

Stuart building contractors during the period 1618 to 1623. Sections of wooden pipe recovered showed trunks of 30–35 cm diameter, with internal bores of 10–13 cm, bored off-centre to avoid the heartwood. Connections were of the male-to-female type, with the exposed end-grain protected by a flanged collar formed from a crimped lead sheet.

PETER WAY, **Shovel and Shamrock: Irish Workers and Labor Violence in the Digging of the Chesapeake and Ohio Canal**, *Labor History*, 30, 4 (Fall 1989), pp. 489–517. The Chesapeake and Ohio Canal experienced at least ten significant disturbances and virtually-continuous labour unrest between 1834 and 1840, necessitating the state militia to be called out five times and Federal troops once. Although Irish immigrants worked throughout the North East, nowhere else experienced the endemic disorder that plagued the canals, early railroads and roads. The author identifies the roots of these disturbances on major public works projects in their organisation of work (their financing, recruitment, discipline and poor working and living conditions) and in the Irish tradition of secret societies and collective violence, which were imported to the New World and adapted to its nascent capitalist social system.

MARC A. WEISS, **Real Estate History: An Overview and Research Agenda**, *Business History Review*, 63 (Summer 1989), pp. 241–82. As perhaps the first comprehensive historiographic and bibliographic essay on real estate history to be published, this article casts a wide net, offering a review of the literature and suggestions for research opportunities in the many and varied streams of academic endeavour that flow into the new specialism of real estate history. Moving away from anecdotal personal and company biographies, the field is maturing and expanding toward more sophisticated and analytical studies that interest a variety of disciplines. The exhaustive analysis of both traditional and innovative work provided in the text is complemented by a selective bibliography of the publications discussed in the article. This is the keynote article in a special issue of *Business History Review* dedicated to real estate history (see also the articles by Friedrichs, Stach, and Paterson & Shearer).

Book Reviews

Hagia Sophia: architecture, structure and liturgy of Justinian's Great Church

ROLAND J. MAINSTONE, 1988
London. Thames & Hudson
288pp, illust., £35
ISBN 0 500 34098 6

Hagia Sophia is the third church of that name on its site, both the first two having been burnt down. Built by the Emperor Justinian and begun in 532, it was completed in less than 6 years, a remarkable achievement for a building of its size. The central space enclosed is over 80m long by 30m wide and with a height of over 50m under the centre of the dome. When it was built it was the principal church of Constantinople and therefore of the Byzantine empire. With the end of that empire it became a Catholic church until Constantinople fell to the Ottoman Empire in 1453, whereupon it was promptly converted to a mosque. During its life it has been damaged by earthquakes and partially rebuilt on a number of occasions, the most important being the reconstruction of the dome which collapsed in 558. Since it became a mosque it has had a number of additions, the most noticeable being the minaretttes, and it has lost whatever Christian furnishings it may have had. Secularised in 1935 it is now preserved as a museum, so that what the visitor to modern Istanbul sees is a building that was a major feat of construction in its day and which then enjoyed some 1400 years as a place of worship; a building of stone columns and brick and tile walls roofed by a dome and semi-domes that are still decorated in the Christian mosaics that have survived its use as a mosque.

Roland Mainstone's association with this building goes back over many years and his knowledge of its fabric is based upon careful, detailed observation and accurate surveying. From this he has been able to build up a history of the construction, chronicling the changes that have been made in repairs and alterations, and showing the way that it has responded to the forces within it. Here he uses this work to present more than just an account of the building's history. The book is a model of the way in which the detailed history of an individual building may be studied, showing the kind of evidence that is assembled and the way that it can be used.

What then are the questions that may be asked of the construction of an historic building and what are the techniques that we may use to answer them? Giving an account of a building of this scale is inevitably a major undertaking but the questions became more complex, and the evidence needed to provide the answers more difficult to unearth, when we are dealing, not with a single building campaign, but as here with the third major building on the site and one which has suffered structural damage and

subsequent strengthening as well as partial rebuilding. For the earlier buildings we have to rely largely upon archaeological evidence, although in this case such evidence is difficult to gather because of the presence of the surviving building. We are lucky indeed if there are ever any drawings which tell us something about their design but there may be contemporary descriptions of a building, even perhaps accounts of its construction, and these have been used in this case.

The same is equally true of the present building but for this the structure itself must be the primary source because, whilst the physical evidence may be supplemented by contemporary accounts, they may not always be reliable. There may have been a certain amount of myth making in their writing, whether conscious or unconscious, and reporting may be inaccurate simply because the information was either second hand or written up long after the event, as Mainstone demonstrates in his cautious approach to these sources.

We may first ask of the present building what the sequence of construction may have been, in particular what is part of the original construction and what are additions. The starting point here is careful observation, but while this can show the sequence of building, and some of the additions to the structure, it cannot reveal the intervals between the events which are necessary to follow the sequence of strengthening and repairs and the reasons for remedial action that was taken. The sequence of construction is partly revealed by movements that have taken place between different building operations, so that if the rate of movement can be assessed an estimate can be made of the time interval; an assessment that depends upon a modern understanding of the behaviour of materials and their response to load. To be able to take this step we are in a world that depends as much upon assumptions as it does upon careful and accurate measurements.

For example, the step beyond careful observation of the building is to make exact measurements from which the plan and sections can be drawn. An assessment of the amount of movement can then be made from any deviations that there may be from an assumed ideal form. But what was this ideal form? What were the intentions of the designers? To answer such questions we have to look at the architectural history of the period and the design of other buildings that may have influenced the design of the building being studied. So much for the overall form, but the actual setting out dimensions needs to be determined and this may require some statistical manipulation of the actual surveyed dimensions because deviations from an ideal form may be the result of inaccuracies in setting out as well as from movement of the building. Even when looking at possible movements it is necessary to try to distinguish those that occurred during construction and those, probably larger movements, that occurred after completion. Assumptions also have to be made about the way in which later work would be set out to accommodate movements that had already taken place. Were piers built vertically or inclined to produce a particular visual effect, and if the former, how accurate was the construction? Only when these questions have been answered can we determine what movement has occurred.

The movement that might take place while building depends upon the speed and the sequence of construction and to an extent upon the methods that were used. For example, different kinds of centring to provide temporary support while building arches produce different forces in the structure and so a different rate of movement. The resulting movements will also depend upon when the restraining buttresses were built. This requires information that cannot be obtained directly from either the surviving structure or from any records associated with it because builders are not in

the habit of recording their methods; so we must again have recourse to indirect sources.

Piecing together the history of the building therefore requires some initial working assumptions about the design, a clear view of the processes of construction that might have been used and a judicious combination of a number of techniques of analysis of the surviving fabric. Mainstone has used all these methods, laying out his evidence carefully in a book lavishly illustrated with his own photographs and with drawings to explain the building, the forces in it, the movements that have occurred and the sequence of construction. To a large extent the form of the book follows the process that he must have gone through in his analysis of the building. It begins with a painstaking description of the fabric as it exists today, looking first at the overall form and then at the details of construction and the materials used. From this it has been possible to determine the changes that have been made to the building throughout its history. An understanding of the design of the church requires a knowledge of the historic background, the political climate and the state of architecture of the time, which includes the evidence of the form of the previous churches on the site. With this as a background, the exact form of the original design, i.e. the exact proportion of solid to void, the relationship between the sizes of various spaces and hence the exact dimensions used in the setting out have to be determined by an accurate survey and careful analysis of the results. As Mainstone points out, it is all too easy to find what one is looking for in these measurements unless they are objectively assessed. With the design principles established, and the ideal form determined, the movements can be described and so the sequence of construction. To conclude, he considers the liturgy and furnishings of the building in its use as a church, plus an assessment of its influence in later architecture.

Naturally laying all the evidence out in this way does not make for easy reading, particularly at the beginning where the building is described in some detail. The reader may have some difficulty in following this because, not being in front of the building, it is not always immediately clear how one part of the construction relates to the rest. It will be easier for the reader who has visited the building and can call upon memory to relate the parts to the whole. Mainstone provides excellent drawings which help considerably but constant turning of the pages makes it difficult: in the absence of a fold out or separate drawing a photocopy comes in useful. This is a complex building, and the sequence of events is also complex and not always easy to follow.

The questions that the architectural historian asks of an historic building are those concerned with its form and function, how was it designed and why, how does its plan and form relate to the history of its type and perhaps what was its social or political importance. Studies of the history of construction have, until quite recently, dealt with the construction of particular periods or particular kinds of building. Such studies hardly provide a coherent history of construction throughout the ages, and when we look at individual buildings there is often no established history of the construction of its period within which it can be placed.

There have been few studies which have considered all the aspects of a single building, covering the relation between function and architectural form and the limitations of structure and construction. Roland Mainstone's early paper on Hagia Sophia, and a later one of St Maria del Fiore, given to the Newcomen Society, considered mainly questions of structure and construction. By contrast in this book he does consider all the aspects of the building. The evidence that he has used has been laid out as fully as one could wish and what readers of this journal will appreciate is

the way in which the architectural, historical and archaeological evidence has been assembled to reveal the processes of its construction, repair and sometimes reconstruction.

DAVID T. YEOMANS, *University of Manchester*

Oscar Faber, His Work, His Firm, and Afterwards

JOHN FABER, 1989
London, Quiller Press Ltd.
103 pp., illust., £9.95
ISBN 1 870948 17 3

Oscar Faber was one of the last of the true multi-disciplinary great engineers. Born in the same century as Brunel, his career echoed some of Brunel's abilities as well as his zest for life.

As a son and a colleague, John Faber is in a unique position to write about his famous father. He is much more aware of all the facets of his father's life than even the closest friend or partner could hope to be. We get some tantalising glimpses of Oscar at home—his marital relationships, stormy at times, his hobbies and enjoyments. We get a glimpse of 'Edwardian' life in the 1930s, and of his uncertainty as that way of life drew to a close in 1939. We get a pencil sketch of Oscar Faber the engineer and the man in the opening chapters, yet that sketch is not fully developed.

There are other aspects of Oscar Faber's life that we should like to know more about: the other children, for instance, more about his wife, and more about his own life during his initial struggles. His secretary for 25 years is brought into the story only very briefly. Oscar's resolution of his pre-war doubts—he had or showed no such doubts when I worked for him immediately after the war—is yet another topic which John Faber might have tackled in more depth from his unique position.

We then come to the chapters on Oscar's early assistants and later partners, particularly Jim Vaughan and Rob Kell. We are told that Oscar considered with Jim Vaughan making him a partner in 1939, and later Kell. It is not surprising that this odd proposal came to nothing, but John's own words indicate that had such a partnership happened it would have been applauded in the profession, and would have been a true recognition of their ability and devotion. Rightly or wrongly one is given the impression that Jim Vaughan was somewhat destroyed, certainly in Oscar's eyes, by this episode. But in his later years Vaughan was appreciated as a gentleman, if not *the* gentleman, of our profession.

One has the feeling that Rob Kell was the one whose brain Oscar was picking. Oscar had been educated as an electrical engineer, had changed to a structural and civil engineer, and seemingly wanted to master—as he did—the skills of the mechanical engineer. Whether or not the feeling is right, the effect was to place Kell as the *doyen* and possibly the originator of the building services engineers' profession. In the end it was he who borrowed Oscar's name and fame as much as Oscar borrowed Rob's knowledge.

The decade of the 1930s was when perhaps the fame of the Faber firm was at its height: the most successful, albeit dictatorially managed, multi-disciplinary practice of consulting engineers, making its own contribution to architecture. Oscar Faber's career took place in the most difficult decades of this century—our economic failure in the 1920s, the world stagnation of the 1930s, the Second World War, and the slow start of

the 1950s. The period of the Second World War saw the greatest changes for the consulting engineer. Jobs stopped in mid-air: staff disappeared into the Army, the Navy and Air Force. The problems changed: huge ordnance factories were wanted quickly, and Oscar's practice helped to provide them. Later more technically demanding problems arose, and Faber's name was to the forefront of those designing such projects as the Mulberry Harbour and the D-Day floating harbour which made the Second Front possible.

During this time Faber moved from Westminster to St Albans, and for the rest of his career worked there from three small houses in Church Road and Worley Road. At the end of the war came perhaps his ultimate public triumph: the consulting engineering commission for both the structure and services engineering of the new House of Commons, after the destruction of the old one by bombing.

Faber died in 1956, soon after building licences were abolished: we have forgotten the bureaucratic difficulties of that era. His practice had grown as he had conquered these adversities and profited by them. During that time his chief assistants, most of whom eventually became his partners, were Vaughan and Kell, Montgomery-Smith, Glover and Budgen.

Oscar Faber was clearly a complex character and John Faber touches, perhaps too lightly, on the obverse side to the brilliant, successful and original consulting engineer throwing himself into his work and his life. How forceful he could be is shown by his ability to pressure Vaughan to stay with him at the end of the war, after the abortive partnership discussions of the early war years.

I was present at the shameful and unnecessary attack on Professor Hiley, then an old man, on the occasion of Oscar's paper to the Institution of Civil Engineers on 'A New Piling Formula'. Strangely, and perhaps because our piling methods changed, the formula did not alter significantly our approach to the calculation of the load-bearing capacity of piles. John Faber couples two of Oscar's papers together, the other being 'The Aesthetics of Engineering Structures'. To my mind they are chalk and cheese: the latter makes a significant contribution to a much discussed subject.

By far the weakest part of this book is the final chapter, 'After Oscar Faber's Death'. He had formed a partnership a few years before he died—to my surprise since he was not a natural partner of many people. But this appeared not to change in any way how the practice of Oscar Faber and Partners was managed. Oscar's relatively sudden death must have left a big hole in the partnership, and the progress from there to the distinguished practice (albeit a public limited company) which it is today, warrants a much deeper analysis and commentary than John Faber's last chapter.

RONALD HOBBS, *Ove Arup Partnership*

Houses from the Factory: system building and the Welfare State 1942-74

BRIAN FINNIMORE, 1989
London, Rivers Oram Press
292 pp. £32.50
ISBN 1 85489 002 6

This is an important book. We have heard so much, and for so long now, about the great state housing programmes of the post-war decades in Britain and their deficiencies—deficiencies which in the public mind are bound up with the image of

system building—that any study which may help scotch political cliché, historical simplification or pure architectural bandwaggoning is to be welcomed warmly. There are now good enough general studies of post-war government housing policy and of its urban and social consequences, by Patrick Dunleavy and Alison Ravetz. What we have not had hitherto is a sober measure of the part played by system building in that grand and tragic drama: of the shotgun, wartime marriage between dire necessity and high utopianism that caused its birth, of its premature employment in infancy, and of the delinquency it displayed when it grew strong and of age. All this Brian Finnimore minutely chronicles. Metaphor is not in his manner, and will be discarded for the rest of this notice. It may perhaps be pardoned as a means of highlighting the seriousness and continuing topicality of his subject.

Prefabrication, as all authors treating its history find themselves saying, is nothing new. Globally it is still on the advance in housing, though now (in western countries at least) normally in its right place as technological servant rather than ideological master of the construction process. The questions for Finnimore at the outset are why, when and how British government started to force its pace. The answer to ‘why’ is well established by now: huge housing crises and labour shortages, correctly anticipated towards the end of both world wars, prompted government advisers to try and get housing in particular, and building in general, on to the path of the production-line methods of the ‘second industrial revolution’. The attempt after 1918 was tentative at best and fell victim to a financial crisis; after 1945, a more whole-hearted venture was made possible by the ‘command’ nature of the war economy. This time, ideologists of reform in housing, architecture and building production alike insisted that the political line had to be held if permanent improvements were to be made. That is why experiments in prefabricated housing were for years the beneficiaries of positive official discrimination, even when they seemed to cost more, save little in labour, or take as much time to build. With sufficient patient investment, so the thinking ran, the benefits would begin to emerge. Of the many versions of this *credo* cited by Finnimore, the most telling are not the pep-talks or articles of architects, politicians or civil servants but the reports back to his superiors of C. H. H. Smith, a Regional Production Officer for the Ministry of Housing and Local Government in the early 1950s. There we see a middling official ‘on the ground’ struggling against the grain to persuade local authorities and builders not to give up on prefabrication, on the grounds that they would not ultimately regret it. The argument was in the end largely but not by any means utterly discredited, concludes Finnimore.

So far the book is enlightening but scarcely original. Where Finnimore scores is in his investigation of the ‘when’ and the ‘how’ of his subject. Sharp attention to the chronology of post-war housing policy must be paid, for a start, or misconceptions will result. The prefabricators by no means always had things their own way. After the initial boom in systems fuelled by the post-war temporary and permanent housing programmes, understandable in view of the state of the building industry at the time, there was a sharp curb in 1948. This corresponds in part to the Cripps austerity programme, but also to an unwillingness to tolerate the experimental expense of some housing systems. The steel BISF house, for instance, most successful of the early types with nearly 30,000 completions in 1946–8 (Finnimore has the figures laid out in excellent and handy appendices), needed costly special erection contractors which the Government would no longer subsidise. Its production collapsed in 1949 and ceased altogether in 1951. It was not until 1952, with the Macmillan housing drive, that the brakes were taken off. Even then, apart from a tiny bump in 1954, housing comple-

tions in systems never got above a quarter of the total until the red-letter years 1966–72 (1970 was the peak year with 41.3 per cent of completions).

Why the second boom, linked in popular mythology with Harold Wilson’s talk of technological revolution, at that particular time? Of the many answers, two seem especially stressed by Finnimore. One was the success of the Emmerson Report of 1962, which called for an end to ‘stop-go’ regulation of the economy through the building industry and for a new concept of partnership between that industry and government. Emmerson led to the setting-up of the National Building Agency in 1963, and gave the confidence for contractors to invest in the costly plant for major systems which in the years of ‘stop-go’ they would have been foolish to countenance. The other explanation, worth further investigation, is that of foreign influence. By the early 1960s France, for instance, had built a huge amount of housing in systems as part of its now notorious *grandes ensembles*; Denmark, too, had done a good deal in the same way. In 1961–2 we see the London County Council’s architects looking at ‘large-scale’ continental production methods and preparing to jettison their own, hard-won expertise in concrete slab-blocks and towers; Liverpool, too, sent a delegation trotting off to Paris and ordered 2500 dwellings from the British licensee of the Camus system. Sectra, Larsen Nielsen (of Ronan Point fame), Jespersen (most interesting of the large-panel systems) and other names now appeared, as one big British builder after another linked up with a European producer. Was this mostly a matter of fashion, or were the French and Scandinavians able to show real, not just apparent, advances in productivity? One would have liked to know. Doubtless part of the appeal of the foreign systems was that they already existed. Contractors racing to get in on the systems act could buy ready-made, rather than waste precious time developing something of their own while competitors stole a march on them.

By 1967 the picture was one of far too many systems scrabbling about for too little work, says Finnimore, with the National Building Agency overwhelmed by the success of its early efforts to promote systems, trying to reduce them to a semblance of order and at the same time, through pressure on local authorities, to hand round enough work to keep the main ones going. The NBA and its hapless director A. W. Cleeve Barr (perhaps the most fascinating of all figures in the British systems building saga) have always had a bad press. It is perhaps not always grasped that from the late 1960s they were trying to put the lid on the Pandora’s box they had opened. But their policies of rationalisation, metric house shells and the like met with short shrift on the ground. A point often made is that the partial collapse at Ronan Point (1968) came after the switch from subsidies for high-rise blocks (1965); one less often put is that the retreat from systems in housing well antedates the inflation and oil crisis of 1973–4. As always, the lapse in time from policy-change at the centre to a shift in what is built on the ground muddles things—and has political consequences.

The ‘how’ of Finnimore’s account is as absorbing as the ‘when’, and is much mixed up with the ‘where’. Above all, he underlines, systems needed sponsors for their initial investment and promotion. Sponsors came in two basic guises—private and public. In the 1940s burst of energy, many of the sponsors were engineering firms looking for new civil markets after the end of war production. Many of them were more enthusiastic than knowledgeable about the building industry, and so came to grief or withdrew when less hazardous markets for their products re-established themselves (the AIROH house, studied by Finnimore in the first issue of *Construction History*, is the classic example). Many contractors fought shy of prefabrication at this early stage. The major exception was Wimpey, whose ‘No-Fines’ method is the success story of the

book; Finnimore's lists give a total of 61,197 No-Fines units built between 1946 and 1955, and 128,898 between 1964 and 1979. No-Fines was more an elaborate method of shuttering than of true prefabrication. One of the lessons of the systems story is that contractors like Wimpey who went in for compromises of one kind or another did better than purist, whole-hog prefabricators. The incidence of No-Fines housing was very regional, and Finnimore examines in some detail the policy of Coventry where the strong-minded city architect, Donald Gibson, procured some of Wimpeys' largest contracts.

This example is one which might have given Finnimore pause for thought, as he tends perhaps to distinguish too strongly between private and public sponsorship. To be sure, a building or engineering firm had to invest in the plant necessary for production—a moral and financial investment in proportion to the number of elements in that system actually made and erected by the firm itself. In the 1940s many sponsors were makers and not builders at all, and in some cases makers only of the frame of the house. With the 'heavy panel' concrete systems of the 1960s one sees the builders providing far more of an all-in service, so that it becomes easy to imagine Laing, Wates, Bison and the rest ruling the roost. On the other side were the systems sponsored by local authorities, so seemingly successful in schools from Hertfordshire onwards to the era of the 'consortia', yet never translated convincingly into housing. But just as Wimpey needed an authority like Coventry with its particular housing policy to develop its No-Fines method, so Hertfordshire, CLASP and the other sponsoring local authorities were dependent on industrial partners. Sponsorship was always a two-way street. The crucial question was, who was in the driving seat; industrial sponsor or client sponsor? The experience of the schools programmes, into which Finnimore is obliged to diverge in some detail, was that to get satisfactory buildings it had to be the clients. He claims that there is no evidence that system-built schools erected by commercial firms were any worse than ones where local authorities were in the driving seat. It is difficult to know what such 'evidence' might be. But it was always believed, for instance, that the Hills steel-frame primary schools built by Hertfordshire in the early 1950s were educationally superior to those built by the LCC at the same time, using a Hills 'package' with little intervention from the LCC architects and educationists. A public sponsor had to be strong enough to resist undue pressure from the makers and builders of a system, yet flexible and enduring enough to respond to developing client needs. These conditions never obtained in housing in the 1960s: hence the abortive efforts of the Midlands Housing Consortium, the Yorkshire Development Group, Nenck, Jespersen 12M and the other experiments of this kind that Finnimore valuably chronicles. Nor did they persist in education, as the example of MACE, last and most disastrous of the school-building consortia, reminds us.

Finnimore's is a view from the centre, and some might say he should have investigated the experience of living in the housing created by the systems. That, however, would have departed from his cool, factual and objective line, which is so very welcome at a time like the present. There is no doubt he does not like a lot of the housing he describes (who ever did?), but the calm tone he adopts makes his conclusions the more trustworthy. Dunleavy put much of the blame for the systems-building débâcle on big contractors; Finnimore puts it back on the state, or to be more precise, on an expectation that the Welfare State could solve our problems technologically, without fundamental social change. It is not a novel conclusion, but it seems sober and right.

One final grumble. *Houses from the Factory* is produced by a new small publisher,

and is good-looking and easy to read. But it contains a sequence of mis-spellings that author and editor should have ruled out. It is trivial to make too much of tiny faults. But when Reyner Banham, Thomas Carlyle, J. H. Forshaw, Denis Clarke Hall, Geoffrey Jellicoe, Malcolm MacEwen, Harold Macmillan, Charles Pannell, Michael Patrick, Renée Short, Thamesmead, Trollope and Colls, and sundry other victims whom this reviewer did not bother to note *all* have their names misspelt, he feels he has a duty to register a protest!

ANDREW SAINT, *English Heritage*

Second Century of the Skyscraper

LYNN BEEDLE, (Ed.), 1988

New York, Van Nostrand Reinhold

xxv + 1108 pp., Illust., bibl. and indexes US \$82.95

ISBN 0 442 22116 9

Hongkong Bank: the building of Norman Foster's masterpiece

STEPHANIE WILLIAMS, 1989

London, Jonathan Cape

302 pp., Illust., bibl. and index, £40

ISBN 0 224 02490 6

"On the occasion of the one hundredth anniversary of the tall building, the natural question emerges: What will the second century hold?" asks editor Lynn Beedle in his preface to the most recent volume sponsored by the Council on Tall Building and Urban Habitat. The 84 contributions which follow explore the second as well as the first century of the skyscraper: these essays were originally presented in January 1986 at the Third International Conference on Tall Buildings held in Chicago.

Most of the volume deals with technical aspects of the design and construction of tall buildings, although one of its six major sections includes a subsection on their history. In their respective essays, Carl Condit and Tom F. Peters reconsider the criteria by which historians define the skyscraper and date its advent. Critical of narrow definitions that emphasise external form, Carl Condit explores "Two Centuries of Technical Evolution Underlying the Skyscraper," focusing on structure, safety, internal transportation, and "habitability"—heating, plumbing, artificial lighting, and ventilation—as equally valid criteria in a broader definition. Peter examines the "primacy of invention, originality, and clarity of concept in engineering matters" in the development of structural concepts. He concludes that establishing "primacy of invention" is a far less valuable approach to the history of structural engineering than one which takes into account major conceptual shifts, such as from the structure conceived as a post-and-beam frame to the structure as a tubular form.

In the most interesting historical essay in the volume, Tom Peters and Giselher Hartung shed new light on the development of the "Chicago School" in the last half of the nineteenth century. They argue that the European development of the load-bearing iron and steel structural frame as distinct from the non-load-bearing walls resulted in a new architectural concept that separated skin and structure. This concept was 'transplanted' to Chicago by architects and engineers such as William L. Jenney, who studied engineering in Paris, and Charles Strobel, who was trained in structural

engineering in Stuttgart. One hopes that Peters and Hartung plan further, well-documented writings on this conceptual shift and its diffusion.

One of the technical essays in *Second Century* deals in part with the Hongkong and Shanghai Bank, the innovative design in Hong Kong by Norman Foster and Ove Arup & Partners which is also the subject of *Hongkong Bank* by the British journalist Stephanie Williams. Although oversized and well-illustrated with colour photos, the book is not a typical 'coffee table' architecture book. Given unlimited access to the papers of architect Norman Foster and the Hongkong and Shanghai Banking Corporation, as well as a variety of other unpublished materials, Williams has produced a fascinating design and construction history of one of the most visually and technically interesting buildings of this century.

Although the story begins in 1978—when the Bank had outgrown its 1935 Central District headquarters—Williams outlines the history of the Bank and its buildings back to its founding in 1865, the completion of its first building in 1886 and the second in 1935. Context is a key element of the story and Williams does not neglect it: she makes clear the important ramifications of Hong Kong's unique topography, demographics, and building craft traditions—it is a city where in construction, "above all two things count: the ability to get maximum floorspace out of a site, and to build with remarkable speed". (p. 21) A strong craft tradition has for centuries built the same designs of the same materials, aesthetics and layout having been originally dictated by a Chinese Imperial building code. In the late 1970s, even the notion of an architect was still alien, for a building's designer could be any 'authorised person'; a category which included engineers, surveyors and draughtsmen.

In fact, the Bank chose structural engineers, quantity surveyors, and building service engineers long before an architect. Norman Foster eventually edged out the other short-listed competitors. Foster's was one of the first firms in Britain to introduce 'fast track' construction and to make effective use of management contractors, a system well known in the US but little-used in Britain in the 1970s. The Bank liked Foster's design, his emphasis on speed and costs, and his involvement in the technical aspects of design and construction. On previous projects he had improved conventional components and methods of construction and had successfully added extra modelling, prototyping, and testing to extremely tight construction schedules.

The very best sections of this book deal with the various constraints placed on the design and the construction process, and how the design and construction team worked around these. The site, time schedule, materials costs and availability, restrictions placed on noise and vibrations levels, and the fact that Hong Kong had its own way of doing things called for innovative, but not necessarily high-tech solutions. For instance, noise and vibration levels had to be kept low in the crowded business district, so hand labour was used to sink 98 caissons down to levels of 20, 38 or 53 m. Hand labour was also used to excavate earth to a depth of 20 m around the first 58 caissons, revealing them as steel columns to support the basement floor slabs. Under the basements were eight giant caissons—each supported by four more caissons sunk 15 m into bedrock—and these anchor eight enormous steel masts that form the basis of the structure. The eight masts support a series of suspension trusses located at intervals up the structure and from which the floors are suspended by hangers.

Two things frustrate the reader of this otherwise first-rate construction history case study. As a journalist, Williams was not particularly concerned with providing her readers with any kind of historiographical framework and she develops no large themes. She follows a strictly chronological approach: in some instances a thematic

approach would have been better, for example, in her lengthy treatment of the fabrication of the structural steel and its claddings. Second, the index contains largely personal and institutional names, with very few subject headings.

Hongkong Bank might very well have served as a model for *Skyscraper* (New York and London, 1989), but it remains the better book. The design and construction of Norman Foster's Hong Kong building certainly would have made a more interesting American Public Broadcasting System television series.

JANE MORLEY, *American Society of Civil Engineers*

Skyscraper—the making of a building

KARL SABBAGH, 1989

London, Macmillan

291 pp. illust. (18 colour photographs: 47 line drawings) £14.95

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Four 1-hour video tapes of the original TV programmes have the same title. Shown on Channel 4 in 1989, made by InCA, they are available from Video Sales, Yorkshire Television, Leeds.

When I look at a Greek temple or a Gothic cathedral, as well as seeing a masterpiece of architecture and engineering, I imagine the frantic meetings between the architect and the site manager about the entasis on column seventeen, and the roofing sub-contractors complaining that they can't do the job for the agreed price because they were given inaccurate information about the height of the flying buttresses. Sadly, there are few eye-witness accounts of the actuality of great construction projects. A few stories have been passed down to us—Vasari's gripping account of Brunelleschi's design and construction of the dome on the cathedral of Santa Maria del Fiore in Florence, for instance. Writers of fiction have occasionally tried to fill the gap—*The Spire* by William Golding springs to mind. This dearth of information about our past is as unfortunate for those interested in history as it is understandable—why, in 1142, would anyone have bothered to write down what was going on on site in Chartres that day?

It was the mass media which changed all this. The design and construction of the Crystal Palace in 1849–51 happened to coincide with a growing circulation of periodicals such as the *Illustrated London News* and the *Builder*—a trend which was helped by the development of new methods of printing illustrations. As a result we have an account of this story in hitherto unparalleled detail—reading the weekly reports of progress on the project makes it seem as though it is still under construction and there is a sense of disappointment to go to Hyde Park and find no trace of the bustle of activity.

Sadly, with time, the novelty of reading about (yet another) construction project has worn off, and it is only when they get into difficulties that we now tend to hear about them—the Thames Barrier, the Channel Tunnel. Yet, consider how this contrasts with the genuine interest people have in projects going on around them—the holes cut in the plywood hoardings around building sites at eye level are evidence enough (the more thoughtful contractors provide an even more important service to the image of the construction industry—holes at the eye level of an eight year old!).

How refreshing it was then, in 1989, to see Britain's Channel 4 television station devote no less than four hours of transmission time to the story of a construction project—a major new skyscraper in New York which came to be called Worldwide Plaza. Fortunately for those who missed the transmission, the film's director, Karl Sabbagh, has also written an engaging book about the project, and even in this video age, books are still the more accessible medium (in this case, about forty times cheaper).

Mr Sabbagh tells the extremely complicated story of how a US \$550 million construction project comes to happen with great clarity; unlike most accounts of such buildings which appear in the technical press, he tells the whole story. He begins by looking at the project from the point of view of Bill Zeckendorf, the man whose idea it all was. We follow through the way such a project has to be conceived in order to make money—attracting likely occupants even before it is definite that it will go ahead—plus negotiations and deals with the city administration and local residents.

The project is followed through the architectural, structural and building services design, through the planning of the construction, to the day-to-day story of the construction itself—blasting the foundations, erecting the steelwork, cladding the building in brickwork, fitting it out and, last but not least, placing 'David's Diamond', a 42 ft copper and glass pyramid named after the architect, atop the 650 ft steel-frame building—a jewel on the New York skyline.

What makes this book such an excellent read is that it gives so much more than simply a factual account of the project. It has a rather unusual style which reflects its origins in a television documentary. It is part reportage, part technical journalism and part oral history. At nearly every point in the book which needs it, the technical details of a large modern building are explained for a non-technical audience. Indeed, the book would be far more effective in educating students about details of the construction process than most of the text books which are currently available—one of the advantages of the book having come from the world of professional communicators. But the great strength of the book, again because it comes from the world of the mass media, is that it follows the story from the point of view of all the types of people involved, not just the 'most important' ones. We follow a series of mini-sagas such as that surrounding the marble facing to the ground floor facade—a story which takes us to, amongst other places, the Cafe Florian in the Piazza San Marco in Venice and to Brazil, and which involves the Mafia. We follow the story of the brick-work, from the intense arguments about its colours, the problems of making 1.2 million non-standard bricks, the 'negotiations' about when the bricks would actually get delivered on site, and the astonishing fact that masons in New York are not allowed to use a plumb line to ensure their brickwork is vertical (only a spirit level).

We also meet a wonderful variety of individuals. Virginia Adelstein, for instance, who trained as a physical education teacher until she found the pay was none-too-good. Now she dispatches thousands of tons of steel for a fabricator, from their 65 acre storage area to construction sites all over New York. And Mary Dunn, who lived in one of the small houses next to the Madison Square Garden site. She gate-crashed the ceremony marking the beginning of the site excavations to which 200 or so developers, chairmen, chief executives and even the Mayor were invited—"no invitation arrived, so I said, I'm going anyway". And there was Dominic Fonti, the construction manager with whom every moving buck had, finally, to stop. In the midst of dozens of amazingly complex problems, most of which appeared to be irreconcilably log-jammed, he managed to keep things going while still preserving his sanity and good humour: in

the words of Rob Schubert, the architects' project manager, "he's a hothead in that if something needs to get done, he will climb all over you, but he doesn't climb all over you unnecessarily for the sheer pleasure of it. There are a lot of people in the construction business who love to do that; they just love beating up on architects. I think we're remarkably free of architect-beaters here".

The book does have some weak points. The diagrams, although informative, are of a rather poor quality, belying their home-computer origins. It would also have been helpful if the figures and excellent colour plates had been referenced in the text—almost essential for a reader who did not see the film. Given the complexity of the project and the story, it would also have been useful to have had a bar-chart to indicate the timing and sequence of the main activities. There is some unfortunate repetition of material, perhaps a hangover from the film script origins. Finally, considering what a wonderfully human story it was, it would have been good to have seen some photographs of the many people involved in the project.

If you missed the television programmes, you should certainly read the book: ideally one should have both, for they do complement each other. As a record of the late twentieth century construction industry, Karl Sabbagh's story of a skyscraper is remarkable, if for no other reason than he achieved it at all. Real life is always tough and involves a mess of arguments, deception and frustration which lie behind the apparent elegance of the architect's finished drawings and the cosmetic accounts of projects which usually appear. It is a measure of the strong character of many of the people involved in the project that they allowed themselves to be filmed while having disagreements or being shown to have made mistakes. It is also a measure of the openness of the American character; I find it difficult to imagine a major European construction project being recorded for posterity in the same manner.

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