Book Reviews

The Stone Skeleton
JACQUES HEYMAN 1995
Cambridge, Cambridge University Press
160pp., 107 illustr. £35.00
ISBN 0 521 47270 9

Back in the 1960s, whenever we structural engineers were faced with a masonry arch problem, we reached for a publication, called *International Journal for Solids and Structures* 2, in order to consult a paper entitled "The Stone Skeleton", written by Professor Jacques Heyman. More papers on this and related topics followed and some of us have been privileged to hear Jacques lecture, lucidly and elegantly on the subject. Following two slim volumes: *Equilibrium of Shell Structures* and *The Masonry Arch* in 1977 and 1982, respectively, we now have in the author's own words a book that "*....attempts a synthesis of these studies of masonry....which, it is hoped, will be helpful to those who wish to understand how a particular stone building might behave.*" Whilst there may not be much new material on these 160 pages, the effort of distilling the author's knowledge has been well worth while:

Chapter One states very clearly why, of the three main general structural criteria, strength and stiffness are of minor concern when assessing masonry arches, and how stability is of overriding importance. Stability is demonstrated to depend almost exclusively on the proportions of the arch. As this may be a concept that appears strange to a modern engineer, there follows a brief history of structural design procedures, from Classical and Gothic rules of proportion, through Galileo and Navier's elastic analysis, back to modern "limit state design".

Chapter Two develops the structural theory of masonry, emphasising that a practical masonry arch will almost invariably have cracked at some stage, in order to adjust itself to slight changes in the geometry of its surroundings. It shows that such cracks do not impair the stability and it defines the "Geometric Factor of Safety" as the actual thickness of the arch, divided by the minimum thickness that can contain a thrustline for the load on the arch.

So far everything has been explained concisely and clearly without a single equation but, as befits the subject, with just the right number of simple diagrams. In Chapter Three, however, some equations do appear in order to arrive at the stresses that would exist in an uncracked dome. Here, a few more words, explaining the directions in which equilibrium is considered by equations 3.5 and 3.6, would have been welcome to those of us whose shell theory is getting a little rusty. One can, however, read past this minor hurdle and find the results shown graphically with great clarity. Then comes the demonstration of the "orange segment mechanism" of dome behaviour, as used by Poleni in 1748 to show that the dome of St. Peter's in Rome was safe notwithstanding the cracks that had appeared. The ability of a dome to have its crown omitted is contrasted with the dependence of the arch on its keystone. Similarly, the stability of other partial domes is explained.

Chapter Four deals with vaults, barrel- as well as cross-vaults, at some but not excessive length. The causes of the various patterns of cracks, which most vaults are likely to have suffered from at some time, are explained and the importance of the fill in the vault pockets

is stressed. Part of Ungewitter's tables, showing coefficients for vault thrusts, applicable for a range of height-to-span ratios is included. The structural working of the particularly English feature of the fan vault is then explained and whilst non-mathematicians might blanch at the term "Gaussian Curvature", it is explained in terms relating to what can be observed by looking, in such a way that it should not hold any terrors for anybody.

The assumption that strength does not matter has to be abandoned at the beginning of Chapter Five where ashlar-and-rubble-core walls and piers are dealt with, together with their common ailments, such as their tendency to bulge and to concentrate the load on the ashlar. The chapter goes on to deal with the (minor) structural role of the pinnacle and the function and shapes (correct and incorrect) of flying buttresses, and it finishes with an explanation of the tas de charge, transmitting the vault thrust to the flying buttress.

Whilst the title of Chapter Six is "Towers and Bells", it is particularly instructive in its treatment of the collapses of the Campanile in Venice and the central crossing of Beauvais Cathedral. Viollet-le-Duc's explanation of the second collapse of Beauvais should be food for thought for those who see pure lime mortar as the ideal material, ignoring its tendency to compress under load. The evaluation of cracks due to bell-ringing that finishes this chapter, whilst true in general terms, could be a little optimistic for some cases, if it were to tempt those responsible to merely repair by "stitching", without careful investigation of any history of past damage and its causes.

Spires occupy Chapter Seven which relates back to domes in its discussion of stresses and to vaults in its treatment of the role of the ribs. It includes the paradoxical fact, first described by Blanchard in 1980, that for any solid spire tip there is, in principle, a level at which it will blow over, regardless of the tip angle or the wind speed.

For those interested in the history of design and construction, Chapter Eight has a treat in store. It describes how the medieval masons worked everything by proportions of "The Great Measure", a basic module for the building in question and not necessarily relating to any other standard length. This explains why Villard de Honnecourt's sketchbook from about 1235 nowhere shows any dimensions. The debate over the height of the Milan Cathedral ("*should it be determined by a square or an equilateral triangle with side equal to the overall width*?") is described. Finally it is related how the numerous rules of proportion, many of which originated in Antiquity, found their way into the medieval lodges of masons, who passed them on by word-of-mouth to their members through long apprenticeships, and how they were eventually printed when Vitruvius and Alberti's books were published, illustrated in such a way "*that even bishops could understand them and princes could try their hand at design on their own*".

Chapter Eight is however not the only one with historical and technical interest. Right through the book there are references to medieval and later techniques of construction and design and this, combined with (dare one say) an un-academic style and clear, concise language, should make this book attractive to all concerned with old masonry buildings, regardless of their particular professional discipline.

POUL BECKMAN

Bridges. Three Thousand Years of Defying Nature
DAVID J. BROWN, 1996
London, Mitchell Beazley
176pp., 209 illustr. £19.99
ISBN 1 85732 163 4

David Brown is Publications Coordinator for Ove Arup, the international engineering consultancy; this is a revised reprint of his illustrated history of bridge design and construction, first published in 1993. The book is subtitled "Three Thousand Years of Defying Nature", and is, in the author's words, about the "How?" of bridges, in four, essentially chronological, parts.

Part One progresses from speculation about the prehistoric origins of bridge building, through Roman, medieval and Renaissance examples, to the Ironbridge. Part Two covers the Industrial Revolution and the nineteenth century. Part Three takes the story to the late 1980s, while the final part looks at current and future projects.

Each part is subdivided into themed "chapters". As a typical example, "Victorian Achievement", one of three chapters in Part Two, contains a general introduction dealing with the development of railway bridges, followed by more detailed coverage of the Britannia Railway Bridge, Brunel's timber viaducts and the Clifton Suspension Bridge, the Tay Bridge, the Forth Rail Bridge and so on.

The book is also a celebration of the technical and artistic skills of bridge designers and builders. In evidence, the author has assembled from a host of sources a selection of colour and black-and-white photographs, augmented by line drawings. The attractive format, superb production and glorious photographs will appeal to the general reader, the practising bridge engineer and the technical historian alike. A dip into the book is rewarded by dramatic and evocative images of many of the world's great bridges. Every page carries at least one photograph, and the text is enhanced with occasional line drawings and specially commissioned art-work.

But this is much more than just a coffee-table book. There is enough descriptive and historical information about each bridge and the engineers involved to satisfy all but the expert and specialist reader. The methods employed and the problems resolved in the construction of many of the bridges are described and illustrated, using line drawings, contemporary photographs and prints. The evolution and development of construction and design techniques, and in material technology, are explained. In addition there are passing references to many other bridges and engineers, which serve to set the selected "landmark" bridges in their historical and technical contexts. A "Chronology of Key Events", a glossary of technical terms and a useful bibliography are also included.

By these means, the author provides illustrations, potted histories and some vital statistics for over 100 "exemplary" bridges around the world. Perhaps readers will be disappointed to find no references to a favourite bridge, but they will doubtless find compensation in other discoveries.

For the more-than-casual reader, the basic structural principles involved are explained in a non-patronizing manner. There is, of course, a limit to the degree of technical complexity which should be attempted in a book of this format aimed at a wide readership. The author seems generally to have got the balance just about right, although a few more line drawings would have helped the general reader's understanding of some technicalities. (It has been said, for example, that the difficulties of attempting to get across the principles of reinforced and prestressed concrete to a non-technical reader, without using illustrations, are almost comparable to those of Magnus Pyke attempting, with both hands tied, to explain a solar eclipse).

However, these are trivial criticisms when set against the predominating clarity and comprehensibility. David Brown's splendid book can be highly recommended to all bridge enthusiasts, whatever their level of expertise.
DAVID GREENFIELD

Bâtir la Ville. Rovolutions Industrielles dans les Materiaux de Construction
ANDRÊ GUILLERME, 1995
Paris, Champs Vallon
320pp., illustr. 295 French francs
ISBN 2 87673 203 3

André Guillerme is one of the relatively few academics who teaches the history of building science and technology, and one of even fewer who approaches the subject in the best traditions of historical scholarship. His approach is one that will be rather unfamiliar to many English readers, partly because of the era it addresses and partly because the British history of this period focuses largely on the biographies of eminent engineers rather than on more general historical issues and the relation of the technological developments to changes in their cultural context.
A prologue introduces the *dramatis personae* - entrepreneurs, the State and site workers as well as the architects, scientists and engineers. An overview of the national and regional development of France during the period of study includes notes about the development of the road, canal and the rail networks and the urban transformation from fortified towns to civil urbanisation. The remainder of the book is presented in three sections.

La cervelle de la terre ('The brain of the earth') looks at developments in foundations, water engineering, caissons and what we would now call soil mechanics. This includes various methods of reinforcing earth and the beginnings of using mathematical models to understand the behaviour of soils or semi-fluids' as they were sometimes called. Understanding the behaviour of soils also serves to illustrate the role played by the polytechnics in both teaching and research in these early days of engineering science.

De la chaux au ciment ('From lime to cement') tells the fascinating story of hydraulic cements and modern mortars. This was a dramatic development in the construction industry for it was one of the first examples of involving scientists to help solve a technological problem. Limes and mortars were of interest not only to those such as Lavoisier who were concerned with the new science of chemistry, but also to doctors searching for explanations of how the bones of the human body are created and to naturalists seeking the mechanisms by which stones and pebbles came into being. Experimentation in France to establish how to obtain the best concrete was a mixture of pragmatic approaches by engineers such as Vicat, drawing on Smeaton's work, and the work of academic scientists far removed from the construction site. The effect of these developments on the trades and workplace was considerable. Cement became an industrial product and the strict control of the ingredients and site practice necessary to ensure good quality concrete was, at first, resisted by the workers. The use of higher quality mortars and cements led to enormous cost savings in making canals, locks, dams and bridges. The 1820s also saw several builders using iron rods to bind more effectively the stone, and concrete used in foundations of some bridges and buildings - the very beginning of reinforced concrete.

The final section, entitled *La ville neuve* ('The new town'), brings together the earlier technical developments and concentrates on the construction materials that helped bring about the enormous building programmes in the late 18th and early 19th centuries throughout France. This revolution in the industry consisted of both the adaptation and development of traditional materials such as bricks, tiles, plaster, glass, paint, timber and stone, and the introduction of new materials - wrought and cast iron, and lead, bitumen and zinc (for achieving watertightness). This section also includes some notes on services - the supply of drinking water and town gas for lighting.

In conclusion the author argues that, although France lagged behind Britain in innovations in building and civil engineering, she unquestionably led in the area of public works. France nevertheless underwent her own revolutions in industrialisation and the structure of society, and urban construction was as much part of this process as were the manufacturing industries.

During the period addressed in this book the industrialisation in construction materials was well supported by the state in France. While the latest sciences were often applied to public works, the rapport between science and technology was generally still rather poor. The introduction of new materials into the building industry, both from other industries and abroad (e.g. Britain) brought about great disruption to the workforce and the organisation of the various building trades. All this activity following the end of the Napoleonic era resulted in extensive developments in towns and in the means of transport between them, at both a regional and national level, which brought about an irreversible change to the very geography of France.

The book is well illustrated throughout with engravings from many of the classic engineering texts by Rondelet, Béidor, Poncelet, Wiebeking, Girard and Prony as well as learned periodicals of the day such as the *Annales des Ponts et Chaussées*. It concludes with a lexicon of technical terms, brief bibliographies of some 40 engineers and scientists (including a few English who had impact on French construction), 25 pages of references arranged by subject, and a comprehensive index.

This excellent book is aimed at the level of a university course in the history of building construction. Unlike many books by historians it treats the engineering aspects of the subject very thoroughly; unlike the historical writings of most engineers, the technical subjects are placed in their economic, political, scientific and historical context. The success of this book stems from the fact that it is particularly well-conceived. It is very well-focused and its subject - urban construction, in France, 1760-1840 - is perfectly judged, being large enough to convey the broad picture and narrow enough to get down to the level of detail which brings the subject alive. At every step the main subject matter is illuminated by accounts of the many external influences including the activity in related industries such as fortifications and canals, other disciplines such as medicine and chemistry, other countries, especially Britain, and the overarching influence of the state, the economy and town planning. The book is an extremely interesting read and gives a very full picture of the French building industry some 150-250 years ago. It is a model which someone should follow for British construction history and the book's publication in translation would be an important addition to engineering history in the English-speaking world.

BILL ADDIS University of Reading

Historical building construction, design, materials and technology

DONALD FRIEDMAN, 1995
New York & London, W.W. Norton & Co.
238pp., illustr. £35.00
ISBN 0 393 70200 6

A practical aspect of the history of building construction is to provide information for the rehabilitation of historic buildings. There is, of course, considerable overlap between the study of historic buildings for this purpose and the pursuit of the subject for its own sake, but we should expect there to be differences of emphasis and differences in the manner of presentation. For both approaches the study of buildings in this century presents some difficulties. The extent of the changes that have taken place within a relatively short time, compared with earlier centuries, and the competition between alternative methods makes the telling of the story more difficult. Marian Bowley confessed that in Britain it was not possible to know the relative market shares of steel and concrete in the construction of frame buildings, and as one material or method supersedes another the rapidity of change may depend upon a variety of factors. Understanding the development of the period is as much a matter of archaeology as it is of history, with the buildings themselves telling the story far better than contemporary accounts. That is the advantage of this new book. It is written by an engineer who draws on his experience of the repair and rehabilitation of buildings - indeed the aim of the text is to inform others who may be involved in similar work. At the same time the author has made considerable use of contemporary written sources, particularly the journals of the day, to explain the changes that took place.

The title is misleading because this book is about historic building construction only in New York. It might, from this description, appear to have a rather limited appeal but, despite its geographical limitation, for members of the Construction History Society it needs to be seen both in its own terms and as a useful example of historical writing. The way that the subject is treated, the layout of the book and the nature of the text and illustrations all suggest a book written for graduate engineers who might be engaged in rehabilitation. It deals with a number of structural and construction issues at a level which the young graduate might well need, pointing out the practical concerns that govern building design which are so often so poorly covered in engineering degree courses. This is important because it also explains the practical issues that have led to choices of construction methods in the past. This is to be commended - the reader is not told simply what happened but also why it happened.

A certain amount of repetition occurs because of the presentation adopted. The chronological text is illustrated with case studies which mainly describe particular jobs which involved the examination of a building and making recommendations for work to be carried out.

Perhaps these are a little too brief in places, both for the conservator and the historian, and occasionally they would have benefitted from drawings to illustrate the points being made. These studies express concern for the present conditions of historical buildings and illustrate the implications which their original construction have for their present use and durability; an aspect of the subject which the author also discusses at the end of each chapter. A number of appendices provide information on the material stresses, design loads and design formulae used at various times within the city of New York. For anyone working on historic buildings in the city, this would be an invaluable source.

As a book for historians the treatment is not always as comprehensive as they would like - although this is a direct result of the nature of the book. The treatment of the development of iron and steel frames and the floors that they carried is very thorough, if sometimes a little repetitive, but far less is provided on the development of the curtain wall - but then for conservation purposes far less understanding of this history may be needed. One other aspect of the presentation that might disturb the historian is that illustrations are dated by the date of the photograph. This is an interesting piece of information but historically unsatisfactory. I also found the referencing system a little tiresome since it was necessary to use both footnotes and bibliography before one knew the date of a source. But these are comments about editorial style rather than content.

A more serious problem for those interested in this book as an historical source is its New York bias. Occasionally reference is made to developments outside New York, but only where they have a direct influence on that city's practice. I am even concerned about the claim that '*.....since the engineering press coverage of building development necessarily followed the most intense and most innovative activity, New York is better represented than any other city in nationally available source material.*' Can that be true? It makes an unjustified assumption about the reliability of press coverage as a source. If we are going to draw so extensively on contemporary journals as a source for construction history, then we should perhaps be asking how reliable they are, particularly in their geographical bias. As for the claim about the most intense and innovative activity, I can imagine that this might raise some hackles in Chicago. Also, I have the uncomfortable feeling that the development of reinforced concrete is not fairly represented. No doubt the coverage accurately represents practice in New York, but a reading of early American concrete textbooks suggests that there was more development of reinforced concrete in other parts of the country than some of the comments in this text seem to suggest. This was a country that was developing an infrastructure dependent upon concrete during the period covered by this book. Roads, bridges and dams were being constructed all over the country, as the pages of *Engineering News Record* show, so one would expect some transfer of this into building technology. Perhaps New York, with an established steel-framing industry, did not need to adopt concrete technology on the same scale as other areas.

As his claim shows, the author has drawn extensively on contemporary press coverage as well as contemporary engineering manuals. These sources provide an excellent picture of what was happening and the significant events. This is where the book most successfully breaks away from its stated aim and provides accounts of the reasons for change that will be of most interest to readers of this journal. The discussion of the collapses of buildings of cage construction and the time that it took to learn the lessons from these failures makes particularly fascinating reading. This is not the kind of history that is concerned with inventions and pioneering efforts - it is about the construction of the ordinary and the mainstream.

Perhaps a reviewer should always declare his own bias. Mine is an interest in the ordinary rather than the extraordinary, the processes of change rather than the inspired new idea and this is what this book is about. It is not so much about ideas as about the process by which ideas were adopted by those who were putting up ordinary buildings. Of course this is what the conservator of such buildings actually needs, so that it is because of his practical concerns that the author has presented this kind of history, and the weakness of the book is in its bias towards the steel frames of New York it is also its strength. It cannot claim to present a clear perspective on the development of construction in America, but for the limited area concerned it is thorough and insightful.

DAVID YEOMANS University of Manchester

Building in Britain: the Origins of a Modern Industry
AKIRA SATOH and RALPH MORTON
Aldershot, Scolar Press
316pp., 105 illustr. £45.00
ISBN 1 85928 084 6

The ambitious stated aim of this book is to give a "comprehensive description of the modern British building industry in its early years" in the first half of the nineteenth century. As such it is likely to be of considerable interest to many historians of construction. The period is regarded as a crucial formative phase, when the modern industry evolved from its medieval system of building production. The procedure, methods, roles and relationships which emerged were those which were to remain stamped deeply upon the industry until recently. Only now, after a century and a half, it may be added, are they coming under pressure for change. Today it is our questionable privilege to live at a time of rapid change in building which, curiously, has features in common with the period covered by this book.

Part One of the three part *Building in Britain* deals with the rise of the general contractor. A short review of the literature, embracing the work of such pioneering authors as Cooney and Port, precedes a detailed consideration of the decline of the medieval system of building production. A brisk overview is offered of measure and value, and work "by the great". This leads to the emergence of the style "builder" (871 of them in London by 1831) and the ways in which they may be classified. From there the reader is introduced to the more arcane topics of fixed price contracts and single contractors which emerged haltingly from a scene of some considerable variety and, particularly at this distance in time, uncertainty. Satoh and Morton next consider the identities and activities of the first general contractors, about whom we still have a patchy understanding. Such figures already existed before the emergence and eventual dominance of the system of contracting for whole projects at a fixed price, but it was the earlier nineteenth century which saw their rise to ascendancy. The careers of 22 such general contractors are briefly plotted. Among them are many, such as Alexander Copland (1774-1834), who would repay the extended treatment which Spencer-Silver has already accorded to George Myers. Typically such men were born in the country and moved to London to make their mark (and often their fortune), though a handful of Lancashire men also appear here. Having described a representative range of individual general contractors, some generalisations about their methods are ventured. Consideration is given to their probable size and number at mid-century, and to their employment practices. The extent of sub-contracting emerges as being quite widespread, particularly later in the period, although it carried with it a doubtful reputation which made respectable general contractors evasive about the subject. Other topics addressed here are the role of foremen, the grouping of proprietors into local business associations and their rise to status.

The second part of the book dals with technical advances in building production. The authors note that this aspect has been hitherto given scant attention. Successive short chapters address developments in the fields of stone and woodworking, brickmaking, component manufacture, and pumping and lifting equipment. Numerous items of quintessentially nineteenth century equipment, such as Bramah's planing machine, and Clayton's tile, brick and pipe machine, are briefly described and illustrated. The adoption of new machinery, and workers' reactions to it are addressed. Also considered is the rise of components ready made and off-the-shelf, such as Coade stone ornaments, iron brackets and columns, and ventilation and sanitary items. In this respect the nature of building activity was beginning to undergo a significant change, with builders no longer themselves producing all the elements of a building, but beginning to assemble parts made elsewhere.

A range of impressive machinery by way of pumps, mortar mills, pile drivers, cranes and devices for moving material, such as Surgin's "endless ladder", is discussed. A great deal of this, though not all, was probably used on engineering rather than building projects, and very likely by large firms rather than small.

The third part of the book is entitled "Building as Capitalism: Some Theoretical Questions". This may be seen as a reward (or punishment, according to your inclination) for readers who will have just read about such intensely practical concerns as Buckwell's scaffolding and steam excavators. The first of the four chapters making up this section addresses the salient question of the origins and causes of the emergent system of building production. After reviewing the respective merits of the contributions of Colvin, Port and Cooney, the authors conclude that the new contracts, business conduct and organisation of the period were not independent, but in symbiotic relationship. Underlying that relationship was the spread in society of the key competitive principle which undermined the medieval system of building production. The following chapter pursues related themes, as elsewhere in the book, somewhat in the style of separate essays. The themes are: how general contracting was founded on industrial capitalism; the significance of the expanding means of production in terms of investment in industrial facilities, giving technical improvements and incentives; and, finally, the distinction between the few large contractors and the many smaller firms, and resistance from architects and craftsmen to the emergence of the new contracting system.

The book was written in unusual circumstances. Akira Satoh's work was based on a doctoral thesis submitted at Tokyo University in 1986. He undertook further research in Britain in the early 1990s and drafted an English translation. Dr Ralph Morton then took upon himself the task of converting the draft into idiomatic and readable English, at which he has succeeded. Presumably as a consequence of the tortuous route from scholar's pen to finished book, no works later than 1984 are acknowledged (except, idiosyncratically, John Summerson's *The Unromantic Castle and Other Essays* of 1990). The result, of course, is to miss the benefit of more recent research by such authors as Clarke, Cooney, Spencer- Silver and others. Regular *Construction History* readers will seek in vain for reference to, for example, Louw's very substantial contribution on woodworking mechanisation.

The standard of book production is quite high, although many of the hundred or more illustration are reproduced so small as to lose detail. While it may be questioned whether the initial aim of a comprehensive description of the industry is attained, this is to quibble. The book has a great deal to commend it, although regrettably incorporation of the fruits of research over the last decade is not among its merits.

CHRISTOPHER POWELL University of Wales, Cardiff

Form Follows Function. Skyscrapers and Skylines in New York and Chicago
CAROL WILLIS, 1995
New York & London, Princeton University Press
160pp., 125 illustr. £15.00
ISBN 1 56898 044 2

Rise of the New York Skyscraper 1865-1913
SARAH BRADFORD LANDAU and CARL W. CONDIT, 1996
New Haven & London, Yale University Press
478pp., 210 illustr. £30.00
ISBN 0 300 06444 6

The early development of the skyscraper has been the subject of much attention by American architectural historians. The consensus of opinion has been that the skyscraper developed in Chicago where architects first gave functionalist expression to this building type. Both Willis and Landau and Condit challenge this view by pointing to the significance of the New York skyscrapers and the importance of the profit motive in the shaping of this building form. However while both publications draw upon a common theme they are quite distinct in emphasis. Willis examines both the New York and Chicago skyscrapers, encompassing a period of property development from the late nineteenth century to the 1940s. Landau and Condit by contrast focus exclusively on the first phase of skyscraper construction in New York, from the elevator buildings of the 1870s to the introduction of the Building Ordinance in 1916.

Willis examines the different characteristic building forms in New York and Chicago and interprets these as the product of standard market formulas and specific urban conditions. She argues that the economic and programmatic formulas for quality office space tended to standardize high rise design. While such economic strictures as land cost, building cost and rental return produced a design template, zoning, municipal codes and the historic grid of blocks and lots were instrumental in the development of distinctive forms, creating a vernacular unique to each city. The text is organised into two main parts. Part One focuses on the development of typical building forms in each city and is divided into two major phases - the vernacular period and the international period. Willis describes the vernacular period as encompassing the last quarter of the nineteenth century to the Great Depression. During this time period the building plan was closely related to the lot and the requirement for light offices. She describes in detail the role of the site plan and building codes in the development of the early skyscraper towers in New York, the hollow square office plan in Chicago and the massing of the "setback" skyscraper. In her discussion of the international period of skyscraper design Willis points to the role of fluorescent lighting and air conditioning in dramatically increasing rentable space and enabling the building plan to be independent of the site and interchangeable from one city to another. The effect of the revision of the 1916 New York zoning ordinance in 1961 on the promotion of tall towers set within public plazas is discussed.

In Part Two Willis examines the role of property speculation and building cycles in skyscraper property investment. She details the intense speculation in land prices that accompanied land assembly and comments upon the role of the elevated railway in Chicago in fuelling land price rises. In the financing of skyscraper building the author examines the significance of savings banks and bond houses in this process. Willis's book makes an important contribution to the literature on architectural history in countering the all too prevalent architectonic emphasis of many scholars. In taking a thematic rather than building

by building approach her argument is imparted with particular clarity. It is well illustrated and a pleasure to read.

Landau and Condit's book on the early New York skyscrapers constitutes a meticulously researched work which is encyclopaedic in its coverage. The authors emphasis at the outset that the skyscraper owes much of its character to the desire for profit, prestige and advances in technology than simply to theories of style or aesthetics. Such an argument is most interesting, bearing great similarity to research which I completed in 1985 on the early Chicago skyscrapers (of which both authors were aware). This theme is pursued in the eleven chapters of the book. The study begins with an analysis of the possible influences on the style of the early skyscrapers in New York. Landau and Condit discuss the technological advances that were essential for tall office building construction. Reference is made to the importance of advances in metal framing, windbracing, secure anchoring, fire protection and the development of power operated construction equipment. The role of heating, ventilation, plumbing and lighting in commercial buildings is also considered. Analysis is made of the early use of iron framing in commercial buildings prior to 1870.

From an analysis of the technical preconditions for the skyscraper the authors examine the historical circumstances surrounding the construction of the first skyscrapers of the 1870s and 1880s. The role of the client in the formulation of each plan is discussed together with the rental revenues that were realised from these buildings. Reference is made to the technical advances which occurred during the 1880s in construction techniques, heating and plumbing and the extent to which economic and engineering principles governed design. The growing maturity of skyscraper design during the 1890s is examined and the role of corporate promoters in seeking powerful visual symbols is detailed. Reference is also made to the technical advances that occurred in the syndicate built skyscrapers erected during the latter half of the nineteenth century. The impact of these buildings on public opinion and pressure for the introduction of a municipal height restriction is broached.

The book closes with a detailed analysis of the skyscrapers which were erected from 1900 to the introduction of the municipal Building Ordinance of 1916. Landau and Condit consider that architects produced mature design solutions for skyscraper building faáades. They discuss the increasing scale and heavy capital investment in these buildings and the extent to which architects realised the sculptural possibilities of this building type.

In summary *Rise of the New York Skyscraper: 1865-1913* constitutes a most scholarly analysis of the early New York skyscrapers. The publication of this book is of central importance in placing this fascinating phase of building construction on centre stage. Landau and Condit's careful assemblage of the individual construction histories surrounding a whole period of high rise office development is further enhanced by a wealth of illustrations. However in producing a chronological account of individual construction details, some of the force of the argument is lost. In particular it would have been valuable to have situated technical developments firmly within the context of the crucial structural and organisational changes that occurred in the building industry and building supplies industries at this time. Furthermore the role of land speculation in the land assembly process remains rather submerged. The authors argue that they have "taken capitalism for granted" in their study. It is arguable that in dealing with such a baldly commodified form as the skyscraper that the forces of capital were most explicit and should be boldly stated. Nevertheless the book is masterful in its coverage and is an important contribution to architectural history.

JANE BONSHEK

Prefabs. A history of the U.K. Temporary Housing Programme

BRENDA VALE, 1995
London, E. & F.N. Spon
192pp., 58 illustr. £42.00
ISBN 0 419 18800 2

It is extraordinary that the post-war prefab has had to wait almost fifty years to receive its recognition in a full length study, especially as Brenda Vale says the programme was in essence a public success', residents becoming very attached to them. The book identifies this acceptance with the pre-war desire for a bungalow or, as the final chapter says, the *'single storey form and detached layout produced a type of housing that allowed the occupier control'*. However, these broader provisions were allied to unusually high internal standards achieved by ingenious design and innovative technology.

It was this technology, the author points out, that interested the architectural press of the time, rather than the acceptable housing model that emerged'. I am very much in sympathy with the author's view, that architects have over-emphasised the importance of technology. Nevertheless, with the prefabs it is clear that the technological context, both of the war and of architectural ideas, gave a strong direction, and maybe legitimisation, to the results and the way they were received by the public and politicians.

The book is curiously organised. Only two chapters focus directly on the prefabs themselves; the first, describing the types and the sixth, by far the longest, dealing very thoroughly with the question of costs. Another chapter, 'The New Jerusalem', covering the wartime discussion of postwar needs and the Portal prototype bungalow would have been more logically placed at the beginning of the book since it sets the scene. But all in all this presents good coverage of the 'official' story and will become the standard source on the topic.

However the three intervening chapters, which summarise topics extensively covered elsewhere, fit uneasily in the book. These deal with the general attraction of the bungalow, North American and Scandinavian precedents, and the idea of the factory-made house. Here Brenda Vale's approach leads to problems; for instance the influence of Le Corbusier and Gropius is highlighted but not that of Bemis or Buckminster Fuller, who merits only one reference.

Greater conciseness in dealing with this material could have created space for a curious omission, a thorough discussion of the technology involved. For, in spite of the author's reservations as to its ultimate importance, this was central to the programme's realisation. Although in the opening chapter the construction of each type is described and plans shown, there is not one construction cross section, nor any detail on the very innovative kitchen/bathroom core unit, or of the Arcon exploded component drawing, the influential forerunner of so many subsequent drawings, especially amongst the Hi-Tech designers. There is little on the process of design or of the factory production techniques. Is this due to a lack of source material? All this seems strange given that the prefab was driven, as the book says, so much by the Ideal of the Factory Produced' house.

The significantly different approach adopted by Arcon is undeveloped. They were not a company offering a package but a firm of designers who had the idea of developing, with a number of manufacturers, a series of components into a final integrated design. This approach had far-reaching effects, first on school building and later on the so-called Hi-Tech school of architects who have developed this idea to a fine art. Much of this can be traced back to the 1944 report of the Building Industries Council which called for the development of ranges of internal components standardised throughout by BSI. But behind such dry

reports there were enthusiastic people and, inevitably perhaps, such an account relying heavily on government sources fails to convey their significance. Edric Neel, for example, had been invited to Coventry in 1942 by Donald Gibson to design an experimental house using tubular steel, a pair of which were built. Subsequently he, with Raglan Squire and Rodney Thomas, set up the consultancy Arcon and Neel sold' the already designed house to Lord Portal. There was development through five designs reflecting Lord Portal's insistence on a central entrance, the elimination of a large window and shading device and, most significantly, the use of a tubular lightweight steel frame (by Stewarts and Lloyds), now almost as ubiquitous as brick. It is surprising that there is no reference to my own work on this subject *(Building Systems, Industrialisation and Architecture)*, nor to Noel Moffett's invaluable articles in the *Architectural Review* of 1955.

But it is the failure of the Ideal of the Factory Produced House', beloved by designers, that the book analyses especially well in the last chapter, pointing out that '*what mattered was not the technology used to construct them but the chance offered to make some kind of home*'. It may be hard for designers to accept the lesson that the sophistication of the technology is less important than the form, and we have seen the repeated attraction such ideas have for them and for politicians; the author points out the problems when the ideal was applied to the high rise programme with much less success.

For the truth is that the prefabs proved to be expensive, they did not transfer labour to the factory as expected, they demanded more use of skilled labour not less, and only constituted 6% of the postwar housing programme since only 150,000 were produced instead of the half million proposed. The book questions why they were not made extendable, or involve the users as had timber cottage homes in Sweden. Yet it was an impressively planned operation involving central and local government, often at odds, with a complex network of delivery and storage for components, and it offered many lessons for subsequent work.

In addition the prefabs were liked. They were seen as a success and many still survive, temporary though they were claimed to be. For most people it would seem, the ideal home is still a castle, however miniaturised.

It should be pointed out that the book, although well thought out, is produced to a very basic level indeed, but at high cost. Perhaps the publishers were aiming for a subtle match with its subject matter!

BARRY RUSSELL University of Portsmouth