

# The Design Quality Manual

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Improving building performance

**Martin Cook**

Building Research Establishment Ltd



**Blackwell**  
Publishing



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*'All truth passes through three stages. First it is ridiculed, second it is violently opposed, and third it is accepted as being self-evident.'*

Arthur Schopenhauer, German philosopher, 1788–1860.



# Abbreviations and acronyms

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<b>ACA</b>	Association of Consultant Architects
<b>APM</b>	Association of Project Managers
<b>BEC</b>	Building Employers Confederation
<b>BEDC</b>	Building Economic Development Council
<b>BPF</b>	British Property Federation
<b>B of Q</b>	Bill of Quantities
<b>BRE</b>	Building Research Establishment
<b>BRT</b>	Business Round Table
<b>BUILD</b>	Building Users' Insurance against Latent Defects
<b>CABE</b>	Commission for Architecture and the Built Environment
<b>CAD</b>	Computer Aided Design
<b>CCMI</b>	Centre for Construction Market Information
<b>CIB</b>	International Research Council for Building Research Studies and Documentation
<b>CIC</b>	Construction Industry Council
<b>CIOB</b>	Chartered Institute of Building
<b>CIRIA</b>	Construction Industry Research and Information Association
<b>CMF</b>	Construction Management Forum
<b>CPM</b>	Critical Path Method
<b>CRT</b>	Construction Round Table
<b>CSSC</b>	Centre for Strategic Studies in Construction (Reading)
<b>CUP</b>	Central Unit for Procurement (DoE)
<b>DoE</b>	Department of the Environment
<b>FIDIC</b>	International Federation of Consulting Engineers
<b>GDP</b>	Gross Domestic Product
<b>GMP</b>	Guaranteed Maximum Price
<b>HBS</b>	Harvard Business School
<b>HMSO</b>	Her Majesty's Stationery Office
<b>ICE</b>	Institution of Civil Engineers
<b>IOD</b>	Institute of Directors
<b>IT</b>	Information Technology
<b>JCT</b>	Joint Contracts Tribunal
<b>MIT</b>	Massachusetts Institute of Technology
<b>MMC</b>	Modern Methods of Construction
<b>NASA</b>	National Aeronautics and Space Administration (USA)
<b>NCC</b>	New Construction Contract (proposed by Latham)
<b>NEC</b>	New Engineering Contract
<b>NEDO</b>	National Economic Development Office

<b>NJCC</b>	National Joint Consultative Committee for Building
<b>PCP</b>	Project Client Consultants
<b>PERT</b>	Programme Evaluation and Review Technique
<b>PSA</b>	Property Services Agency (DoE) [now defunct]
<b>QS</b>	Quantity Surveyor
<b>QUANGO</b>	Quasi-autonomous non-governmental organisation
<b>RIBA</b>	Royal Institute of British Architects
<b>RICS</b>	Royal Institution of Chartered Surveyors
<b>USM</b>	Unlisted Securities Market
<b>WBS</b>	Work Breakdown Structure

# Chapter 1

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## Introduction

### 1.1 Overview of design quality and building performance

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The design quality of buildings and their subsequent performance is a pre-occupation of humankind stretching back to ancient times. And not just expressed in aesthetic terms, such as the Roman architect, Vitruvius', three principles of *firmitas*, *utilitas* and *venustas* – later interpreted as firmness, commodity and delight in the architectural treatise of Sir Henry Wootton, *The elements of architecture*, published in 1624. But Marco Vitruvius was also a highly practical Roman military engineer and his ten books on architecture, the only surviving ancient writings on the subject, also contain sound advice on the construction of military hardware such as catapults and other siege machinery. Functionality is implicit in the search for optimum design quality – and although it may not entirely follow form, it is obviously an integral and essential part of the whole architectural solution. The three ancient principles of design quality still hold true, and I suspect that they always will. A building must certainly have firmness, or strength, to resist the forces of gravity and other natural forces such as those of the wind, not to mention being robust enough to age and weather gracefully with optimal maintenance and repair, to fulfil its designed life-cycle, and beyond. It must be commodious, or functional, or fit for purpose, otherwise what is the point of building it at all? Even seemingly minor functional shortfalls can escalate into serious and long-term failings which plague a building's life and those of its users. Finally, it should certainly be delightful or beautiful – capable of lifting human spirits in regular users and visitors alike, if it is truly to be called architecture, and not merely utilitarian 'building'. Pevsner's simplistic description of a cathedral as architecture and a bicycle shed as building, useful in establishing diametric extremes, is less helpful when assessing the subtle shades of grey between them – and the place of individual structures in the continuum.

The subsequent performance of a building over its lifetime is inevitably bound-up with, and begins with, its design parameters, programme, or brief. Vitruvius' ancient advice focused on aesthetic matters, and centred around detailed explanations of architectural orders and column proportions. He was espousing the virtues of Greek architecture mainly for the

purpose of temple building – the aesthetic impact of a religious structure on its worshippers was the paramount criterion of his design brief. But such symbolic architecture was closely linked to the continued political power of such a building's clients and funders. A tradition continued well into the Middle Ages with cathedral building, and beyond, to the present day in secular architecture. A religious, or other such symbolic structure, is performing if it wields power over worshippers and visitors. User comfort, for example, was certainly secondary, in terms of performance criteria, to inspiring awe and fear among worshippers, and probably irrelevant as the initiated did not even enter ancient temples. Fortunately, building users have become more demanding, and nowadays even a brief, weekly, foray into an uncomfortable place of worship is largely unacceptable.

Building performance in more complex, modern times, with a plethora of different building types, is not quite as simple as in ancient precedents. But, the basic physical dictates of shelter from the elements, ventilation, sunlight, acoustics and daylight remain the same. Some would say that we have allowed scientific principles too much reign at the expense of spiritual, symbolic and human aspects. Le Corbusier's definition of the house as 'a machine for living in' certainly does nothing to dispell this view of contemporary architecture and helps to explain the burgeoning membership of heritage organisations, as well as the general public's choice of buildings such as the Houses of Parliament and St Paul's as the most popular, confirming the 'performance' success of such political and religious symbols in the population's consciousness. Or, possibly, the failure of modern architecture, made more poignant at a time when the public building estate is being rebuilt in the United Kingdom – which only happens once in a generation. However, in a scientific age there are still doubts over the physical performance of buildings and their ability to provide comfort for all users, and perform in other areas such as energy efficiency or environmental sustainability. Our architecture is a reflection of the state of society at the time of construction and society's conventions, contracts and methods of procuring buildings will always have a strong influence over the results in terms of design quality – for better or worse. In the words of Winston Churchill, referring to the Houses of Parliament, '... first we shape our buildings and then they shape us'.

The eighteenth century was a simpler time than our own, but even then there was an urge for a simpler form of society, expressed in the literature of Jean-Jacques Rousseau, but also in the architectural theory of M. A. Laugier (1713–69). Laugier's *Essai sur l'architecture* (1755), like most previous writers on the subject, again invoked Vitruvius in the form of an iconic image of architectural theory (Figure 1.1 left). The primitive hut was used by Vitruvius to prove that Greek architecture had transposed the principles of timber-constructed architecture directly into stone construction. The functions of the carpentry joints were honestly expressed and contained the ubiquitous architectural elements of column, pediment and entablature. These are formal elements which express function in any and every form of architecture. Laugier's ideas influenced the development of neoclassicism and further perpetuated Vitruvius' theories. The revival of classical architecture was a search for perfect forms, usually inspired by Andrea





**Figure 1.1** Laugier's primitive hut from *Essai sur l'architecture* (1755), and modern stripped-down portico. Reproduced with permission RIBA Library Photographs Collection.

Palladio's Renaissance villas and his treatise, *Quattro libri*, or *The four books of architecture* (1570). The four books are partly a theoretical and partly a practical manual, as Palladio was originally a stonemason who rapidly became a popular architect to the villa-building classes in and around Venice. The books are well illustrated with Palladio's completed works and idealised versions of unimplemented projects, establishing a 'pattern book' format that became essential for all future manuals on architecture. Palladio's acknowledged debt to Vitruvius, and the four books' subsequent popularity, further enshrined the ancient Roman's principles in all ages of Western architecture. Palladianism took a strong hold on architecture in the British Isles, first with Inigo Jones, Christopher Wren and Vanbrugh. Later, the patronage of Lord Burlington ensured that British Palladianism was popular well into the nineteenth century. Although, doubts over the suitability of a form of architecture conceived in a Mediterranean climate, echoed by later doubts over such continental imports, led Alexander Pope to satirise architects' choice in verse:

*Shall call forth the Winds through long arcades to roar,  
Proud to catch cold at a Venetian door,  
Conscious to act a true Palladian part.*<sup>1</sup>

However, the timeless power of the classical symbolism of columns and porticos is shown by the reliance on this device to produce dramatic entrances to banks, colleges, and other building types. And it is still in use today, although usually in a stripped down form (Figure 1.1 right).



**Figure 1.2** The Casino at Marino, Dublin, by Sir William Chambers, 1764. The urn is a chimney.

The search for the perfect building continued in the eighteenth century, under the patronage of Lord Charlemont and his architect Sir William Chambers – leaving Ireland with a strong symbol of neo-classicism. Charlemont was inspired by his grand tour of the classical world which ultimately lasted nine years, including his long residence in Rome. He did, however, venture further east to Greece, Turkey and Egypt.<sup>2</sup> The Casino at Marino, sited in a park between the centre of Dublin and the airport to the north, is predominantly informed by Roman classical architecture (Figure 1.2 left, right). Charlemont’s architect, Chambers, was also a writer, and his *Treatise on civil architecture* (1759) was highly influential, focused on decorative elements and provided an accessible guide to the use of column orders. Chambers also presaged the Gothic revival of the nineteenth century when he called for the preservation and appreciation of medieval architecture. The Casino is an architectural gem, which, through ingenious devices, appears externally as a single-roomed, single-storey, Greek temple. It is, in fact, a sixteen-roomed, three-storeyed, functional belvedere, or as the name suggests, a small ornamental house. That most famous of Georgian architects working in Ireland, James Gandon, is also thought, by some, to have had a hand in the Casino, as he was Chamber’s pupil in the mid-eighteenth century. It is likely that he executed the working drawings for the Casino and the composition contains many motifs uncommon to Chamber’s other work (e.g. Somerset House, 1776–86), but symbolic of Gandon’s, such as a surfeit of externally visible windows – most being top-lights or clerestories. These are ingeniously hidden by the entablature in this case, along with other devices such as small convex panes of glass to the windows to disguise the deceit behind, and naturally light each of the sixteen rooms.<sup>3</sup>

British architecture became a battle of the styles in the nineteenth century, with neo-classicism largely holding sway for public buildings early in the century, such as the National Gallery (1834–8) by William Wilkins (1778–1839), who was also the architect of another neo-classical portico at

University College London (1826). Wilkins, in common with other architects of this era, although largely a committed neo-classicist employed other architectural styles, such as Tudor-Gothic for the New Court of Corpus Christi College, Cambridge. This is in contrast to his neo-classical essay at Downing College (1806); the latter was virtually a green-field site, while the former was adjacent to the oldest, medieval Court in Cambridge. Gothic and Classic styles battled it out throughout the century for public building commissions, while an Italianate style became popular for villas; all the while the search for a British 'national style' continued. Ironically, many of these variegated examples of stylism have become treasured national icons, but buildings such as the Houses of Parliament were as controversial in their day as other new national parliament buildings are today. Modernist architecture claims many roots in the freestyle experiments of the later nineteenth century, such as the stripped, whitewash rendering of Charles Voysey's domestic architecture, to the rationalism of Philip Webb's Red House for William Morris.

Architecture and design quality is rarely without controversy, as it is largely viewed as subjective. One person's 'carbuncle on the face of a much loved friend' is often another's idea of design perfection. Benchmarks to help achieve consensus are essential. However, there is invariably a route back to the ancient treatise of Vitruvius, even if it is sometimes through the enduring legacy of modern architects such as the American, Robert Venturi, who often chooses to refract neo-classicism through the lens of Pop Art, and the popularism of Las Vegas.<sup>4</sup> His architecture is in many ways a backlash against the simplifications of Modernism, and he uses architectural history to regain a 'complexity and contradiction' in the built environment – centred, once more, around symbolism and meaning in architecture.<sup>5</sup> But, it is a difficult task to find such meaning in a largely secular society, and possibly the only way to seek it is through popularism. The 'architectural joke', such as games with scale and proportion of the one-lined meaning, is rarely enduring, but even this can contain more symbolism than the bland and meaningless structures that tend to make up most of our modern built environment. Venturi actually argues for 'ordinariness' which he symbolises as the 'decorated shed', as it provides a contrast for the 'duck' – the former containing its meaning in its, often commercially inspired, façade, with a shed behind it, while the latter subverts its architectural form into the message or symbol of its function – the building as sign (Figure 1.3 left, right).<sup>\*</sup> Venturi also invokes Vitruvius' three principles, but famously changes the formula Firmness + Commodity + Delight = Architecture, into a criticism of Modernism's 'form follows function' dictact which implies that Firmness + Commodity = Delight. Design quality in architecture must ensure the first two ingredients and also integrate the third and final ingredient to achieve a high quality of architecture.<sup>6</sup>

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\*The 'duck' is named after a roadside eatery in Long Island, New York – literally built in the shape of a duck as an implicit advertisement of its wares.



**Figure 1.3** Imaginative buildings for young children – ‘ducks’. The boat and waves are primary schools. Copyright Joe Low/Architectural Association. This figure is also reproduced in colour in the colour plate section.

## 1.2 Building procurement systems

The method or system by which a building is procured is crucial to consequent design and building performance quality. Defined as the entire approach to creating the building, including initial approaches to the construction industry, briefing, designing, contract choice, communications systems, and consultant and client involvement. All too often this choice of approach is made by default, too late, or simply by choosing the currently fashionable method from a burgeoning array of alternatives. Unfortunately, the choice is also often dictated by political or organisational circumstances, and approaches dubbed mere ‘funding mechanisms’ have a crucial impact on subsequent design quality and functionality. Inexperienced clients in particular are often unsure about how to approach the construction industry, and ill-advised decisions at the early stages can have disastrous consequences.

The Royal Academy of Engineering’s rule of thumb concerning the proportional effect of different stages of a building’s life estimates that the capital cost is in a ratio of 1:5:200 when compared to operational costs and business costs. Even if this ratio is lower, such as 1:2:100, it is still undeniable that the capital cost of a building is invariably smaller than its operational costs, and minute against the impact of the building in use for an average life span of 60 years. Design costs must be an even smaller fraction of this ratio, and if added as an interpolation would probably give the ratio 0.1:1:5:200 (Figure 1.4). Even seemingly minor functionality problems, such as narrow corridors or inadequate daylight, will have negative business, educational or health impacts over the life of the facility. The whole life context of a building places early decisions, such as choice of procurement route or system, in a crucial light.

## 1.3 Chequered history of building procurement systems

The construction industry, like most other industries, has always had its problems – no doubt these were solved relatively easily in a slave-based



# 0.1 : 1 : 5 : 200

## Typical office building

KEY	
0.1	Design cost
1	Construction cost
5	Maintenance and building operating costs
200	Business operating costs

Figure 1.4 Design influences performance over time.

society such as that of the Egyptians building the pyramids, or for that matter, the Greeks and Romans with their monumental architectural achievements. Many critics of the industry would hazard that it has not changed much since those days, and is still 'brick upon brick' or 'stone upon stone'. A conservative industry, construction has responded slowly to technological and social change – but the industry was never short of, usually external, pundits highlighting problems and putting forward, sometimes simplistic, solutions. Exhortations to emulate other, seemingly more efficient industries, are among the more recent suggestions. But a long line of such reports litter the history of the UK construction industry in the late twentieth century, dating back to the Simon Report in 1944, an era in which there were still some social and technological certainties, and there was still only, really, one acceptable route of procuring a building – or preferably 'architecture'.

There was only one form of building procurement system that was really respectable at the beginning of the twentieth century. This 'traditional system', which remained essentially unchanged into the 1960s, retained sharp vestiges of social stratification. Cultured clients would use no other system. It was approved by architects and they were recognised as head of the hierarchy. However, increasing social, economic, and technological change heralded by post-war rebuilding began to show up flaws in the system. This led Bowley to comment:

*It is difficult to see how any system more wasteful of technical knowledge, intellectual ability, and practical and organising experience could have been invented.<sup>7</sup>*

The traditional system persisted, despite the technical advances of industrialisation. It was the social agenda of the welfare state, with the need for a rapid rebuilding programme, that led to the recommendations arising from successive government reports into the 'problems' of the construction industry. Among the first was the Simon Report (1944), which abhorred the use of open tendering as 'contrary to the interests both of the building owner and of the building industry'. Selective tendering was advocated in this and later reports, which culminated in its detailed formalisation in various NJCC codes of procedure.<sup>8</sup> Other shortcomings of the traditional system were variously identified by reports, such as Emmerson's in 1962.<sup>9</sup> He contended that, '... in no other industry is the responsibility for design

so far removed from the responsibility for production.’ Such a state of affairs has obviously been exacerbated by the sociological evolution of the system in which increased status and influence accrued to the design professionals. Architects could further their vested interests by divorcing design from construction, and increase their influence with the client at the earliest stages of the project. This schism between design and construction was not improved by educational initiatives of the late 1950s – the infamous Oxford conference required architects to completely abandon articles, or apprenticeships, in favour of full-time academic training; followed by a few years practical experience.

Emmerson also recommended that unconventional types of contract, which integrated design and construction, should be carefully considered by public bodies. The Banwell Committee (1964) went on to advocate openly the use of such variants of the traditional system as negotiated contracts. Banwell’s main message was that:

*... the various sections of the industry have long acted independently. We consider that the most urgent problem which confronts the construction industry is the necessity of thinking and acting as a whole.*<sup>10</sup>

However, such well meaning platitudes belie the inherently fragmented nature of the building industry. Any attempt to integrate design and construction has to contend with the disparate socio-economic and organisational objectives of the various protagonists. The client is clearly the key participant, and increasingly a catalyst for change.<sup>11</sup> In the post-war period up to the early 1970s the majority of building work was implemented using the traditional procurement system. This was in spite of all the recommendations to use relatively unconventional systems, such as negotiation, serial tendering and package deals. The economic impact of the oil shocks of the mid- to late-1970s created a plethora of alternative building procurement systems – making informed and rational selection of an appropriate system increasingly difficult. However, there are really only a few generic systems, and correct selection of an appropriate one is made simpler by classifying them in terms of their organisational structure (i.e. communications, functions and responsibilities).<sup>12</sup>

Poor or biased client guidance often leads to inappropriate procurement systems being selected: even between the three generic systems of ‘traditional’, ‘design and build’ and ‘management’. The choice of building procurement system is too often made by default, too late, or by choosing the currently fashionable process which is being lauded in journals and other publicity vehicles. The National Economic Development Office (NEDO) also found that customers of the industry ‘lacked sources of information or impartial advice about the options or alternative courses of action open to them’ and that, ‘projects were often organised traditionally by default rather than as a result of a conscious decision’.<sup>13</sup>

The traditional system relies on the architect ‘taking a brief from his client’. But the concept of one individual communicating his requirements to another individual, derived from older professions such as law, was condemned as obsolete as long ago as the mid-1960s.<sup>14</sup> The main grounds for