Steel Frame Architecture versus the London Building Regulations: Selfridges, the Ritz, and American Technology

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Between 1906 and 1909, there unfolded an Anglo–American drama which had a significant impact upon retailing practice in London: an American businessman, H. Gordon Selfridge, arrived from Chicago in order to found a department store at the west end of Oxford Street. It would be, he declared, "the best thing of its kind in the world" [1]. Selfridge's enterprise was described as the "American Invasion of London" [2] by the daily and drapery trade presses, which accorded the venture extensive, and generally hostile, coverage as it evolved. However, the American methods of retailing thus ostensibly introduced to the British shopping and shopkeeping public were not the only trans-Atlantic innovations which Selfridge's "gigantic building" [3] brought to public attention. The success of his scheme was dependent upon the size and appearance of the store itself. Selfridge envisioned a truly monumental retail emporium which would help him to achieve his ultimate goal, that of raising "the business of a merchant to the Dignity of a Science." [4] (Fig. 1).

The modern methods of steel-frame and reinforced-concrete construction being used in Chicago and elsewhere in the USA at the turn of the century were critical to Selfridge's vision of an enormous, technologically-advanced department store. However, the London Building Regulations contained no provisions for structures of this kind, and therefore hindered the construction of buildings with the wide internal spaces and vast street-level windows which Selfridge desired, and with which his architects and engineers were familiar. These regulations were contained in the London Building Acts of 1894 and 1905. The 1894 Act incorporated all previous Acts from 1844 to 1893, and was aimed at the regulation of "widths of streets, lines of frontages, open spaces to dwellings, heights of buildings and projections therefrom, ventilation and height of habitable rooms and the control and prevention of the spread of fire" [5]. The London Building Acts (Amendment) Act 1905 required new buildings to be equipped with means of escape from fire [6].

The 1894 and 1905 Acts impeded the construction of the Selfridge building through their regulations for (1) fire prevention (which entailed restrictions placed on cubic footage between party walls) and (2) structural stability (for which the 1894 Building Act prescribed the required thickness of external walls). Although reinforced-concrete flooring could be used to create larger (yet fire-resistant) spaces, and structural steelwork could be employed to support the loads and stresses of a building (thus making load-bearing external walls unnecessary), the building regulations served

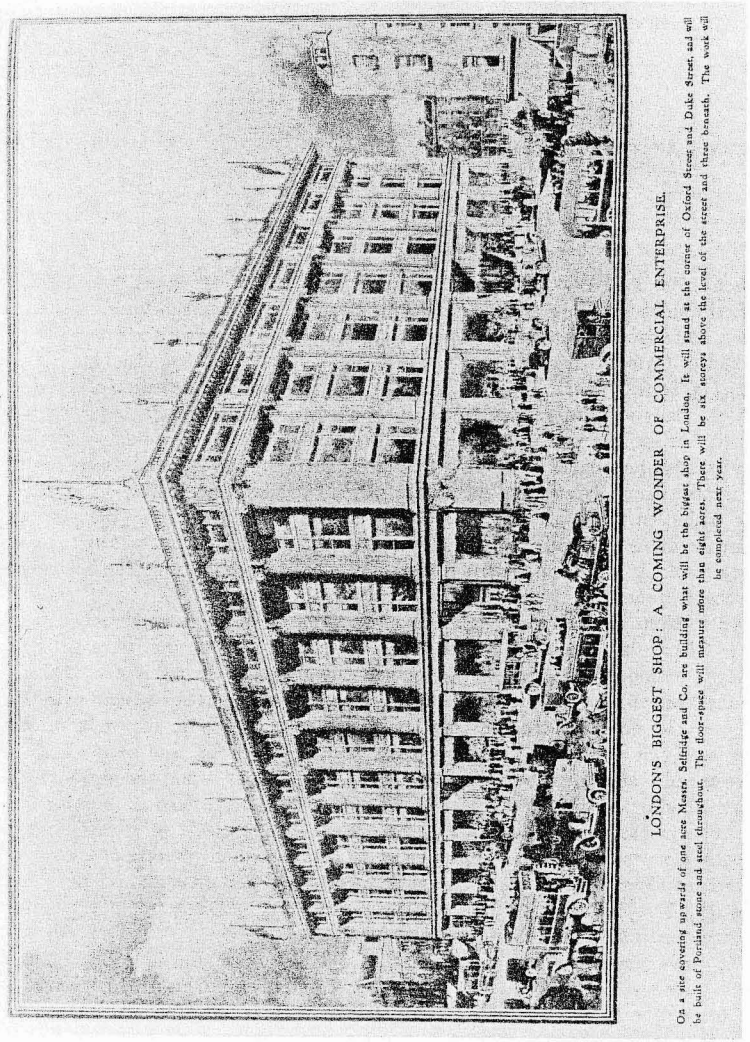

FIG. 1. Selfridges as foreseen by the *Illustrated London News*, 25 July 1908.

to inhibit the erection of large structures whose interior and exterior appearance fully benefitted from these advances in technology.

The Building Acts were finally reformed after years of agitation by engineers, architects, and businessmen for legislation to allow the construction of large open premises supported by structural steelwork. The LCC (General Powers) Act of 1908 allowed greater cubical extent, and dealt with the uniting of buildings by openings in internal and external walls [7]. The LCC (General Powers) Act of 1909, popularly titled the Steel Frame Act, officially recognised steel-frame construction [8].

In the reform of the Building Acts to accommodate new construction methods, Selfridges department store played an important and instrumental role. The building was not solely responsible for legislative change. However, the highly publicised construction techniques employed by structural engineer Sven Bylander, first on the Ritz Hotel (1904–5) and then on Selfridge's daring commercial and architectural venture, were an important part of the process which led the LCC to take account of progressively more sophisticated methods of steel and reinforced-concrete construction. In effect, the Selfridge store was a transitional building, erected under the prevailing regulations, but with the knowledge that they were soon to change. H. Gordon Selfridge fully expected, and therefore anticipated, legislative reform; he consistently petitioned for waivers from the regulations, and, through his persistence, helped the building reforms come to pass. Selfridges department store therefore became the first large building in London to fully exploit steel-frame and reinforced-concrete construction so that both the interior and exterior of the building revealed the use of these modern methods of structural engineering.

Complex Foundations

> At the Corner of Oxford Street and Duke Street, Mr H. G. Selfridge, formerly of Chicago, is erecting a large department store . . . It is aggressively big in scale and entirely at odds with everything else in Oxford Street, a matter which is not altogether to be regretted because Oxford Street is one of the ugliest streets in the world, and everything that pertains to architecture has been until recently conspicuous by its absence. (Francis Swales, 'Notes from Europe', *The American Architect* XCIV 28 October 1908, p. 140.)

Subsequent building programmes have altered and extended Selfridges premises, involving a number of architectural and building firms, and resulting in a tangled web of architectural history. Yet even as the first Selfridge premises (now the south-east wing of the building) opened to the public in 1909, the store was known to have had complicated origins. The entire enterprise was dependent upon a network of connections which linked together Selfridge, his business associates, and the architectural and engineering firms engaged to carry out the Selfridge store's construction.

Selfridge was no newcomer to the department store scene. He began his career as a sales assistant at Marshall Field's, Chicago's premier department store, in 1879, and become one of Field's junior partners in 1889 [9]. At Field's, Selfridge introduced amenities such as the ladies' tearoom and the cut-price bargain basement which were to become standard features of American department stores [10]. In 1904 Selfridge left Field's to go into business on his own, buying Schlesinger and Mayer's department store, the steel-frame building (1899–1903) designed by Louis Sullivan, which was

located just down the street from Marshall Field's [11]. But Selfridge disliked competing with his old employer, and within a few months sold the store to Carson Pirie Scott & Co [12]. He next turned his attention to London, which he believed was in need of a progressive and modern department store [13].

Across the Atlantic, Harrods reigned over the vast London retail field which included Whiteley's (the self-proclaimed "Universal Provider"), D. H. Evans, John Lewis, John Barker of Kensington, and a number of other large drapery concerns. Most of these stores had evolved piecemeal from small shops, gradually adding departments and taking over neighbouring buildings; many had roots going back to the 1860s or even earlier. Purpose-built structures to house these retail establishments were, therefore, rare: in fact, despite its unified appearance, Harrods grandiose building of 1901–5 was actually a re-building, in stages, over the old existing structures [14].

Once in London, Selfridge secured English support for his "American Invasion". He entered into partnership with Samuel J. Waring, of Messrs Waring & Gillow, London's largest furniture and furnishings emporium, and highly successful interior decoration firm, with headquarters located at 175 Oxford Street [15]. The businessmen formed a company, Selfridge and Waring Ltd, "to purchase land and carry on the business of drapers, tailors, hosiers, . . ." [16] and Selfridge joined the board of directors of Waring & Gillow Ltd [17]. The partnership of Selfridge and Waring was short-lived: the company was dissolved in 1909, and Selfridge's new company, Selfridge & Co. Ltd, bought out Waring's interest in the venture with the understanding that the store would not sell furniture [18]. From 1906 to 1908, though, Selfridge and Waring Ltd had bought up a number of the property leases on the proposed Oxford Street/Duke Street site (owned by the Portman Estate), which was occupied by a "medley of small shops and private houses" [19].

Builders, Engineers and Architects

In addition to aiding Selfridge's enterprise, initially with both his capital and his knowledge of the London retail scene, Samuel J. Waring's interest in the venture extended to the building of the proposed store, for he also controlled a construction firm, the Waring White Building Co. Waring's partner in this business was James Gilbert White, an American engineer who had undertaken a number of large projects for English entrepreneurs in Australia. In 1900 White had founded an English branch of his firm, J. G. White and Co. Ltd, through which he supervised several power plant and electric railway works [20]. Waring and Gillow had entered the construction business in order to build their own new eight storey premises near Oxford Circus [21]. In 1904 Samuel J. Waring and J. G. White merged their interests to take construction contracts over from Waring & Gillow Ltd: these included, notably, that for the Piccadilly hotel which would become the Ritz. Two years later, the company re-registered as Waring and White (1906) Ltd, and took several contracts over from the Waring White Building Co., including that of 13 November 1906 for Selfridge and Waring Ltd to erect "Stores in Oxford Street" [22].

Chief engineer for the Waring White Building Co. was Sven Bylander, a Swedish-born structural engineer who had designed large steelwork buildings in Germany and America, prior to moving to London in 1902 [23]. Bylander designed the Ritz and Selfridges steel frames, and also that of the Royal Automobile Club (1910–11), in accordance with precedents set by Chicago and New York commercial high-rise architecture in the late nineteenth century, using, in fact, the Carnegie Steel Company's Handbook, issued in 1897 [24].

Selfridge also counted upon the expertise of Daniel Burnham's Chicago architectural firm. Burnham was the architect to whom Marshall Field consistently turned for his retail buildings and warehouse structures [25]. Selfridge, an integral member of the Field organisation for over 20 years, was well aware of Burnham's mastery of the technical requirements of department store construction such as fire-proofing, elevator placement and electric lighting [26]. Indeed, Burnham's reputation in this sphere had already spread far beyond Chicago; his firm had designed such stores as the New York Wanamaker Annex and the 1903 addition to Milwaukee's Gimble Brothers Department Store. In 1910 Gimbel's Department Store in New York would open their new D. H. Burnham & Co. designed premises, and likewise Philadelphia's new Wanamaker Building in 1911 [27].

Burnham's office supplied Selfridge with a complete set of drawings in 1906 [28]. During a trip to England in April 1907, Burnham visited Selfridge, perhaps to finalise plans for the store [29]. However, Burnham's firm was but the first of a series of "supernumerary cooks" [30] involved in the building's design. The Burnham elevation was soon altered by another American, Francis Swales. Swales modified the building's external appearance, including, as he explained, the introduction of triple windows in the friese, and "the change in style of detail from the neo-Grec to that of Louis XVI" [31]. A shrewd self-publicist, Swales praised his own contributions to the building's design in the *Architectural Record* [32].

Burnham's firm bowed out of the project altogether when the London building regulations, which required that commercial premises be split into cellular compartments of no more than 250,000 cubic ft each, became too difficult for them to deal with trans-Atlantically [33]. This measurement of a building's "cubical extent" meant "the space contained within the external surfaces of its walls and roof, and the upper surface of the floor of its lowest storey" (irrespective of horizontal divisions created by floors) [34]. The internal walls of a building (referred to in the Act as "party walls") could contain openings of no more than 7 ft in width and 8 ft in height, and, taken together, these openings could not exceed one half the length of the party wall in which they occurred. Such openings were required to be fitted with wrought iron doors or shutters to prevent the spread of fire; otherwise the two connecting spaces could not, taken together, exceed 250,000 cubic ft [35]. The 250,000 cubical extent limit could be waived, but the absolute maximum was 450,000 cubic ft. The D. H. Burnham & Co. plans submitted to the LCC in February 1907 showed divisions exceeding 450,000 cubic ft, and permission to erect the building was initially refused because "no power is given to the Council under the London Building Act 1894, to consent to the erection of buildings of the warehouse class with divisions of a greater cubical extent than 450,000 cubic ft" [36]. In order to realise Selfridge's vision of a spacious store, a London-based architect was needed, first, to petition the LCC for permission to divide the building into compartments of 450,000 cubic ft each; and, secondly, to alter the Burnham plans (presumably by adding more internal walls) in order to bring the cubical extent within the divisions down to the 450,000 maximum [37].

R. Frank Atkinson, Waring & Gillow's architect, was contracted to carry out the project. Like Waring, Atkinson had moved to London from Liverpool; in his case, he had studied architecture there [38]. The new store premises for Waring & Gillow which opened in June 1906 had been designed by Atkinson, who was, therefore, familiar with the process of erecting buildings on Oxford Street [39].

Bypassing the Building Regulations

Atkinson's main diplomatic chore in London throughout 1907 and 1908 was petitioning the LCC Building Act Committee on behalf of the Selfridge venture to exceed the regulations for structures of the "warehouse class" as defined and laid out in the London Building Acts of 1894 and 1905 [40]. According to the definition used in those acts:

> The expression 'building of the warehouse class' means a warehouse, factory, manufactory, brewery, or distillery, and any other building exceeding in cubical extent one hundred and fifty thousand cubic feet, which is neither a public building nor a domestic building. [41]

Structures corresponding to this description were not to exceed 250,000 cubic ft without party walls; hence the existing London department stores (including Harrods) each consisted of a series of separate, but interconnecting, rooms, like individual stores side by side, rather than departments within a single building [42]. It is worth noting that another large London drapery establishment, D. H. Evans, also petitioned the LCC for permission to exceed 250,000 cubic ft in divisions of their proposed Oxford Street extension throughout 1907 [43]. Pressure on the LCC therefore came from others in the drapery trade as well, quite possibly in response to the threat of increasing competition posed by Selfridge's much publicised grand scheme [44].

By 1907 the authorities were beginning to realise that adherence to this regulation was not always essential. *The Builder* noted in 1907 that during the 1905–6 construction year 12 businesses had petitioned the London County Council for permission to exceed 250,000 cubic ft; six of the requests were granted, and six were refused [45]. In August 1907 *The Builder* reprinted an LCC Building Act Committee report which urged that the current regulations be amended "so as to remove all restrictions on the Council's power to allow increased cubical capacity for buildings of the warehouse class" [46]. The London and District Association of Engineering Employers had initiated the proposal, reasoning that "these restrictions made it almost impossible for engineering firms to carry out their work in London in accordance with modern requirements" [47]. The proposed amendment would give the Council discretionary power to allow for horizontal separations within buildings; openings in party walls; fire-resisting doors of materials other than iron; and the uniting of buildings through wall openings. Much of this proposal was eventually passed in the LCC (General Powers) Act of 1908, but first it was defeated on the grounds that "the erection in London of buildings of great cubical extent, not sub-divided by party walls, cannot fail to expose London to the risk of conflagrations . . ." [48]

Fear of Fire

The risk of fire was of great concern to the Council's Building Act Committee. As noted in *The Builder*, of 112 fires involving questions of structural safety which occurred within the London County boundaries in the year 1906, 97 occurred in buildings coming under the Council's building regulations; in these fires 24 lives were lost and 136 were endangered [49]. The Council clearly felt responsible for the structural safety of buildings coming under its jurisdiction, and was reluctant to pass any amendment which might result in further tragedies. Theatres, with their large crowd capacity, were notorious fire hazards. However, drapery houses too posed an especial threat, as fabrics, clothes and other dry goods were highly flammable. The danger was further heightened by the fact that in London a large proportion of drapery shop assistants lived-in, residing in crowded company-owned accommodation either on or very near the business premises. They were therefore spending 24 hours a day in a high-risk environment [50].

Widespread recognition of the need for fire legislation had resulted in the London Building Act (Amendment) Act of 1905. This Act required new buildings to be provided with so-called 'reasonable' means of escape in case of fire, and stipulated that plans and particulars be deposited with the Council before building work began [51]. Still, these new regulations lagged behind technological innovations in fire-proofing and building construction which enabled structures of greater cubical extent to be essentially safe from fire. Such advances included concrete flooring, encased steel framing, and rolling steel shutters in place of iron doors. These were understood to be particularly relevant to the construction of large commercial premises, a connection clearly made in 1907 when a spokesman for the LCC Building Act Committee stated that "the Building Act of London was obsolete", with the result that "restrictions placed on trade in London were too great" [52].

In addition to his repeated requests for greater cubic footage allowances, R. Frank Atkinson petitioned the Council for the use of rolling iron shutters to be used in place of iron doors for fire prevention, and also for wider and more numerous wall openings than the regulation allowance of 7×8 ft for interior walls. The interior openings Atkinson requested were 12×12 ft and the Building Act Committee eventually granted permission for them [53]. Atkinson's petition for exterior window openings equalling more than half the area of the external walls was also granted. However, the architect was not so lucky in his requests for greater building height. The maximum allowed under the 1894 act was 80 ft, and Atkinson therefore had to subtract two stories from the proposed building, leaving a total height of five floors above ground, with three basement floors [54]. Atkinson submitted the plans for the Selfridge store to the Council in early 1907. The Building Act Committee granted permission for exterior windows to exceed half the external wall area in June 1907; for divisions of the store to exceed 250,000 (but not 450,000) cubic ft in July 1907; and for internal openings to exceed the regulation size, along with the use of rolling iron shutters for fire prevention, in October 1908 [55]. Also at this time, and clearly related to Selfridge's and Atkinson's perseverance in petitioning for waivers from legislation, the LCC passed the London County Council (General Powers) Act 1908 [56]. Part III of this Act amended the 1894 Building Act, and allowed for horizontal divisions in buildings of the warehouse class, for cubic footage to exceed 250,000 (but not 450,000) cubic ft, and for the uniting of buildings by openings in party or external walls [57]. These changes had the effect of vastly increasing the legal limits of internal spaces bounded by walls. But there were still no regulations for reinforced-concrete and steel-frame construction.

The Steel Frame

Although still a new departure from traditional building methods, the internal steel frame was becoming more and more common in Chicago and New York by the turn of the century, but Britain lagged behind in its adoption [58]. Many architects resisted the use of steel in building construction because they dreaded the necessary study, or were reluctant to collaborate so closely with engineers [59]. The RIBA held up the process

of legislation for new building methods by insisting that very definite rules, arrived at after much discussion and research, were needed in order to control builders [60]. Finally, it has been argued that the nature of Britain's design market, and the bifurcation of the architectural and engineering professions along the lines of building types and clients, hindered the acceptance of new building methods by providing no impetus (such as competition) for creativity or innovation [61].

Yet steelwork was definitely being employed, albeit in idiosyncratic ways. As Sven Bylander later noted, when he arrived in London in 1902 it was usual practice to "employ some steelwork in the internal part of the building only, or to carry the external wall at the first floor level on steelwork to permit large shop windows, and sometimes steel pillars were used to strengthen external walls", while little precaution was taken for the stability or fire protection of individual steel members [62]. One of Bylander's engineering colleagues affirmed that at that time "builders, in using steelwork in building simply piled one piece on top of another, stuck a few bolts in and called it constructional steelwork", a practice he described as "ironmongery" [63]. Because of the haphazard ways in which steelwork was employed, and the lack of standardisation in either methods or materials, it is virtually impossible to pinpoint the 'first' steel-framed building in Britain—although claims have been made for, among others, Robinson's Emporium in West Hartlepool [64].

The issue is further complicated by the fact that no standard *definition* of 'steel-frame construction' existed at the time—the term 'steel frame' was often used to describe any structure that employed some steelwork, in some way. The discrepancies in use of the term, and the ensuing difficulties in understanding just how various buildings had been constructed, were brought up in discussion at a meeting of structural engineers as late as 1913. There a speaker noted that a number of terms were used quite loosely in reference to steel construction, namely: "steel-cage construction", "interior skeleton", "steel skeleton", "skeleton construction", and "cage construction", and this lack of firm definition prevented one's understanding of exactly how and where the loads and stresses were being carried in buildings utilising structural steelwork [65]. At stake was the question of whether the steel frame supported solely (or primarily) the floor loads of a building which had self-supporting external walls, or whether the frame actually supported *all* loads and stresses, including those of the walls.

In early twentieth century London there was no real incentive to erect a steel-frame building with non-loadbearing external walls. This was because Part II of the 1894 London Building Act defined the necessary thickness of walls for large buildings: depending upon the height and length of the walls. Their base measurement was to range, for example, from 13 in. (for a wall of 25 ft or less in height) to 31 in. (for walls of between 100 and 120 ft in height and 45 ft in length); a taller or longer building would require even more substantial walls. Further, no wall was to be less in thickness than one fourteenth part of the height of the storey [66].

The Ritz and American Technology

The Ritz Hotel, the first London steel-framed building of "importance" [67], was designed with a "complete steel frame"[68] which carried all loads on steelwork, including the reinforced concrete fire-proof floor system. Still, the structure had also to conform to the LCC 1894 and 1905 Building Acts, and therefore the Ritz walls measured 39 in. in thickness at street level and 14 in. at sixth floor level [69]. The

hotel, designed by Mewes and Davis with Sven Bylander as structural engineer, and constructed by Waring White Building Co., was built in 1904–5, amidst great excitement in the architectural community [70]. The most minute details of the building's steel framework, and every 'Americanism' inherent in its construction, were fully recorded in the architectural press. *The Builder's Journal and Architectural Record* ran a lengthy series on the engineering side of the Ritz construction for a full year, from 28 September 1904 through 13 September 1905. Readers were assured that they would "be introduced to various methods employed in modern American contracting practice new to this country," because the hotel was "being erected under the management and supervision of men from the United States who have had wide experience of large building works there" [71] (i.e. J. G. White and Sven Bylander). Full details were provided of such innovations as the "American cranes" used in raising the steelwork, including "a derrick of American pattern specially constructed for the builders" with a 360° arc and, importantly, Bylander's standardised drafting procedures [72].

Bylander credited his method of preparing drawings to his experience in America, where "every office in good standing has a set of standard tables" which "are used throughout the office by each member, and this produces uniformity in methods and design" [73]. *The Builder's Journal* noted the significance of Bylander's system:

> We would particularly call attention to the great exactitude of the work, every dimension being figured on the drawings and nothing left to be scaled off; the elaborate nature and number of the drawings—this being no useless expense, because the drawing-office expenses form but a small percentage of the cost of the steel, and the German steelworks are thereby enabled to execute the work at a reduced price and without preparing templates, as is usual in English practice; and finally the careful way in which the details are standardized and facility of erection studied both to secure cheapness and to aid the execution being correct as designed. [74]

Numerous reproductions of the engineer's drawings and extensive photographic coverage of the Ritz frame as it went up testified to the interest in, and importance of, the new form of construction (Fig. 2). Two of the *Builder's Journal* articles included "Notes on the Steelwork by S. Bylander," in which the structural engineer explained how to read the accompanying framing plans, described the use of standardised parts which eliminated the need for on-site templates, outlined the numbering system used to distinguish each piece of steelwork, provided factual information on loads and stresses, and, importantly, reassured the public that "the construction practically conforms to the latest standards for steel-framed office buildings in America" [75].

Reinforced Concrete Construction

After the Ritz was completed and work on Selfridges had begun, a new professional organisation, the Concrete Institute, was founded to study and promote the use of reinforced concrete in construction. The birth of the Concrete Institute in 1908 (renamed the Institution of Structural Engineers in 1922) coincided with the creation, by the Institution of Civil Engineers, of a special committee to report on reinforced-concrete construction in response to prevailing doubts about its safety [76]. Just as the LCC building regulations hindered the adoption of steel-frame construction, so too did they inhibit use of reinforced concrete. Although several systems of this type of

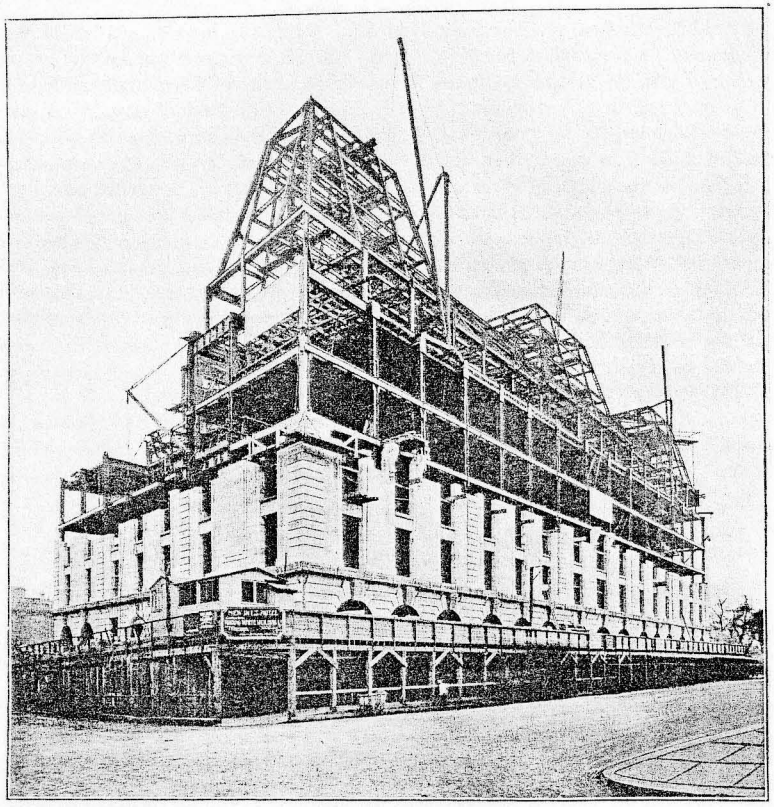

FIG. 2. The Ritz Hotel under construction (from *The Builder's Journal*, 12 April 1905).

construction were well known in Britain, and the Hennibique system in particular was commonly used outside London, the LCC regulations contained no provisions for the use of concrete in building [77]. New methods or materials could not be used unless a waiver was obtained, and the LCC had no power to grant waivers for the use of either reinforced concrete or structural steelwork [78].

In the absence of any regulations for concrete construction, the 1894 Building Act required that, as the Concrete Institute put it, "every building must practically be enclosed with brick or stone or concrete walls of an unnecessary thickness", whereas "by the use of reinforced concrete, as by the use of steel skeleton construction, this unnecessary expense may be saved" [79]. The Ritz Hotel was a victim of this legislation; although the building was constructed with a load-bearing steel frame, it was clad with masonry of loadbearing thickness, as if the steel frame were not there. Sven Bylander was a member of the Concrete Institute, which pushed for Council

authority to waive the existing Building Act rules where steel framing and/or reinforced concrete were involved, and agitated for the official recognition of these building methods in the LCC regulations [80].

Selfridges

In this atmosphere of increasing pressure for the repeal of antiquated legislation, and the enactment of new regulations appropriate to the erection of steel-framed buildings, the Selfridges department store was constructed along the lines of American high-rise technology. It incorporated a steel frame together with staircases, flooring, and one retaining wall of reinforced concrete [81]. In light of the Selfridge store's incubation as a Burnham design, the internal steel framework is entirely understandable. So, too, is Bylander's involvement in the project: not only was he chief engineer for Waring & White (1906) Ltd, the construction firm headed by Selfridge's short-lived partner, Samuel J. Waring, but his approach and methods had received wide publicity through the Ritz Hotel project. *The Builder's Journal* had promoted Bylander's "considerable experience in the design of steel-framed or skeleton buildings in the United States" [82].

Work on the Selfridge building progressed at exceptional speed: the structure was completed in twelve months, "the erection of the steelwork, amounting to 3000 tons, occupying less than half this time" [83]. Much of the facility with which Selfridges was erected was due to Bylander's organised system of preparing the engineering drawings and specifications, which enabled the steelwork to be cut (and in some instances shaped or riveted) in the shop (Fig. 3). For Selfridges, Bylander prepared 12,000 blueprints, and construction was carried on at the rate of about 125 tons per week; as Bylander noted, "The shop details prepared per week was equivalent to 100 tons of steel" [84]. (Figs 4 and 5 show interior and exterior views of the constructional steelwork).

The internal steel frame which Bylander designed for Selfridges corresponded to the building's exterior, as well as interior, appearance. The LCC regulation wall thicknesses for buildings of the warehouse class were bypassed, allowing not only much thinner walls, but far greater window area. Traditionally, the width of window openings had been determined by the safe span for a stone lintel [85]. At Selfridges the steel frame, combined with the use of cast iron window surrounds and entrances, allowed a much larger proportion of the facade to be taken up by windows. Very large plate glass windows were installed, some as large as 19 ft 4 in. long by 12 ft high [86]. In fact, the window area was greater than half the area of the external walls on both the Oxford Street and Duke Street frontages, and permission for this had been granted by the LCC in 1907 [87].

The steel frame carried the weight of the interior walls and the reinforced concrete floors; the ground floor piers were built "sufficiently large in blue brick to carry the external wall as well as the load from the floors" [88]. The "external wall" actually amounted to masonry strips supporting the pillars on the building's facade. (Figs 3 and 6 show the correlation between the engineering and architectural plans of the building). Bylander contributed a 13 page, fully illustrated account of the Selfridge store's construction to the March 1909 issue of *Concrete and Constructional Engineering* in which he explained that:

> All the interior walls, except the west party wall, are carried on steel framing, and the floors are built independent of the walls. The exterior wall to Oxford

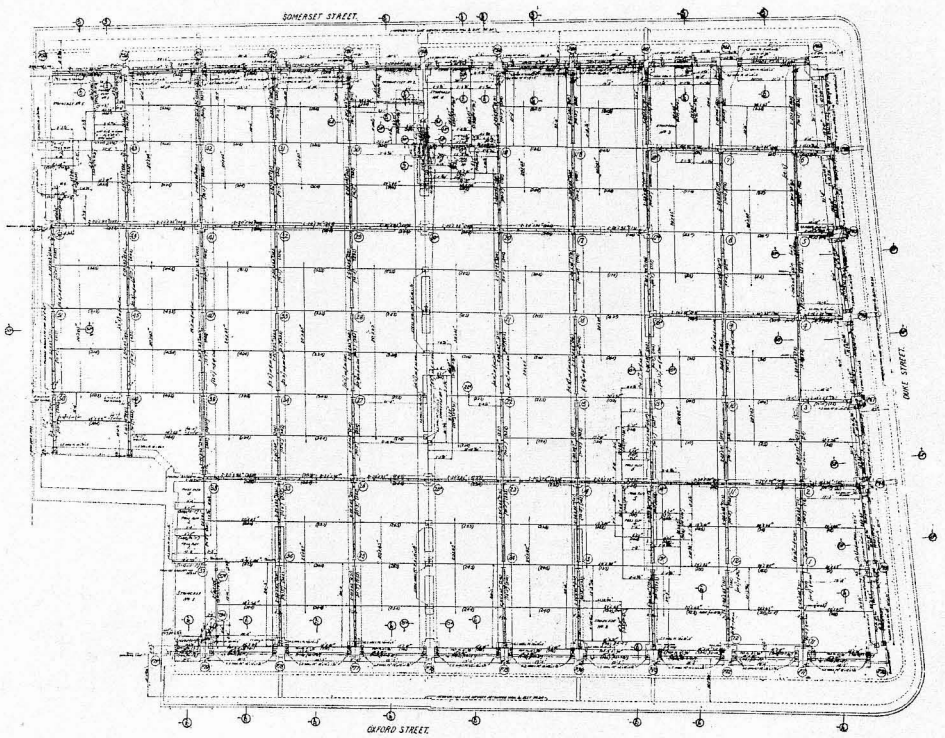

FIG. 3. Selfridges: the ground floor framing plan and the completed layout (from *Concrete and Construction Engineering*, March 1909).

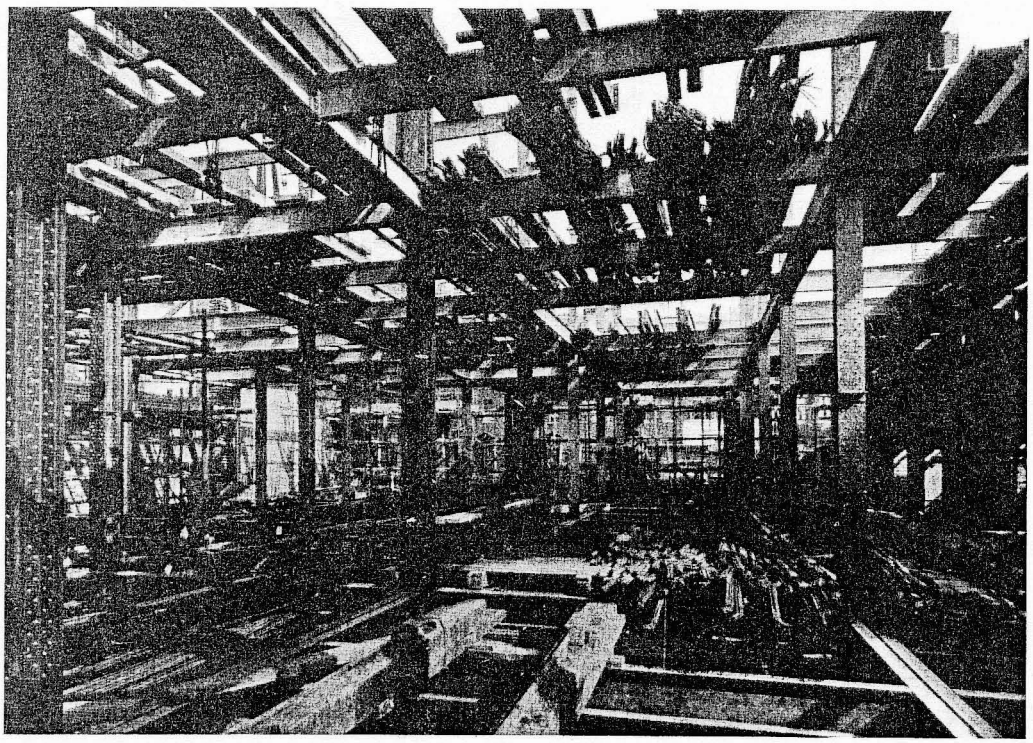

FIG. 4. The constructional steelwork of Selfridges (from *Concrete and Constructional Engineering*, March 1909).

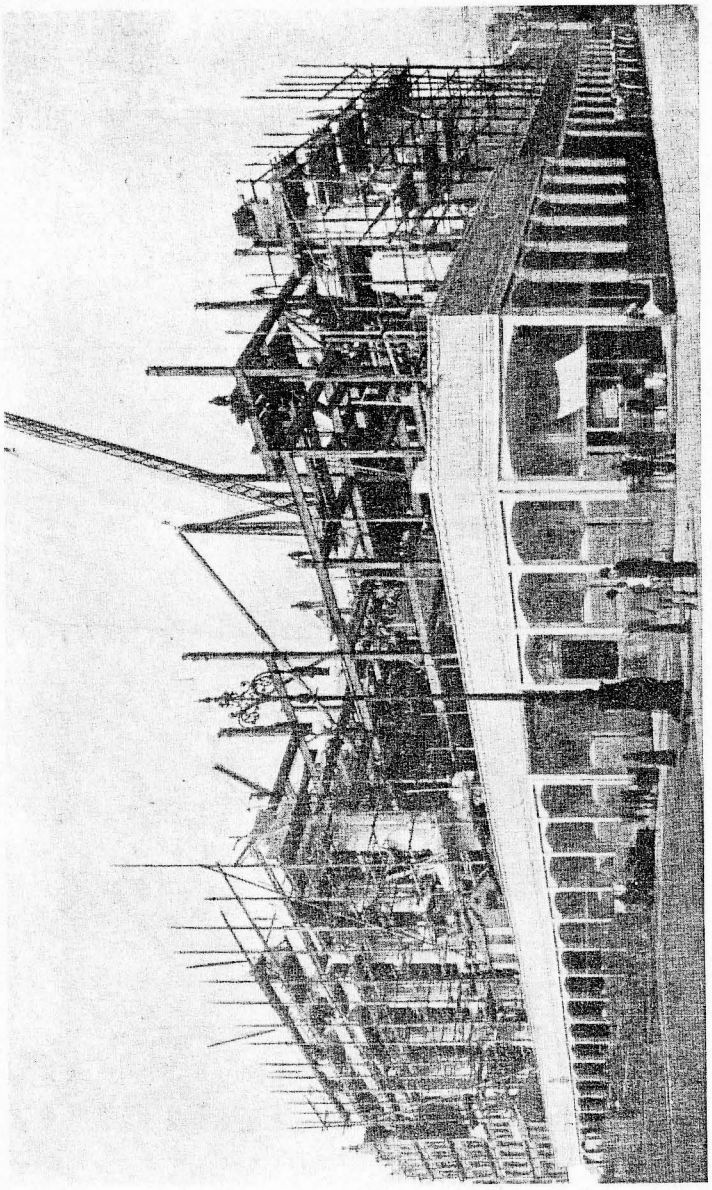

FIG. 5. Selfridges: the steelwork erected to the third floor except on the last bay (from *Concrete and Constructional Engineering*, March 1909).

> Street and Duke Street is faced with Portland Stone and the backing is blue brick for piers. The frontage to Somerset Street is brick. One of the most noticeable features of the building is the great distance between the columns, and the omission of brick or stone mullions. The window area, therefore, is very large, and good lighting has thus been obtained, also the weight of the exterior walls has been materially reduced. The window frames and mullions are of cast iron. [89]

Importantly, the internal division walls were carried on steel and not self-supporting, so they could be removed at a later date if and when the LCC would permit more than 450,000 cubic ft in each section of the building. Placed at approximately 40 ft intervals, many of these walls were taken down 20 years later, when legislation allowed a greater cube for divisions within buildings [90].

The open interior spaces, combined with the great degree of window area, created "an impression of lightness and brightness" throughout the floors of the store [91]. Shop fixtures such as counters were purposely built lower than the usual height so that, Bylander claimed, one could "see from end to end of the building" [92]. (Fig. 7 affords an interior view of the newly-opened premises). These wide internal spaces were allowed under the 1908 LCC (General Powers) Act which, in effect, the Selfridge venture had helped to enact. As noted in the editor's introduction to the article on Selfridges which Bylander contributed to *Concrete and Constructional Engineering:*

> ... The building is one of the first, if not the first, in the Metropolis to which the recent amendments to the London Building Act have been applied, and which thus comprises a number of compartments of 450,000 cubic feet each, separated from one another by divisional walls, in which the door openings are also of larger area than was allowable before the passing of the new Act—12 ft by 12 ft. [93]

The journal's editor also praised Selfridge, who "by his perseverance did much, not only to obtain a building of very high qualities, but also to improve the legislative conditions under which it was executed" [94].

The Steel Frame Act

The efforts of H. G. Selfridge, his architect R. Frank Atkinson, his engineer Sven Bylander, and the Concrete Institute were instrumental, also, in the enactment of the LCC (General Powers) Act of 1909. Known as the Steel Frame Act, this was the legislation which finally gave the Council the power to regulate the construction of reinforced-concrete structures, and decreed that:

> ... it shall be lawful to erect subject to the provisions of this Section buildings wherein the loads and stresses are transmitted through each storey to the foundations by a skeleton framework of metal, or partly by a skeleton framework of metal, and partly by a party wall or party walls ... [95]

The Act provided guidelines for the encasement of steelwork with fire-resistant material, and laid out required wall thicknesses of 8.5 in. for the topmost 20 ft of a building and 13 in. for the remainder of its height, but allowed for this regulation to be modified or waived [96].

Yet in some ways the passage of the Steel Frame Act complicated, rather than

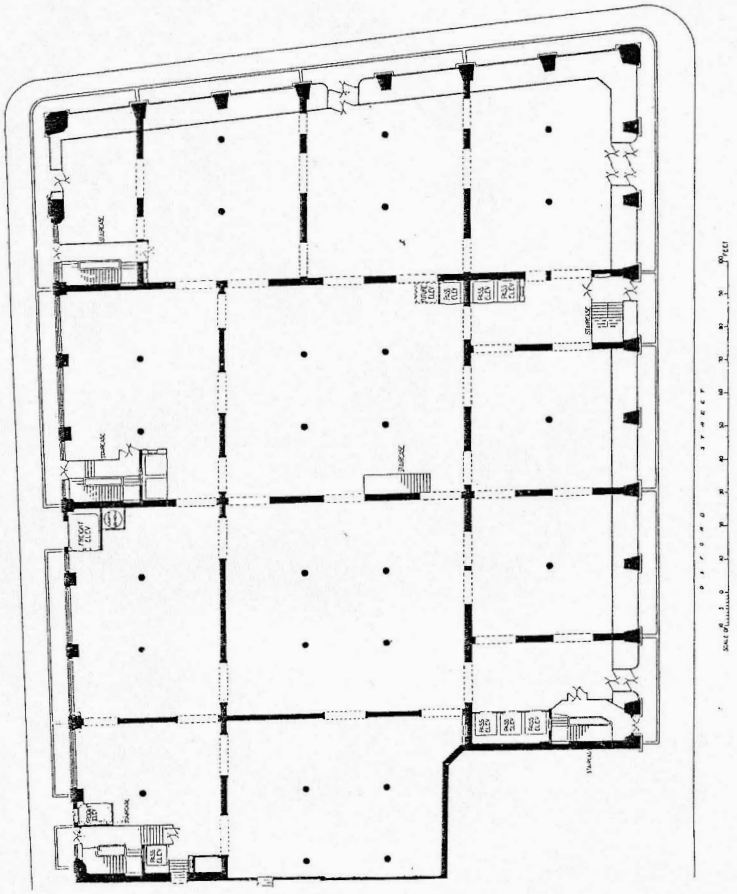

FIG. 6. Selfridges' ground floor plan (from the *Architectural Review*, June 1909).

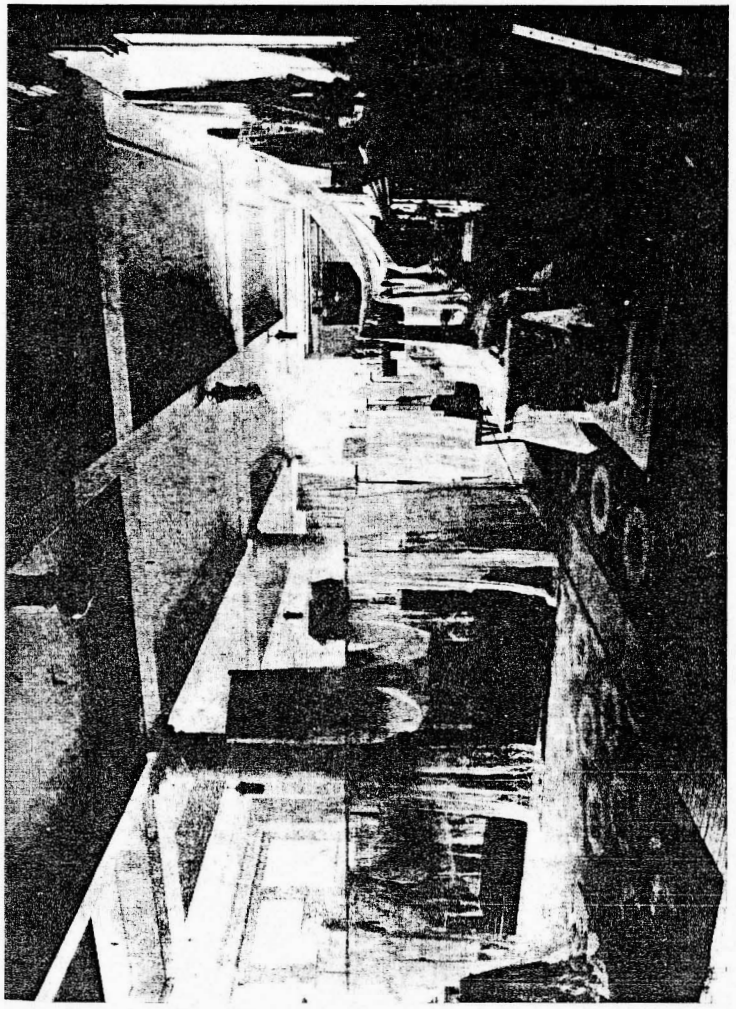

FIG. 7. A showroom in the completed Selfridges (from the *Architectural Review*, June 1909).

simplified, the problems faced by structural engineers. There was no consensus on how to interpret the legislation, for it contained insufficient details. "When the Act first came out, engineers had to consult the district surveyor in each particular district in order to find out what was his reading of it, because it would probably be opposite from that of his neighbour" [97]. The new Act did not apply to buildings designed under the old regulations. And difficulties also stemmed from the fact that the legislation was in the form of an Act of Parliament rather than a local bye-law. As evidenced by the time taken to pass the General Powers Acts of 1908 and 1909, innovations in building technology could not quickly be introduced, and the process of amendment was slow [98]. Finally, 450,000 cubic ft remained the maximum space allowed for divisions within commercial buildings.

Conclusion

Selfridges department store opened its doors to the public on 15 March 1909. The building occupied the whole of its 250 by 175 ft site. There were nine passenger lifts, two service lifts, and six staircases. The store's eight floors (five above ground and three below) averaged 15 ft in height, and housed over 100 departments as well as a vast range of amenities, including an Information Bureau; First Aid Room with trained nurse; French, German, American and Colonial retiring-rooms "typically furnished"; restaurant, luncheon-hall, tea-room and roof garden. Some 1400 employees had been hired to ensure the smooth running of Oxford Street's new commercial palace [99].

In *The British Building Industry*, Marian Bowley suggests that "the need for new buildings for new purposes" may stimulate innovation in construction methods [100]. Selfridges provides an example of such an enterprise and demonstrates, indeed, that modern construction techniques were critical to the success of the venture. However, in order to construct the store H. G. Selfridge envisioned, the obstacle of the London building regulations had to be overcome. The highly publicised raising of the Ritz steel frame in 1904–5, followed by the much promoted Selfridge undertaking in 1906–9, were important events in the transformation of the building regulations to permit recognition of steel-frame and reinforced-concrete methods of construction. Both projects drew attention to modern American methods of structural engineering, and introduced British engineers to standardisation techniques in the production of drawings and specifications, as well as in the actual steelwork. The Ritz, constructed under the old Building Act of 1894, was covered in masonry of the required thickness, and its steel-frame construction was therefore not apparent. But Selfridges, with its wide plate glass windows and near-absence of external walls, was clearly a different sort of building, achieved only after much negotiation with the LCC. The Building Act reforms of 1908 dealing with cubic footage, and the steel-frame and reinforced-concrete sections in the 1909 (General Powers) Act were, at least in part, due to H. G. Selfridge's determination to build a Chicago-style department store in London.

Selfridge's novel approach to building, that of planning in anticipation of legislative changes, and then pushing for the necessary reforms, surfaced again in 1919. At that time he determined to construct a massive 300 ft tower on top his emporium, as part of the western extension designed by Sir John Burnet and Thomas Tait in association with Burnham & Co.'s Chicago successor firm, Graham, Anderson, Probst & White [101]. Building work, including the laying of foundations for the tower, was begun in 1919 and completed in 1924 [102]. In this instance, however, the LCC Building Act Committee could not be persuaded to waive their regulations. The Committee remained unconvinced that Selfridge's should be allowed a monumental tower which would vie with the dome of St Paul's; permission to exceed the 80 ft height regulation was not granted and the tower was never constructed.

In effect, the construction techniques introduced to London through the 1909 Selfridges building had a significant impact upon the urban landscape. The steel frame allowed wide interior spaces and permitted the installation of very large plate glass windows which provided the store with considerable natural light, whilst also creating grander window shopping possibilities for passers-by. As stated in *The Architects' Journal* in 1920, "The building gave a new scale to Oxford Street and has exercised a strong influence over the design of many big structures that have since been erected in the metropolis" [103]. These features were already becoming standard architectural design for retail premises elsewhere; to the extent allowed by the revised but still restrictive Building Acts, H. G. Selfridge's monument to commerce brought modern American department store design to London.

Acknowledgements

This paper derives from my master's thesis, 'THE 'AMERICAN INVASION' OF LONDON: MODERN AMERICAN METHODS OF CONSTRUCTION CROSS THE ATLANTIC IN H. GORDON SELFRIDGE'S OXFORD STREET DEPARTMENT STORE OF 1909' (University of London, 1986). I would like to thank Maxine Copeland, Ellen Miles and Robert Thorne. Special thanks are due to Adrian Forty and Nicholas J. Morgan, who provided much appreciated comments and suggestions and to the Selfridge's Archivist, Fred Redding.

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[1] *Draper*, 13 March 1909, p. 256.
[2] *Drapery Times*, 20 Feb. 1909, pp. 359–60. The phrase "American Invasion" held potent meaning for British tradesmen at the turn of the century; see William T. Stead, *The Americanization of the World* (1902; reprinted New York, 1972), pp. 132–9.
[3] *Draper*, 13 March 1909, p. 256.
[4] *Drapery Times*, 13 March 1909, p. 523. Selfridge argued for the validity of commerce as a worthy profession in *The Romance of Commerce* (1918), particularly pp. 377–85.
[5] Quoted in C. C. Knowles and P. H. Pitt, *The History of Building Regulations in London 1189–1972* (1972), p. 93. For the Act itself, see W. R. Griffiths & F. W. Pember, *The London Building Act, 1894* (1895).
[6] Bernard C. Molloy, *London Building Acts (Amendment) Act, 1905* (1905).
[7] Horace R. Chanter, *London Building Law* (1946), p. 302.
[8] H. D. Searles-Wood & Henry Adams, *Modern Building* (1921), p. 157.
[9] For biographical information on Selfridge see: Richard Kenin, 'The Captains of Commerce and Journalism', *Return to Albion: Americans in England 1760–1940* (Washington, D.C., 1979); Lloyd Wendt & Herman Kogan, *Give the Lady What She Wants!* (Chicago, 1952); Reginald Pound, *Selfridge: A Biography* (1960); A. H. Williams and W. H. Allen, *No Name on the Door* (1957); Gordon

Honeycombe, *Selfridges, Seventy-Five Years: the Story of the Store* (1984); and Robert W. Twyman, *History of Marshall Field & Co., 1852–1906* (Philadelphia, 1954).

[10] Wendt & Kogan, *Give the Lady*, pp. 201–41.

[11] Joseph Siry, *Carson-Pirie-Scott: Louis Sullivan and the Chicago Department Store* (Chicago, 1988), p. 112; Siry provides an excellent account of this building, and the development of the department store as an urban building type, in the context of turn of the century Chicago.

[12] Siry, *Carson-Pirie-Scott*, p. 112.

[13] Wendt & Kogan, *Give the Lady*, p. 241; for description of what such a modern store entailed, see Wendt & Kogan, pp. 201–41, and Neil Harris, 'Shopping—Chicago Style', in John Zukowsky (ed.), *Chicago Architecture 1872–1922: Birth of a Metropolis* (Munich, 1987), pp. 145–7.

[14] F. H. W. Sheppard (ed.), *Survey of London XLI, Southern Kensington: Brompton* (1983), pp. 17–23; see also 'Shops' in H. D. Searles-Wood & Henry Adams, *Modern Building* V (1922) p. 24.

[15] For the meeting of Waring and Selfridge see Pound, *Selfridge*, p. 33.

[16] PRO BT31/11562/89184. For particulars of Waring's shareholding involvement with both Selfridge and Waring Ltd and Selfridge & Co. Ltd see *Drapery Times*, 12 June 1909, p. 1262, and Pound, *Selfridge*, pp. 33, 40–1.

[17] Waring & Gillow Ltd Administration Chart, in Selfridge's 1906–8 Scrapbook, Selfridges' Archives, 400 Oxford St., London W1A 1AB.

[18] Letter, S. J. Waring to H. G. Selfridge, 24 March 1909, Selfridges' Archives.

[19] Lease Catalogue and Company Books, Selfridges' Archives; *Draper's Record*, 10 April 1909, p. 105.

[20] Obituary, *Trans. of the American Soc. of Civil Engineers* 109 (1944), p. 1548–9.

[21] Designed by R. Frank Atkinson, Waring and Gillow's new furniture and furnishings emporium, complete with art galleries, furnished rooms, restaurant, and reading rooms, was described in detail in *The Times*, 11 June 1906, p. 4; 13 June 1906, p. 13.

[22] PRO. BT31/10695/81048 & BT31/11783/91435.

[23] Obituaries in *Structural Engineer*, Nov. 1943, pp. 475–6, and *Junior Inst. of Engineers Journ. and Record of Trans.* LIV (1943–4), p. 118; for Bylander's American experience see *Concrete Inst. Trans. and Notes* IV (July 1912), p. 88 & *Structural Engineer*, XVII (March 1939), pp. 471–2; for his move to London see *Concrete Inst. Trans. and Notes* (Oct. 1913), p. 57.

[24] See S. Bylander, 'The Architectural and Engineering Features of the Royal Automobile Club Building,' *Junior Inst. of Engineers Journ. and Record of Trans.* XXI (1910–11), pp. 243–70. The Carnegie hand-book is mentioned by S. Bylander, 'Steelwork in Buildings—Thirty Years' Progress', *Structural Engineer* (Jan. 1937), p. 3. Bylander also was engineer (with Waring & White) or consultant (after 1912) on the 'Morning Post' building; Australia House; the Waldorf Hotel; London Opera House (Palladium); Imperial House, Kingsway, London; and several Calico Printers Assoc. Buildings in Manchester, among others. Work in N. America included the Parliament Buildings, Winnipeg; other foreign work ranged from a Yokohama hotel to a Costa Rica hospital. For a more complete list see 'The Consulting Engineer and the Great Value of His Services' in *Industrial World* 27 (Sept. 1933); construction details are in Bylander, 'Steelwork in Buildings—Thirty Years' Progress'.

[25] Thomas S. Hines, *Burnham of Chicago: Architect and Planner* (New York, 1974), pp. 378–82. The Marshall Field Wholesale Store by H. H. Richardson (1885–7) was an exception.

[26] e.g. see the description of Burnham's Philadelphia Wanamaker Building in 'Technical Department: A Modern Department Store,' *Architectural Record* 29 (April 1911), p. 277–88.

[27] Other Burnham department stores include Filene's, Boston and the May Company, Cleveland (both 1912). See Ira J. Bach (ed.), *Chicago's Famous Buildings* (Chicago, 3rd edn., 1980). For illustrations, see *The Architectural Work of Graham, Anderson, Probst and White, Chicago and Their Predecessors D. H. Burnham and Co. and Graham, Burnham and Co.* (1933), Vol. 1, plates 121–70.

[28] Drawings not located. D. H. Burnham & Co. plans dated 21 Feb. 1907 are noted in *LCC Minutes* (April–June 1907), Appendix A, 'Applications under Building Acts', no. 1023.

[29] For Burnham's diary entries on this meeting see Charles Moore, *Daniel H. Burnham, Architect—Planner of Cities* (New York, 1968), pp. 32–3.

[30] *American Architect*, XCIV (28 Oct. 1908), p. 140.

[31] Francis Swales, 'The Influence of the Ecole Des Beaux-Arts Upon Recent Architecture in England', *Architectural Record* 26 (Dec. 1909), pp. 422–3.

[32] Ibid, pp. 421–3. Selfridge and Waring paid Swales £29 presumably for his sketch, in Nov. 1906: Selfridge & Waring Cash Book, p. 31, Selfridges' Archives.

[33] *American Architect*, XCIV (28 Oct. 1908), p. 140; *Builder*, 16 May 1947, p. 464.

[34] Griffiths & Pember, *London Building Act, 1894*, p. 12.

[35] Ibid, p. 86.

[36] *LCC Minutes* (April–June 1907), Appendix A, 'Applications under Building Acts', no. 1023.

[37] For encounters with the London building regulations when erecting Selfridges see Pound, *Selfridge: a biography*, pp. 34–8.

[38] *Draper's Record*, 12 March 1904, p. 717; obituary, *RIBA Journ.* XXX, 14 July 1923, p. 566.

[39] *RIBA Journ.*, 14 July 1923, p. 566. Atkinson divided his work between Liverpool and London commissions, and from 1908–12 was engaged upon his principal building, Liverpool's Adelphi Hotel.

[40] At this time Atkinson also petitioned the LCC on behalf of Waring & Gillow for a furniture warehouse in Holborn, alterations to premises on Castle-street E. Marylebone, and an advertising screen in Hammersmith: *LCC Minutes*, 'Building Act Committee Report', 24 March 1908, p. 712; 31 March 1908, p. 802; and 7 July 1908, p. 94.

[41] Griffiths & Pember, *The London Building Act, 1894*, p. 13.

[42] For details of effects of building legislation on internal planning of Harrods, see F. H. W. Sheppard (ed.), *Survey of London XLI, Southern Kensington: Brompton* (1983), pp. 17–23.

[43] LCC *Minutes of Proceedings* (April–June 1907), Appendix A, no. 1062–4; *Builder*, 28 Sept. 1907, p. 339; 18 May 1907, p. 608.

[44] The extension to D. H. Evans, "the building of which has been pushed on rapidly of late" opened simultaneously with the Selfridges' grand opening in March 1909. See *Draper*, 20 March 1909, p. 329, and *Drapery Times*, 19 June

1909, p. 1309. Though its street-level display windows and greater cubic extent indicate use of structural steel-work, the new D. H. Evans building, designed by John Murray, was heavily clad in masonry with much Beaux-Arts detailing. Also at this time, Harrods, Whiteleys, and Swan & Edgar opened new accommodation.

[45] 'A Year's Work Under the London Building Act, 1894,' *Builder*, 12 Oct. 1907, p. 393–4.

[46] *Builder*, 3 Aug. 1907, p. 145.

[47] Ibid.

[48] *Builder*, 19 Oct. 1907, p. 417.

[49] *Builder*, 26 Jan. 1907, p. 92.

[50] Whiteleys, for example, suffered five fires in 7 years during the 1880s alone, see *Draper's Record*, 13 Aug. 1887, p. 26. In a widely publicised case, five girls died in the 1913 Barkers', Kensington blaze which occurred after LCC suggestions for fire prevention were not carried out. See P. C. Hoffman, *They Also Serve* (1947), pp. 60–3, and *Shop Assistant* 12 June 1909, p. 392; 27 March 1909, p. 202–3. While Harrods did not have employees living-in, on the upper floors were luxury flats, an equally dangerous situation.

[51] Knowles & Pitt, *History of Building Regulations*, p. 97.

[52] Capt. Hemphill of the LCC Building Act Committee, quoted in *Builder*, 18 May 1907, p. 608.

[53] *LCC Minutes*, 'Building Act Committee Report', 20 Oct. 1908, p. 676. In 1905, Atkinson unsuccessfully petitioned the Council, on behalf of Waring & Gillow, for internal wall openings of 10×16 ft. see: *LCC Building Act Committee Minutes*, 20 March 1905, p. 582.

[54] Swales, 'The Influence of the Ecole Des Beaux-Arts,' p. 423.

[55] *LCC Minutes*, 'Building Act Committee Report', 24 June 1907, p. 751; 2 July 1907, p. 73; 20 Oct. 1908, p. 676.

[56] Editor's note, S. Bylander, 'Steel and Concrete at the Selfridge Stores, London', *Concrete and Constructional Engineering*, March 1909, p. 9.

[57] Horace R. Chanter, *London Building Law* (1946), p. 2; the bill is described in *Builder*, 14 Dec. 1907, p. 651.

[58] Joseph Siry describes adoption of the steel frame for Chicago's retail buildings during the 1890s in *Carson-Pirie-Scott*, pp. 39–63; see also Marian Bowley, *The British Building Industry* (1966), pp. 9–12.

[59] L. E. Kent and G. W. Kirkland, 'Construction of Steel-Framed Buildings,' *The Structural Engineer Jubilee Issue, 1908–1958*, July 1958, p. 105.

[60] Bowley, *British Building Industry*, p. 13.

[61] Ibid, p. 33–4.

[62] *Concrete Inst. Trans. and Notes* V (Oct. 1913), p. 57.

[63] W. G. Perkins, discussion of Bylander's paper, ibid, p. 107.

[64] Kent & Kirkland, 'Construction of Steel-Framed Buildings,' p. 106.

[65] E. Fiander Etchells, discussion of Bylander's paper, *Concrete Inst. Trans. and Notes* (Oct. 1913), pp. 109–10. Lack of a clear definition of 'steel frame' among early twentieth century professional engineers and architects highlights the difficulty for historians interpreting contemporary accounts of the building process, and even published handbooks, as evidence. Since not even the experts were using a uniform technical vocabulary, interpretation of their work based on contemporary sources can be problematic.

[66] Griffiths & Pember, *The London Building Act, 1894*, pp. 196–9. Outside London, such stringent impediments to steel-frame construction were not the norm., e.g. the John Walsh store, Sheffield (1899) had no internal walls—the interior consisted of six sales shops, each 25 ft wide by 200 ft long, separated only by structural columns. See *Sheffield and Rotherham Independent*, quoted in Michael Moss and Alison Turton, *House of Fraser: a legend of retailing* (1989), p. 65. Also, a number of Glasgow stores had removed all or most of their internal walls by the turn of the century.

[67] S. Bylander, 'Steelwork in Buildings—Thirty Years' Progress,' *Structural Engineer*, Jan. 1937, p. 2. Because of confusion surrounding the term 'steel frame', Bylander himself was not sure that the Ritz was the first such building in London.

[68] Bylander, *Steel Frame Buildings in London*, p. 71.

[69] 'The Ritz Hotel', *Builder's Journ.*, 30 Nov. 1904, p. 286; 22 March 1905, p. 148.

[70] Waring & White (1906) Ltd, with Bylander as chief engineer, also worked with Mewes and Davis on offices for "The Morning Post" (1906–8) and the Royal Automobile Club (1910–11).

[71] 'The Ritz Hotel,' *Builder's Journ.*, 28 Sept. 1904, p. 165.

[72] 'The Ritz Hotel,' *Builder's Journ.*, 2 Nov. 1904, pp. 235–6. Much attention was paid to the guy boom derrick used on the Ritz site, a type of crane not in general use in England until 1922. See 'The Consulting Engineer and the Great Value of His Services,' *Industrial World*, 27 Sept. 1933.

[73] S. Bylander, *Concrete Inst. Trans. and Notes* IV (July 1912), p. 88.

[74] 'The Ritz Hotel', *Builder's Journ.*, 22 March 1905, p. 148. German manufacture of steel was also noted in *Builder's Journ.*, 2 Nov. 1904, p. 235. Bylander's Ritz drawings are held by the Bylander-Waddell Partnership, Middx. I would like to thank James Robertson and Douglas Scott of Bylander-Waddell.

[75] 'The Ritz Hotel,' *Builder's Journ.*, 22 March 1905, p. 148–56; 13 Sept. 1905, p. 146–8.

[76] Tom Harley-Haddow, 'Structural Engineering 1910–1939' in A. R. Collins (ed.), *Structural Engineering—two centuries of British achievement* (Chislehurst, Kent, 1983), p. 90. The RIBA's Joint Reinforced Concrete Committee, set up for similar reasons in 1906, had been boycotted by both the Inst. of Civil Engineers and the Inst. of Mechanical Engineers. See Bowley, *British Building Industry*, pp. 23–5.

[77] See S. Bylander, 'Ferro-Concrete', *Junior Inst. of Engineers Journ. and Record of Trans.*, XVI (1905–1906), pp. 309–32; Patricia Cusack, 'Agents of Change: Hennebique, Mouchel and ferro-concrete in Britain, 1897–1908,' *Construction History* 3 (1987), pp. 61–74; Bowley, *British Building Industry*, pp. 15–27.

[78] Bowley, *British Building Industry*, p. 25.

[79] *Concrete Inst. Trans. and Notes* (Feb. 1909–Dec. 1910), p. xi.

[80] Bylander was present at Concrete Inst. meetings, contributed frequently to discussions, and presented several papers to the Institute. He also joined the Junior Inst. of Engineers in 1905.

[81] Bylander, *Steel Frame Buildings in London*, pp. 71–2.

[82] 'The Ritz Hotel,' *Builder's Journ.*, 22 March 1905, p. 148.

[83] S. Bylander, 'Steel and Concrete at the Selfridge Stores, London.' *Concrete and Constructional Engineering*, March 1909, p. 26.

[84] Bylander, *Steel Frame Buildings in London*, p. 70.

[85] C. H. Reilly, *Scaffolding in the Sky: a Semi-Architectural Autobiography* (1938), p. 118.
[86] R. Frank Atkinson, 'The Selfridge Store, London', *Architectural Review* 25 (June 1909), p. 296. Cast iron work was by Walter MacFarlane & Co., Saracen Foundry, Glasgow.
[87] *LCC Minutes*, 'Building Act Committee Report', 24 June 1907, p. 751.
[88] Bylander, *Steel Frame Buildings in London*, p. 71. Bylander's drawings for Selfridges are retained by the Bylander Waddell Partnership.
[89] Bylander, *Steel and Concrete at the Selfridge Stores, London*, p. 22. Cast iron work by Walter MacFarlane & Co. See R. Frank Atkinson, 'The Selfridge Store, London', *Architectural Review* 25 (June 1909), pp. 292–301, for an account of the building by its London architect.
[90] Bylander, *Steelwork in Buildings*, p. 6; Summary, *Waring White Building Co. Estimate for Selfridge Store Oxford Street W, 8 Oct. 1908*, Selfridges Archives; A. Stuart Gray, *Edwardian Architecture: A Biographical Dictionary* (1985), p. 70.
[91] S. Bylander, 'Concrete and Steel Construction at the Selfridge Stores', *Builder's Journ.*, 31 March 1909, p. 280.
[92] Ibid.
[93] Editor's preface to Bylander, *Steel and Concrete at the Selfridge Stores, London*, p. 9. While the *LCC Minutes* record Atkinson's petitions for use of rolling iron shutters as a fire prevention measure, the quote above indicates that the shutters actually installed were steel.
[94] Ibid, p. 9.
[95] 'Steel Frame Act,' H. D. Searles-Wood & Henry Adams, *Modern Building* (1921), pp. 157–62.
[96] Ibid, pp. 158, 161.
[97] E. Lawrence Hall, discussion of Bylander's 'Steel Specifications' paper, *Structural Engineer* IV (March 1926), p. 120.
[98] 'The London County Council Regulations,' *Concrete and Constructional Engineering* III (Aug. 1913), p. 522–3; also discussed are the complications faced by architects and engineers building under the Acts of 1894, 1905, 1908 and 1909.
[99] Bylander, *Steel and Concrete at the Selfridge Stores, London*, p. 10; R. Frank Atkinson, *The Selfridge Store, London*, p. 292; *The Lady*, 18 March 1909, p. 462; *New York Times*, 18 April 1909, p. 4.
[100] Bowley, *British Building Industry*, p. 35.
[101] Drawings by Burnet and Tait for Selfridges, including studies for the tower, are held in the offices of Sir John Burnet, Tait & Partners, London. Graham, Anderson, Probst & White's London representative, Albert Millar, was engaged as Selfridges' House Architect throughout the 1920s; today the MacDonald Price Partnership, Surrey retains drawings for various Selfridges' projects c. 1919–30, signed by Millar. I would like to thank Gavin Tait and Brian MacDonald for access to these drawings
[102] For initial stages of the western extension see: 'Retaining Walls and Foundation for Selfridge's New Building', *Architects' Journ.*, 15 April 1925, pp. 221–2; 'Development of Mechanical Appliances in Building', *Builder*, 6 Feb. 1920, pp. 167–71.
[103] 'Retaining Walls and Foundation for Selfridge's New Building,' *Architects' Journ.*, 18 Feb. 1920, p. 222.

The Finnish Wooden House Transformed: American prefabrication, war-time housing and Alvar Aalto

PEKKA KORVENMAA

This article deals with the industrialisation of wooden one-family housing in Finland and the American impulses that were vital to this process [1]. It starts with a short introduction on the development of wooden architecture in both countries, but the main focus is on the years 1935–1945. The aim is to show the outline of events and the central themes of research which is still in progress. An attempt is made to relate this discussion of architectural and technological history to the transatlantic exchange of innovation, with the wooden one-family house serving as the case material.

Wood and Architecture in the Periphery

The traditional building culture both in northern USA and Fennoscandia relied overwhelmingly on the abundant forests that provided the material for houses as well as for domestic utensils [2]. In both cultures stylistic concepts such as Neo-Classicism, first developed in other materials, and were translated into a vocabulary based on the possibilities of wood. This happened with a time-lag, and mostly without academically trained architects. Techniques were simple enough to be mastered by untrained labour. Further common factors also included the low level of urbanisation, an emphasis on small building units, and the location of settlements in close proximity to the building materials. In this way both areas, although far apart, showed similarities in their pre-industrial wooden architecture. Parallel developments, dominated by a variety of technical and formal solutions adapted to one major material, were crucial to the interaction between US and Finnish construction techniques.

One important difference between building practices in the two countries was the fact that in the USA, the frame house was well established even from the beginning of the colonial settlements, whereas the log cabin was mostly reserved for the frontier. In Finland, by contrast, solid horizontal timber construction dominated all wooden building up to the Second World War. A decisive factor was the difference in climate. Frame walls did not give protection from the Nordic winter before the advent of modern insulation technology (Fig. 1).

Introduction of American innovations in Finland: the first stage

By the end of the nineteenth century the American way of erecting wooden houses had undergone a transformation that had led to the dominance of the several versions of the pre-sawn frame, of which the well-documented balloon frame was the most popular [3]. Mechanisation, industrialisation and finally mass-production, combined