The British Construction Industry

an Introduction

Dennis F. Dolan

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Dennis F. Dolan, F.I.Q.S.

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1 AN HISTORICAL BACKGROUND

Man's ability to conceive, plan and erect the structures and buildings that his contemporary society required has played a formative, integral and important part in the development of civilisation throughout the world. So ever since Neolithic times when life styles first evolved from those of hunters and nomads to farmers and urban dwellers, architecture has reflected the religious, political and socio-economic climate of each successive age.

In the British Isles the religious climate of the Bronze Age, for example, can be assessed in such megaliths and tumuli as Stonehenge and the West Kennet Long Barrow. The political climate of Roman Britain can be adjudged by their roads and fortified towns such as Watling Street and Chester. The socio-economic climate of Regency England can be measured by such extremes as the wealthy Nash terraces of Regent's Park and the poor back-to-back terraced houses in London's East End.

As in the past the interpretation of contemporary aspirations and ideals through building continues today. Churches in the round reflect the ecumenical movement, comprehensive schools a political dogma and uniform housing the economic limitation of the times.

The translation of abstract thought into practical reality in the medium of construction is not merely an expression of the convictions of an age, however. It is also a statement of its design and building skills which nowadays have reached a very high level of sophistication accelerated by the technology synonymous with the twentieth century.

In addition much is owed to the past. Keen aesthetic awareness transmuted into physical form by architectural vision frequently spans the centuries. Many ideas have been slowly evolving, of course, but throughout the ages there have also occurred several major watersheds in design thought. The sixth century Dome of the Hagia Sophia in Constantinople and the eleventh century Quadripartite Vault in Durham Cathedral are recognised as two such metamorphoses.

Inspirational developments in organisation methods occur in the same way and have still more far-reaching results. The establishment of craft guilds in the thirteenth century created the foundation from which sprang not only the finest examples of early British architecture but also the modern building industry itself. Indeed, although totally protectionist in outlook, the guilds became the primitive forerunners of twentieth century trade unions and even gave birth to the closed shop. For these reasons it is necessary to examine the conditions which prevailed in mediaeval times in some depth.

Established at local level a guild had no link with any other group. Its primary objective was to ensure that all work in the neighbourhood was reserved solely for its own guild members and to this end tradesmen from elsewhere were strictly banned.

The only exception to this rule occurred in rural districts where the comparative rarity of stone buildings led to the admittance whenever necessary of itinerant masons on a temporary basis. Of course, in urban areas masons were permanent members of their local guild because of the greater volume of work for their craft.

Crafts in general fell into two distinct predominant categories: masonry and carpentry. Within these there existed many separate yet associated disciplines. For instance the term carpentry covered such trades as felling, sawing and joinery; that of masonry included work like hewing, laying and carving.

Subsidiary to the two major crafts, though making a vital contribution to any building project, were what today would be known as the finishing trades. Among their activities were glazing, thatching, wattling and daubing. (Wattle and daub was a method of walling mostly used in cottage work. The wattle consisted of interwoven willow rods and the daub of filling and facing both sides with clay.)

Now in addition to craftsmen there existed a great army of supporting unskilled labour working in such capacities as lime burners, barrowmen and carriers. So it follows that the thirteenth century building industry was as highly labour orientated as its twentieth century successor.

However, unlike the present industry in which the architect is the generally acknowledged leader of the building team, in the thirteenth century the master mason filled this role on all military and religious stone structures. Usually his terms of reference called on him not only to design the building but also to organise and supervise its actual construction. To achieve this he was empowered to prepare plans and

specifications, to establish workshops and to engage, pay and discharge both craftsmen and labourers as he considered appropriate.

Throughout the thirteenth, fourteenth and fifteenth centuries his position grew steadily in influence and respect. Employers were prepared to go to considerable lengths in order to attract and retain the services of men of vision and ability. This was reflected in the salaries and fringe benefits such master mason architects could command.

The Dean and Chapter of York induced William Hyndlee to work for them by promising to pay the sum of five pounds in settlement of a lawsuit brought against him in London. The Chapter of Canterbury Cathedral influenced Richard Beke to enter their employ by offering him a salary of twenty pence a week, by providing him with a house, clothes and extra money for firewood and by guaranteeing him a disability pension should work injury interrupt his contract. (The actual value of money at this time can better be appreciated when it is realised that the possession of land worth a mere twenty pounds a year automatically compelled an individual to become a knight with the responsibility of bearing arms for his king and country.)

Of all the master mason architects who flourished during the late mediaeval period, perhaps the greatest was Henry Yevele. He held the position of Master of the King's Masons from about 1359 to 1399 and at the height of his career owned five estates at Deptford, Wennington, Greenwich, Aveley and Southwark. His most prestigious work was Westminster Hall on which he collaborated with Hugh Herland, the most influential master carpenter of his day. Yevele designed his own tomb and expressed the wish that a simple epitaph be inscribed on it stating that he had been mason to three monarchs, Edward III, Richard II and Henry IV. He died on 21 August 1400.

The administrative complement to the master mason's design and constructional abilities and the final link in the thirteenth century manpower chain was the clerk of works. Each had to be a craftsman in his own right following many years' apprenticeship. His trade efficiency therefore became the criteria by which the clerk of works' sphere of activity was largely determined.

His chief function during this period was to record all building instructions and costs, physically to distribute their wages to the workforce and to pay the suppliers for their materials. In view of this it is frequently claimed that the mediaeval clerk of works was the early ancestor of the twentieth century quantity surveyor rather than the modern clerk of works, whose duties are primarily supervisory in charac-

ter. Be that as it may, the profession of quantity surveying *per se* began to emerge as a separate discipline after the Great Fire of London in 1666.

The intervening centuries had witnessed no dramatic changes in either the operation or performance of the building industry. Rather they had seen a slow but inevitable development keeping pace with changing needs and fashions. Nevertheless it was during this period that both the bricklayer and the independent architect were to emerge from the craft of the mason.

The bricklayer originally evolved in order to satisfy the fourteenth century passion for the brick buildings first inspired by similar constructions in Flanders. Examples of his work at Hampton Court and Charlecote Park in Warwickshire would seem to indicate that the bricklayer's craft probably reached its zenith during the Tudor period when such elaborate designs as highly ornate chimneys and the diaper pattern became fashionable. However, it was the Great Fire of London which was to establish his acceptance as an important separate element in the construction team. As a direct result of the Fire an Act was passed by Parliament in 1667 making it compulsory for buildings to have walls of either stone or brick.

The independent architect began his evolvement at about the same time as the bricklayer. Master masons of extraordinary design ability began to realise their own value and the potential in specialisation. Gradually they started to withdraw from the existing guilds in order to form their own, until by the seventeenth century their influence and position dominated the construction industry. From this background were to spring the great architects like Sir Christopher Wren, who was to play such a major role in the rebuilding of London after the Great Fire.

With the dawn of the seventeenth century had come the first stirrings of the Industrial Revolution which was to alter the whole emphasis of British society irrevocably from rural to urban. The British building industry was to change radically too from the generally easy going and often fragmented enterprise of the past into a far more efficient and cohesive force.

The reasons for the sweeping changes brought about by the Industrial Revolution were declining cottage industries and concomitant availability of cheap labour. The commercialisation of new inventions and the progress of mercantile capitalism produced a general expansion of wealth which in turn led to a growing demand for consumer goods.

This national economic growth placed an ever increasing burden on the shoulders of the builder to service rapidly and effectively the manufacturing needs of the captain of industry and the speculative requirements of the domestic property market. Warehouses, wharves, mills, factories, roads and houses proliferated accordingly and new thought in the fields of design, personnel and procedure was at a premium. In fact inventiveness and ingenuity became almost a symbol of the age except in the use of new materials. Strangely this aspect of development was largely ignored.

The one exception was in the exploitation of cast iron and the period abounded with examples of its imaginative use. The two most famous were probably the complete iron bridge erected across the River Severn at Coalbrookdale in 1779 and the illfated Crystal Palace designed by Sir Joseph Paxton in Hyde Park for the Great Exhibition of 1851.

The erection of such structures required the services of a new type of specialist who would understand not only construction techniques but also mathematics and physics. The profession which evolved to fulfil these requirements was that of the civil engineer. The soundness of his solution to the challenges of the Industrial Revolution, particularly in the area of transportation, endures to this day. The aqueducts of Thomas Telford, the bridges of Isambard Kingdom Brunel and the canals of James Watt are still in commercial use.

Another profession to reach prominence during the Industrial Revolution was that of the quantity surveyor. His knowledge of construction costs and ability to produce both estimates and bills of quantities for competitive tendering purposes made him the natural candidate to assume responsibility for the greater economy in their building projects which clients were now beginning to demand. His importance increased with the progress of the Industrial Revolution itself until by the early nineteenth century he had attained a position of considerable influence. Probably the most well-known quantity surveyor of this period was John Wallen to whom Edward I'Anson, later to become president of the Surveyors' Institution, was to become articled.

The greatest change in procedural methods brought about by the new order was in the development of gross tendering during the late eighteenth and early nineteenth centuries. This was a system in which a general contractor would submit a comprehensive tender for a project. His price would encompass the cost of all trades required in its erection. In addition he would guarantee the financial sufficiency of his composite estimate and accept complete responsibility for the organisation, super-

vision and discipline of the workforce.

In 1805 during the Napoleonic Wars the future of contracting in gross became assured when the government's Barrack Department adopted it as standard procedure for its escalating programme of prison, barrack and hospital building. The Department insisted that all tenders should be based on detailed drawings and specifications, contracts should provide for stage payments and extras should be valued on a fair assessment. Substantially these are the procedures used in the realm of small works contracts even today.

2 TWENTIETH CENTURY PROGRESS

The modern building industry has embraced more new ideas and achieved a higher degree of competence than in any previous period. Much of the credit for this must lie with the modifications and developments which have occurred in mechanisation, industrialisation and prefabrication. The application of such aids has reduced labour costs and increased speed of construction. Consequently earlier occupancy and quicker returns on capital investment have been made possible for the client.

Conversely it must be admitted here that these trends have led to more monotonous architecture because they impede, at least to some extent, the full realisation of designers' aesthetic capabilities. All the same, on balance the positive repercussions have far outweighed the negative.

Mechanisation is not a twentieth century innovation, of course. Mechanical equipment, even if primitive, has assisted the building process over hundreds of years. In Roman times, for instance, pile drivers and large cranes were in common use. Today, however, a peak has been reached in both efficiency and handling capacity.

The most notable development is probably in the history of lifting devices. In the past their primary function was to hoist and place materials in position but the invention of the tower crane with its long jib has allowed them to be used additionally for the precise and rapid movement round the site of large quantities of components.

Although so many modern mechanical aids derive from the past, a considerable number have originated in the twentieth century. Machinery like the excavator, bulldozer and scraper used in civil engineering schemes and portable power tools such as the saw, drill and spray gun used in smaller building tasks are typical examples.

Industrialisation and prefabrication should be considered as associated activities. Industrialisation has grown out of the expanding construction market for plentiful materials and competitive prices. Prefabrication on the other hand developed to satisfy the need for speedier

erection methods and reduced site labour commitment. Both became fully viable with the advancement of engineering technology, production-line systems and component standardisation. In consequence manufacturers are now able to produce materials and components of exact tolerances and uniform quality. The benefit of this facility to the industry has proved invaluable.

The architect, for instance, has been given the means to accelerate the design process by relieving him of the necessity for preparing so much contract detail. The variety of choice at his disposal has simplified the solution of design prerequisites in the most economic, functional and efficient manner.

The builder has been placed in the position of achieving greater labour productivity at lower cost. The result has been earlier completion dates, improved financial returns and keener competitive tendering.

Paramount considerations if mechanisation, industrialisation and prefabrication were to gain universal acceptance, however, were quality, performance and suitability. The monitoring of these requirements therefore has been a matter of vital concern to the whole building industry, which helps to explain why research, standards and testing organisations have expanded so dramatically in the last thirty years.

The Building Research Establishment, founded in 1921, undertakes to research practical problems and to disseminate its findings as widely and as quickly as possible. The prime function of the British Standards Institution, which received its royal charter in 1929, is to produce standards of quality, performance and usage of materials, components and plant. The Agrément Board was established in 1966 to assess the viability of new components, materials and systems prior to their inclusion in British Standards Specifications.

The initial development of the fresh ideas ultimately to be examined by these bodies owes much to the recent emergence of the structural scientist and researcher. Their investigations into solar penetration, heat expansion and wind loadings, for example, have made possible the tall, steel, concrete and glass buildings now familiar in every modern city.

However, as the construction industry has grown more complex in its operations and more exacting in its requirements so the evolvement of all the traditional disciplines has continued to expand. In response to the changing conditions it is true that some old skills have been abandoned but many others have been extended and refined and new areas of involvement detected.

This has been particularly noticeable in the case of craft operatives.

Today greater emphasis is being laid on the understanding of building theory and the acquisition of technical education for those under apprenticeship. A growing number of construction organisations are establishing their own supplementary training schemes. Further education to qualify suitable candidates for supervisory and managerial positions is now being actively encouraged. Together with the more customary practical experience at site level this is producing people of much higher ability who can readily adapt to the industry's changing demands.

The professions have also reacted constructively to the modern challenge. Increasing limitations in money availability, for instance, have encouraged the quantity surveyor to enlarge his scope to include the monitoring of building finance within that traditional cornerstone of his responsibilities. This has resulted in new methods of cost control being devised and developed so that construction team members can be continually conversant with a contract's financial status and clients may arrange their cash flow commitments to advantage.

The quantity surveyor's early involvement in precontract procedures, by providing advice and guidance on more economic solutions to problems of structural alternatives and material/component selection, is yet another emergent utilisation of his knowledge and experience. In fact architect and client are only now beginning to appreciate just how significant a contribution to cost control this capability is likely to prove.

The engineer has responded to the demands of twentieth century technology by intensifying development of the scientific approach to his profession. In this respect the introduction of computers to help him deal with the increasing complexity of new methods of structural and mechanical design has considerably augmented his efforts. As a result he has been able to meet both the client's wish for efficient, economic and up-to-date systems and the architect's need for specialist advice on their availability and effective integration into his scheme.

Indeed the dimension and weight of a modern architect's duties have become far more comprehensive and exacting. Not merely must he cope with the exigencies of over-all design, construction supervision and general coordination but he must also accept responsibility for blending all other professional and craft disciplines into an harmoniously productive unit. Fresh thought, current systems and the latest technology must be incorporated into the building structure and allowance made for society's growing environmental awareness, rising safety standards and developing health consciousness.

The practical application of this sense of community responsibility

for the environment, safety and health is embodied and quantified in statutory building regulations and planning laws. The impact of these on design and construction has steadily increased ever since the first by-laws were introduced by Henry Fitz-Alwyn, Mayor of London, in 1189.

Nowadays the United Kingdom has four distinct systems of regulations, each of which is limited in use to its own particular area. The regions involved are England and Wales, Scotland, Northern Ireland and Inner London.

Although local authorities are empowered to relax or even dispense with certain specific provisions, generally the building regulations are mandatory when related to new construction and alteration work. They cover almost every conceivable aspect of design and building from site preparation, material suitability and structural strength to thermal insulation, refuse disposal and fire precautions. They detail what a building or element is, what it must do and how it should be formed or constructed. In fact many architects would claim these regulations are so far-reaching in their requirements that they restrict design possibilities, escalate costs and effectively retard accurate attainment of target dates.

The first separately identifiable planning law was enacted by Parliament in 1909. In 1947, however, stimulated by wartime urban devastation and post war public demand for better living standards, the government introduced the Town and Country Planning Act. This combined the consolidation, expansion and modernisation of all previous legislation with the new idealistic and radical ideas. As a comprehensive package it won extensive powers for local government to control and guide building design and land improvement but imposed on it the responsibility for implementing national fiscal, environmental and development policies.

Today the scope of the Town and Country Planning Act and its subsequent amendments and re-enactments encompasses most facets of design and construction activity. It protects the public interest in everything from traffic control and amenity preservation to environmental improvement and land zoning.

Of course, there are numerous other Acts of Parliament which affect the building industry either directly or indirectly. All must be considered and when relevant their provisions incorporated within any scheme devised by the architect or builder. Probably among the most important from the industry's point of view are those dealing with housing, factories, education and civic amenities.

This wide spectrum of legislative measures has combined with the search for greater economies in construction work and the need for remaining competitive to formulate and pioneer new procedural and organisational methods. These include tendering processes, contract documentation and project management techniques and normally find their main application with major clients embarking on substantial programmes. Together with improved efficiency in design capability and enlarged output of traditional craft skills, they have enabled the twentieth century building industry to play an increasingly significant role in the economic life of the nation.

It has developed, for instance, into one of the largest employers in the United Kingdom. At the census in March 1977 its total manpower numbered 1 640 000 or 6.9 per cent of the country's workforce. Its performance contributed about 7 per cent to the gross domestic product. Total output computed at 1970 prices was £5 920 million in 1973, £5 429 million in 1974, £5 113 million in 1975 and, the last available statistic, £4 900 million in 1976.

In the international league table the British construction industry's gross domestic product is lower than several of its continental counterparts. The varied and often complex problems which have influenced this disparity are considered by informed opinion to have been caused largely through the policies adopted by successive national governments.

Since the Second World War the industry has suffered from Britain's constant economic instability. This has been compounded by wide fluctuations in the money supply, extreme variations in the minimum lending rate, increasingly heavy tax burdens and a governmental policy designed to use the industry as an economic regulator.

The result has been to prevent it from attaining a substantial growth pattern or realising its full potential. Naturally in times of economic recession reductions in manpower, training and development have necessarily to be made. However, this in turn prevents the industry from responding effectively to national building requirements when a period of reflation is introduced.

The reversal of this trend could be achieved by the total implementation of the first and last of Sir Harold Emmerson's conclusions and recommendations contained in his 1962 report, A Survey of Problems before the Construction Industries. These are that 'confidence in the future must be inspired by realistic forward planning on a national basis' and that 'central government should realise its responsibilities towards the industry'.

In fact the encouragement the government has given to large British contracting organisations, suppliers and professional firms to operate abroad has enabled the industry to gain an increasing share of world markets, particularly those of the Third World. This success has been firmly consolidated by the respect in which the British construction industry is held by foreign clients who regard its technical, organisational and financial abilities as second to none. The practical results have been that the building industry's overseas output at current prices has climbed from £369 million in 1974 to £881 million during 1976, which represents an increase in its workload of 239 per cent in just two years.

3 THE PROFESSIONAL ARCHITECT

In all ages the skill of the architect has lain in his capacity to span the gulf between society's abstract ideals and its desire for their material expression. This facility has led to the creation of structures which encapsulate as visual history in three-dimensional form the prime motivation of each succeeding generation throughout every civilisation.

The Egypt of the Pharaohs, for instance, was dominated by a certain rigidity of religious belief and practice which resulted in centuries of static architectural design and building methods. The luxury and ostentation of Assyrian structural forms reflected their autocratic and military mentality. The symmetry, balance and harmony of the Greek ideal was eloquently portrayed by buildings in which each element contributed to the perfection of the whole.

Indeed the aesthetic and visual satisfaction accorded by the study of such a structure as the Parthenon of Ictinus and Callicrates must surely account for the endurance and imitation of Grecian styles originally developed between the ninth and fourth centuries B.C. Recognised universally for their intrinsic elegance and classic simplicity the ageless Doric, Ionic and Corinthian architectural orders, however, have probably never been more effectively adopted by any single culture as by that of Rome. Thus imperial pride, power and wealth influenced Roman architects so to apply the old Doric and Corinthian orders that finally two new ones evolved, the Tuscan and the Composite, which were to be used as decorative rather than constructional elements.

It was, in fact, the Roman architect Vitruvius in the first century B.C. who not only collected and described these orders of architecture but also analysed and defined required contemporary qualifications for the architect himself. In the first book of his ten-part treatise *De Architura* he wrote 'architects who have manual skill and dexterity without scholarship are not able to reach the professional heights which their position would warrant whilst those with scholarship and no practical skill hunt the shadow not the substance'.