1 Introduction

The aim of this introductory chapter is to highlight some of the factors that determine how buildings are constructed and also to provide some context to the chapters that follow. Related issues are dealt with in the introduction to *Barry's Advanced Construction of Buildings*. We start with the need to decarbonise our built environment and the challenges of responding to climate change. This is followed by an overview of the function and performance of buildings, a description of the general principles of construction, and concludes with some comments on legislation and sources of information.

1.1 Towards a decarbonised built environment

To provide some context to the construction of buildings, it is important to start with an overview of the challenges facing our planet, and the impact of the built environment on our natural one. It is well documented that everyone involved in the design, construction, operation, and recovery of buildings need to take responsibility for their actions if we are to tackle climate change. Some of these decisions will be significant, for example deciding not to build a new building, but reconfigure and upgrade an existing one. Other decisions may have a smaller impact on their own, for example improving the thermal insulation of an existing building to reduce the amount of energy used for heating and cooling; and if many buildings are improved in a similar manner, the collective impact is significant.

Adopting the philosophy of 'leaving this planet in a better state than we found it' requires an understanding and appreciation of the environmental impact of construction and buildings. In many cases, this requires a change in how we think about building, how we construct buildings, how we use buildings, and how we dismantle and reuse valuable materials. While the focus is often on the amount of energy used in construction (embodied energy) and the amount of energy used to service buildings once they have been constructed (operational energy), we also need to reduce the amount of material waste produced during assembly and disassembly. Construction should operate as a circular economy, with very little or no waste in the cycle. We need to address the fundamental questions: why do we build? and how do we build? The why question is linked to need, which is influenced by many socio-economic factors. How we choose to build is linked to our traditions and habits, our desire to do things more sustainably, and the need to decarbonise our building stock. This is associated with construction technology, the focus of the Barry books.

Barry's Introduction to Construction of Buildings, Fifth Edition. Stephen Emmitt.

The environmental impact of buildings will be influenced by many factors – starting in the design phase and moving to construction to include issues such as the responsible (ethical) sourcing and manufacturing of environmentally sustainable materials and building products; the (informed) decisions taken during the construction process; the actions of owners and occupants through a long period of use, including decisions relating to maintenance, repair, alteration, and reuse; through to deconstruction and the recovery of valuable materials and components at the end of the building's useful life. At this stage, materials and components can be reused in new projects, or recycled for use in new building products, helping to reduce the amount of material sent to landfill and improving environmental impact. The focus on decarbonising the built environment is driving innovation in building technologies and materials; and helping to raise questions about how we build in a more ethical manner. We should seek to minimise environmental impact through sensitive design and material selection. The mantra is to reduce, reuse, recycle, revitalise, and restore through regenerative design and building.

1.2 Responding to climate change

Although we cannot accurately predict the future impact of climate change, the general consensus is that, in the UK, the average temperature will rise, as will the amount of rainfall and the average wind speed. Combined with the prospect of more 'extreme' weather events, this raises concerns about the resilience of the existing building stock. It also raises questions about the appropriateness of construction technologies employed for new buildings and the suitability of prevailing building codes, regulations, and standards. How, for example, do these predicted changes in our climate impact on the way in which we detail the external fabric of buildings? Are existing codes, standards, regulations, and building practices adequate to cope with, for example, higher wind gusts or more intense rainfall in a short period of time? We should resist the temptation to over-detail and over-specify to insure against unknown changes, which may be wasteful of resources. However, we do need to look at making changes to the way in which we build to ensure a resilient built environment that performs in the context of a changing climate.

Concern has been expressed about new buildings, especially homes that are built from lightweight materials, such as timber-framed, steel-framed, modular, and other lightweight construction systems. The fear is that, with the expected increase in temperatures, the internal temperature of lightweight construction may become too high during the summer, thus necessitating air conditioning (and increased energy demands) and/or better shading and natural ventilation. By comparison, buildings constructed with high thermal mass, with small windows, and sun shaing devices (e.g. shutters, verandas) are less susceptible to temperature fluctuation. However, there are plenty of places around the world that have a warmer climate than the UK and where lightweight construction is used successfully. The answer to the problem is not so much about the type of construction used as it is about the way the building is designed and constructed to suit its unique context.

Decarbonising our existing building stock is more challenging due to the variety and complexity of buildings and the physical constraints of the building and its immediate surroundings. This may make retrofitting difficult to achieve from an economic and practical perspective. This may become more challenging when buildings are located within conservation areas and/or are designated as being of historic interest (e.g. those having listed or protected status). In these situations, improving the energy performance of the building must be balanced against the overall impact on the building's appearance and what is permissible in the eyes of the conservation officer. Upgrading the building fabric, retrofitting, and adaptive reuse is addressed in *Barry's Advanced Construction of Buildings*.

Passive design includes the selection of energy-efficient building materials, so that there is very little or no need to provide heating (or cooling) of the interior space. This is referred to as a 'fabric first' approach to design and construction. An example is *Passivhaus* (German for 'passive house'), a building standard that effectively eliminates the need for space heating by using a highly insulated building fabric. Taking this concept a little further, the active building concept aims to design and construct a building that generates more energy than it uses through the micro-generation of power. Unwanted energy can be stored in batteries and/or transferred to the National grid.

Increasingly there are a variety of approaches to ecological (alternative) construction. Some have their roots in vernacular architecture and construction techniques, others in technological advancement. Many combine features present in both old and new construction techniques to create more sustainable materials, products, and buildings. We urge readers to look beyond the familiar and explore ideas and technologies that will help us decarbonise our buildings.

1.3 The function and performance of buildings

All building projects need to fulfil a function and meet set performance criteria, no matter how fundamental or sophisticated the client's requirements may be. The function of the building, be it, for example, a house, school, office, or medical facility, will influence its design and construction. Similarly, the performance requirements will influence the type of materials and technologies used to realise the building, factors that will influence the building's architecture. Both the function of the building and the performance requirements are initially determined through discussions with the client at the briefing stage.

The briefing process aims to establish what the client wants and why. The written brief will set out the type of building required and its primary function. Performance requirements, such as the thermal performance of the building, size of rooms, etc., will also be stated, along with a financial budget, timescale for completion of the project, and the required level of quality. The brief informs and guides the design team. As the design develops, attention will turn to the function of individual building elements and components and their assembly to meet the agreed performance requirements safely and efficiently. This involves interaction with specialists, manufacturers, and constructors to harness knowledge and expertise to the benefit of the building's design and construction.

Function

The primary function of a building is to provide shelter from the weather, and as a container for living, working, and playing in. This involves understanding how people will use the building and the equipment required to support the comfort and well-being of the occupants over a long time period. Thus, the daily activities that will take place within and around the building will influence the building's function. The principal functional requirements may be broken down into the following:

- ❑ Provide shelter, security, and privacy
- ❑ Provide structural safety and fire safety
- ❑ Ensure the thermal comfort and well-being of all occupants
- ❑ Ensure minimal environmental impact (e.g. net zero carbon)
- ❑ Use ethically resourced materials and components that can be reused at a future date
- ❑ Be functional (easy to use, maintain, repair, and replace/upgrade)
- ❑ Be adaptable, durable, and resilient

The overall goal is to achieve these functions in an economical, safe, and timely fashion using the most appropriate resources available and with minimal negative impact on the environment. These primary functional requirements are explored in the chapters that follow in relation to specific building elements – for example, walls and windows.

Performance criteria

The appearance of a building, its aesthetic, is a subjective matter and something that is difficult to quantify objectively. By contrast the desired performance of a building can be defined at the briefing stage by establishing objective performance criteria. Performance criteria relate to technical aspects, such as the thermal resistance of the fabric, acoustic performance, lighting levels, fire resistance, energy use, and so on. These are set out in building regulations, codes, and standards. Specific criteria may be dictated by the client to suit a specific use or function, and these criteria may be more stringent than the prevailing regulations and guidance. Performance criteria set a standard to be reached, or bettered, by the designers and constructors. Similar to functional requirements, performance requirements are explored in the chapters that follow as a means of demonstrating the type of solution that may arise from specific criteria. The main performance criteria are likely to be:

- ❑ Space, determined by the floor area and/or volume (and related to anticipated use)
- ❑ Thermal, visual, and acoustic criteria (quality of the indoor climate)
- ❑ Fire safety
- ❑ Design life and service life of the building and specific building components/elements
- ❑ Cost of construction, costs in use, and cost of demolition/deconstruction and recycling
- ❑ Quality of the finished building (functionality, durability, and usability)

It is also important to know how our buildings perform in use. This helps building owners to manage their assets in a sustainable way. Knowledge gleaned from post-occupancy evaluation can be incorporated into future building upgrades to improve functionality and performance.

Quality

Although quality can be difficult to quantify objectively, there are three types of quality that influence buildings:

(1) *Quality control* is a managerial tool, which ensures that both work and products conform to predetermined performance specifications. This applies both to the design and the construction phases. Getting the performance criteria right is an important step in achieving the required quality, be it for an individual component or the whole building.

(2) *Quality assurance* is a managerial system that ensures quality service to predetermined parameters. The ethos of total quality management aims at continual improvement and greater integration through a focus on client satisfaction. Manufacturers, contractors, and professional consultants use this to ensure a consistent service to their clients/customers.

(3) *Quality of the finished artefact* will be determined by several variables that are constant for all projects: time, finances, and resources. The quality of the building will be determined by the interaction of individuals and the choices made during all stages of the project, from briefing and design to manufacture and assembly.

The required quality of materials and workmanship will be set out in the written specification (see *Barry's Advanced Construction of Buildings* for additional detail on specifications). Good-quality materials and good-quality work tend to carry a higher initial cost than lower-quality alternatives. However, the overall feel of the building and its long-term durability may be considerably improved – we tend to get what we pay for. When making decisions about the materials and components to be used, it is important to consider the whole-life cost of the materials, and not just their initial capital cost and the cost of labour to assemble the materials.

Economics

The building site and the structures constructed on the land are economic assets. They have a value to the owner, building users, and society at large. In addition to the cost of the land, there are three interrelated costs to consider that make up the whole-life cost of the building.

The first is the *initial cost* – that is the cost of designing and erecting the building. It covers professional fees and the costs associated with land acquisition and permissions, the capital cost of materials and components, and the labour costs associated with carrying out the work. Material costs are prone to wide swings in price depending on the market, and it may sometimes be necessary to adjust the design to suit the supply and price challenges. An example would be to change from a steel frame to a concrete frame because of the shortage, and hence higher-than-anticipated cost, of steel. Labour costs comprise a substantial part of the initial cost of most building projects and are related to the type of construction technologies to be used, be it site based or offsite. Ideally, we should be aiming to use local labour and locally sourced materials to reduce the carbon footprint of the building and to help stimulate the local economy.

The second cost to consider is the *cost of the building in use* – that is the costs associated with routine maintenance and replacement, and the costs associated with heating and servicing the building over its life. These costs can be reduced by sensitive design and detailing – for example designing a building to use zero energy and to be easy to maintain will carry significant cost benefits over the longer term (not to mention benefits to the environment). All materials and components have a specified design life and should also have a specified service life. Designers and contractors need to be aware of these factors before starting work, thus helping to reduce future maintenance requirements.

The third cost is the *cost of materials recovery* at the end of the life of the building – that is the cost of demolition (disassembly), materials recovery, recycling, and reuse. Although it may be difficult to predict exactly when the building is likely to be substantially remodelled or dismantled, this should be an important consideration when detailing and constructing buildings. Considering the building as part of a circular economy can also help to plan for its end of life and materials recovery and reuse.

All three areas of cost associated with a building project should be considered within a whole-life cost model, from which decisions can be made about the type of materials and components to be used and the manner in which they are to be assembled (and subsequently disassembled).

1.4 General principles of construction

In simple terms, the process of design and construction starts with a want or need. This may relate to, for example, a new building; or extension, repair, and/or alteration of an existing structure. These wants and needs are translated into a set of requirements, a written 'brief' that informs the design team. The design team will develop a conceptual design and increase the level of detail to such an extent that a constructor, or manufacturer in the case of offsite production, can interpret written and drawn instructions to realise a physical artefact. The constructor and/or manufacturer will bring together appropriate resources – people, materials, and machinery – to produce the design safely and within the agreed parameters of time, cost quality, and environmental impact. This process, or more correctly this series of interlinked and overlapping processes, involves many people working towards a common goal. This requires a collaborative and integrated approach to deliver the project and the product (the building) to the expectations of the client.

In recent years, the emphasis in construction process improvement has been on prefabrication and offsite production. With the rapid uptake of BIMs and advances in generative design and digital fabrication, the opportunities for using offsite production are more obvious than they may have been previously. While offsite production is still best suited to repeat building types and repeat components and elements of buildings, such as toilet and bathroom pods, it is also feasible to use offsite production for bespoke projects. Improvements in product quality, worker health and safety, material waste, and environmental impact are some of the benefits possible with the use of prefabricated components and proprietary systems. This has tended to move the labour skills away from the building site into the controlled environment of the factory. Site operations become limited to the lifting, positioning, and fixing of components into the correct position, and the emphasis is on the transportation of components from the factory to the site when required, and not before. Offsite construction is described more fully in *Barry's Advanced Construction of Buildings*.

The process of design and construction is extensively covered in the literature on design management, project management, and construction management, and therefore it does not need to be repeated here. However, it is necessary to make the point that we rarely make decisions in isolation when designing and constructing buildings. The nature of collaboration is determined by the type of procurement route used for a project and the success of the interactions between the organisations and individuals assembled to realise the project. The process is aided by information communication technologies (ICTs) and building information models (BIMs) and conducted within a legislative framework.

Digital technologies allow project contributors to communicate regardless of physical location and to work collaboratively on the design and construction in a virtual environment, contributing to digital representations of the building. The legislative framework includes regulations and guidance relating to fire protection, health and safety, the well-being of workers and building users, and the protection of our environment. Decisions are also influenced by the physical constraints of the site on which the building is to be constructed, as well as the availability of materials, labour, and technologies.

Regardless of the approach taken in the design and construction of buildings, there are several fundamental principles that hold true. The primary principle is that the building must resist gravity and hence remain safe throughout its design life. It must be resistant to fire and it must resist the weather to provide a safe, healthy, and durable building. This is achieved by employing loadbearing or framed construction, comprising the following common elements:

- Foundations (see Chapter 3)
- Floors (see Chapter 4)
- Walls (see Chapter 5)
- Roof (see Chapter 6)
- Windows and doors (see Chapters 7 and 8)
- Stairs and ramps (see Chapter 9)
- Surface finishes (see Chapter 10)
- Services, energy supply and thermal comfort (see Chapters 11 and 12)

It is vital for the success of the building project and the performance of the constructed building that an integrated approach be adopted. It is impossible to consider the choice of, for example, a window without considering its interaction with the wall in which it is to be positioned and fixed, maintained, and eventually replaced. It follows that the window should exhibit the same, or very similar, thermal and acoustic performance characteristics as the wall. The same argument holds for all building services, which should be integrated with the building structure and fabric in such a way as to make access for routine maintenance, repair, and upgrading a safe and straightforward event that does not cause any damage to the fabric.

Fire safety

All buildings must be designed, constructed, and maintained to ensure compliance with fire safety legislation. For relatively small, domestic scale buildings, the general principles of fire safety can be applied by reference to prevailing regulations and codes, and the considered selection of materials. For larger and more intricate buildings, such as multi-storey and multi-occupancy buildings, the challenges are more complex, and a fire safety engineer will need to advise on a fire safety strategy. This will inform the design, construction, operational, and maintenance strategies for the building to ensure compliance with fire safety. The fire safety of the finished building will also be dependent on the quality of construction and adherence to the design and specification.

Fires require a source of ignition (a heat source), a source of combustion (material that burns), and oxygen. While it is impossible to completely rule out the possibility of a fire starting in a building, it is possible to reduce the risk of ignition and combustion through the careful selection of materials, finishes, and furnishings. Similarly, once a building is occupied it is possible to minimise the risk of ignition my regular monitoring and careful control of material that burns. If a fire does start it is important that the building is designed to maintain structural integrity for long enough to allow occupants to escape. This includes designing buildings to contain the fire for a specified period, and thus prevent fire and smoke spreading quickly from room to room, from floor to floor, and to adjacent buildings. Containment allows time for the occupants to escape via a safe route, and for fire fighters to attend the scene and extinguish the blaze before it has spread.

Fire safety is a major driver in the design of buildings, which should be designed and constructed to provide adequate protection, as well as early warning of fire and an appropriate means of escape. The extent to which measures are necessary will be related to the size, complexity, and use of the building, with regulations differing between, for example, a dwelling house and an office building. The emphasis in this book is on construction and the performance of materials and components. Therefore, the main principles of fire safety are described here as context for the chapters that follow.

Surface spread of flame

Internal fire spread can be inhibited by the careful selection of materials and finishes for walls, partitions, ceilings, and other internal structures. The finishes (linings) must resist the spread of flame over their surface. If surface finishes do ignite, the rate of heat release or fire growth must be appropriate to the circumstances. Materials should be selected, which also inhibit the generation of smoke and fumes if they ignite. This is particularly important in circulation spaces and escape routes where fire spread may prevent building occupants from escaping. External spread of fire can be inhibited by using non-combustible materials and materials that limit the spread of flame. The measures to be taken will relate to the building's proximity to a boundary and its height.

Structural stability and internal spread of fire

All buildings need to be designed and constructed to retain their stability for a specified period in the event of a fire. This relates to the careful selection of structural elements of the building and its fire protection, be it inherent or applied as a coating or covering. Fire resisting construction is required to create sub-divisions in buildings (known as compartmentation) to prevent the spread of fire within the building. It is also required for common walls (party walls) and floors (party floors) between adjacent buildings or apartments to prevent fire from spreading from one property to another. Installation of automatic fire detection and suppression systems, such as sprinklers, is also an important aspect of preventing fire and smoke spread. One of the biggest challenges is detecting fire and smoke spread in concealed spaces, the voids within the building structure and fabric. For example, the air gap in a cavity wall or between cladding panels and a structural frame, and ductwork for services. It is necessary to inhibit spread of fire and smoke within concealed spaces by the installation of cavity barriers. These need to be installed at the edges of cavities and at junctions of compartment walls and floors, thus forming a fire and smoke resisting barrier. Specialist design advice will be needed for the majority of new buildings and buildings that are being refurbished/retrofitted.

Loadbearing or framed construction?

A fundamental question for many designers, engineers, and constructors relates to which type of construction to use – loadbearing or framed.

Masonry loadbearing construction is well established in the British building sector, and, despite a move towards offsite construction and prefabrication, loadbearing construction tends to be the preferred option for many house builders and small commercial buildings. The two approaches are solid wall construction and, more typically, cavity wall construction. In a typical loadbearing cavity wall construction, the main loads are transferred to the foundations via the internal loadbearing wall made of blocks or bricks. The internal wall may also be constructed from timber or metal frames. In both cases, the external skin serves to provide weather protection and aesthetic quality. Primarily, 'wet' construction techniques are employed for bricklaying, plastering, and so on. Quality control is highly dependent on the labour used and the quality of the supervision on site. Disassembly and recovery of materials will be dependent on the way materials are connected and hence the ease of separation without damage.

Framed construction has a long pedigree in the UK, starting with the framed construction of low-rise buildings from timber and followed by early experiments with iron, reinforced concrete frames, and steel frames. Subsequent technological developments and advances in production have resulted in three main materials being used for structural frames: timber, steel, and concrete (see *Barry's Advanced Construction of Buildings*). Sometimes these materials are used in combination as a hybrid construction technique, for example steel and timber. Framed construction is also used in modular manufacturing, which usually uses lightweight steel sections and/or timber framing. Framed construction is a quick and efficient means of construction, with individual elements being craned into position and fixed using bolts and screws. The building envelope is then fixed to the frame to form a weatherproof enclosure. Site operations are concerned with the correct placement and connection of individual pre-assembled component parts in a safe and timely manner. Disassembly and recovery of materials is facilitated by the use of non-destructive fixings, such as screws and bolts.

Assembly and disassembly

The functional and performance requirements will inform the design process, from the initial concepts right through to the completion of the detailed designs and production of the information (drawings, schedules, and specifications) from which the building will be constructed or manufactured offsite. The design of the junction between different materials, that is, the solution for how different parts are assembled, is crucial in helping to meet the performance and functional requirements of the overall building. Good design and detailing will help the contractor and subcontractors in assembling the building safely and economically. Good design and detailing, combined with good workmanship, will contribute to the durability and ease of use of the building over its life. This is also true of offsite manufacturing and assembly, which is increasingly being adopted to help improve quality, safety, and environmental footprint.

The manner in which materials are joined together will be determined by their material properties, shapes and sizes available, types of joints required, construction method (e.g. framed or loadbearing) and the safe sequence of assembly (and anticipated disassembly sequence). Ideally, buildings should be designed to use standard sizes to avoid cutting on site and hence reduce material waste. Offsite production tends to be more efficient in the use of materials and it is easier to recycle waste. It is also more practical to adopt a circular approach to the manufacture of buildings compared to site-based construction. Interfaces between materials and components can be quite complex and will be specific to individual materials and components. However, in simple terms, the following methods are used widely to join separate parts, either in isolation or in combination:

- *Gravity*. The simple placing of materials so that they stay in place due to their mass (e.g. stone on stone) or shape (e.g. interlocking roof tiles) is common, although it tends to be used in conjunction with an adhesive joint or mechanical fixing. Masonry is usually laid in mortar in loadbearing construction, and roof tiles need to be clipped in position at regular intervals.
- *Screws and bolts*. Screws and bolts perform a similar function in joining two (or more) materials together by a mechanical fixing. Screws are widely used for joining timber, with the thread of the screw drawing the timber components together through the act of screwing through one piece of the material into the other. Bolts tend to be used for joining two pieces of metal and are (usually) placed in pre-drilled holes. A nut is threaded onto the end of the bolt, and the bolt and nut are tightened to hold the materials together. The advantage of screws and bolts is that it is relatively straightforward to unscrew the screw or undo the bolt with minimum damage to the materials. Both screws and bolts can be reused. This is helpful for routine maintenance and inspection and also for recovering materials and reusing them at a future date.
- *Nails*. Nails are driven through the first material into the second using a hammer or a nail gun, with the materials held together by friction. This is a common method of joining two materials together. It is difficult to withdraw the nail without causing damage to the materials and the nail, and therefore screws may be a better choice to facilitate future materials recovery.
- *Adhesives, glues, and welds*. A wide variety of materials are employed to stick or bond one material to another. These include lime and cement mortars, chemical adhesives, glues, and welds. Unless the bond is designed to be comparatively weak in comparison with the materials being joined together (e.g. lime mortar in brickwork), it will be very difficult to disassemble the construction without damaging the materials.
- *Mastics*. Mastics are primarily used to fill joints. These 'flexible' filling materials are designed to allow movement between adjacent materials and to prevent the penetration of rain and wind through the joint. Mastic materials are usually forced into the joint, often making them difficult to remove, although this varies, depending on the material used and the shape of the joint.

Constructability (or buildability) is an approach to building design and construction that seeks to eliminate non-productive work on site, make the production process simpler and provide the opportunity for more efficient site management and safer working. Thus, designing and detailing for constructability requires an understanding of how components are manufactured off site, as well as how the building is to be assembled (the sequence of work packages) on the site; and disassembled at the end of the building's life and materials and components recovered for reuse. The core message of constructability is simplicity (of joints between materials); greater standardisation (to avoid unnecessary cutting on site, and hence reduce material waste); and better communication between designer, manufacturer and builder. These three principles also relate to the eventual disassembly of the building, when materials and building products will be recovered, reused, and/or recycled. An ethical approach should be taken to the sustainable sourcing of all building materials and products, which means that those making the decisions about which materials and products to specify and purchase must understand the supply chain and seek assurances about the provenance of each and every item. Some of the practical considerations are concerned with the time available and the budget for the project. Other factors to consider include:

- ❑ Availability of labour and materials (supply chain logistics)
- ❑ Sequence of construction and tolerances (constructability)
- ❑ Reduction of waste (materials, labour, time and energy)
- ❑ Temporary protection of workers and materials from the weather
- ❑ Integration of structure, fabric and services
- ❑ Ease of maintenance and replacement of individual components
- ❑ Disassembly and recycling strategies

1.5 Regulations and approvals

A number of approvals need to be in place before building work commences. The two main consents required in the UK are from the appropriate town planning authority and building control. Specific conditions relating to town planning consent and building regulation approval will be influenced by the physical location, and characteristics of the site and its immediate surroundings.

Planning consent

Issues concerning local town planning approval are outside the scope of this book. However, it is important to understand that (with a few exceptions) planning approval must be applied for and have been granted before any construction or demolition work commences in the UK. The legislation concerning the right to develop, alter and/or demolish buildings is extensive, and professional advice should be sought before applying for the appropriate approvals. The process of obtaining approval can be very time consuming (preparing the necessary information for submission, allowing time for consultation and decisions, etc.), and conditions attached to the approval may affect the construction process (restricted times of working, conditions on materials to be used, etc.). The application may sometimes be unsuccessful, leading to an appeal or the submission of a revised proposal. Planning consent will permit development; it does not deal with how the building is to be constructed safely; this is dealt with by building control.

Building control and building regulations

In the UK, building control is governed by differing, though broadly similar, sets of legislation, for England, Wales, Northern Ireland, and Scotland, respectively. Building regulations aim to ensure the health and safety of people in and around buildings by setting functional requirements for the design and construction of buildings. The regulations also aim to promote wider concerns, such as low environmental impact and the well-being of building occupants.

In England and Wales, the Building Act 1984 and Building Regulations 2010 set out minimum functional requirements for buildings and the health and safety requirements that may be met through the practical guidance given in the Approved Documents. These in turn refer to British and European Standards and Codes of Practice. In Northern Ireland, construction is covered by the Building Regulations (Northern Ireland) 2012 with Approved Documents, similar to those for England and Wales. In 2014, the Welsh Government brought in a series of changes that now differ from the regulations in England, with the changes binding from April 2017.

In Scotland, the Building (Scotland) Act 2003, which came into force in 2005, has replaced the old prescriptive standards with performance standards. The Act is a response to European harmonisation of standards and their use in Scotland as required under the Construction Products Directive (CPD). The Act has two objectives: to allow greater flexibility for designers in meeting minimum performance standards and to ensure greater consistency across the country. There are separate Guidance Documents for domestic and non-domestic buildings, both of which are divided into six subject areas that match the essential requirements of the CPD – namely structure, fire, environment, safety, noise, and energy.

The Approved/Guidance Documents give practical guidance to meeting the requirements, but there is no obligation to adopt any particular solution in the documents if the stated functional requirements can be met in some other way. The stated aim of the current regulations is to allow freedom in the choice of building form and construction, so long as the stated (minimum) performance requirements are satisfied. In practice, the likelihood is that the majority of designers will accept the guidance given in the Approved/Guidance Documents as if the guidance were prescriptive. This is the easier and quicker approach to construction, rather than proposing some other form of construction that would involve calculation and reference to a bewildering array of British Standards, Codes and Agrément Certificates.

Although the guidance in this book is intended to be as broad as possible, both for consistency and to avoid confusion, reference is made only to the Approved Documents for England. However, the principles for readers in the UK are broadly similar, with differences in detailing buildings arising from a combination of legislation, response to local climate, and building tradition. Readers should also consult fire regulations that apply to the proposed location of the building as there may be regional variations to the national guidance.

Health and safety legislation

In addition to the legislation set down in the Building Regulations, other legislations affect the way in which buildings are designed and constructed. For example, health and safety and fire safety legislation are covered in a number of documents that sit alongside the Approved/Guidance Documents. The European Union is particularly active in promoting consistent standards across the Union through a series of directives. For example, the European Union Council Directive 89/106/EEC (1988), the CPD, requires all construction products to satisfy the Essential Requirements, which deal with health and safety issues – namely mechanical resistance and stability; safety in case of fire; hygiene, health, and environment; safety in use; protection against noise; and energy economy and heat retention. Over 600 CEN standards have been mandated under the CPD. In addition to this, there exists a large body of Codes and guidance documents.

Health and safety, along with the well-being of workers, is covered under a variety of statutes and guidance. In the UK, the Construction (Design and Management) Regulations 2015 came into force on 6 April 2015. The regulations set out what people need to do to protect themselves and others from harm when engaged in construction work. Good health and safety starts early in the design phase and continues into the detailing of a building, so that it can be assembled, maintained, and dismantled in a safe manner. Constructors need to plan the work to manage the risks involved, and also engage with the workforce about the risks and how they are being managed.

1.6 Sources of information

Construction is essentially a process of assembly where products are chosen from manufacturers' catalogues and/or from the builders' merchants and are put together using a raft of different fixing techniques. Each building project brings with it a new set of challenges and a fresh search for information to answer specific challenges. Some of the main sources of information for readers working in the UK are:

- Building Regulations and Codes
- British (BS), European (EN), and International (ISO) standards
- British Board of Agrément (BBA) certificates
- Building Research Establishment (BRE) publications
- Trade association publications
- Manufacturers' technical literature
- Compendia of technical literature
- Technical articles and guides in professional journals
- Building information centres
- Organisational knowledge (codified in 'standard' details and specifications)

Readers should make use of the information and details provided by manufacturers, but should avoid making a choice based on information from any one source. Explore at least three different suppliers to compare functional and performance requirements, including costs and availability – and then compare this with current legislation and standards – thus making an informed decision based on achieving the best value within given parameters.

Further reading

www.gov.uk. This is an important site that provides access to information and documentation relating to buildings, such as the Building Safety Bill and Building Regulations. Full details of the Acts as well as the current versions of the Approved Documents and Guidance Documents are available online (http://www.planningportal. gov.uk; http://www.planningportal.co.uk/wales; http://www.beta.gov.scot; http://www.buildingcontrol-ni.com). Alternatively via www.legislation.gov.uk.

Consulting the Approved Documents while reading this book should help to further understanding of specific issues. Additional guidance can be found in the book: *The Building Regulations: Explained and Illustrated* (MJ Billington, SP Barnshaw, KT Bright and A Crooks)

For additional information on health and safety, and fire safety, see the Health and Safety Executive homepage; www.hse.gov.uk

For additional information on green building design, products and materials see, for example: www.greenspec.co.uk and www.designingbuildings.co.uk/wiki/Green_Guide_to_Specification.