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Charles Holden and the Issue of High Buildings in London, 1927-47

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55 Broadway and the debate about high buildings

In January 1931 the President of the Royal Institute of British Architects (RIBA) presented the London Architecture Medal and Diploma for 1929 to the firm of Adams, Holden and Pearson. It had been awarded to them for their design of a new headquarters building for the London Underground Railways Ltd. The building is still the headquarters of London Underground (Fig. 1), but is commonly known simply as 55 Broadway. In 1931 it was the tallest building in London. At the presentation ceremony Mr Frank Pick, the Managing Director of the Underground Railways, spoke as a well satisfied client:

> *'...it is a plain expression of just a business building; there has been no attempt to ornament and disguise it; there it rises up, sheer and stark, with a rather mechanical array of windows, indicating, perhaps, the volume of routine work which has to be transacted in connection with our transport system in London. In fact, it goes so high that it has a 9th floor, which we cannot use because the London County Council has decided that it is unsafe for us to live there. But our architects insisted there should be a 9th floor, because the proportions of the building required it, and we were complacent clients, so it was built. And above the ninth floor there is a tower; the tower is not used for much – the water tanks are there, also the lift machinery; but there is a 10th floor, which is, perhaps, the most magnificent floor of all, and nothing can be put there. And there is a 12th floor, which is equally empty, and so we come to the top of the tower.'*[1]

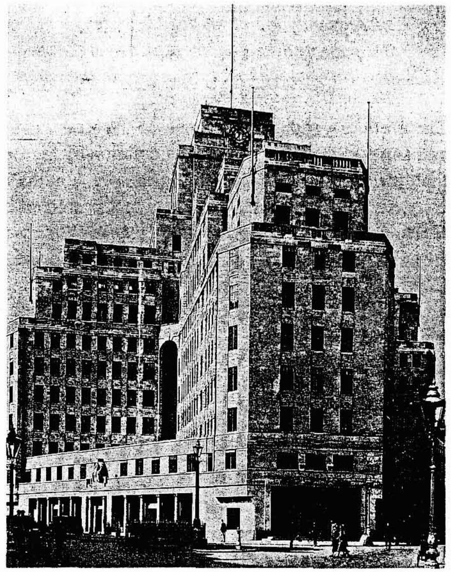


Fig. 1 55 Broadway seen from the east in 1930 (London Underground Ltd).

That was a graphic and succinct description of the effects of legal control of building height in London in the 1920s.

Objections to the height control had been heard many times since the decade began. On 1 January 1920 an article in *The Times* suggested that *'there may be so great a demand for central properties that, in time, a new type of building may be sanctioned in London – new to London, and probably* *peculiar to it – something intermediate between the larger structures such as those in Kingsway and the "skyscraper".'* This provoked a very lively correspondence. Several Members of Parliament, supported by business men and architects who worked on commercial buildings, argued for revision of the existing height limits; while an 'old guard' of architects, who included professors and central government officials, sided with the members of the London Society and some senior members of the London County Council (LCC) in opposing any change. The Council members included one former vice-chairman of Council who was an architect and also the current chairmen of the Building Acts Committee and the Improvements Committee.[2]

Many of the same men met and expressed their views at a meeting in March 1920 at the RIBA. Their debate on that occasion was on a paper entitled Higher buildings for London' presented by Delissa Joseph.[3] During the next four years Joseph was the most persistent and eloquent advocate of changes to permit higher buildings' up to 200 ft – but no more – on suitable sites. He won the support of a special committee of nineteen members of the RIBA (though with two dissenting in a minority report) for a recommendation to the London County Council that higher buildings should be generally permitted, in several defined circumstances, to a maximum height of 150 ft to the eaves. Such a policy could be implemented under a power of consent given to the Council by the existing legislation. The LCC considered and formally rejected these suggestions, the RIBA's Art Committee also expressed opposition, and the RIBA Council then took the same side.[4] A special general meeting of the RIBA was called in 1922 to discuss the issue and rejected Joseph's proposals by a decisive vote of 51 to 12.[5]

The existing legal restrictions on form and height of buildings were quite complex, especially with regard to space and light at the back of a building, but the limitation on overall height, as well as the Council's right to waive it, was in a single sentence of *The London Building Act 1894* which applied primarily to the street frontage:

> *'A building (not being a church or a chapel) shall not be erected of, or be subsequently increased to, a greater height than 80 feet (exclusive of two storeys in the roof and of ornamental towers, turrets, or other architectural features or decorations) without the consent of the Council.'*[6]

The need for various amendments to the Building Act had become apparent to the LCC by 1921 and amendments were under consideration by the Council's Building Acts Committee throughout the decade. The RIBA maintained its own London Building Acts Committee to offer advice and comment all the time. Public debate on the issue of building height and volume re-kindled several times, notably in RIBA debates on papers for and against higher buildings in 1923-4 by Delissa Joseph and Raymond Unwin respectively, and in discussion of another report of the RIBA's Committee in 1924.[7] The expected new London Building Act, however, did not reach Parliament until 1930 and even then was confined to the task of consolidating legislation concerning building in London in a single Act. *The London Building Act* (1930) re-enacted the provisions of the 1894 Act, including those governing height, virtually unchanged.[8]

Against the triumph of conservatism in the matter of building height throughout the 1920s, what significance should we see in the award of the London Architectural Medal for the *best building* completed in the three years 1927 to 1929 to the new *highest building* in London – the 175 ft high Underground Railway headquarters? And how significant was the identity of its architect, Charles Holden?

Respect for Holden's architecture was certainly high in the early post-war years – he was one of the four architects appointed in 1918 for the design of the war cemeteries in France – and this reputation was enhanced by his many fine designs of stations and offices for the Underground Railways during the 1920s.[9] That he did not speak in the debates of 1920-24 on higher buildings

at first seems notable, but actually imports nothing because he confessed when receiving the Medal in 1931 that he had never made a speech before – being then 55 years of age![10] In April 1930, however, he was one of four representatives sent by the RIBA to a conference called by the London Society *'to consider the growing tendency to relax the conditions governing the height of buildings in London'*. The representatives were asked *'to support he previous policy.....that the [RIBA] Council are not in favour of any general relaxation of the present conditions as laid down in the London Building Act.'* Two of the other three representatives (Prof. S.D. Adshead and Arthur Keen) were the twin supporters of the minority report which had opposed change in 1921.[11] Possible reasons for Holden's inclusion might be recognition of his experience in the design of 55 Broadway, simple respect for his judgement and integrity, or the desire to allow expression of a contrary view. In view of the Council's request and the honours accorded to Holden in succeeding years, it is very likely that the first two reasons ruled their decision.

The 1930 conference, which was attended by representatives of the Town Planning Institute as well as the London Society and the RIBA, reported its agreement with the RIBA Council's view but considered that the Building Act should be amended in various ways; it also called for a comprehensive zoning scheme in which the existing maximum height would only be permitted in some central districts. It was reported that, if zoning were adopted, the conference

> *'would see no serious objection to permission being granted, under certain well-defined conditions, for part of the occupied portion of a new building to exceed the statutory limit of height zoned for any particular district, provided always that:-*
>
> *(a) No increase in total volume and floor space over and above* hat zoned for the area is thereby obtained.
>
> *(b) Effective protection from fire is assured.*
>
> *(c) Adequate protection is given to the rights of surrounding* owners to their share of light and air.
>
> *(d) A reasonable uniform cornice level is maintained in certain* classes of streets.'[12]

This was a move away from dogmatic conservatism, for both the London Society and the RIBA. The freedom recommended in relation to particular sites and designs was a freedom which Holden had taken in the Broadway building, which resulted in a tower 175 ft high, and which nobody seems to have criticised.[13] (The applied sculptures on the facades, by Epstein, Moore and others, were greatly criticised, but that is another story).

At the presentation of the London Architectural Medal only Frank Pick made reference to the building's unusual height. Holden, in his maiden public speech, spoke of the design as a whole; of the thrill of finding a cruciform plan which made sense on the shapeless site, and gave order, light and air to the whole building which could almost be said to design itself externally.' He went on to speak of his visions of architecture'....

> *'an architecture telling of joy in plain structure and material; joy, too, in all the humble and even the mechanical activities which make up architecture today.....*
>
> *I believe that is the thought underlying the birth of what is called "Modernism" today. It must be remembered that it was the modernist of the past who was the maker of the traditions which some would have us follow exclusively today. We, too,*

have our part to play in the making of traditions; but let us see to it that these grow naturally out of the adjustment of our ideas to the changing conditions of life and changing methods of construction. Only so shall we keep our architecture sane and free from the element of ephemeral fashion.'[14]

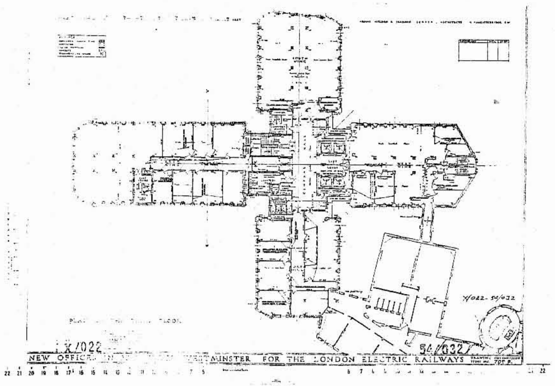


Fig. 2 55 Broadway, plan of third floor (Adams, Holden and Pearson, n.d.)

Holden's choice of cruciform plan (Fig. 2) was made in 1925 or earlier. The shorter, north-south, axis gave a short-cut' passage within the building for pedestrians from Victoria Street approaching St James's Park Station, which lay below ground in the northern half of the site. It must have been accepted from the outset that the structure of the building would bridge over both the tracks and platforms of the station. The north-south passage was made the ground floor of a ten-storey building and an east-west building of equal height was placed transverse to it, the crossing of the two providing the main vertical circulation, toilets at every floor, and a base for the tower.

Drawings were completed in 1927 and construction occupied about two years. The structure is a steel frame encased with concrete which extends to form the whole of the external walls (Fig. 3). It is clad externally with Portland Stone, the cladding detailed to bond back into the concrete and also to form pilasters, string courses, etc., on the outside. The stone thus varies in thickness from 4 to 13 inches. The floors are of the patent Truscon system, a composite of precast and in-situ concrete, set low in the depth of the steel floor beams and carrying timber joists and boards on top, the timber work ventilated by an air inlet through the spandrel below every window.[15]

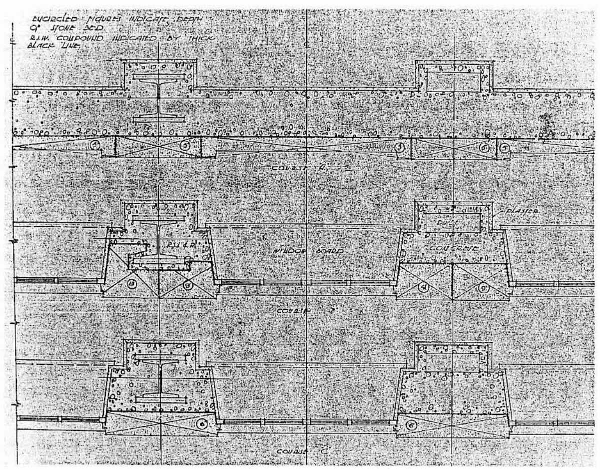


Fig. 3 55 Broadway, sectional plan of part of the external wall: Top-solid spandral between windows: middle- at window cill; bottom-window and piers containing steel column and service duct (Adams, Holdenand Pearson)

Each of the four wings is braced in vertical planes by its concrete external walls, but at the time more mention was made of the wings acting as buttresses to each other and to the tower. With regard to provision of daylight, mention had often been made in the previous decade's arguments of the superiority, in tall buildings, of external re-entrant courts compared with the internal courts and light-wells which were common in large buildings in London. Holden's cruciform plan gave a long perimeter with no elevations enclosed or screened from daylight. He also cut out of each corner of the central core a square shaft to give daylight to the core in all storeys from the second upwards (Fig. 2).

The fine freedom of massing apparent in the building from all points of view disguises meticulous care to obtain in all four wings the maximum height permitted by the 1894 Act, as quoted above. Each wing has a set-back at the seventh floor with a parapet wall whose coping is exactly 80 ft above the street pavement. Above that are one or two storeys surmounted by another parapet whose coping lies on a line drawn from the lower coping at 75° to the horizontal, 75° being the highest pitch of roof surface allowed in the interpretation of the phrase two storeys in the roof'. On at least one section in the contract drawings the 75° line is drawn between the copings to demonstrate the building's compliance with the Act (Fig. 4).[16] There are further set-backs at the ninth and tenth floors, at angles much lower than 75°, and due to the cruciform plan no part of these floors is ever near the building line on the streets or lanes bordering the site. The tower itself, with its top more than 50 ft in plan from any street building line, was an easy subject for waiver of the normal height restriction.

Since the form of the building was novel in London, we are bound to ask whether it was influenced by knowledge of American buildings; and the answer must be affirmative, although no mimicking of any specific building is suggested. Holden had travelled widely in North American cities in 1913, returning with a sketchbook full of details of internal rooms, furniture, fittings and finishes. His employee for many years, Charles Hutton, expressed '*no doubt that Holden was much influenced by America.*'[17] During an early stage of his work on 55 Broadway he asked his partner, Lionel Pearson, while travelling in the United States, to visit the General Motors building in Detroit – the largest office block in the world – and bring him back plans of it. It was a building with no internal court, which might have had some influence, as Pearson speculated, on the Broadway design.[18]

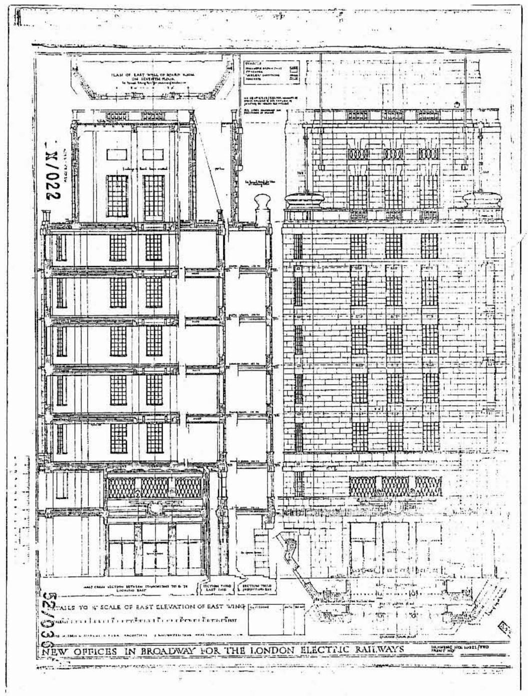


Fig. 4 55 Broadway, Section and Elevation of East Wing. The 75° line defining the permitted roof storeys is drawn at the top right of the section (Adams, Holden and Paerson, n.d. August 1927?)

The Senate House

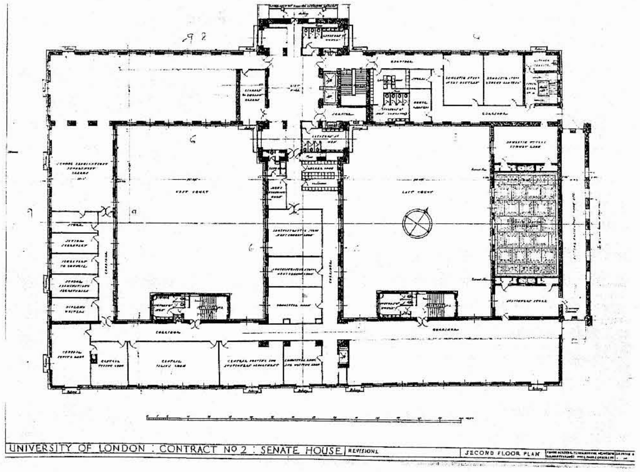


Fig. 5 Senate House, second floor plan of the southern courts of the 'balanced scheme'. The tower joins this part at top middle, and the northern courts meet the tower at its other end (Adams, Holden and Pearson, 11 January 1935, reproduced by courtesy of the RIBA Drawings Collection).

In August 1931, some seven months after receiving his medal for 55 Broadway, Holden was commissioned by the Court and Senate of the University of London as architect for the development of their site in Bloomsbury of ten and a half acres stretching northwards from Montague Place at the back of the British Museum. Many years later he referred to the commission in public as a *'life sentence'*, and *'I have been informed by Charles Hutton that he used the phrase privately immediately after he received the commission'*.[19] Eleven different units of the University were initially scheduled to be accommodated on the site, with others to follow. The University's initial instructions to the architect suggested that the plan should include an open centre or quadrangle and a tower.[20]

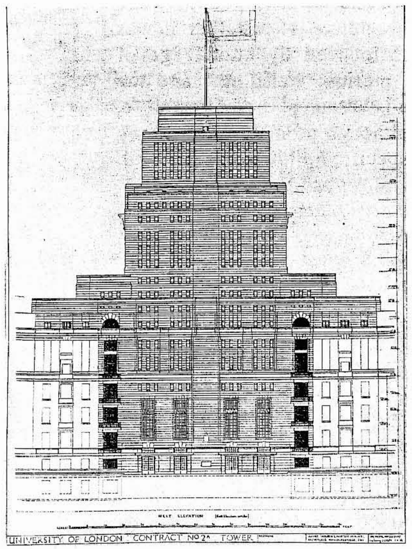


Fig. 6 Senate House, west elevation of the tower (Adams, Holden and Pearson, 1 May 1935, reproduced by courtesy of the RIBA Drawings Collection).

Considerable time was spent on studies for plans of the whole site and not until 1933 was the detail design of the first buildings undertaken. In that year Holden was appointed a member of the Royal Fine Art Commission. The Commission (as well as the King, the LCC and Holborn Borough Council), had already seen and approved Holden's master model for the University site, with a large and high tower.[21]

The initial buildings to be designed in detail formed a balanced scheme' of two large blocks, each containing two courts separated by a north-south spine and the spines connected across the gap between the blocks by the tower, 120 ft wide x 50 ft deep at the base, and 210 ft high (Figs. 5, 6). Most of 'the balanced scheme' was built under three contracts. Contract No.1

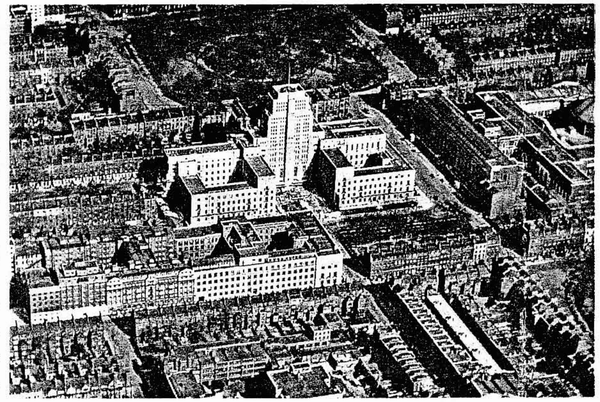


Fig. 7 Senate House, aerial view of the 'balanced scheme'.

covered the foundations of the southern block facing Montague Place; work on these began about April 1934. Contract No.2, placed in August 1934, was for the superstructure of this block. The general form of building surrounding the twin courts was a basement and four storeys but some ranges had five and one six storeys above ground. The block contained the administrative offices and Senate Room of the University and was called Senate House, but the name has subsequently been applied to the whole of the balanced scheme'. Assembly halls filled the two courts up to the level of the first floor.[22]

Construction was complete by mid-1936 but was overlapped by the start of Contract No.2A which included the whole of the tower and part of the northern block. This contract was more or less complete by April 1938 when Holden gave a full description of the project to a meeting at the RIBA.[23] In the meantime he had received the Institute's highest accolade in the award of the Royal Gold Medal for Architecture in 1936.[24]

Except for the existence of a sixth storey in one range of building, which could be fairly considered a storey in the roof', and the fact that the parapets of several ranges rose 2 or 3 ft more than the permitted 80 ft from the ground floor, the only part of the complex which transgressed the legal height limit was the tower. It was 210 ft high but stood at least 150 ft from the boundary of the site in any direction. Agreement by the LCC to the application for special consent seems to have been a formality, since it is recorded as a chairman's decision during the summer recess of the Building Acts Committee in 1934. There was mention of the condition that notices must be served on freeholders and head-lessees of any properties within 100 yards of the tower (*not* the site boundary), and must be published in *The Times* and 'on the hoardings'.[25] The notice 'on the hoardings' was a poster measuring about 4 ft x 2′ ft.[26]

The chief interest of Senate House therefore lies, not in its breach of the legal height limit, but in its singular principles of design and construction. A structural system was devised which could be, and was, used for both the lower ranges and the tower.[27] The underlying concepts were clearly formulated by Holden, but in carrying them out he had the cooperation of R. Travers Morgan as structural engineer. The surviving structural design drawings are by Travers Morgan & Partners', but Morgan was at some time in partnership with J. Sharman, who was named as engineer on the structural drawings for 55 Broadway. It is likely that Morgan was involved in the later stages of the Broadway project. There are similarities in the structural massing of the two buildings but notable differences in materials and systems.

The form of Senate House (Fig. 7) provided what Holden called:

> *'grouping within a pyramid...probably the most stable form of building short of the pyramid itself, for every portion as it rises above its neighbour is upported at its most vulnerable end by one or two side wings, while the tower, with its broad face to*

the prevailing wind, is strongly buttressed in its centre by the central pier containing the staircase and lifts connecting the library and bookstacks. It is a building with many buttresses, but the buttresses serve the dual purpose of enclosure as well as support.'[28]

The principles expressed here, like the form itself, were a development of those applied in 55 Broadway.

Holden's policy for the construction of the Senate House sounded rather as if he had been entrusted with the building of a cathedral. In his own words:

'For the more important buildings in a large university.....continuity of active life extending over many centuries must be anticipated...

We therefore resorted to a method of construction based upon centuries of experience, for we did not feel that this was an occasion for the admission of any element of doubt as to the permanence of the structure.

For this reason brick and stone were selected for their known permanence and stability in the construction of weight-bearing walls and piers ... The floors are of steel girders (actually I- beams, often with added flange plates) in pairs spanning from outside wall to outside wall, with the intervening spaces filled with hollow brick tiles separated with concrete ribs cross-reinforced ... The fact that these latter materials are fully protected from external moisture will no doubt contribute to their longer life, but if failure were to occur this would probably be local, and would give warning of failure, and replacement would be possible without the need for demolishing the building.'[29]

This prejudice against 'new' materials exteneded to the design of the foundations. The lower ranges of building were found on concerete piles which were reinforced, but the pile caps and retaining walls round the basement were virtually unreinforced, and the tower was founded on a thick raft of unreinforced concrete. By these decisions the risk of deterioration through corrosion of the reinforcement was virtually eliminated.

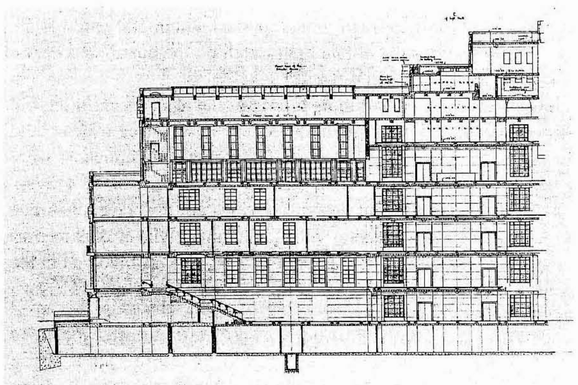


Fig. 8 Senate House, part section of the spine between the southern courts (Adams, Holden and Pearson, n.d., reproduced by courtesy of the RIBA Drawings Collection).

The basic structure consists of piers of brickwork between every two vertical lines of windows, each pier carrying a pair of steel I beams at each floor level (Figs 8, 9). The beams span the whole width of the building, a maximum of 33 ft, and carry on their bottom flanges a reinforced concrete hollow-tile floor, the beam webs being holed to pass the reinforcement through them (Fig 10). On

these concrete slabs any arrangement of partition walls was possible, both initially and at any later date;[30] but the floors were of timber joists and boards, supported on the slabs between the upper parts of the steel beams and ventilated, as in the Broadway building, by holes in the spandrels under the windows.

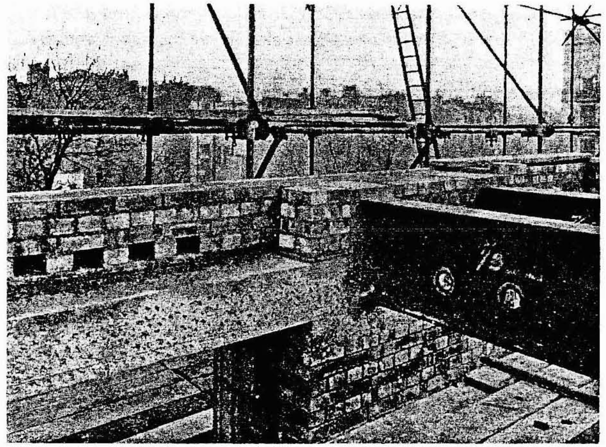
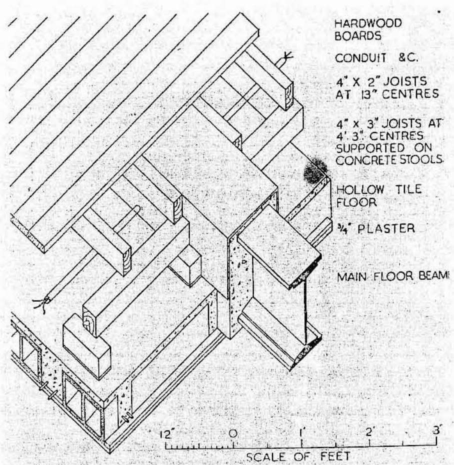


Fig. 9 Senate House: Photograph of the backing lintel over the window, air inlets through the brickwork, and steel beams seated in the brickwork between windows, from the *RIBA Journal*, 9 May 1938.

Each end of all steel beams whose clear span exceeded 26 ft was placed on a rocker bearing. This was part of the elaborate precautions to ensure that movement of the steel beams – deflection being the chief concern – would not cause stresses or cracking in the brickwork. A detailed survey of the whole building in the early 1960s explained the rocker as a steel packing 3 in. long in direction of span and ¨ in. thick, placed at the middle of length of the bearing plate which was 9 in. long in direction of span and bedded fully on brickwork, the beam resting on the 3 in. pack and felt pads laid between beam and bearing plate both fore and aft of the pack.[31] The brickwork above the beam socket was carried on a concrete lintel and another felt pad inserted between the lintel and the concrete filling of the socket which, according to this account, was not cast until the beam was carrying the full load of the floor and ceiling structure. This description corresponds closely, though not exactly, with drawings submitted to the District Surveyor (the building control authority) in 1958 for completion of the north-east court of the balanced scheme', which had been left unfinished in 1938. Whether the beam bearings built in the 1930s were precisely similar must be a matter of doubt.



The construction. Left: A typical interior showing solid wall piers and twin steel beams spanning 33 feet. Above: An axonometric showing the built-up floor construction; for flat roofs and solid floors reinforced concrete joists and flat slabs are used. Below: Detail of pier and beams, showing the continuous vertical chases in the reveals for the electric leads, the holes for floor ventilation and, in the beams, for conduit

Fig. 10 Senate House: floor construction detail, from the *RIBA Journal*, 9 May 1938.

The concrete pads under the beam ends stretched over the full width of a brick pier, that is, the width of solid wall between two windows. The spanning

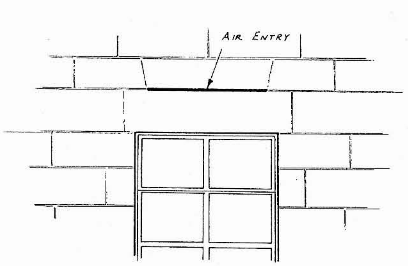


Fig. 11 Senate House, detail of masonry over window
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Fig. 11 Senate House: detail of masonry over window.

length of each beam was encased in concrete before or during the construction of the floor slabs. The concrete floor ribs were cast on tile soffits similar to the intervening hollow tiles, thus ensuring a uniform surface for ceiling plaster. All the plasterwork was on the solid', using lime run on the site, which was considered another aid to long life.[32]

The exterior was finished with Cornish granite up to the first floor and thereafter with Portland Stone. Courses of stone were alternately 4´ in. and 9 in. thick on the bed and so bonded solidly with the brickwork. String courses had extra thickness on the outside. Holden quoted the length normal to the capacity of the stone to span the opening' as a constraint on the width of all windows and exterior doors in the building – and therefore an important influence on the design of the elevations.[33] But, while making the stone lintels span the openings unaided, a trick was used to relieve them of all load other than their own weight. A voussoir-shaped stone in the next course above and almost as long as the clear span of the lintel throws the spandrel's weight sideways into the piers and the bed-joint below it is empty to prevent it from exerting any load on the lintel; the empty joint is also the air inlet for ventilation of the floor timbers (Fig 11), the brickwork behind it being built honeycombed. A backing lintel of concrete (presumably reinforced) carries the single skin of brickwork in the window spandrels and any other local loads. These lintels are continuous with the padstones and infill concrete round the steel beam ends, so that together they form a 'bonding beam......through the whole of the walls at each floor level.'[34]

For vertical distribution of services a small duct was formed in the side of each brickwork pier at the jambs of the windows and through each concrete lintel, carrying electrical cables and gas and water supplies for laboratories where necessary. Heating is by radiation from flat panels of metal, travertine or black marble to match the rooms in which they are placed, the panels heated by electric elements behind them and inset to finish flush with the general wall surface, each room's radiators being controlled by a local thermostat. The system demands minimal space for ducts and gives an admirable level of control. A single open grate for a coal fire was

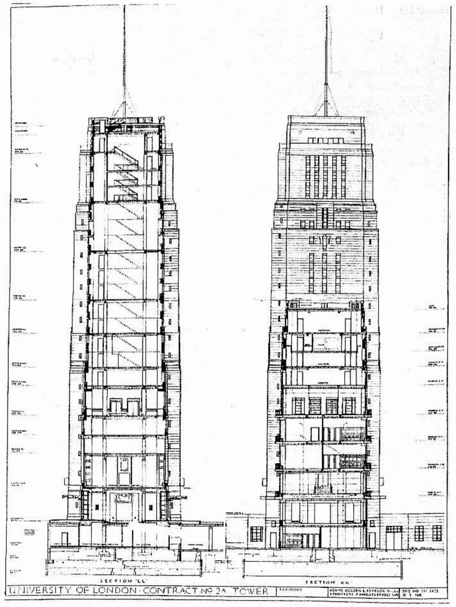

Fig. 12 Senate House: sections through the tower (Adams, Holden and Pearson, 31 May 1935, reproduced by courtesy of the RIBA Drawings Collection)

provided – in the Principal's office! Toilets are grouped in vertical stacks' on successive floors, with vertical ducts for the pipes, and a warmed air plant in the basement heats the assembly halls on the ground floor.[35]

The tower (Fig. 12) has 21 floors (excluding the basement), but eight of the floors above the sixth were conceived as book-stack floors within storeys and the construction of these eight differs from the rest. At first it was intended to support all the floors on brick piers just as in the lower buildings; and the small-scale drawings which survive show similar construction of steel beams with concrete slabs and a span of 33 ft between the piers. But after Morgan had suggested the use of a raft foundation for the tower it became possible to erect on it a steel frame '*independent of the outer walls.....to carry some part of the heavy load of books in the book stacks direct to the foundations.*'[36] The vertical members of this frame are two lines of columns, symmetrically placed at 10 ft each side of the long axis of the plan. Longitudinal beams appear on these lines in the sections and the structural plan at each main floor, but not the eight subsidiary floors, and the grid of beams (encased in concrete) can be seen on the soffits of main floors in the upper levels of the tower. It therefore appears that the load from the central part of many, and perhaps all, of the main floors, goes into the steel columns, but that probably half of the load from the outer areas of these floors is transferred by transverse beams (also seen in the sections and on the floor soffits) to the brickwork piers of the two long walls of the tower. (See Appendix for details of the brickwork and assessment of stresses).

Visual inspection also shows that above the sixth floor, where the whole volume is given over to book stacks, the main floors are built hard against (and possibly into) the external walls, but the edges of the subsidiary floors are ´ to 1 inch clear of the walls and were cast as concrete panels in a grid of steel members whose flanges show on the soffits. The areas of these floors between the column lines and the outside walls must be cantilevered from the columns. It is clearly doubtful that the frame is fully independent of the outside walls, as stated by Holden, but there are certainly no vertical steel members in the walls.

An additional expedient, which was proposed to help give solidity and long life to the walls, appears to have been used at some point, but not carried through the building, as it does not appear in Fig.9. The proposal was to lay in the brickwork, just under the concrete padstones on which the steel beams were seated, '*several courses of tiles....embedded in mortar to form a continuous band 13´ in. thick and the full width of the brickwork. The intention being that they should bond the wall together and spread the floor loads at lintel level in the way they were believed to have done in Roman masonry walls.*'[38] Most surprisingly, two section drawings published with the Building Research Station's 1964 report show these bands of tiles acting as backing lintels over windows, carrying only their own weight but still a hazardous proposition. When consulted by the architect at the time of design, the Station had said the bands of large, flat tiles used in Roman work were bonding courses between the well-built faces of walls whose interior was '*merely rubble thrown in with mortar*', and '*could add little if anything to the strength of well bonded brickwork*'. They reported in 1964, however, that one band of tiles could be seen at a point in the east wall left exposed for future extensions.[39] It seems likely that the construction shown in Fig.9, published with Holden's description of the building in 1938, replaced the tile bands as the general construction.

Changing Structure of Control in the 1930s

The technical problems which had to be solved in design of a large and high building changed very little during the 1920s and 1930s. They included fire protection, for which American experience provided solutions; the generation of extra traffic, which could be solved by setting back the building lines and widening the streets, but only when the whole length of a street or block was redeveloped at once; and preserving the access of light and air to adjacent properties, by the satisfactory shaping of the building. Aesthetic questions were also posed: the principles enunciated by different bodies included continuity of the building line, or of the cornice line, along a street, and the preservation of views and axial vistas.

The complexity and interaction of these questions clearly demanded flexibility in administrative control. Flexibility was permitted by the Acts of 1894 and 1930, but understanding of the consequences of decisions was clearly lacking and negative attitudes to proposals for increases in the height and bulk of buildings were a natural result. Slowly, however, new methods and types of control were emerging under the powers of town planning legislation. The longer term view of town or city development which was written into a town planning scheme' made possible some flexibility of response by the local authority without necessary loss of direction. It was implied that new building proposals would be assessed in relation to an understanding, crude though it might be, of the whole town system. The *Town and Country Planning Act (1932)*[40] encouraged the preparation of town planning schemes and under that Act *The County of London Planning Scheme*[41] received Government approval on 27 May 1935.

The Scheme introduced zones in which different rules of maximum building height would operate, the most obvious change being the imposition of lower height limits in non-central districts. An important, less straightforward, change was the adoption of different maximum plot ratios for different zones, with the largest ratios in the central business districts. The norms of maximum height on street fronts in central districts were very similar to those applied by the 1930 Building Act to the whole of London. But, overall, the rules proposed in the Scheme were responsive to local conditions, and were clearly intended to promote planning' rather than simply to restrict height. Reasonable flexibility in their application might be expected.

The processes are well illustrated in the Sixth Report of the Royal Fine Art Commission, dated 2 November 1937.[42] Virtually the whole of the Commission's Fifth Report (8 February 1934), presented less than a year after Holden became a Commissioner, was devoted to discussion of height control (for which it found the existing legislation and byelaws ineffective) in English towns and cities, but primarily in London. The Sixth Report returned to the topic with much greater experience of reviewing applications for building consent, and with emphasis on the expanding ideas and procedures of town planning control.

The Report recognised a threat to 'regularity' and 'homogeneity', both of height and of general design, in the operation of rules allowing different heights in different types of building in the same zone and, more particularly, the same street. It made a positive plea for 'town planning practice' to '*recognise the importance of mass, composition, sky-line, and the design of those "architectural features" such as towers and pavilions which are permitted irrespective of the height of the main cornice.*' But from such pleas for sensitivity to all architectural qualities it returned several times to the need for regularity' in streets, and to the single issue of building height. Bluntly, '*the effort of the ......Commission has always been directed towards moderation in altitude.*' However:

> '*special height levels should be applicable to particular ranges of buildings and these may vary from street to street, but wherever attainable the balanced ky-lines of Nash and Pennethorne are advantageous.....As seen in five or six very large buildings in the centre of Park Lane.....a continuous high sky-line is not unbecoming.*'

The report concluded that '*the duties of the planning authorities are therefore critical in respect of aesthetic considerations*', but that many planning authorities '*are unversed in the obligations placed upon them*' and should be offered Government assistance in '*those aspects of town-planning which particularly affect considerations of aesthetic technique.*'

In describing developments which had occurred and on which the Commission had advised, the City of London's Town Planning Scheme was praised as the first which had drawn its height zones specifically to preserve views, namely, views of St Paul's Cathedral from various directions. Designs for a huge complex of new Government offices between Whitehall and the Embankment had been submitted to the Commission at least three times in 1934-36, with the maximum height reducing from over 150 ft in the first design to 121 ft 6 ins (at the ridge of the roof) in the last. The Report commented:

> '*the height is not excessive in relation to the size of other buildings on the Embankment, which vary from 114 ft to 152 ft.*'

That sentence indicates the considerable number of buildings for which consent to build higher than the general rule had been sought and granted – most of them standing along the edges of large spaces like the River Thames and Hyde Park.

The Commission's Report was signed, among others, by Charles Holden whose Senate House tower already stood 210 ft high and was almost finished. Is there a paradox between the Report's pleas for 'moderation in altitude' and 'regularity' in street elevations and Holden's modulation of height, with towers leaping to double the buildings' regular heights, in his designs for London's two highest buildings? Certainly a paradox, but no contradiction. For his sites and his buildings were both large enough – though perhaps, in the case of 55 Broadway, only just large enough – to enliven the skyline with towers while maintaining regularity' in their elevations on the streets. The primary motive of those who campaigned for higher buildings in the 1920s, had been commercial. By contrast the motives in Holden's two buildings seem wholly architectural. Given such motives in a designer of his class, neither the planning authority nor the Fine Art Commission had any call to restrict heights on purely aesthetic grounds. Rather, his buildings showed how modulation of heights could enrich the urban fabric of London. They may have helped businessmen, landowners, developers, and the architects who worked for them, to build more interesting buildings; but they added nothing to the arguments for general increase of building heights and density.

Post-war influences

By 1943, when plans for post-war reconstruction were being drafted and discussed, there was general confidence in the ability of town planning authorities to control heights, requiring regularity where it was deemed necessary and permitting abnormal height or bulk where it was appropriate. Both principles were commended to the LCC, for instance, in the 1943 *County of London Plan*, prepared by Forshaw and Abercrombie; they suggested architectural, as well as commercial, motives:

> '*....we should like to encourage greater intensity of use and designed variety of skyline where the situation justifies it.*'[43]

The point was made more sharply, by reference to specific well-known buildings, in a consultants' interim report to the City of London Improvements and Town Planning Committee in March 1946. Although the City covers only a single square mile in the heart of greater London the report was very important because no less than 30 per cent of the commercial floor-space in the City had been destroyed by bombing and large-scale reconstruction was certain. Its extra interest, in the context of this paper, is that one of its authors was Charles Holden. Here he wrote directly of building height in relation to architectural design in the dense urban context. His co-author was William (later Lord) Holford.

'The building up of all frontages to maximum permissible height would make later street improvements more costly, create unsatisfactory conditions of building within the perimeter of blocks, and produce a dull architectural effect.....London business buildings must now compete with those of foreign capitals, and the trend is definitely away from the "closed" to the "open" building block, particularly where every room in the building has to provide efficient working or display space and where maximum ground floor area is required. (Compare, for example, the type of lay-out at the Rockefeller Centre, New York, or 55 Broadway, Westminster, or the Bank of England, Threadneedle Street; with that of Wall Street in New York, or Drapers' Gardens, or even Britannic House, Finsbury Circus). Setting aside, for the moment, aesthetic and sentimental values, there is no question which of the two principles of building is likely to be more successful in meeting contemporary requirements.'[44]

And later:

'We are in favour...of a general rather than a detailed architectural control, i.e., one which aims at conformity with frontage and fascia lines, harmony of materials, a consistently high standard of daylighting, and freedom of treatment and massing of the required building volume within the broad limits of a ratio of floor-space to site, measured over a reasonably large unit.'[45]

Thus Holden and Holford, in their interim report to the City repeated the point which Holden had first made at 55 Broadway more than fifteen years before. A year later, in their final report to the City, they provided the necessary daylighting code and plot-ratio proposals.[46] The rest of design they would commit to architects.

Appendix

Stresses in Brickwork in Senate House

As a consequence of Holden's principle of using only long-tried materials The Senate House tower became a brickwork structure of quite exceptional height. The piers are 6 ft 7′ inch thick (including some stone facing) in the basement and ground storey and decrease by a number of offsetts to 3 ft 7 inch at the sixth floor (80 ft 6 inch above ground floor) and 1 ft 10′ inch at the 10th main floor (165 ft above ground floor). The clear internal width of 33 ft is maintained throughout this height.

Only the most heavily loaded piers were designed by the engineer. In both the tower and the lower ranges the materials specified varied with the predicted maximum stress as follows:

Applied Stress	Brick	Mortar
(a) 15-20 ton/ft² (1.61 – 2.15 N/mm²	Cattybrook (80.4 N/mm² crushing strength)	1 cement: 3 sand
(b) 6-15 ton/ft² (0.64 – 1.61 N/mm²)	Lingfield (48.2 N/mm² crushing strength)	1 lime: 2′ sand
(c) Less than 6 ton/ft² (0.64 N/mm²)	London stocks	1 lime: 2′ sand

The specified materials for piers of type (a) conformed to the LCC *Code of practice for the use of structural steel and other materials*, published in 1932.[47]

For type (b), sample piers 1 ft 6 in square (or cubed?) were tested because the Code did not countenance use of lime mortar except for brickwork carrying applied stress less *than 4 ton/ft². The lime used for piers of type (b) and (c) was described as hydrolised'* [48] and a proprietary prehydrated hydraulic lime'[49]. It was used in proportions 1 lime: 3 sand. Although both the lime and the bricks actually used in the building, and named in the table, differed from those used in the tests, it was stated that a factor of safety' (presumably the ratio of brick crushing strength to applied stress in wall) equal to that used in the code for brickwork in cement mortar was satisfied[50]. Bricks in the body of the walls were required by the specification to be slurried in' to ensure full joints. The early 1960s survey records that *'where for any reason brickwork had been cut away, every joint had been found to be filled'*, a condition *'typical of the quality of workmanship in this building.'*[51]

A fairly close comparison can be made between the applied stresses allowed in the design, as listed above, and equivalent allowable stresses under BS5628 (1992) for structural masonry[52]. Assuming a partial safety 'factor of 1.4 on total load and material strength factor of 3.5, the equivalent allowable stress by the 1992 code for Cattybrook brick in cement mortar is 4.24 N/mm² and that for Lingfield brick in hydraulic lime mortar is 1.81 N/mm². These figures include no reduction for slenderness. The slenderness ratio of all the piers in the Senate House tower below the eighth main floor are less than 8 and therefore, by the rules of the modern code, require no reduction of stress; and, the applied stresses above the eighth floor being relatively light, the larger slenderness ratios there cannot cause critical stresses.

The comparison shows, rather surprisingly, that the maximum applied stress on Lingfield brickwork allowed in the design (1.61 N/mm²) was very little less than the modern code would allow (1.81 N/mm²); but the applied stress allowed by the modern code on the Cattybrook brickwork in 1:3 cement mortar (4.24 N/mm²) is nearly twice the highest which occurred in Travers Morgan's design (2.15 N/mm²) in 1934-5. The 1932 code made no provision at all for applied stress greater than 2.15 N/mm².

The general conclusion is that in British codes of practice for engineer-designed masonry there has been no large change in the margin of safety since the 1930s.

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References

1 The RIBA London Architecture Medal and Diploma 1929', *Journal of the RIBA*, xxxviii (24 Jan 1931), pp167-72.

2 Many letters and articles were printed in London newspapers and journals, of which a brief summary is given in Delissa Joseph, Higher buildings for London', *Journal of RIBA*, xxvii (8 May 1921), pp301-16.

3 *Ibid.*

4 Higher buildings for London', *Journal of RIBA*, xxix (11 Feb 1922), pp218-22.

5 Report of General Business Meeting, 20 Feb 1922, *Journal of RIBA*, xxix (25 Mar 1922), pp310-19.

6 *The London Building Act 1894* (57-8 Vic.c.213), Part V, Section 47.

7 Delissa Joseph, Building heights and ancient lights', *Journal of RIBA*, xxx (16 June 1923), pp477-497; Raymond Unwin, Higher buildings in relation to town planning', ibid, xxxi (12 Jan 1924), pp125-50; London Building Acts Committee', ibid (7 June 1924), pp515-19; Charles A Daubeny, The proposed reform of the London building law' (28 June 1924), pp525-33, and discussion, (12 July 1924), pp569-76.

8 *The London Building Act 1930* (20-21 Geo V. c.158). Virtually the whole text is included in T.J. Kelly, *The London Building Acts, 1930 and 1935*, (1938), and a summary in H R Chanter, *London Building Law* (1946), chapter 2.

9 Biographical information is in *The Builder*, 17 Jan 1936. See also Eitan Karol and Finch Allibone, *Charles Holden Architect 1875-1950* (1988) and David Lawrence, *Underground architecture* (Harrow, Middx. 1994).

10 RIBA London Architectural Medal', pp167-72.

11 *Journal of RIBA*, xxxvii (24 May 1930), p530.

12 *Ibid* (20 Sept 1930), p713.

13 Mr Charles Hutton comments that Holden always felt and knew that he had to persuade the authorities of the day to agree that his proposals were the best solution to a particular problem. How such matters should be presented was always a subject which worried him greatly.' (see note 17).

14 RIBA London Architectural Medal', pp167-72.

15 Architects' and engineer's drawings, 1925-1931, in Civil Engineer's Plan Room, London Underground Ltd.

16 Civil Engineer's Plan Room, No. 52/036, Details of east elevation of east wing' by Adams, Holden & Pearson.

17 Letter, Charles Hutton to author, 15 Dec. 1985.

18 RIBA London Architectural Medal', pp167-72.

19 C. Holden, The University of London', *Journal of RIBA*, xv (9 May 1938), pp634- 61. For Hutton's comment, see ref. 17.

20 *Ibid.*

21 *Ibid.*

22 These and subsequent details derived from contract drawings at offices of the University of London and Adams, Holden & Pearson, specification for Contract No. 2 and various press cuttings at the latter, and some published details (eg. ref. 19).

23 C. Holden, The University of London'.

24

See *The Builder*, 10 April 1936.

25 Minutes of Building Acts Committee, 30 Aug 1934 (MS), at the Greater London Record Office.

26 Copy at Adams, Holden & Pearson.

27 C. Holden, The University of London' and Notes on structural engineering work, University of London, Bloomsbury', *The Structural Engineer*, xiii (May 1935), pp249-53.

28 C. Holden, The University of London'.

29 *Ibid.*

30 Mr Hutton (see note 17) recalls that the building masses were designed to enclose the total volume of the accommodation' without consideration of the location of individual departments. It was not clear until quite late in the planning stage that the libraries (i.e. reading rooms) could be at high level in the spine and the wings and the bookstack lie centrally between them in the tower.'

31 The University of London – the Senate House building', chapter in S.B. Hamilton, H. Bagenal and R.B. White, *A qualitative study of some buildings in the London area.* National Building Studies Report 33 (Her Majesty's Stationery Office, London, 1964), pp109-125.

32 C. Holden, The University of London'.

33 *Ibid.*

34 *Ibid.*

35 *Ibid.*

36 *Ibid.*

37 See Ref. 22.

38 S.B. Hamilton et al (1964), pp109-125.

39 *Ibid.*

40 22-3 Geo V c.48.

41 *The County of London Planning Scheme*, 1935.

42 *Sixth report of the Royal Fine Art Commission*, Cmnd. 5610, 1937.

43 J.H. Forshaw and Patrick Abercrombie, *County of London Plan*, 1943, p119.

44 C.H. Holden and W.G. Holford, *Reconstruction in the City of London: interim report to the Improvements and Town Planning Committee*, March 1946, p6.

45 *Ibid*, p14.

46 C.H. Holden and W.G. Holford, *Reconstruction in the City of London: final report*, April 1947.

47 London County Council. *London Building Act 1930. Code of practice for the use of structural steel and other materials in buildings*, approved by LCC 16 Feb. 1932. A Proposed code of practice for the use of reinforced concrete and other materials', submitted to the Council on 23 Oct. 1934, contained similar but not identical requirements for brickwork. There was no separate code for brickwork or masonry.

48 C. Holden, 'The University of London', and *The Structural Engineer* xiii (May 1935).

49 S.B. Hamilton et al (1964), pp104-125.

50 S.B. Hamilton et al (1964) and *The Structural Engineer* xiii May 1935).

51 S.B. Hamilton et al (1964).

52 *BS5628: Part 1: 1978*, British Standards Institution, London.