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chapter one

The context of refurbishment

Aims

After studying this chapter you should be able to:

- Explain the meaning of the terms refurbishment, conversion, restoration, renovation and retrofit
- Appreciate the amount of refurbishment work that is undertaken in the UK, and the associated costs
- Discuss the issues that will affect the decision to refurbish a building as opposed to demolition and new build
- Show an understanding of the environmental implications of refurbishment as opposed to demolition and new build
- Explain issues relating to the listing of buildings
- Relate current Building Regulation requirements to refurbishment projects
- Explain how health and safety legislation should be applied to the design and management of refurbishment contracts

This chapter contains the following sections:

1.1 Definitions of refurbishment

1.2 The amount of refurbishment work undertaken in the UK and associated costs

1.3 Issues that affect the decision to refurbish

1.4 Refurbishment vs. redevelopment from an environmental perspective

1.5 Issues relating to the listing of buildings

1.6 Overview of statutory control of buildings

Hot links

- Building Regulations Approved Document L 2002
- Building Regulations Approved Document M 2000
- Chartered Institute of Building (CIOB) Construction Paper No. 66 1996: Characteristics and difficulties associated with refurbishment
- Building Research Establishment paper IP9/02 Part 1: Refurbishment or redevelopment of office buildings? Sustainability comparisons
- Building Research Establishment paper IP9/02 Part 2: Refurbishment or redevelopment of office buildings? Sustainability case histories
- CIRIA Report 113: A guide to the management of building refurbishment
- BRE Digest 446: Assessing environmental impacts of construction
- BRE Digest 452: Whole life costing and life cycle assessment for sustainable building design
- http://www.officescorer.info/
- http://www.bre.co.uk/envest/
- http://projects.bre.co.uk/refurb/nitecool/
- Edwards, B. (1999) *Sustainable Architecture: European Directives and Building Design*, 2nd edn. Architectural Press, Oxford, pp. xiv–xvi, 229
- Webb, R. (2000) Sustainable architecture – cities, buildings and technology. Paper presented at Sustainable Building 2000 Conference, Maastricht

1.1 Definitions of refurbishment

Introduction

After studying this section you should be able to explain the differences between common terms associated with refurbishment work. You should also have developed an understanding of the variables that will affect the decision to refurbish a building and to what extent they will do so. In addition, you should be able to explain where refurbishment activity fits into the whole life cycle of a building.

Overview

There is a general acceptance that the decision to refurbish rather than to demolish and rebuild can have benefits in terms of sustainability and economics. The extent of refurbishment required will vary from situation to situation, but there are certain principles that can be applied in all cases. There is an escalating 'scale of intervention' which spans from superficial 'face lifting' of a building to extensive remodelling and upgrading. Between these two extremes the term 'refurbishment' may be applied to many different approaches in terms of technology utilised.

What is refurbishment?

Building work can be classified as either *new build* or *refurbishment*. New build is an easy concept to grasp, as it is a term applied to any work that is starting from scratch. There is no part of any structure left on a site. Refurbishment, however, is a more difficult concept to generalise.

A very broad definition of the term refurbishment is:

Work undertaken to an existing building

However, refurbishment schemes can take many forms and may be undertaken for a variety of very different reasons. There are also a number of terms that are commonly used to describe work undertaken to an existing building, and clarification of the exact meaning of these terms is essential. Throughout this book there will be references to these other terms, and the definitions used will be

The value of buildings can be determined by assessing how fit for purpose and/or flexible they are.

those of the authors. Terms used in other publications may be based on different definitions.

Refurbishment can be defined as:

> Extending the useful life of existing buildings through the adaptation of their basic forms to provide a new or updated version of the original structure

The amount of work that is required in order to achieve this definition will be very different on different projects, and will depend on:

- The condition of the existing structure
- The shape and size of the existing structure
- The location of the structure
- The intended use of the structure
- The amount of work required to the existing structure to enable compliance with current Building Regulations
- Whether the building is listed, either wholly or partly
- Adequate funding being available
- Whether the work can be carried out safely

These issues will be discussed further in Section 1.4.

Other terms that are often used instead of or in conjunction with refurbishment are:

- *Conversion* implies that the main use of the building will be altered, but that the main structure will not be changed.
- *Renovation* and *restoration* imply that the work consists of renewal and repair only, and that the works carried out will simply address dilapidations to avoid further degradation of the building.
- *Retrofit* essentially means fitting new and more modern systems into an existing building. The term is commonly associated with building services because a common phenomena in buildings is that the life of the building structure and fabric will be considerably longer than that of the installed services.

From these definitions it can be seen that refurbishment could include all of these elements on both a large or a small scale.

The commonly used expression of barn conversion is an example of this confusion of terms. Certainly the barn is to be converted from a building that animals live in to a building that humans live in, and major works are required to create a suitable living arrangement. However, usually the external walls will remain, but will be restored and renovated. An entire services installation will be required, and this could be termed a retrofit, as a modern system is to be installed in an old building. In addition to this the useful life of the existing buildings will be

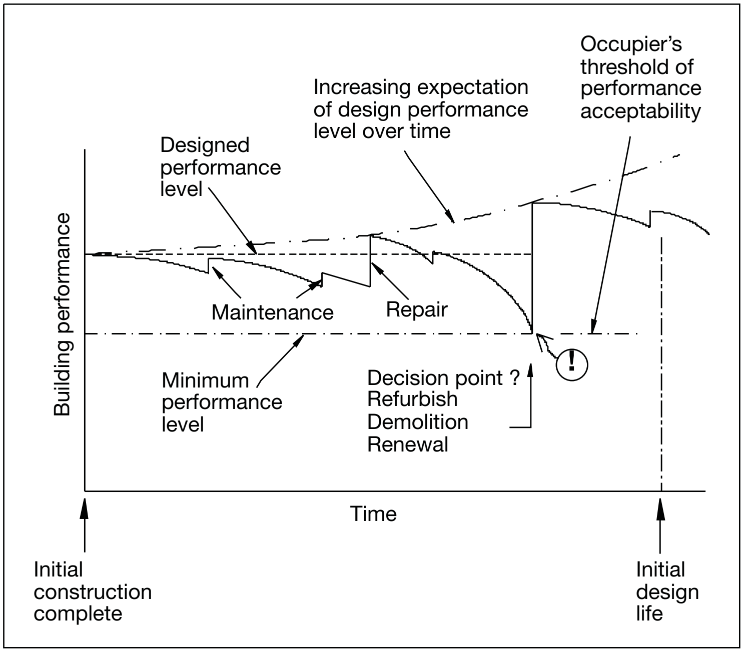

Figure 1.1 Life cycle of a building.

extended through the adaptation of its basic form to provide a new version of the original structure, and therefore the building is being refurbished!

The term *refurbishment* can therefore be taken to mean that the existing building is not usable in its present form. Figure 1.1 illustrates where the refurbishment phase of a building fits into the whole life cycle of the building. The diagram does not show a specific time when refurbishment is required, as this may depend on the level of maintenance that has been undertaken during the occupation of the building; nor does it give actual values of performance requirement. A building could have been very well maintained but not meet the performance criteria of the existing or planned occupier, or very little maintenance may have been undertaken but refurbishment is not undertaken because the building owner/occupier has low performance requirements.

Owner/occupiers are expecting more from buildings than ever before, and the diagram illustrates how this trend towards increasing performance requirements will impact on the need for refurbishment.

Reflective summary

- The extent of refurbishment required will vary from situation to situation.
- There is an escalating 'scale of intervention' which spans from superficial 'face lifting' of a building to extensive remodelling and upgrading.
- Refurbishment can be defined as:

  Extending the useful life of existing buildings through the adaptation of their basic forms to provide a new or updated version of the original structure

- The amount of work that is required in order to achieve this definition will be very different on different projects and will depend on a number of factors.
- Terms that are often used instead of or in conjunction with refurbishment are *conversion*, *renovation*, *restoration* and *retrofit*.
- There is no 'fixed' time in the whole life of a building when refurbishment should take place. It will depend on the required building performance of the owner/occupier

Review tasks

Explain the terms *refurbishment*, *conversion* and *retrofit*.

Discuss the issues that could affect the amount of work required in a refurbishment project.

1.2 The amount of refurbishment work undertaken in the UK and associated costs

Introduction

After studying this section you should have developed an understanding of the level of refurbishment work undertaken in the UK, and in which sectors of work refurbishment is most favourably viewed. You should be able to compare this with the amount of new build work undertaken in the various sectors. You should also be able to explain the problems associated with the costing of refurbishment work and what is meant by the term 'allowing for contingencies'. In addition you should be able discuss the discrepancies that occur between tender price and actual completion costs for refurbishment work as opposed to new build.

Overview

Refurbishment work is undertaken extensively in the UK for a variety of reasons such as buildings being listed (to be discussed in detail in Section 1.5) and most commonly because the building structure is sound, but the plan layout of the building is unsuitable for modern purposes. The owners of commercial buildings frequently specify that they require flexible floor plans that can easily be adapted to suit potentially different occupiers during the life of the building. Most older buildings have very rigid floor layouts, which will need extensive work carried out every time there is changed occupancy.

There is a common misconception that to refurbish will cost less than to demolish and build new, based on the idea that the amount of building work required will be reduced if most of the existing structure is to remain in tact. However, this is not necessarily the case, and one of the main problems with refurbishment work is control of costs during the construction work.

The amount of refurbishment work undertaken

The value of all construction work excluding maintenance in the UK in 2000 was in the region of £60 billion. Of this, approximately half was classified as refurbishment work; in addition, nearly £50 billion is estimated to have been spent on maintenance. These figures demonstrate that refurbishment is a major element of the UK construction industry, and that trend is likely to grow during the next decade due to the regeneration of inner cities and towns, and the growing concern about building on green field sites. The environmental impact of refurbishment work is less than that of new build work and this is another driver that will probably encourage clients to opt for refurbishment as opposed to new build.

A breakdown of the type of work undertaken that was classified as refurbishment compared to new build is shown in Figure 1.2

If the figure stated for new infrastructure is removed from the overall figures, then refurbishment work actually accounts for more of the total value of works to buildings than new build. The only area where new build work is still more popular than refurbishment is in the commercial private sector, and this could be accounted for by the problems associated with the costing of refurbishment work, and reduction of competitiveness of tenders for refurbishment work as opposed to new build.

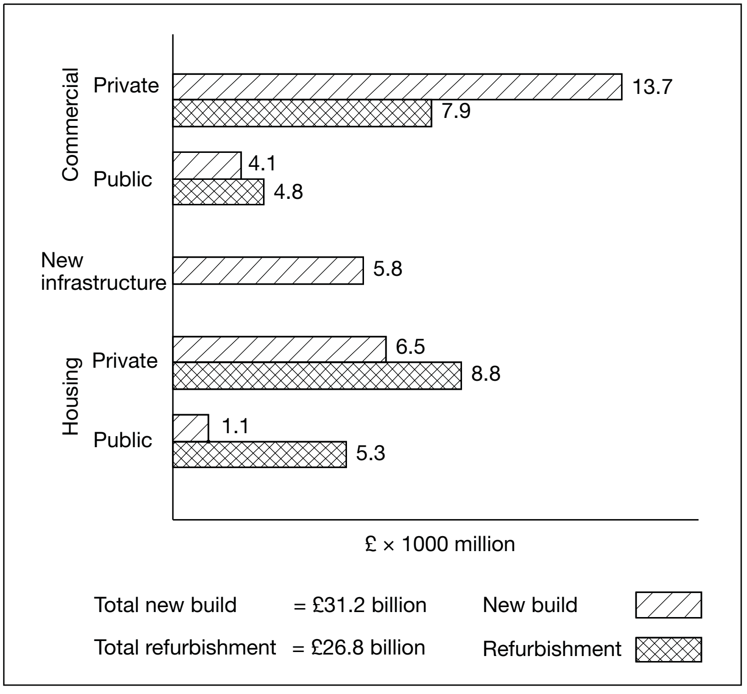

Figure 1.2 Breakdown of construction work undertaken in the UK.

Pricing of refurbishment work

One of the major problems with refurbishment work is the difficulty in determining a cost for the works before construction work starts. This is due to a number of factors:

- There will always be a high level of 'unknowns', i.e. problems with the existing building that will only become apparent during construction work.
- These items cannot be shown on a drawing, and therefore they are priced as the work proceeds. When work that is not shown on a drawing is required, the usual practice is to price them on a daywork basis, which will always be more expensive than bill rates.
- If the building to be refurbished is to remain occupied during the works, a large amount of money will need to be set aside to facilitate this.
- High levels of protection may be required to areas of the building that are listed, and it may be difficulty to price this accurately before work starts.
- The work may be very 'bitty', with small amounts of work required all over the building. It is difficult to price this work accurately.
- Small amounts of materials may be required and it is difficult to get competitive prices for such small quantities.
- Health and safety issues may be more difficult to determine before the contract proceeds and may require additional funding while work is being undertaken.
- In any refurbishment projects some demolition is usually required. Restrictions may apply regarding noise control and the work may have to be undertaken out of hours, which will increase costs.
- In new build work, methods of work are fairly standard and can be priced accurately. This may not be the case in refurbishment work, and solutions to construction problems may need to be decided on site. The solution to the problem may require extra funding than the amount allocated in the bill.
- Because of the difficulty in producing a Bill of Quantities, a great deal of refurbishment work is priced using drawings and a specification. The work to be undertaken will never be 'standard' and each tendering contractor will interpret the documents in a different way. This can lead to large differences in tender bids and can affect competition. In new build work very competitive prices can be achieved.
- It is common to come across what are now classified as dangerous materials in existing buildings (e.g. lead and asbestos). If the presence of these materials is not known at the time of the initial pricing, additional costs will be required in order to remove these materials. Specialist subcontractors are required for the removal of these materials and it can be an expensive process.

Generally it is more difficult to manage refurbishment contracts when buildings remain occupied.

- While undertaking refurbishment, older technologies may be uncovered that need restoration and repair. This work could require specialist materials and labour and also the use of 'one-off' components, which will be more expensive than those that can be bought 'off the shelf'.
- All of the above could lead to the contract duration being increased. This will increase costs because, for example, site accommodation will be required for longer. From a client perspective this increased duration will mean that revenue cannot be generated from the building as early and potential rental income will be lost. If the proposed occupier is to move from another building into the newly refurbished building, they may have to change arrangements for the move, which could incur costs.

It is far more difficult to produce accurate works budgets for refurbishment as opposed to new build work.

This potential for additional costs being incurred in refurbishment contracts after the contract has been awarded creates problems for clients relating to the overall budget they have to spend. Cost consultants will advise clients who are planning to commission refurbishment work to include a large sum of money to allow for contingencies such as those stated previously. This may mean that the planned scheme may have to be based on an inferior specification in order for the work to be completed within budget. However, none of the contingencies may actually materialise, and the client will have 'spare' money that they could have spent on the scheme. This is not generally the situation in new build work.

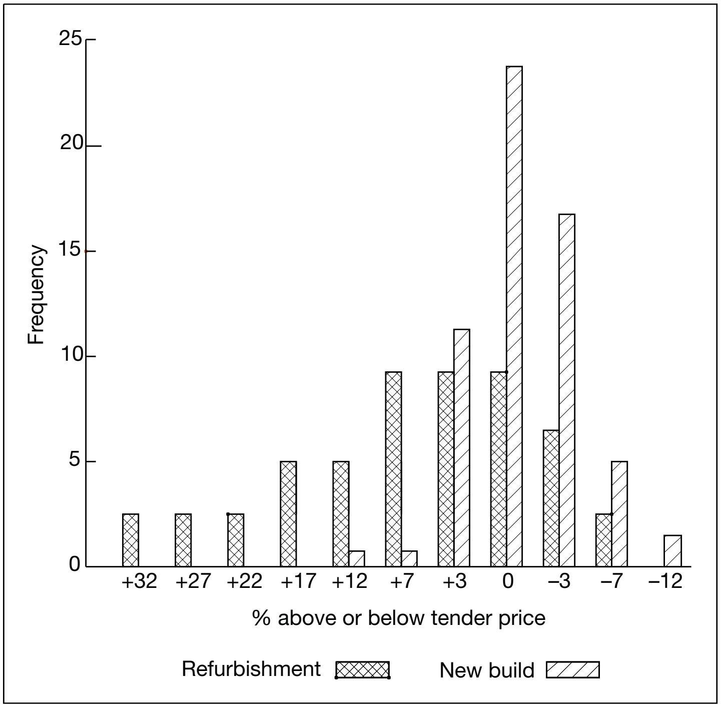

Figure 1.3 Frequency distribution of contracts completed above or below tender price.

Figure 1.3 illustrates the frequency distribution with which build and refurbishment contracts are completed above or below the tender price.

A large percentage of new build contracts are completed for the tender price and a significant number complete below tender price. Far fewer refurbishment contracts are completed for the tender price, and there are a number that go over tender price significantly. If this occurred and the client had not allowed for contingencies then the work would undoubtedly go uncompleted or the scope of the planned scheme would be significantly reduced. Alternatively, the quality of the scheme would have been reviewed and lower quality products used.

Reflective summary

— A common reason for clients requiring refurbishment of existing buildings is that the building structure is sound but the plan layout of the building is unsuitable for modern purposes.

— There is a common misconception that to refurbish will cost less than to demolish and build new.

— Over half of the value of construction work to buildings undertaken in the UK is used in refurbishment.

— There are a number of factors that can make it difficult to price refurbishment work accurately. Clients are therefore generally advised to set aside a sum of money for any contingencies that may arise during the works.

— There is a far greater tendency for refurbishment contracts to be completed over the tender price than new build contracts. A significant number of new build contracts are completed for the tender price or below.

Review task

Produce a list of the factors that may incur additional costs during refurbishment work.

1.3 Issues that affect the decision to refurbish

Introduction

After studying this section you should have developed an understanding of why clients may choose to refurbish a building as opposed to demolishing and rebuilding. You should also be able to explain how and why buildings fail, and how these factors are linked to definitions of the size of refurbishment schemes.

You should also be able to explain the need for appraisal of buildings which may be refurbished, the stages of the appraisal process, and how this can lead to a scheme being deemed as feasible or unfeasible. You should also understand the cost implications of undertaking an appraisal of an existing building, and how this may affect the decision of a client to pursue the refurbishment option.

Overview

The decision to refurbish a building is made when a building is not deemed to be 'fit for purpose'. Buildings that may be refurbished are:

- Occupied by the client who wishes to remain in the building, but the building does not suit current business practices.
- Existing buildings that are chosen by clients specifically because of location and size, but which are not suitable for the proposed use.
- Buildings bought by a developer without a specific occupier in mind. The aim is to refurbish the building and then rent out or sell commercial/industrial/residential space.

Generally, the layouts of older buildings do not suit modern requirements and this is a major reason to refurbish, but refurbishment is also required where buildings have failed.

Failure of buildings

Buildings may fail for a number of reasons. Figure 1.4 shows a breakdown of the most common reasons for this.

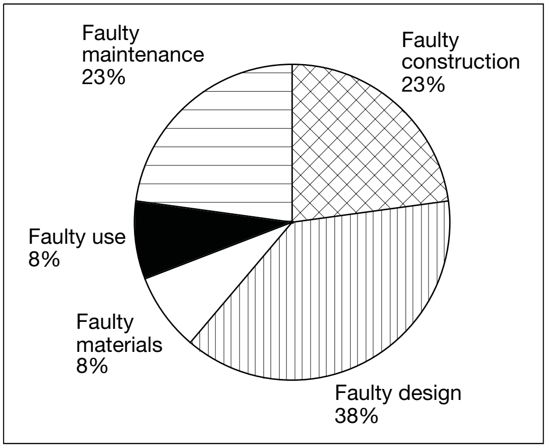

Figure 1.4 Causes of failure in buildings.

Faulty design accounts for a significant number of building failures, but this is not a representation of the poor performance of building designers. The nature of construction work does not enable the building of prototypes to test in every conceivable situation. If we compare the production of cars, for example, a car is designed and then built; it is tested exhaustively, faults identified and then rectified. The model is then tested again and again and the cycle repeated until all faults are eliminated. If you relate this to building work, you would need to construct a building, test it over time and then demolish and rebuild, removing all the problems in the next design. This is obviously unfeasible, and the reason why most designers will specify systems of construction that have been tried and tested over the years. This does, however, lead to a restriction in the amount of 'design flair' that can incorporated into building design, and sometimes designers will specify using a system that has not been tried and tested. These systems can fail either quickly or over a longer period of time, but essentially if they were not used the built environment would be far less interesting aesthetically were these new systems not to be tried.

The Building Research Establishment does produce prototypes of buildings and building elements in an attempt to reduce design caused defects.

Faulty construction accounts for many building failures and this can be linked to the above. If a new system has not been specified or used previously, then the builder will have no experience of this system and may build it incorrectly. Sometimes lack of suitably qualified supervision can lead to this problem, as can the lack of testing that is carried out during construction work, such as concrete tests. An example of using systems that have not been used before creating this problem is that of the use of precast concrete structural frames. During the 1950s, in order to increase the amount of housing the development of high-rise blocks of flats became endemic. As precast concrete frames were used extensively and successfully in Europe, they were adopted for use as the structural frame in these flats in the UK. However, builders and supervisors had no experience of this type of construction and problems have arisen with this type of construction – or more specifically with the *in situ* concrete joints used to form the joints between precast concrete members. Water has penetrated the joints and corroded the steel reinforcement, which in turn has led to spalling of the concrete around the steel, so that the joints are no longer rigid. Some of these structures have been demolished, but some are still standing and essentially it is only the sheer weight of the structure that holds them together. The term *buildability* is commonly used these days, and basically means that designs have been developed from the perspective of the person who is to construct them and that the details should be very clear. Furthermore, the increasing demand for quality from clients is leading to better qualified supervision of construction work. This should lead to fewer problems of faulty construction and, very importantly from a health and safety perspective, the design should be able to be constructed with a reduction of risk to site workers.

Faulty maintenance accounts for a similar number of building failures, and this can be broken down into two parts: maintenance that has been carried out incorrectly, or more commonly where no maintenance has been carried out during the life of the building. A large section of this book is dedicated to building maintenance, and how it can lead to the improved performance of buildings over their lifespan. If the procedures specified in this book are adopted then this figure should be reduced. However, maintaining buildings costs money, and therefore although building maintenance can be planned and specified correctly, if the funding available is not adequate this will ultimately lead to building failure.

Faulty materials account for fewer, but still substantial, amounts of building failures, and the reasons for this are to a certain extent the same as for faulty design. We cannot test all materials for 60 years before they are used for construction, and we cannot test all materials in conjunction with all of the materials that they may potentially come into contact with. However, as a general rule, materials that are manufactured in factories will be of better quality than materials manufactured on site (*in situ*). More prefabrication should reduce this problem, but it can be argued that prefabrication reduces design flair and flexibility.

Finally, faulty use accounts for some building failures, and this generally occurs where the building is not being used for the purpose for which it was designed. For example, occupiers may wish to create more space and therefore knock down walls without the advice of the designer, which can have major implications and possibly cause a collapse.

The decision to refurbish as opposed to demolish and rebuild

The decision to refurbish a building as opposed to demolishing any existing building and undertaking a new build scheme may be taken for the following reasons:

- Refurbishment is currently seen as a more sustainable option than new build work (see Section 1.4).
- Buildings may be listed (see Section 1.5).
- Many buildings are structurally sound, and therefore to demolish a sound structure is not economically viable.
- The current or proposed occupier may wish to change the use of the existing building.
- The existing building services may not provide the levels of performance that are required by building occupiers, and work may be required to the structure in order to facilitate new services.

Refurbishment schemes can be classed as:

- *Minor refurbishment*: this would include replacement or upgrading of plant and services, redecoration and new floor coverings.
- *Major refurbishment*: this would include replacement of major plant and services, suspended ceilings, floor finishes, raised floors and internal walls.
- *Complete refurbishment*: only the substructure, superstructure and floor structure are retained.
- *Redevelopment*: where the only element to remain is the existing façade and foundations to the façade.

The extent of refurbishment required would be established after an appraisal of the existing building has been carried out. In the initial appraisal the following assessments would be made:

> If planned maintenance is carried out on buildings, the need for large-scale refurbishment should be reduced.

- Whether the building is in a state of serious deterioration, and a collapse is possible.
- Whether the building is suffering from significant deterioration, which may indicate that major remedial works are necessary, i.e. works to the structure.
- Whether or not there are any evident defects in the original design and/or construction that have caused or are causing damage.
- Whether or not there has been any accidental damage to the building.
- Whether it is feasible that the building could be used for an intended change of use.
- Whether a further and more detailed structural survey is required.

The process to be adopted when undertaking an appraisal is shown in Figure 1.5. As the figure shows, there is a great deal of work that is required to be undertaken before any drawings are prepared. This has a major cost implication that does not occur when specifying new build work. In new build work the only real investigation that is required is a soil investigation to allow for the foundations to

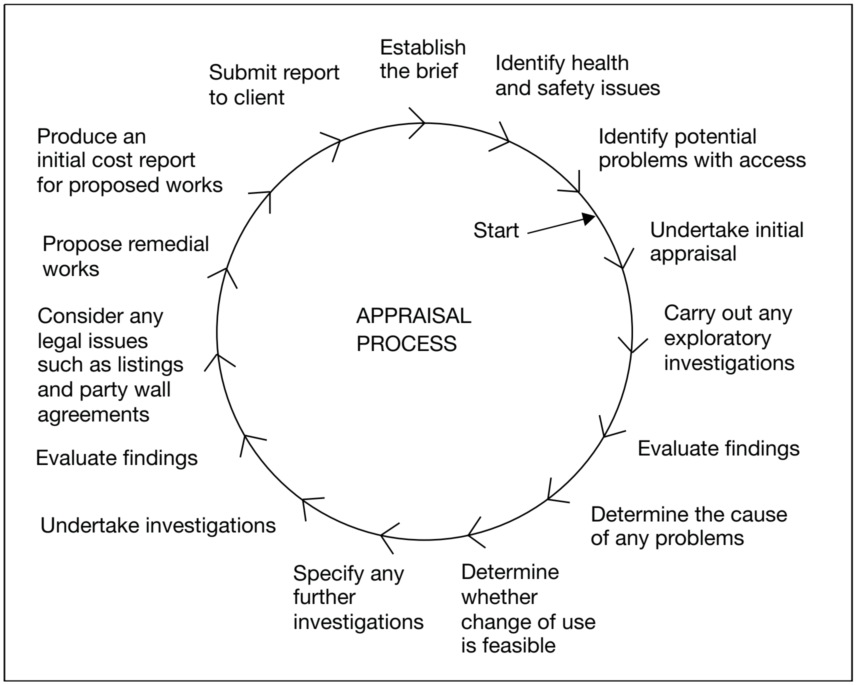

Figure 1.5 The appraisal process.

be designed. The additional cost of the appraisal needs to be borne by the client, who may be deterred from choosing to refurbish because of this cost. The appraisal could be completed and the report could recommend that refurbishment is not a feasible option and therefore the money spent is unrecoverable. However, there may be grants available to refurbish buildings that are not available for new build schemes and this may provide an incentive to clients to pursue the refurbishment route.

Reflective summary

- The decision to refurbish a building is made when a building is not deemed to be 'fit for purpose'.
- Generally, the layouts of older buildings do not suit modern requirements. This is a major reason to refurbish, but refurbishment is also required where buildings have failed.
- Buildings may fail because of faulty initial design, construction, use, maintenance or materials. Commonly a combination of these leads to building failure.
- Refurbishment work can be classified by the extent of work required to make it 'fit for purpose'.
- An appraisal of an existing building is essential when deciding whether a refurbishment scheme is feasible and viable.
- The cost of undertaking an appraisal may deter clients from pursuing the potential of a refurbishment scheme.

Review tasks

Produce a list of how buildings can fail and give examples in each case.

Outline the procedures that need to be undertaken when carrying out an appraisal of an existing building

1.4 Refurbishment vs. redevelopment from an environmental perspective

Introduction

After studying this section you should have developed an understanding of the environmental impact of construction work, both new build and refurbishment. You should be able to explain the main points and implications of changes to Part L of the Building Regulations (England and Wales) and Part J of the Building Technical Standards (Scotland) to proposed refurbishment schemes. After studying this section you should also have developed an understanding of the future changes to the regulations that may occur and the implications for future buildings, in particular buildings that are to be refurbished. You will also have developed a knowledge of how buildings can be assessed as to their environmental impact both during construction and during the life of the building.

Overview

Buildings are believed to account for 50% of all energy used globally. Half of that energy is consumed during the construction of the building and half during the life of the building (Figure 1.6). It is obviously therefore important that materials and systems of construction that can reduce this energy use are utilised by the construction industry as much as possible. Refurbishment, rather than redevelopment is currently seen to be the more sustainable option because the amount of new build work is reduced.

In addition, the UK government has pledged to contain and reduce the growth in carbon dioxide emissions, a large part of which is due to the energy use in buildings. The energy consumption of houses represents 27% of the national emission of carbon dioxide, and a further 19% comes from non-domestic buildings.

Reducing environmental damage during the construction stage involves utilising the principles of sustainable construction. These principles can be summarised as:

An EPM is basically a system that allows for the comparison of alternative materials from an environmental perspective.

- Choosing materials and systems using an environmental preference method (EPM).

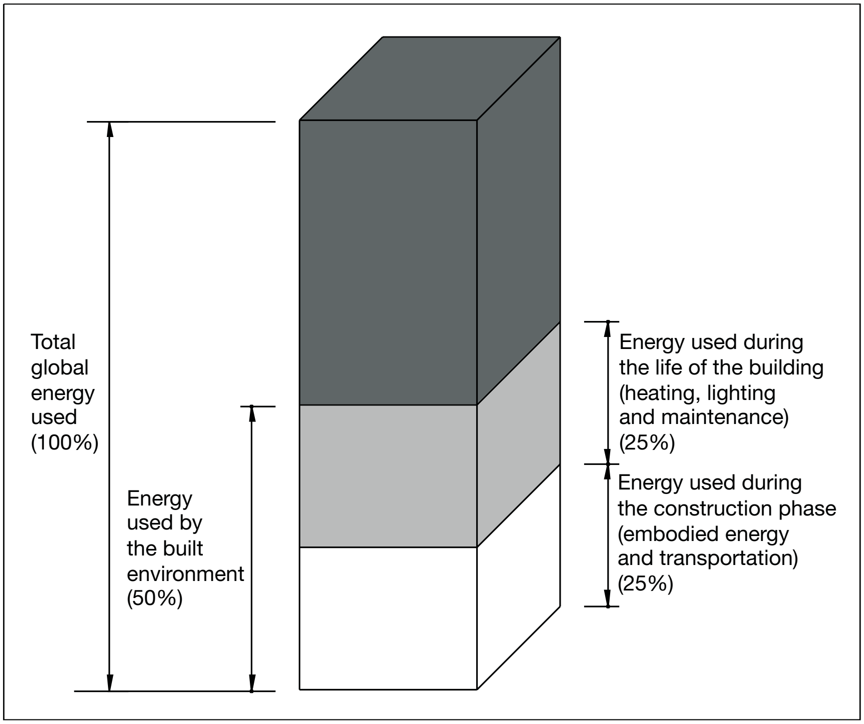

Figure 1.6 Energy used by the built environment.

- Non-sustainable materials and systems must only be used when there is no feasible alternative.
- Materials must be reused wherever possible.
- The amount of waste water that is generated on site must be reduced so as to prevent pollution of the surrounding areas.
- Excavation methods must be carefully considered.
- Waste must be sorted.
- Storm water must be contained.
- Waste and tipping must be minimised.

Utilising these principles it becomes apparent why refurbishment is the more sustainable option. If less new material is used during the construction phase then fewer materials need to be assessed using an environmental preference method. Excavation in most refurbishment projects is not required as the existing substructure will remain, and waste and tipping are reduced because demolition is limited. There is also the possibility of reusing any demolished materials from the site to be refurbished, but it is more likely that reclaimed materials can be used from other demolished buildings to try to 'match' older materials on the refurbishment project. An example of this is replacing roof tiles on older buildings. Tiles that have been reclaimed from demolished buildings can be used and newly manufactured materials will not need to be specified.

The Building Research Establishment (BRE) has developed a tool that enables users to compare refurbishment and redevelopment scenarios for a particular site from an environmental perspective. This tool is called Office Scorer and allows for the comparison of environmental impacts and whole life costs of refurbishment and redevelopment. The BRE recommends the early use of this tool in the decision-making process, when the options of refurbishing, redeveloping on the same site and redeveloping elsewhere are being considered. It uses financial costs (£) or ecopoints per m² or per person as the basis for comparison. One hundred ecopoints is equal to the environmental impact of one person in the UK over one year.

A major part of this tool looks to identify the amount of embodied energy required in material and systems manufacture. The amount of embodied energy of a material is determined after assessing the environmental impact of the manufacture of materials and transportation, the construction process (including transport to site, any maintenance repairs or replacement required over the life of the building), and the energy required for demolition and disposal at the end of the life of the building. The research undertaken by the BRE suggests that from an environmental perspective, refurbishment is the best option. Figure 1.7 compares the ecopoints and costs per m² of undertaking refurbishment and redevelopment. It also shows that if the scheme is to include air conditioning the ecopoint score will be higher than if natural ventilation is used.

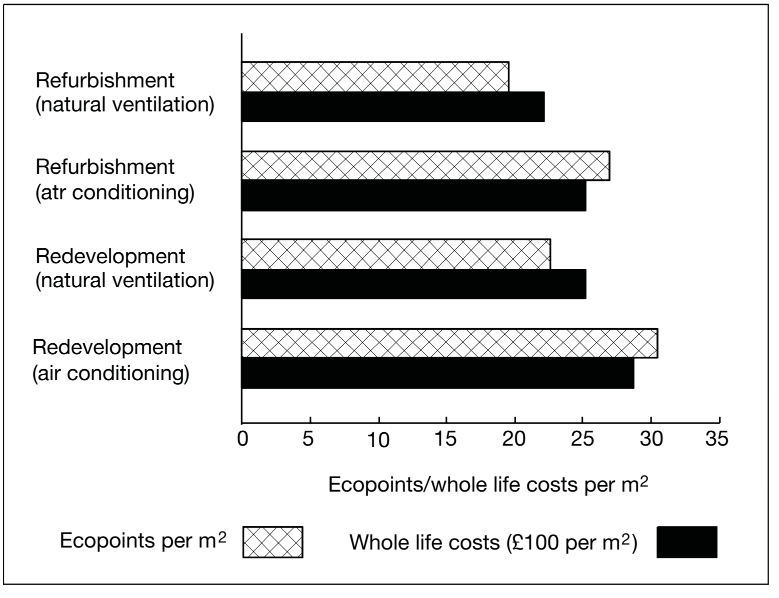

Figure 1.7 Comparison of the environmental impact of refurbishment vs. new build.

This indicates that refurbishment is indeed the better option, and if natural ventilation is adopted this is even better from an environmental perspective.

Part L of the Building Regulations; Part J of the Building Technical Standards

Parts L and J deal mainly with the environmental performance of buildings after construction. Parts L (England and Wales) and J (Scotland) deal with the energy efficiency of buildings and were revised in 2002. It is envisaged that over the coming years the requirements will become even more stringent regarding the environmental performance of buildings.

Parts L and J consist of two sections:

- Part 1, which covers dwellings
- Part 2, which covers buildings other than dwellings

Implications of changes to the Building Regulations: Part L (England and Wales); Part J (Scotland)

The requirements in both Parts 1 and 2 are intended to improve the energy efficiency of all construction work, including extensions and refurbishment work, with an emphasis on higher standards of insulation for the building fabric. The regulations will continue to allow for traditional forms of construction to be used, but require more insulating products to be incorporated and a reduction in cold bridges and air leakage.

The principal changes include the introduction of improved *U* values to be used under an 'elemental' (non-trade-off) approach which reflects more accurately the effects of cold (thermal) bridging and air gaps within construction.

The new regulations retain other whole-building approaches to compliance as alternatives to the 'Elemental Method' which offer a more holistic approach for the energy-efficient design of buildings, looking at energy wastage for the building as a whole.

The regulations consider aspects such as:

- the effects of airtightness
- standards of workmanship
- the efficiency of the heating and lighting system

When a component of relatively high thermal conductivity extends partly or completely through the thickness of a building element, the high thermal conductivity component provides an easier passage for heat flow, and is called a cold bridge. Examples include lintels and wall ties.

Methods of compliance – Part 1 (Dwellings)

The elemental *U* value method

U values are measured in W/m² K. A *U* value of 0.25 means that one quarter of a watt of heat is lost through each square metre of the element when a 1 °C temperature difference exists between the inside and outside of the element.

In this method the builder has to ensure that the elements of the new building comply with the prescribed *U* values given in the regulations. The values are given in Table 1.1.

In England and Wales the values are linked to the efficiency of the heating system. This is based on boiler efficiency and uses the government's SEDBUK rating system (**S**easonal **E**fficiency of a **D**omestic **B**oiler in the **UK)** as a standard. The builder is only allowed to demonstrate compliance using elemental *U* values if the heating system meets or exceeds SEDBUK ratings. Otherwise a different trade-off method must be used. In Scotland, under the elemental method there is an immediate trade-off available, but more onerous *U* values need to be adopted.

Further, the area of the windows must not exceed 25% of the total floor area in order for the elemental *U* value method to be used. It is expected that all new dwellings that are constructed will comply with this elemental *U* value method. In refurbishment schemes or when an extension is planned to an existing house,

Table 1.1 Typical elemental *U* values.

Exposed element	**England and Wales**	**Scotland (where minimum SEDBUK values for boilers are achieved)**	**Scotland (poorest acceptable *U* values when using the Target *U* value and Carbon Index calculation methods only)**
Pitched roof			
Insulation between rafters	0.20	0.20	0.18
Insulation between joists	0.16	0.16	0.16
Integral insulation	0.25	N/A	N/A
Flat roof	0.25	0.25	0.22
Wall	0.35	0.30	0.27
Floor	0.25	0.25	0.22
Windows doors and rooflights			
Metal frames	2.2	2.2	2.0
Wood on PVC frames	2.0	2.0	1.8

it may be beneficial for a boiler with a SEDBUK rating to be installed, as this will allow for reduced *U* values in elements of the existing building that do not comply with current regulations.

The target *U* value method

This is a simple method of showing compliance that allows for a high level of design flexibility and includes the option of taking into account not only the *U* values but also the performance of the heating system and the performance of the areas of glazing. This method allows variation of the elemental *U* values within certain limits. The regulations give guidance as to the poorest acceptable *U* values that would be expected in certain elements. This trade-off method of compliance allows builders to compensate for poorer *U* values in some elements of the building by having better *U* values in other elements. For example, this method will allow for an increase in insulation where it is more practical and economic, such as loft spaces.

The carbon index method

This method is an extension to the 1998 Standard Assessment Procedure (SAP). SAP ratings need to be calculated but will not be accepted as a way of complying with the new regulations, and there is no obligation to achieve a certain rating. Under this method the regulations will be met if the calculated carbon index for the house is not less than the prescribed value. This method also allows a variation in elemental *U* values within certain limits.

A Standard Assessment Procedure rating is an energy rating that estimates the space and water heating costs of a property and converts them into a rating of between 1 and 100.

The latter two methods allow for some flexibility. For example, where an integral garage is incorporated into a property, using the elemental method the unheated space is disregarded and the external wall must comply with the stated *U* value for walls. However, with the target *U* value and carbon index methods less onerous values may be accepted. It is these two methods that will usually be utilised for refurbishment work, as it is unlikely that older buildings will have elements that have *U* values that comply with Part L of the Building Regulations.

Methods of compliance – Part 2 (Buildings other than dwellings)

The main change is the improved *U* values under an elemental approach, with a similar choice of two alternative ways of showing compliance. However, for non-domestic buildings there is an equal emphasis placed on the energy efficiency of aspects of building design other than the building envelope. In particular, there is emphasis on:

- heating and hot water systems
- mechanical ventilation and air conditioning
- airtightness of buildings
- lighting efficiency
- thermal insulation for pipework, ducting and vessels

Air leakage and airtightness standards must comply with CIBSE Technical Manual 23.

The elemental *U* value method

Under this method *U* values should be no worse than those Prescribed in Tables 1.2 and 1.3.

Table 1.2 Part L2 requirements: England and Wales.

Exposed element	***U* value (W/m^2 K)**
Pitched roof with insulation between rafters	0.2
Pitched roof with insulation between joists	0.16
Flat roof or roof with integral insulation	0.25
Walls, including basement walls	0.35
Floors, including ground and basements	0.25
Windows, roof windows and personnel doors (area weighted for the whole building) glazing in metal frames	2.2
Windows, roof windows and personnel doors (area weighted for the whole building) glazing in wood or uPVC frames	2.0
Rooflights, vehicle access and similar large doors	0.7

Table 1.3 Part J requirements: Scotland.

Exposed element	***U* value (W/m^2 K)**
Roof with integral insulation	0.25
Roof with horizontal insulation between/over joists	0.26
Walls	0.30
Floor	0.25
Windows, personnel doors and rooflights	2.0
Vehicle access and similar large doors	0.7

Table 1.4 Maximum prescribed glazed areas.

Building type	Windows and doors as percentage of the area of exposed wall	Rooflights as percentage of area of roof
Residential buildings, where people temporarily live or permanently reside)	30	20
Places of assembly – offices and shops	40	20
Industrial and storage buildings	15	20
Vehicle access doors and display windows and similar glazing	As required	

There are also maximum prescribed glazed areas depending on the size of building, as shown in Table 1.4.

In addition, the regulations call for the building to be constructed so that there are no gaps or bridges in thermal insulation at joints or edges.

The whole building method

This approach allows for greater flexibility than the elemental method. For office buildings the heating, ventilation, air conditioning and lighting systems should, when in full operation, emit no more carbon per square metre than a specified Carbon Performance Rating or CPR, minimum *U* values should be met and airtightness requirements should be met. The maximum CPR will depend on whether the building is classified as a naturally ventilated, mechanically ventilated or air-conditioned. Air-conditioned offices produce the highest levels of carbon dioxide, especially refurbished air-conditioned offices.

The carbon emissions calculation method

This method also considers the performance of the building as a whole, but can be used for any building. The calculated annual carbon emissions should be no greater than those for an equivalent reference building that has been designed to comply with the elemental method. An acceptable calculation method must be used that will have been produced by a relevant authority, such as CIBSE.

Energy conservation measures and solar and internal heat gains can be taken into consideration.

U value calculation method

The *U* value of exposed elements of the building fabric should be calculated in accordance with:

- BS EN ISO 6946:1997 for walls and roofs
- BS EN ISO 13370:1998 for ground floors
- Combined methods that allow for the effects of thermal bridging to be taken into account.

Design and construction Issues related to the changes to the regulations

When considering refurbishment of a building, there are a number of issues that need consideration.

Airtightness could become the 'Achilles heel', as designers will be required to ensure that a building meets the air leakage target of 10 m^3 per hour from the building fabric at an applied pressure of 50 Pa. Mobile testing units can be used by building control bodies and if buildings 'fail' they will have to be adapted to ensure compliance. Robust standard details will have to be produced, but they may require improved standards of workmanship. Current industry operatives may need retraining. Building control bodies will have to monitor compliance and may need extra resources. This may create problems in refurbishment schemes and may deter designers from choosing the refurbishment option because of a fear that the building may not comply with this regulation when complete. Further major works may be required which will require additional funding.

The revisions discourage reliance on mechanical cooling systems and encourage the reduction of overheating through shading, orientation, thermal mass, night cooling etc. There can be a trade-off between the elemental *U* values and the efficiency of the boilers, but this could lead to constantly changing to boilers that are increasingly more efficient, and could lead to reliance on boilers to achieve compliance. In addition, every building will need some low-energy lighting systems.

Refurbishment projects may not be able to comply with the regulations and design and build as a procurement tool may drop in popularity due to the amount of work required during the pre-tender design stage by the contractor, which could prove financially uneconomical. However, the changes are excellent for the sustainability-minded designer and design and build contractors

Facilities management issues

All buildings will have to have energy meters and building log books, which are essential if building owners and operators are to monitor energy consumption against a benchmark figure.

The changes to the regulations have been made in order to reduce the negative environmental impact of buildings. However, there is a danger that the regulations will lead to a reduction in refurbishment projects because of the concern over non-compliance with the regulations when work is complete, and the high levels of funding required to ensure compliance. From a designer's perspective it will be easier to guarantee compliance for new build schemes than for refurbishment schemes. If this occurs then the regulations may actually work against environmental improvements, as it is clear that from a sustainable angle, refurbishment is the better option as less new material is required and therefore the amount of embodied energy used will be reduced.

Reflective summary

— Buildings are believed to account for 50% of all energy used globally. Half of that energy is consumed during the construction of the building and half during the life of the building.

— Refurbishment, rather than redevelopment, is currently seen to be the more sustainable option because the amount of new build work is reduced.

— Part L of the Building Regulations (England and Wales) and Part J of the Building Technical Standards (Scotland) deal with the energy efficiency of buildings.

— There are a number of methods to prove compliance with the regulations, both for domestic and for industrial and commercial buildings.

— The changes to the regulations have been made in order to reduce the negative environmental impact of buildings. However, there is a danger that the regulations will lead to a reduction in refurbishment projects because of the concern over non-compliance with the regulations when work is complete.

Review task

Outline the methods for testing that buildings comply with Part L of the Building Regulations and/or Part J of the Building Technical Standards.

Produce a matrix to compare the environmental impact of refurbishment schemes compared to new build schemes. This should be developed by identifying criteria to compare the two types of construction work and then grading the criteria.

1.5 Issues relating to the listing of buildings

Introduction

After studying this section you should appreciate the relevance of listed building status in the context of building refurbishment. You should appreciate the basis of statutory control of listed buildings and the mechanisms by which this can be imposed by various agencies. In addition, you should understand the basis upon which listed building status is granted and the broad classifications used to describe different grades of listing.

Overview

Listed buildings are those included in the statutory lists of buildings of special architectural or historic interest. Detailed records of listings are held which define the nature and extent of the listing and hence the degree to which the listing affects the potential to alter, refurbish or demolish the building.

Many of the older buildings in the United Kingdom, as well as some newer ones, are listed. The listed status of a building indicates that it is thought to be worthy of special protection for the future. The 'List of Buildings of Special Architectural or Historic Interest' is compiled by national conservation agencies and the Department of the Environment. Although it is possible to list a building which was constructed as recently as 30 years ago, in practice the majority are much older.

A building can be listed at any time, and it is often the case that building owners are notified of this process after the event by the Department of the Environment and the Local Authority. Under normal circumstances there is no right of appeal against listing. Naturally this can have major implications for any proposals to refurbish, alter or demolish existing buildings and the formal process of listed building consent must be initiated prior to undertaking works. The nature of works allowed on listed buildings is tightly controlled in terms of scope and quality and the consent to undertake works will often carry with it strict conditions. This has significant cost implications when working with listed buildings.

Implications of listing

As previously noted, the controls that are applied to listed buildings are far stricter than normal planning controls that apply to other buildings. This does not mean that changes cannot be made to listed buildings, but it does imply a requirement to apply for Listed Building Consent to carry out any works that would affect the character and/or architectural merit.

If a listed building is demolished, altered or extended without consent, such that the character and appearance of the building are affected, the Local Authority may serve a Listed Building Enforcement Notice requiring reinstatement of the building as it was prior to the work. If this is not possible, the building owner may be fined, imprisoned, or both.

In practice, most repair, maintenance and alteration to listed buildings requires Listed Building Consent. Work which involves replacing building elements, components and finishes in different styles or materials from the original will need consent, as will demolition works and extension or alteration. Whilst the listed elements of many buildings are restricted to the external elevations (allowing façade retention schemes to be initiated), it is important to remember that the interiors of some buildings are also protected. Architectural features of the building interior, such as staircases, may often need to be retained. Boundaries to properties may also form part of the listed building and work to these elements may also require consent.

The vast majority of listed buildings are of considerable age and the need for ongoing repair and maintenance increases as they get older. In some situations the building may fall into a state of disrepair such that its special interest as a listed building is in danger. In such situations the Local Authority may be forced to serve a 'Repairs Notice'. The notice will specify work that should be undertaken to bring the building up to an acceptable condition. If the required work is not carried out within a defined period, the Local Authority may acquire the building by compulsory purchase. It also has the power to undertake works and claim the cost from the owner.

The nature of listed buildings

Listed buildings in England and Wales are classified by grade to define their relative importance with reference to historic or architectural merit. The grades currently adopted are as follows:

- Grade I: buildings of exceptional interest
- Grade II*: particularly important buildings of more than special interest
- Grade II: buildings of special interest, which warrant every effort being made to preserve them (these account for the vast majority of listed buildings)

The process of listing applies a range of broad rules to assist selection. Although these are by no means definitive, they include the following general principles. Buildings likely to be listed include:

- most buildings built before 1700
- selected buildings built between 1700 and 1840
- buildings of definite quality and character built between 1840 and 1914
- selected buildings of high quality built between 1914 and 1939
- outstanding buildings of exceptional interest built after 1939

Buildings become eligible for listing when they are 30 years old; however, in exceptional circumstances buildings 10 years old which are deemed to be under threat may be listed.

In Scotland, listed buildings are dealt with by grading using a different system including categories A, B and C(S).

- Category A includes buildings of national architectural or historic importance.
- Category B includes buildings of local importance.
- Category C(S) includes buildings which may have been altered, or in some cases buildings of little individual merit but which group well with others in Categories A or B.

In Northern Ireland buildings of historical or architectural merit may be listed but this is non-statutory.

Modern, well-kept buildings are easy and cheap to keep and manage. However, older buildings become increasingly difficult to maintain as they age. The physical deterioration of the structure and fabric will become more extensive with time, and once decay is allowed to set in a building becomes increasingly difficult and expensive to maintain. When considering refurbishment and alteration the age of the basic building must be considered. If the building is to be fit for alternative use, refurbishment will be required, and if the disposal value is to be maintained it must be properly maintained. When dealing with older buildings it is essential that a long-term view of the cost-effectiveness of maintenance and refurbishment be taken.

Figure 1.8 shows examples of listed buildings, one old and one more modern. They are both listed for specific reasons.

Figure 1.8 Two listed buildings.

Reflective summary

- Listed buildings are those included in the statutory lists of buildings of special architectural or historic interest.
- Many of the older buildings in the United Kingdom, as well as some newer ones, are listed.
- A building can be listed at any time, and it is often the case that building owners are notified of this process after the event by the Department of the Environment and the Local Authority.
- Under normal circumstances there is no right of appeal against listing.
- The nature of works allowed on listed buildings is tightly controlled in terms of scope and quality and the consent to undertake works will often carry with it strict conditions.
- If a listed building is demolished, altered or extended without consent, such that the character and appearance of the building are affected, the Local Authority may serve a Listed Building Enforcement Notice requiring reinstatement of the building as it was prior to the work.
- Listed buildings in England and Wales are classified by grade to define their relative importance with reference to historic or architectural merit.
- In Scotland, listed buildings are dealt with by grading using a different system including categories A, B and C(S).
- In Northern Ireland buildings of historical or architectural merit may be listed, which is non-statutory.

Review tasks

In the area that you live or study, try to find out which buildings are listed and why.

Outline the difficulties for a developer when proposing works to listed buildings.

1.6 Overview of statutory control of buildings

Introduction

After studying this section you should be able to appreciate the evolutionary development of building control through public health and other associated legislation. You should be able to outline the basic processes required to obtain formal approval to build and how control extends to the building process.

Building to accommodate disabled people is now a major issue, and an outline of the requirements are given in an overview of Part M of the Building Regulations.

Standards are considered, and you should be able to develop an understanding of the future changes to the regulations that may occur and the implications for future buildings. You should also develop an understanding of the legal responsibilities of all the parties involved in the construction process with regard to the health, safety and welfare of site workers and the public during construction work and develop an understanding of relevant regulations.

The Building Technical Standards are the Scottish equivalent of the Building Regulations in England and Wales.

Overview

The application of controls over the building process is a relatively new concept. Prior to the first set of Building Regulations in 1965, control over the building process was limited. The first real major realisation of the need for control probably came in the aftermath of the Great Fire of London in 1666, and in 1667 the building of the external structure and fabric of buildings in timber was outlawed in London.

A main feature of the development of control in the rest of England was the various Public Health Acts (PHA), and probably the most notable of these was the PHA 1875. This had three main focuses: structural stability, dampness and sanitation. Following this Act a set of Model Bye Laws was issued in 1877 as a guide for Local Authorities who were delegated the responsibility for setting and enforcing minimum standards of construction.

Following limited progress in the 19th century, legislation concerning construction was limited, and mainly in the area of public health. By the 1950s many local authorities were issuing bye laws peculiar to their locality, and this made it difficult because laws varied from area to area. Because of the need for consistency, National Bye Laws were established in 1952, and following these items of significance include the Public Health Act 1961 and the first set of national Building Regulations in 1965. The aims of the building regulations were to set out what the minimum standards acceptable for building works are. It is not within the scope of this book to discuss all the Building Regulations, but reference is made to them throughout the text. An overview of Part M is given in this section.

A major reference for the safety of persons associated with the building process is the Health and Safety at Work Act 1974, which applies to all industries and aspects of construction work. The Act is an 'umbrella' for a huge set of regulations that are specific to individual industries and aspects of those industries. Some of the most recent and important regulations affecting construction work will be discussed in this section.

Refurbishing buildings for people with disabilities

Physical disabilities include mobility problems, impaired hearing and sight.

With an increasingly ageing population, the proportion with physical disabilities is a factor of increasing significance. The need to improve access to buildings is reflected in the development of regulations concerning providing suitable facilities for people with disabilities.

The principal legislation which concerns provision for the physically disabled is contained in the Disability Discrimination Act 1995 and Approved Document M of the Building Regulations.

The checklists given later in this section are examples that offer guidance on adapting housing and refurbishing offices to accommodate the physically disabled. Their application will hopefully assist in evaluating the suitability of existing buildings to cater for the special needs of physically disabled people. They will also assist in identifying the building elements which may need changing to provide suitable access.

Before any design is undertaken, the architect could use these guidelines to assess the existing building, identify where there is non-compliance and design in solutions to these problems. It may be deemed that it is impossible to comply with the regulations when undertaking a minor refurbishment and a more major scheme may be required. This will have a cost implication for the client, who may wish to choose another building to refurbish. Occasionally, it may be impossible to convert an existing building to comply with the regulations, and demolition and new build may be the only option. The checklists can also be used to check that any new build scheme is designed in accordance with statutory requirements.

The statutory requirements concerning the provision of suitable adaptations of refurbishment of buildings are contained in the Building Regulations 2000, Access and Facilities for Disabled People – approved document M. Part M offers guidance on where the requirements apply, new buildings, extensions, alterations and external features. The specific matters dealt with are summarised as follows:

- Section 1: Means of access to and into buildings other than dwellings
- Section 2: Means of access within buildings other than dwellings
- Section 3: Use of buildings other than dwellings
- Section 4: Sanitary conveniences in buildings other than dwellings
- Section 5: Audience or spectator seating in buildings other than dwellings
- Section 6: Means of access to and into the dwelling
- Section 7: Circulation within the entrance storey of the building
- Section 8: Accessible switches and socket outlets in the dwelling
- Section 9: Passenger lifts and common stairs in blocks of flats
- Section 10: WC provision in the entrance storey of the building

Examples of checklists

The aim of using these checklists is to try to achieve as many positive responses as possible.

These checklists can be used for assessing existing buildings, and for informing the design of new build work.

ENTRANCE	Yes	No
Is there at least one primary entrance usable without assistance from someone in a wheelchair?		
Is the main entrance accessible from the outside without having to use steps or stairs?		
Does the entrance have a clear opening of at least 810 mm?		
Does the entrance have a vision panel 900–1500 mm from the finished floor level?		
Is there a ramp outside the main entrance?		
Are there handrails at the ramp at a height of 800–920 mm?		
Is there a level, paved area at least 1500 × 1500 mm outside the door?		
Is the threshold less than 15 mm high?		
Is the accessible entrance identified by the international symbol of access?		
Is there an automatic door opening device?		
Does the door have a clear opening of at least 810 mm?		
Are the door handles 760–915 mm from the floor?		
Is there space to manoeuvre a wheelchair in the vestibule?		

ENTRANCE	Yes	No
Are the floor surfaces slip-resistant?		
Is the doorbell or call button lower than 900 mm?		
Where revolving doors are used, is there a clearly marked alternate route not less than 900 mm wide?		
Are doors operable by a single effort?		
Do the door closers allow for the use of the doors by disabled persons (delayed action)		
Are the lock and opening mechanisms operable with one hand?		

RECEPTION/FOYER	Yes	No
Does the door have a clear opening of at least 810 mm?		
Are light switches within the range of 835–1065 mm above the floor?		
Is a 300 mm minimum unobstructed space provided next to the leading edge of the doors?		
Is there adequate space to manoeuvre a wheelchair in the room?		
Is the intercom within a range of 835–1065 mm above the floor?		
Is the window cill 760 mm or less from the floor?		
Are the window operating devices operable from a wheelchair?		
Are the heating/air-conditioning controls operable by a disabled person?		
Is the counter height within a range of 835–915 mm?		
Are the floors slip-resistant?		
Does the carpeting allow free movement of wheelchairs?		
Are all surfaces free from glare?		
Is the lighting adequate for a visually impaired person?		
Is the signage adequate for a visually impaired person (size, colour, contrast)		
Is there proper demarcation of differences in level by contrasting colour and appropriate lighting?		
Is there an induction loop and/or other audio equipment installed for hearing-impaired persons?		

OFFICE/WORKROOMS	Yes	No
Does the door have a clear opening of at least 810 mm?		
Are the door handles within a range of 750–915 mm from the floor?		
Are light switches within the range of 835–1065 mm above the floor?		
Is the thermostat at a height not greater than 1065 mm from the floor?		
Is the intercom within a range of 835–1065 mm above the floor?		
Is the window cill 760 mm or less from the floor?		
Are the window operating devices operable from a wheelchair?		
Are other controls operable be a disabled person?		
Is the counter height within a range of 835–915 mm?		
Is there shelving that is reachable from a seated position?		
Is there adequate space to manoeuvre a wheelchair in the room?		
Are the floors slip-resistant?		
Does the carpeting allow free movement of wheelchairs?		
Are all surfaces free from glare?		
Is the lighting adequate for a visually impaired person?		
Is there proper demarcation of differences in level by contrasting colour and appropriate lighting?		
Does a blind person have an unobstructed path without protrusions from walls, floors or elsewhere?		
Is there an induction loop and/or other audio equipment installed for hearing-impaired persons?		
Is the level of mechanical and other background noises low enough to avoid interference with sound reception on a conversational level by persons using hearing aids (less than 85 dB)?		
Is the room accessible by wheelchair from the main entrance?		

TOILETS/WASHROOMS	Yes	No
Is the designated toilet/washroom generally accessible from other areas?		
Is the designated toilet/washroom appropriately signposted?		
Does the door have a clear opening of at least 810 mm?		

TOILETS/WASHROOMS	Yes	No
Are the door handles within a range of 750–915mm from the floor?		
Is there a turning circle 1500 mm in diameter in the room?		
Are light switches within the range of 835–1065 mm above the floor?		
Are the mirror and shelf less than 960 mm above the floor?		
Are towel racks, soap holders and other fixtures in an accessible space less than 1000 mm above the floor and less than 550 mm from the front of the counter?		
Is the top of the toilet seat 475 mm above the floor?		
Are there adequate plastic-coated grab bars at the toilet?		
Is there a space at least 600 mm wide beside the toilet to allow for a lateral transfer?		
Is there space for a wheelchair at the front of the toilet (minimum depth 1350 mm)?		
If the toilet is in a cubicle, is it at least 1500 mm wide and 1500 mm deep?		
Are taps reachable and easily operable from a wheelchair?		
Is the toilet flushing device reachable and easily operable from a wheelchair?		
Does the room have a device to signal for assistance?		
Does the room have space for an attendant assisting someone in a wheelchair?		

HORIZONTAL CIRCULATION	Yes	No
Is directional signposting provided in the foyer/reception?		
Is directional signposting accessible to the blind?		
Are cloakrooms visible from the foyer/reception?		
Is the cloakroom counter less than 835 mm high?		
Is there an accessible cloakroom with hooks less than 1420 mm high?		
Is the corridor at least 1200 mm wide where wheelchairs must pass one another?		
Do corridors have slip-resistant floors?		
Does the carpeting allow for free movement of the wheelchairs?		

HORIZONTAL CIRCULATION	Yes	No
Are surfaces clear from glare?		
Is there clear demarcation of differences in floor level?		

STAIRS	Yes	No
Is there an alternative to stairs?		
Are there handrails at a height of 920 mm?		
Is there a suitable continuous handrail on each side?		
Does the handrail extend at least 300 mm beyond the bottom step?		
Are flights at least 1000 mm wide?		
Is the rise of flight of stairs between landings not more than 1800 mm wide?		
Do the handrails have tactile cues at changes of floor level?		
Are the risers less than 170 mm high?		
Are treads more than 250 mm high?		
Do the treads have a slip-resistant finish or non-slip nosings?		
Are the edges clearly marked for visually impaired people?		
Have open risers been avoided?		
Are the stairs well lit?		

RAMPS	Yes	No
Are ramps provided where necessary?		
Is the length between landings less than 9000 mm?		
Is the ramp width at least 1200 mm?		
Is the gradient 1:12 or less?		
Is the ramp well lit?		

Health, Safety and welfare on construction sites

The construction industry has an appalling record with regard to health and safety, and many regulations have been introduced which deal specifically with aspects of the industry, such as lifting appliances and excavations. High-risk trades include steel erection, demolition, painting, scaffolding, excavations, falsework, maintenance, roofwork and site transport.

Although there is a large body of law covering many aspects of health and safety at work, we may define the main statutes that are particularly important in construction as:

- The Health and Safety at Work Act 1974
- The Management of Health and Safety at Work Regulations 1999
- The Construction (Design and Management) Regulations 1994
- The Construction (Health, Safety and Welfare) Regulations 1996
- The Manual Handling Operations Regulations 1992
- The Provision and Use of Work Equipment Regulations 1998 (PUWER)
- The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)
- The Control of Substances Hazardous to Health Regulations 1999
- The Personal Protective Equipment at Work Regulations 1992
- Control of Asbestos at Work Regulations 1987
- Control of Lead at Work Regulations 1998 and the
- Noise at Work Regulations 1989

The Construction (Design and Management) Regulations (1994)

The CDM regulations spread the responsibility for health and safety on construction sites between the following parties:

- The client
- The designers
- The planning supervisor
- The principal contractors
- Subcontractors

They are a set of management regulations dealing with responsibilities of the parties identified as opposed to identifying specific risks with particular tasks.

The regulations state that where CDM applies, a health and safety plan must be prepared before tender stage by a planning supervisor, and after being appointed the main contractor needs to develop it and keep it up to date. The **Health and Safety Plan** is then used as the basis for the **Health and Safety File**, which is a record of information for the client or end user, and includes details of any work that may have to be managed during maintenance, repair or renovation. This must be handed to the client on completion of all the works

Safe systems of work

In order to ensure that construction work is undertaken in as safe a manner as is feasibly possible, safe system of work strategies should be adopted. A safe system of work strategy should include:

- *A safety policy*
  A statement of intent setting down appropriate standards and procedures for establishing safe systems of work in an organisation.
- *Risk assessments*
  Identify hazards and associated risks to the workforce and others and where safety method statement will be required to control them.
- *Safety method statements*
  Provide details of how individual safe systems of work may be devised for particular tasks.
- *Permits to work*
  Restrict access to places of work or restrict work activities that are considered 'high risk'.
- *Safety inductions*
  General safety information provided by principal contractors to workers, contractors and visitors when first coming onto site.
- *Site rules*
  Set out the minimum standards of safety and behaviour expected on site.
- *Tool box (task) talks*
  Provide particular safety information and a forum for exchange of views regarding specific operations or activities about to commence on site.
- *Safety audits*
  A procedure for reviewing and appraising safety standards on site both generally and for specific activities where appropriate.

Designing for health and safety

Designers of buildings can make an important contribution to construction site safety. The importance of designing for safety whilst preparing to build both industrial and commercial buildings must be stressed. The statutory duties of designers and the considerations that they should make in order to eliminate or reduce risk in the construction process need to be recognised.

'Design' is a complex process of many interrelating and interacting factors and demands, including:

- form and appearance
- structural stability
- heating and ventilation
- sound and insulation
- access, circulation and means of escape
- environmental impact
- cost

Good design requires a balance of these and other factors, but, as design is an iterative process, different design decisions have to be made as each stage develops. As the design process unfolds from concept to detail design stage, so designers of buildings, whether new build or refurbishment, are constantly seeking technical solutions to design problems.

For instance, at the **concept design** stage, decisions are made concerning:

- plan shape
- plan size
- number of storeys
- floor to ceiling height
- the nature of the building 'envelope'

Design choices here will be influenced not only by the size and shape of the site and any planning restrictions, but also by adjacent buildings, the need to incorporate services (in ceiling voids, for instance) and the tone and general impact of the design required by the client. However, once decided, these decisions will have an irrevocable influence on the project, which the design team and the client will have to live and work with thereafter. These decisions are particularly influential on the economics of the design and they will determine the cost 'bracket' within which the building naturally falls.

During **scheme design**, designers' considerations will turn to the major components of the building, such as:

- the substructure
- the type of frame
- choice of external cladding
- building services
- the design of the roof structure

Consequently, designers will need to consider alternative foundation choices in the context of the prevailing geological conditions on the site and methods for the remediation of contamination. The economics of alternative structural forms (e.g. steel frame vs. *in situ* concrete) and whether to choose curtain walling or precast concrete panel cladding solutions etc. will also be considered at this stage of the design.

When the **detail design** stage is reached, design questions will include:

- staircase construction (steel, timber or precast concrete)
- lifts and access
- the quality and specification of items such as doors and windows
- choice of finishes (walls, floors and ceilings)
- internal fittings (fixed seating, reception desks, special features etc.)

In making decisions throughout the design process, the designer will be constantly balancing issues of **appearance**, **function** and **cost** consistent with the client's brief and budget. As the design develops, more information becomes available, and this may give rise to technical problems or design choices that might have an impact on the financial viability of the project. A further consideration for designers is that their decisions might give rise to hazards in the design, and this will also influence their final choice.

An objective approach to health and safety in design is eminently sensible because specific solutions to particular problems have to be found rather than adopting 'generic' designs that might not be project-specific or address the risks involved on a particular site.

Of course, no designer sets out purposefully to design unsafely, but this is what happens unconsciously in practice. Designers therefore need to give health and safety proper weighting in their design considerations by applying the principles of **preventative design**.

Risk assessment

Risk arises as a consequence of the presence of hazards, and the extent of the risk depends upon the degree to which people are exposed to the hazard. Where there is no hazard there is no risk, but where there is risk this may be judged by considering the likelihood of something happening and the severity of the resulting harm should it happen.

Hazards are articles, substances or workplaces etc. with the potential to cause harm. Some of the common hazards in construction work include:

- working at height
- working in confined spaces
- falling materials
- manual handling of heavy objects
- dust
- noise and vibration
- asbestos

Construction workers are frequently put at risk as a result of decisions made during the design phase of a project. It is at this stage, therefore, that the best opportunity is afforded to consider what could be done to eliminate or lessen the potential impact of such decisions on those carrying out the construction work on site.

Simple measures are all that is needed to remove hazards or reduce their potential for harm, such as providing lifting points for structural steel members or reducing the necessity to work at heights by building structural elements at ground level, which are then lifted into their final position by crane.

Hazards arise in both new work and refurbishment work and, in a generic sense, there is little to distinguish between the health and safety issues in each type of work. However, the nature of refurbishment work is quite different from new build, and this can have a significant impact on the extent of the potential harm and the degree of exposure arising.

Consequently, whilst the hazards may be common to both new work and refurbishment the risks may be entirely different. For instance, the health hazards associated with silica dust in chasing out brickwork may well be more severe in refurbishment work simply because the work is likely to be carried out in a confined space rather than in the open air. The use of heavy blocks in refurbishment work may pose a greater risk of musculo-skeletal injury than in new work because the extent of manual handling is greater. This may be due to access problems or the inability to use mechanical plant for lifting and handling in confined spaces.

Refurbishment work often involves the dismantling of building elements or even the demolition of existing structures or parts of structures. Where this is required, there is the possibility of premature collapse or the accidental discovery of harmful materials such as asbestos.

When existing buildings are to be refurbished they are frequently in a parlous state of repair, but nevertheless have some sort of foundations, floors, walls, a roof and (possibly) some internal walls and partitions, wall/floor/ceiling finishes, electrical and plumbing installations etc. The builder's first job will be to remove those parts of the building that will not be retained and to reduce the building to a 'shell' condition. The 'shell' may then need underpinning and changes to the external envelope.

These 'deconstruction' activities may give rise to hazards such as dust, noise and work in confined spaces which would not be present to the same degree in a new build project. Workers may also be exposed to the dangers of defective electrical systems, unstable floor and roof structures and the possible presence of old and hazardous materials and substances.

The 'soft strip' and dismantling work associated with refurbishment work gives rise to particular risks to construction workers and these should be recognised in the health and safety planning for the project during both design and construction. Means of access and methods of waste disposal need to be carefully thought through especially where the building is to be fully or partially occupied during the refurbishment programme. In such cases, separation of the construction site from the occupied parts of the building may be problematic especially where work is being carried out in common parts of the building such as circulation areas, staircases and lifts.

Risk assessment is clearly a vital issue in refurbishment projects and emphasis may have to be placed on particular persons at risk, such as children and the elderly or infirm, as well as the risk to site workers and the general public. Construction workers may similarly be exposed to risks such as *Legionella pneumophila* from water systems, infected hypodermic syringes, lead, and chemical and toxic waste which may be present in existing buildings.

It is especially important in refurbishment work that risk assessments are project-specific and that they address the particular risks associated with the work in hand. For instance, in new build, risk assessments for activities such as general concreting, brickwork and plastering may be treated generically, as the risks may be the same from site to site. In refurbishment work, however, the particular circumstances in which such work is carried out may well be different on each project, and thus the attendant risks will be different as well.

A worked example of a simple approach to risk assessment for the re-roofing of a 1950s industrial building is given below. The methodology involves the following steps:

1. Identify the hazard.
2. Identify the persons at risk.
3. Evaluate the risk.
4. Eliminate the risk by designing out the hazard or reduce the risk by introducing appropriate controls.
5. Identify any residual risk.
6. Communicate this to those who are best able to control it (e.g. the contractor).

Step	Think about	Examples
1	The design element concerned	1. Removing existing roofing 2. Remove existing rooflights 3. Installing new roof covering 4. Installing new rooflights 5. Installing new guttering
2	The hazards which could be present	1. Operatives working at height 2. Fragile rooflights 3. Asbestos cement roof sheeting 4. Roofing materials stacked at height 5. Weather/wind
3	The persons in danger	1. Roof workers 2. People working below 3. Passers-by 4. Maintenance crews
4	The likelihood of an occurrence and the severity if it happened	Judge the risk by considering the chance of falling and the extent of injury likely. This is a common occurrence where fragile roofs are concerned. Consider the chance of materials falling onto people below. A simple calculation could be used to give a measure of risk or a judgement could be made as to whether the risk is of high, medium or low.
5	The control measures required	1. Can the design be changed to avoid the risk? 2. Could permanent edge protection be included in the design, e.g. parapet wall or permanent protected walkway? 3. Specify loadbearing liner sheets for new roof for use as a working platform. 4. Specify non-fragile rooflights to replace existing 5. Specify a permanent running line system for the new roof for use by construction and maintenance workers
6	Any residual risks that need to be managed	These will be design issues that cannot be resolved, leaving people at risk. They should be raised in the health and safety plan. This could mean that the contractor will have to provide edge protection and/or collective fall arrest measures such as safety nets.

Reflective summary

With reference to statutory control, remember:

— This is a process only recently applied in the history of building.

— The first set of national building regulations was published in 1965.

— Part M of the Building Regulations deals specifically with adapting buildings to accommodate disability.

— Health and safety need to be considered in great detail when building forms and systems materials are specified.

— Major references for health and safety include:
- The Health and Safety at Work Act 1974
- The Management of Health and Safety at Work Regulations 1999
- Construction Health Safety and Welfare Regulations 1996
- Control of Substances Hazardous to Health Regulations (revised 1999)
- Construction (Design and Management) Regulations (1994)

Review tasks

What are the main implications of the requirements of Part M of the Building Regulations and how can these be difficult to achieve in refurbishment contracts?

What are the requirements of clients and designers under the CDM regulations, and how are these roles made more difficult in refurbishment projects?

References

Please refer to the hot links at the start of the chapter.

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