22 Applying the Framework to Commercial Buildings

This chapter provides the link between the first part of the book, which introduced the framework for analysis, and the nature of making choices for commercial building. This is seen as different from the approach taken to housing, mainly because of the greater diversity of scale and use of commercial buildings that leads to a much greater range of solutions. These solutions vary not only in the mix of technologies used but also in the variety of detailing and specification. Housing tends to a common form within which a limited range of details arise, as introduced in Part 2 of the book. The greater variety in commercial buildings created the need to see the technical choice in two stages. First, broad options need to be identified in the early stages of the design. The mix of technologies for structure, enclosure and services has to be chosen. These choices have to be made with the confidence that specific details and specifications can be developed in the second stage of detailed design, that a building can be fully detailed to perform and be constructed at reasonable cost and to fulfil the design vision.

The story so far

Part 1 of this text suggests a general approach or framework to making choices for the construction of buildings. It identifies that the process of choice starts with a suggested specification or detail and that this is evaluated by applying a series of analyses based on the two key questions 'Will it fail?' and 'Can it be built?' The areas for analysis involve a series of physical behaviours, the implications for appearance and then production issues, including economic and social concerns to ensure a safe solution in the environmental and social context pertaining to that building. Here context is most important as it will, often in subtle ways, determine the specific solutions that are adopted for each building. This general approach is outlined in Chapter 1, and each aspect explored in some detail in the subsequent chapters of Part 1 of the text. This approach will be maintained in this part of the book and should therefore be familiar to the reader.

The subsequent chapters in Part 1 suggest that a solution can be seen in a number of ways. Initially the building can be represented as a series of flows and transfers through the building and through the fabric and services systems, as outlined in Chapter 7. It is then necessary to see the fabric and services as fulfilling a series of functions with the function of the parts for the construction derived from the function of the building as a whole. Each function will then need to have a performance assigned to form the basis of choice. While the function of the building as a whole is determined by the purpose of the building, the function of the parts will be determined by the design. This will lead to a mix of technologies, the most significant of which has been identified as the mix between the role of the fabric of the building and the contribution of the building services.

In Chapter 3 it was suggested that the technologies can be seen as broad options based on either generic forms or common forms of solutions. These are appropriate ways to think about construction at the concept design stage and in the early stages of planning the building production process, as broad

production options are associated with each broad technical solution.

Broad options have to be chosen with some confidence that the specific solutions can be derived from materials and detailing that will not fail and can be built, that any detailing can be achieved with little risk of failure and in an economic and timely manner.

At different times in the process of realising a building it may be appropriate to think about the construction as:

- Experiencing flows and transfers (the dynamic conditions it will experience)
- Fulfilling a number of functions (what it has to do) and its performance (how well it has to do it)
- General (generic) forms based on the actions or mechanisms being used to achieve the function (how it is going to do it)
- Common forms/broad options that indicate the materials and the sizes required (what it could look like) to fulfil the performance
- Specific solutions with materials specified and details prepared with all dimensions, jointing and fixings specified to achieve the required performance (what it is going to be)
- A production process initially associated with the broad option but eventually to be followed through in the detailed design (how it can be realised)

All these ways of thinking about construction will be required in the design of commercial buildings.

Although commercial buildings are created in the same physical and social environment that was outlined in Chapter 16 for housing, the demand for commercial building as represented by the clients, those who commission and pay for buildings, is diverse compared to housing. Broad social changes from manufacturing to office-based employment and the growth of retail and leisure, including tourism, as economic drivers has created the need for new buildings with new functions. Regeneration led by investment in infrastructure and iconic buildings has given a wider range of contexts (city centre, business park, edge of city) and the opportunity for design innovation. This has led to a change in the resource base with the use of components and factory-based production with site processes of assembly relying less on traditional craft skills and capitalising on global trade.

Another difference between housing and commercial buildings that influences the range of solutions adopted is the way buildings are procured. Houses are seen as a good, long-term investment, and there is a culture in the UK of individuals purchasing houses where they are primarily concerned with the quality of life they offer. Even the provision of social housing in the UK is so regulated that standards and quality of life are key drivers that, even in the absence of a commercial interest, lead to a similar choice for the construction. The pressure to reduce cost, or more specifically increase the differential between cost and sales price, comes from the house builder (developer). This method of procurement – developers building for individual sale – leaves the choice of technology in the hands of the developer and, given a relatively homogeneous market, there is a convergence of solutions. Any pressures for change come from advantages in production costs as the market sets the land costs and sales price for the home. This gives the house builder an interest in prefabricated systems but only if the set-up costs can be regained in sufficient volume of houses of the value range for which the systems are developed. The developer is such a strong part of the market that the resources availability follows the demand and therefore even more bespoke housing is likely to make similar technological choices, as the resources are available at reasonable cost.

The way commercial buildings are procured is more variable, and this influences the way choices are made not only for the broad technological options but also for the final specifications and detailing. It is not the role of this text to explore in any detail the influence of this variety as it involves an analysis of contract and risk as well as the type of organisations employed at each stage in the technical decision-making. Suffice it to say that each

procurement method determines who has the main responsibility for technical decision-making and the risks they take in those decisions.

The focus of this text is the analysis of solutions, whoever suggests them, to ensure buildings will not fail and can be built against performance criteria. Use and size of buildings are perhaps the greatest determinants of broad options that could be chosen, as is the vision of the design along with the context in which it has to be built. All these factors lead to a greater range of common forms being available and specific solutions that have to be designed for each commercial building.

The need for the integrated approach outlined in Chapter 16 at the beginning of Part 2 of this book is perhaps more important for the choice of commercial buildings than for housing. It may be worth re-reading that section before continuing with this chapter.

The way forward

With the greater diversity of use and form, studying commercial buildings as a series of different types of buildings with their different functions could miss the point that they employ many common forms of construction between them. More importantly, the process for choice for each can be seen as a common process and it is therefore best to retain the broad idea of commercial buildings.

Although these building still need floors, roofs, walls, foundations and services, this is perhaps not the best way to think about making choices for this range of size and types of buildings. There is far more of a need for specific technical solutions for each building. There is far less convergence of details and specification than there is for housing. The analysis of one or two details and/or specifications for each element that provided the key solutions to mass housing in the UK at the beginning of the twenty-first century is not repeatable for commercial buildings. This would require the analysis of hundreds of details, few of which could be used as specific details in the future were the pace of change to continue.

With little variation in the overall operation of the house or its size and appearance there has emerged a common form for the whole building that needs little or no analysis before it is adopted for the next housing project. The focus of technical choice becomes the details and the specification of materials and their implications for the production process. This was therefore the focus of the analysis in Part 2 of this text.

For commercial building the diversity means that the process of choice has to begin with a questioning of which of the common forms of construction would be appropriate to make the building work as a whole, before exploring too deeply the issues of detailed design. There is a need to explore some broad options at the concept design stage that can be developed into details and specifications at the time of the detailed design.

For most commercial buildings there is probably no immediately obvious common form for the whole building. For any one client brief and site there will be a limited set of options, but even these may then be achieved in a number of different materials, making the number of possible combinations quite large. There will need to be an additional stage in the process of choice, very early in the design process, associated with the development of the design concept. The nature of these broad options will have implications for the production process as sequence and methods are best initially analysed from a broad understanding of the overall technological approach to the construction. There is a need to make broad choices of a mix of technological solutions that would work for each individual building.

Ultimately the success of the building will rest on the choice of detailing and specification, and this task will have to be undertaken with the same care and using the same process of analysis as for housing. However, the need to identify broad options for construction for the whole building before getting too involved in detailed design demands an understanding of

general and/or common forms and their potential and economic limits.

To make the link between the function of the building as a whole and the final choice for the technical solution expressed as specification and details is a big a step unless solutions have had time to become established, as they have in house construction. In much commercial development either the design of the building or the emergence of new production approaches may make existing detailing, however well thought through for a previous building, potentially inappropriate for the next. Some intermediate steps in the process of choice are required to develop specific solutions as new forms evolve.

Starting at the concept design

For commercial buildings the client's brief will establish the range of accommodation to be provided and the scale of the building required. If the site is known, the context will have been established and the building can start to have form and size. This will be driven by the design concept (Chapter 7) or the vision of the building, and this will give an early indication of the aesthetics that will determine the appearance of the building. Once the brief and the context have established the use, size and vision, it is possible to start to make suggestions for what the technical solutions could be.

At this stage it is only possible to suggest broad options in line with the emerging design concept. However, there has to be some confidence that the suggestions will be able to be detailed and specified at the detailed design stage to realise the design concept. The dialogue between design concept and technical choice has to start at this very early stage in the design process.

Broad options at the concept stage

The evaluation of these broad options starts during the development of the design concept and gets refined through the detailed design process. During the concept design stage, options are still fluid, changes in design are still emerging, economies can still be achieved, detailing can still potentially be simplified. There needs to be sufficient understanding of these options to establish a level of confidence so that it will be possible to take the option forward to full detailed design without incurring excessive risk or cost.

This need to consider broad options involves a knowledge and understanding of a range of common forms not for the whole building but for parts of the building, the sorts of materials and sizes that are technically possible, their economics and, possibly most important, how they work. It is not possible to start with an overall description of a common form for the whole building as it was with housing. The diversity of commercial buildings requires a range of common forms at the elemental level to be considered to achieve the best mix for each building depending on use, size and vision as established by the context in which the building is to operate.

Choosing components and detailing to ensure that the building works as a whole requires analysis at a broader level than individual components but not at the level of the whole building. This view leads to the notion that what all buildings (including houses if more fundamental changes in design or production methods are considered) have in common are three types of elements, each with their own set of broad options, namely:

- Structure
- Enclosure
- Services

Each of these has a body of knowledge and its own design approach, and there is a danger that, if these are pursued separately, the building will fail to operate efficiently and economically and may not work well as a whole. It should be a constant concern when making choices for the parts of a building that they contribute to the design concepts as a whole. Perhaps as important as the study of these three elements is the analysis of how they interact with each other: the design and technical solutions at the interfaces.

- Enclosure–Structure
- Enclosure–Services
- Structure–Services

Each of these has a different characteristic. These will be explored further in Chapter 24, but broadly the enclosure–structure interface is predominantly a question of detailing to ensure a continuity of performance while the enclosure–services interface is defined in the environmental design strategy and is therefore less physical and more conceptual. This is a very clear example of how the function of each part has to be defined by the overall design concept. Each of the elements can be detailed physically separately, but they are bound together by the overall environmental strategy driven not only by concerns for the quality of the environment to be achieved in the building but also by cost in use and limiting environmental impact, which are three key objectives in providing a sustainable building.

The structure–services interface is often characterised by competition for space, particularly in the horizontal distribution of services in floor zones. When considering the vertical distribution of services (and the location of plant rooms) and the need for the vertical transfer of structural loads, the space competition is normally with the usable and circulation space demands of the user. Although predominantly about physical space, aspects of the low environmental impact design can usefully use structure as thermal mass, illustrating that these interfaces can be as important a focus in choice as the function of the individual elements themselves.

If the building is to function as a whole, there is a need to start to identify the technological mix that may be employed for each of these three elements at the concept design stage of the building.

The technological mix

The technological mix has to be established at the design concept stage. As the design concept establishes how the building will function as a whole it is necessary to start to see how the elements of the construction may contribute to the overall performance of the building: to start to identify the function of the parts. Ultimately each part of the construction will have a function to which can be ascribed a performance and this will allow the choice of materials and detailing to be confirmed at the detailed design stage.

Identifying the technological mix needs knowledge of potential broad options, how they work as a general form and the common forms of construction that these might take. Viable alternatives will be driven by the use and size of the building and from the vision for the building.

Perhaps the broadest technological options are between the building fabric and the building services. While some of the fabric can be used actively (opening windows), most is passive in its response to the changing conditions during the operation of the building. It allows neither intervention (control) nor any energy inputs to perform. In contrast the building services (and the active elements of the fabric) have both energy inputs and controls as they operate only when required to bring conditions back into comfort or operational levels. Active elements can be turned on and off and up and down in response to changing conditions. Their energy inputs mean that achieving many of the sustainability and low environmental impact objectives will be established by the initial decision on the technological mix.

Once the mix of active and passive has been established, it is possible to start to make broad decisions on the passive construction of the structure and enclosure and to think about the interfaces to ensure the building performs as a whole.

Identifying broad options

Broad options can be identified as being a generic form that is defined by the way the construction works to fulfil functions. This generic form will imply the properties the potential

materials must have to ensure economic sizes to achieve performance. An example of a generic form of external wall to fulfil weatherproofing would be a semi-permeable wall. Broad options can also be usefully thought of as common forms of construction. Each common form will have been developed for a range of sizes and types of building for which the resources to both design and construct are available within the society in which the building is to be built. An example of a semi-permeable common form would be the cavity wall. It is either these general forms or the common forms of construction that are the basis of the broad options that need to be identified at the concept design stage.

Broad options will have potential associated materials and a range of economic sizes. For the cavity wall the usual materials are masonry, but the internal skin can be timber-framed. In its domestic form the skins and the cavity are likely to be around 100 mm each. The type of materials and approximate sizes are sufficient at the design concept stage, so long as they can form the basis of the final technical solution as all the materials specification and details can be finalised in the detailed design.

For the structural elements this is predominantly based on their behaviour under load. However, the enclosure elements have a greater number of functions, each of which has a number of generic forms. Therefore the range and combinations of broad options are more varied and more complex to analyse. The complexity of the analysis is compounded if some parts of the construction can fulfil a number of functions in order to achieve certain desired economies without compromising the brief. These economies are only possible at the time of considering the broad options. Cost reductions later in the design stage often involve reducing performance.

As an example an external wall will have some structural functions. This is clear if the structural solution uses loadbearing walls, but even as the enclosure of a framed building the wall has to transmit wind loads and may need some sub-framing to support components that cannot span directly to the elements of the frame. The external wall as an enclosure element will also have functions associated with maintaining environments. Each of the functions will have general forms. These have been introduced in Chapter 11. For waterproofing, an impermeable external layer can be established or the semi-permeable identified above or a rain-screen approach can be adopted. Each of these carries particular issues for the detailed design. For the impermeable surface it is jointing to achieve similar levels of water resistance to the impermeable materials, and for the cavity it is eliminating bridging and offering drainage and, on some rain-screening systems, maintaining pressure differences. Understanding how each general form works suggests the properties of the materials that could be used and indicates the important aspects of detailing. These general forms have, over the years, been developed into a number of common forms of construction. The cavity wall has been adapted to work with framed structures. Cladding, curtain walling and applied facings have been developed in a variety of materials. Each can now be called a common form for the construction as the components and resources to construct these forms are now available within the industry.

Testing the broad option for the specific solution

The extent to which these broad options can just be accepted without any further thought at the concept stage will depend on how well established the technological form is for the scale and use of building being considered.

Each common form will have a range of solutions. These solutions may vary in a number of ways:

- The materials that could be used
- The size and shape of the components
- The way the components are connected together
- The interaction with options being considered for other parts of the building

- The production process options
- The resources required for the scale and timing of production
- The level of risk in adopting that solution

It is necessary to be aware of all these factors in exploring the suitability of a broad option at the concept stage. Indeed, it may be one of these factors that determines the common form that may be most applicable. If for aesthetic reasons an external facade needs a particular material in a particular component form, this may dictate the general form for the whole external wall. If the client is looking to use the building by a particular date, the production process and the availability of resources may influence the broad option.

It is important to realise that if poor choices are made about the broad options at the design stage there is little chance of resolving the design at the detailed design stage. This is no different from the design process for the building as a whole and it is therefore not surprising that some thought about the technological mix for the building has to be introduced at the concept stage.

Summary

1. The two key questions of 'Will it fail?' and 'Can it be built?' apply to commercial buildings.
2. The diversity of the scale and use of commercial buildings has led to a range of technical solutions that introduce the need to make broad decisions on the technological mix of general forms for any one specific building.
3. Broad choice has to be made early in the design stage but with the confidence that the detailing and specification can be resolved in the detailed design stage.
4. An understanding of the general forms of construction that could be used is required along with their typical detailing to judge the potential for the building under consideration.
5. General forms need to be chosen for structure, enclosure and services elements of the building.
6. Interfaces between each option need to be analysed to ensure the building will work as a whole.