CONSTRUCTION HISTORY: **NOTES FOR CONTRIBUTORS**

Papers submitted to the journal must conform to the following guidance.

PRESENTATION

- length up to 8000 words, including notes, Times Roman, 12 point, 1.5 line spacing, prepared in Word using minimum formatting;
- headings: level 1 in bold; level two in italic;
- use endnotes not footnotes, making use of this facility in Word;
- referencing style - follow the style used in papers published in Construction History – and see guidance below.
- up to 12 images (that will be printed in black/white);
- captions, up to 30 words, including source & copyright details;
- images (low-resolution version) and captions inserted in a Word table (1 column, 2 rows, caption below image) at the appropriate place in the text;
- Captions for Tables should appear before the table itself.
- Page 1 to contain:
  - title, author, affiliation
  - an Abstract of 100-150 words
  - 5 key words to facilitate searching in electronic databases
  - number of words and images
  - biography of author, up to 100 words
  - contact details of author (postal and e-mail addresses)
- document to be submitted electronically by email, in Word and as a pdf file;
- high-resolution images to be sent separately as jpeg files.
- acknowledgments (if any) and address for correspondence to be given at the end of article and references.
- authors must obtain permission to use any images or quotations. All necessary copyright clearances must have been obtained in advance by the author.

LITERARY CONVENTIONS

FIGURES
Figures to be used for measurement (6 inches, 88 feet) but time to be in words (seven years, the eighteenth century) except when the century is included (1937, the 1930s).
All other figures up to ten in words (e.g. four reasons) and over ten in figures (e.g. 17 carloads).
In the text, percentages are given in figures (e.g. 12.5 per cent); *per annum* is also given in full.

YEARS AND DATES
1801-4 means the years 1801 to 1804; 1801/2 means a period of 12 months or less within the 24 months between January 1801 and December 1802. Months to be spelt in full in the text and abbreviated in References.

UNITS

These need to be consistent and appropriate. Where possible these should be metric – 23.7 m or 1750 kg, etc. Where original units were non-metric, these may be used with metric equivalents following in brackets - the panels were 4 ft by 6 ft (1.2 m by 1.8 m). If most dimensions are given in metric, it may also sometimes be appropriate to include the original imperial measure in brackets – the panels were available in a number of standard sizes: 1.8 m x 1.2 m (6' x 4' or 6 ft x 4 ft.), 1.2 m x 0.4 m (4' x 1' 4" or 4 ft by 1 ft 4 in.). When using Imperial measures be careful to distinguish between British and US gallons and pints. Also do not confuse metric tonnes (1000 kg) and Imperial tons (2240 lbs).

QUOTATIONS

Quotations to be given within double quotation marks ("..."). Quotations within quotations to be given with single quotation marks ("…'…'…"). Punctuation in a quotation to be exactly as the original: thus the closing quotation mark should precede the full-stop unless the full-stop was in the original.

Omissions from a quotation to be indicated by three stops, without brackets (…); omissions that include a full-stop to be marked by four stops (….). Quotations of more than five lines of type should be indented, but still double spaced.

CAPITALS

Lower case used for geographical divisions (the north-east of England), but upper case for political ones (South Africa).

HYPHENS

Hyphens to be used sparingly. Prewar, interwar and postwar do not require hyphens. But, when two words are used adjectively (provided one is not an adverb), they are hyphenated: 'working-class housing', 'nineteenth-century urbanisation' (but, 'the working class' and 'very rapid municipalisation').

ABBREVIATIONS

Well-known abbreviations to be used when appropriate (Prof.; Co.), with a full stop, except with common titles (Mr, Mrs, Dr).

FOREIGN LANGUAGES

Words or phrases in foreign languages used in English must be in italics – *ipso facto*, *per annum*, *raison d'être*, *Weltanschung*.

ACADEMIC TITLES

Scholars to be referred to by their academic titles (Prof., Dr), but in subsequent references the surname only to be used.

REFERENCES
Consistency of both content and style is most important. Titles to be underlined and NOT *italicised*.

BOOKS
Place of publication to be given, followed by publisher and date.
Where there is a sub-title, it should be given an initial capital and be divided from the main title by a colon: eg

2 L. F. Salzman, Building in England Down to 1540: A Documentary History. London: Routledge, 1952.

First citation to be given as follows, using quotation marks for titles of periodical papers:

3 J. Abram, Perret et l'Ecole du Classicism Structurel. (2 vols., Nancy, 1985), 2, pp.69- 78.
4 T. M. Charlton, "Theoretical Work" in A. G. Pugsley, (Ed.) The Works of Isambard Kingdom Brunel, London: Collins. 1976. pp. 183-202.

Subsequent citations to be abbreviated, with reference to location of first citation: eg

9 Abram, Perret, (Note 3) 2, p.82.
10 Charlton, Brunel, (Note 4) p. 191.

SUBSEQUENT CITATIONS
Do not use *loc. cit*, or *op. cit*. Use ibid. only when re-citing a work cited in the immediately preceding reference, when that previous reference cited only a single work eg:

11 L. G. Mouchel & Partners Ltd., Mouchel-Hennebique Ferro-Concrete: List of Works Executed in the UK 1897-1919 (n.d., c. 1920), pp. 23-7.
12 ibid., p.82.

ARTICLES
First citation:

14 V. J. M. Rankine, "Principles of the Equilibrium of Polyhedral Frames", London, Edinburgh and Dublin Philosophical Magazine, 27 (1864), p. 92.
15 A. Perret, "Architecture, Science et Poesie", La Construction Moderne, 48 (2 Oct. 1930), pp. 2-3.

Subsequent citations abbreviated: eg

18 Rankine, "Principles", London, Edinburgh & Dublin Phil. Mag., (Note 14), p. 90.
19 Perret, "Architecture", Const. Mod., (Note 15), p. 3.

PARLIAMENTARY PAPERS
Name of committee or commission, year, command number (in brackets), volume, page or question number eg

21 Select Committee of House of Commons on Import Duties, Parl. Papers 1840 (601) V, Q. 2815

NEWSPAPERS
Citations of short reports in newspapers and periodicals to be given as follows:

23 Independent (7 March 1995), p.3.
24 Building, 248 no. 11 (15 March 1985), p.23.

Longer reports and articles to be cited as articles, even if unsigned: eg

25 "A Reinforced Concrete Factory in Portobello, Scotland", Concrete and Constructional Engineering, 2 no. 6 (Jan. 1908), pp. 459-61.

THESES

First citation:

27 B.Finnimore, 'The Industrialisation of Building' (Ph.D. thesis, University of London, 1986), pp. 29-30.

Subsequent citation:

36 Finnimore, thesis, (Note 27) p. 89.

MANUSCRIPTS

It is important that MS references can be followed by any future researcher, even if citations become clumsy. The only standard abbreviations are P. R. O. (Public Record Office) and B. L. (British Library). Examples:

38 P.R.O., CAB 124/476, Ministry of Aircraft Production, 'Draft Note on Estimated Costs of Aluminium House', 6 Dec. 1944, p. 2.

42 Scottish Record Office, Airlie Papers, G. D. 16, section 38/82, 5 April 1844.

43 Mouchel Papers (kept at L. G. Mouchel & Partners Ltd., 38 Victoria St., London), 'Project Record No. 1'.

45 Private Collection, letter of P.Webb to W. Estcourt, 3 Jan.1882.

Subsequent citations to abbreviate only as appropriate: eg

55 P. R. O., CAB 124/476, 'Draft Note on Estimated Costs of Aluminium House', (Note 38) p.2.

58 S. R. O. Airlie Papers, G. D. 16, section 38/82, 5 April 1884 (Note 42).

60 Mouchel Papers, 'Project Record No.1' (Note 43).

64 P.C., letter of Webb to Estcourt, 3 Jan. 1882. (Note 45)

WEBSITES

Give the full address, but excluding the www. prefix, and give the date when it was consulted: e.g.

67 Some of Ove Arup's well-known structures can be see at his entry in the Structurae website http://en.structurae.de/persons/data/index.cfm?id=d000129 (Consulted on 25th June 2011).

Bill Addis 25th June 2011

Concrete and steel in twentieth-century construction: from experimentation to mainstream usage

Dr Matthew Roberts
University of Q - x

Abstract
Both reinforced concrete and steel-frame construction were in use in Britain during the last decade of the nineteenth century, albeit on a small scale and, generally speaking, for industrial buildings rather than mainstream architecture. In the early days of the twentieth century, these and other exemplars from continental Europe began to inspire British architects and they were soon pressing building contractors to the new materials more widely. This paper follows the story of these early, tentative applications first into the interwar period when the sculptural qualities of concrete began to be embraced, and its acceptance by architects, and after the 2nd World War when contractors began another period of experimentation in both concrete and steel construction leading to the 19070s by which time both materials had become part of the standard vocabulary of all those engaged in building design and construction.

Key words
Steel, reinforced concrete, frame construction, innovation, 20th century.

Content
5200 words; 8 images.

Biography
The author has worked as a consulting engineer and academic in the building engineering field for over 30 years. He has written widely on ...
His recent publications include:
Addis, Bill (1994) *The Art of the Structural Engineer*, Artemis, London
Etc.

Contact details
e-mail address
postal address

Concrete and steel in twentieth-century construction: from experimentation to mainstream usage

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Matthew Roberts

Introduction

The first part of this chapter is an outline of the story of steel and concrete construction in Britain during the twentieth century. This will serve to illuminate the two main engineering questions in building conservation which are addressed in the later parts, namely:

- identifying the events of historical significance that can inform the debate as to which buildings are worth conserving and the engineering historical arguments for doing so; and
- preparing the client, architect or engineer, faced with the task of conserving any building, by presenting some of the many types of construction that may lurk beneath the carpets of a twentieth-century building, and some guidance on where to gather more detailed information about twentieth-century construction and how to proceed with the structural appraisal of a building.

Steel and concrete construction in the 20th century

Both steel and concrete were, and are, alternative means of achieving the same type of building structure - a frame building with non-load-bearing walls.[1] This idea had been established for many centuries in timber-framed buildings but these were inevitably modest in scale and seldom more than three or four storeys high.

Steel and steel-reinforced concrete were both new materials which reached maturity at about the same time at the end of the nineteenth century. This is not a coincidence since a reinforced-concrete building needs steel just as much as a steel one does. A pre-requisite of both new construction materials was, then, high quality, cheap steel

available in appropriate sizes. This moment arrived, more or less exactly, in the late 1880s.[2] Hitherto steel would only be considered for large prestige projects, such as the Forth Rail Bridge and the Galérie des Machines at the 1889 Paris exhibition, where steel's extra strength (about 20% greater than wrought iron) was worth the cost premium. The first all-steel frame building was the 1889-90 Rand McNally Building, Chicago; the first concrete-frame building in the USA, by Ernest Ransome, was in 1889 and the first Hennebique concrete frame was his 1895 spinning mill in Tourcoing, France.

The growth of steel production

Steel and concrete buildings are nearly always discussed separately, especially by engineers who use a different Design Code of Practice for each.[3] In fact, their use right up to the present day is rather more symbiotic than is usually acknowledged.

Table 1. Tons of steel girders manufactured in UK 1900-1908. Source: National Economic Survey, London, 1910.

	1900	1902	1904	1906	1908
Girders produced (million tons)	1.2	1.6	1.7	1.9	2.4

A comprehensive history of steel and reinforced concrete construction and the modern structural frame has yet to been written, though some of the story can be found in a few key sources.[4] There are many separate lines of development to follow, albethey intricately interwoven, including:

i) the technology of the structural materials: their properties, manufacture and durability; construction methods and site assembly to make whole structures;
ii) protection of structural elements against fire: floor systems and fireproof construction;
iii) design procedures for justifying the structural stability and safety of buildings, and establishing appropriate sizes of structural members and components;
iv) current building regulations, both local and national.

The rest of this chapter will touch a little upon all of these, but will concentrate mainly on the first two and will consider only the French part of the story (Fig.1). It is also worth mentioning at the outset that most of the innovations in steel and concrete construction did not occur in mainstream architecture.[5] Rather it occurred on projects that were not steered by architects - civil engineering, bridges and industrial buildings.

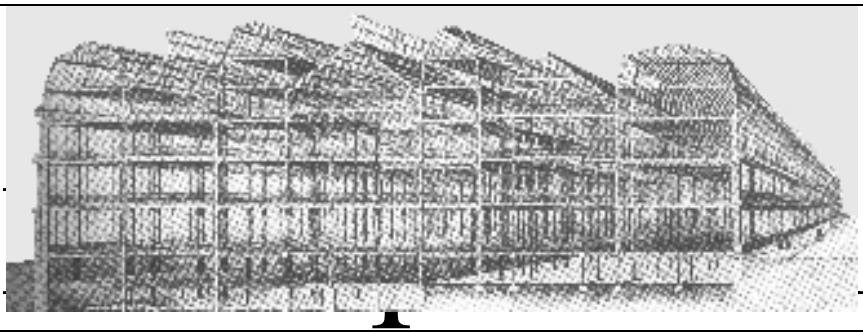

Figure 1. Le Bon Marché department store, Paris, 1869-71. Architect Louis-Charles Boileau; engineer Armand Moisant. The wrought-iron structural frame. (Drawing: Les grandes usines – Moisant-Laruent-Savey by V. Turgan. Paris 16 vols 1860-1882)

During all but the last two decades, the most innovative engineers all worked for contractors during the early years of their careers - Ove Arup, for example, was not a design engineer in the modern sense, and he formed the firm that now bears his name in his fifties after most of a lifetime in contracting.

The legacy of the nineteenth century

Framed construction in steel and modern reinforced concrete were both imports into Britain during the last decade of the nineteenth century - steel from the USA and Germany; concrete from France and Germany and, later, also from Denmark and the USA. This may be a little surprising given Britain's pioneering contributions to the development of iron, steel and concrete well before 1900.

The world's first major structures in wrought iron (Britannia Bridge, 1845-49, Saltash Bridge, 1859) and in steel (Forth Rail Bridge, 1882-90) were all British. Paxton's ideas for the Crystal Palace were realized with engineering input from William Barlow, Robert Stephenson, and the contractors Fox and Henderson. It was conceived

as a pure frame building - cast iron columns and girders of both cast and wrought iron, rigidly connected. In the building as built, wind bracing was provided by diagonal cross-bracing rods of wrought iron. Just a few years later the first genuine frame building was constructed at Sheerness dockyard, a three-storey boat store with cast iron columns and beams of cast iron and of wrought iron. Completed in 1860 it still stands, even after the gales of 1987.

Conclusion

The last and best piece of advice to clients and architects is to choose your structural engineer carefully. Many wonderful buildings have been demolished or irreparably damaged because the chosen engineers have had inadequate experience of old buildings or certain types of construction (but what engineer would admit inadequate experience and thereby lose a job?). In gene0ral, demolishing a structure and rebuilding a new one will always be the most expensive solution, and you should be suspicious of any engineer who tells you that a solid-looking old building is unsuited for modern occupation.

Correspondence

Author contact details postal and/or e-mail address

References

1 P. Cusack, "Agents of change: Hennebique, Mouchel and ferro-concrete in Britain 1897-1908." Construction History, Vol.3, 1987, pp.61-74.

2 J.C. Lawrence, "Steel frame architecture versus the London Building Regulations: Selfridges, the Ritz and American technology." Construction History, Vol.6, 1990, pp.23-46.

3 Malcolm Higgs, "Felix James Samuely." Architectural Association Journal, Vol.76, No.843, June 1960, pp.2-31.

4. The best non-technical history of the period is without doubt Marion Bowley, The British Building Industry: Four Studies in Response and Resistance to Change. Cambridge: Cambridge University Press, 1966.

5. See J.C. Lawrence, 1990, (Note 2), pp.23-46.