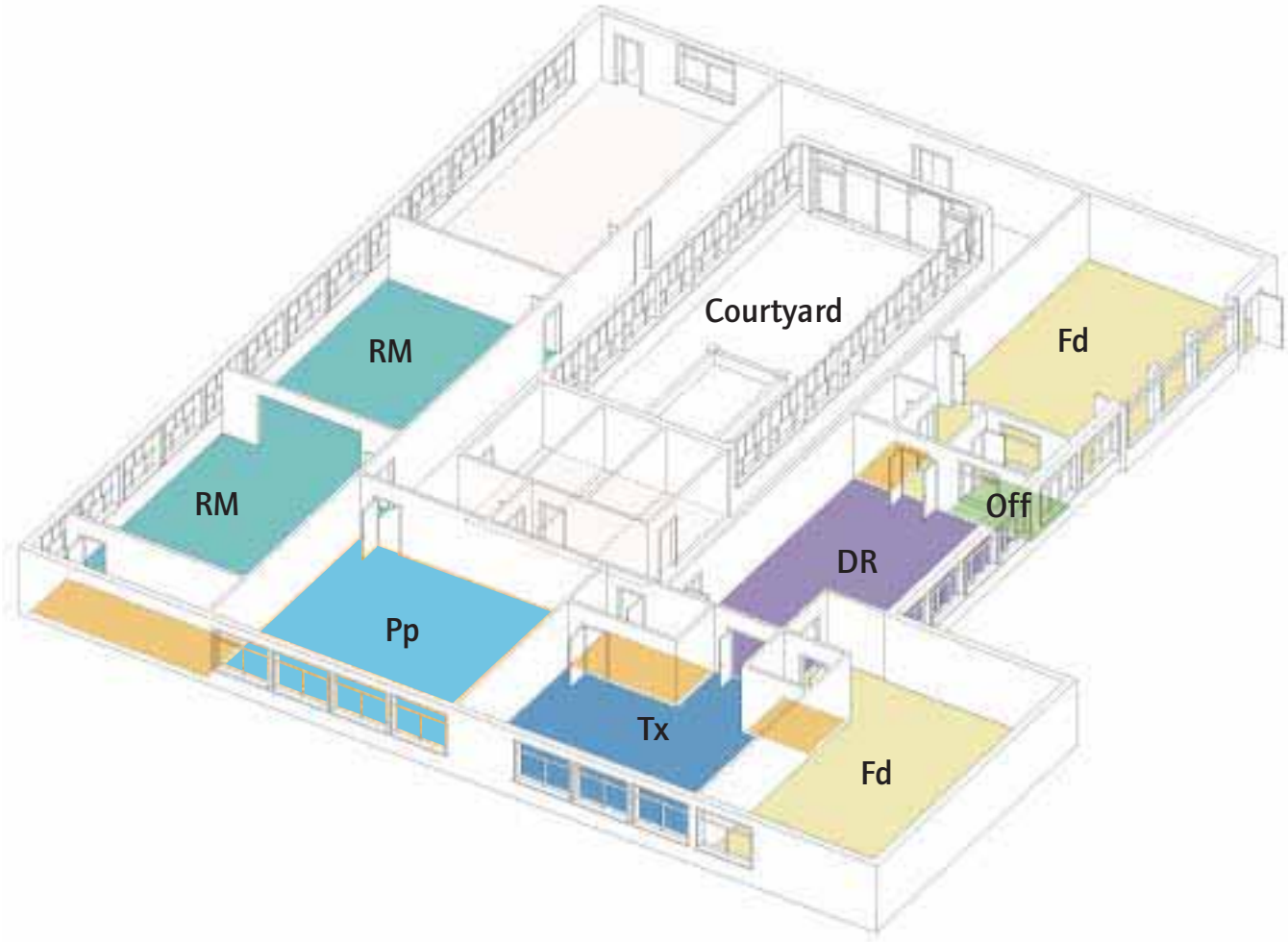


FIGURE 1.9
Planning case study 2

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.

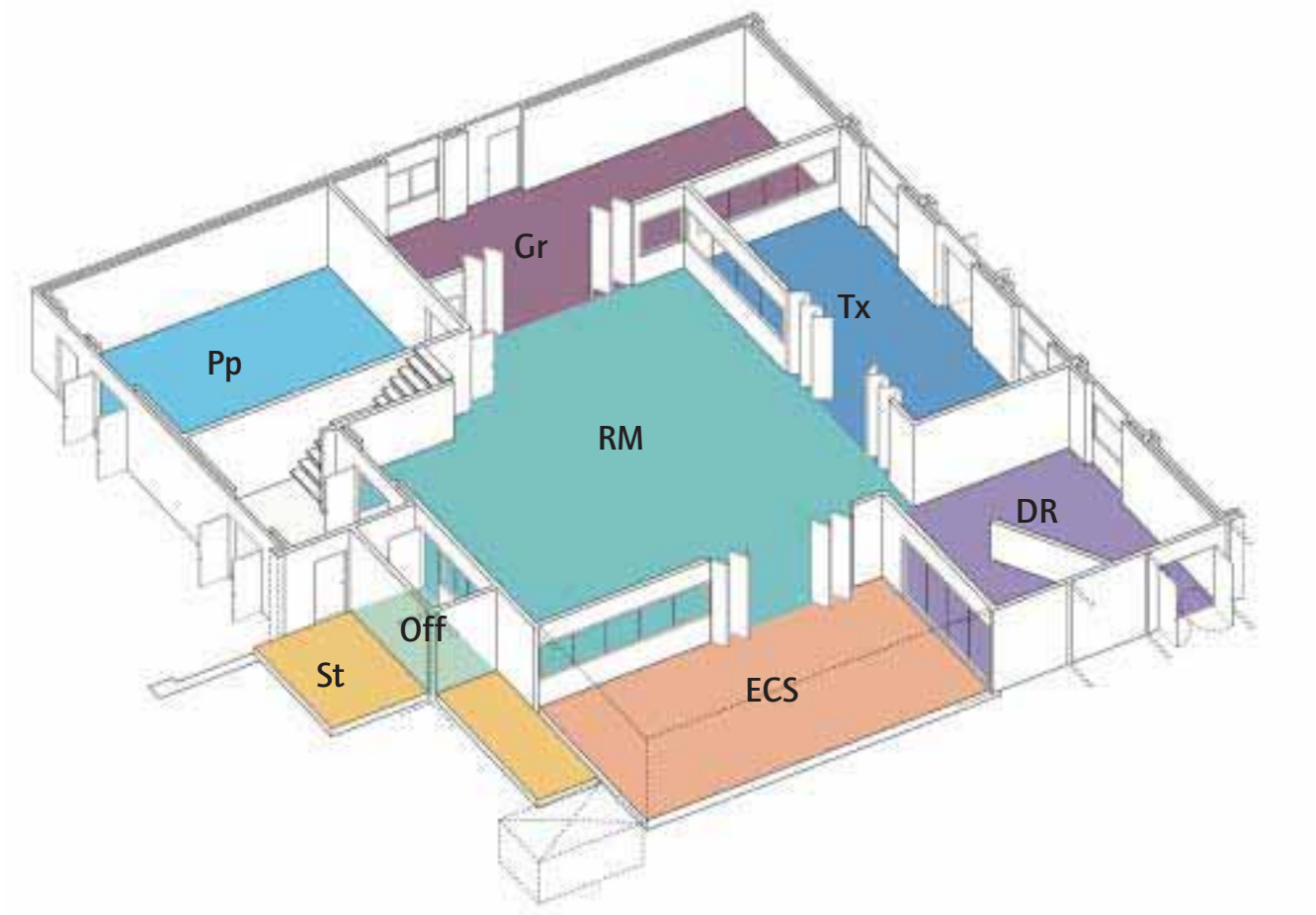


FIGURE 1.10
Planning case study 3