St George’s Hall, Liverpool

In 2005 the Heritage Group of the CIBSE awarded its first Blue Plaque to St George’s Hall recognising it as the World’s First Air-Conditioned Building*, which probably makes it the most important building in our Region in the development of the science of Building Services Engineering.

The genesis of the building is very rarely reported accurately and so it seems appropriate to include something of that here. Two major items of local folklore need to be dispelled straight away. Firstly, the building was not paid for by the City Merchants and secondly, Harvey Lonsdale Elmes was not, 23 or 24 or even 25 years old when he designed the building. (In fact when Elmes won the first of the two competitions held he was three years older than Giles Gilbert Scott was when he won the competition to design the Liverpool Anglican Cathedral, but the title of ‘Young Prodigy Architect’ often assigned to Elmes never seems to be assigned to Scott!)

This plaque is now mounted in the Heritage Centre at St George’s Hall

In the late 18th and early 19th Century a Triennial Music Festival had been held in the City and this had become such a major event that it was becoming difficult to fit it into St Peter’s church, which was its regular venue. A Committee was formed in the 1830s to look into the possibility of erecting a building large enough for this festival.

(*The date of 1851 on the plaque is very significant. The Assize Courts were first used on 8th December 1851 although the rest of the building was not completed until 1854, with the organ finished a year later. Another contender for ‘First Air-Conditioned Building’ – the Houses of Parliament was not brought into use until February 1852. David Boswell Reid also designed what he termed the ‘Systematic Ventilation’ system for the Houses of Parliament. but, again, this building was not completed until several years later.)
It was agreed that the Committee would attempt to raise the funding, estimated at about £30,000, by public subscription and shares were sold at £25 each. The Council was approached and the committee was offered land formerly occupied by an infirmary next to St John’s church and facing John Foster’s neo-classical Lime Street Station. The Committee had raised over £25,000 by the beginning of 1837 and was so confident of raising the rest that a Foundation Stone was laid on Queen Victoria’s Coronation Day in June 1838.

In 1837 the Government had decided that both Liverpool and Manchester should have their own Assize Courts, (previously all Crown Court matters had been dealt with in Lancaster) and a Liverpool Assize Courts Building Committee was formed. The two Committees, one for the Concert Hall and one for the Assize Courts, had joint discussions as early as 1837 about how the two buildings might together form part of a public forum using John Foster’s neo-classical façade of Lime Street Station to form the enclosure.

A competition inviting architects to submit design proposals for the new concert hall, which the Committee had by now decided should be called St George’s Hall, was announced in The Times in March 1839. Harvey Lonsdale Elmes was announced as the winner of this competition in July 1839 at the age of just 25. The façades of his winning entry bear a strong resemblance to the concert hall designed by Joseph Hansom in 1834 to be used for a Triennial Music Festival in Birmingham and known as Birmingham Town Hall. This, in turn, is said to have been inspired by the Temple of Castor and Pollux in Rome.
A competition inviting architects to submit design proposals for an Assize Court Building was announced in The Times in July 1839, the deadline for submission of entries being 1st January 1840. Elmes also entered this competition but after he had won the first one and, as was said at the time ‘it is rather singular that that gent should have chosen to enter a second competition immediately after succeeding in the previous one, unless he had a particularly good reason for anticipating success’. The Concert Hall was his first major commission and would have been a monumental undertaking on its own for such a young and relatively inexperienced architect. It was indeed strange that he should feel able to enter the competition for the Assize Courts as well unless he knew something that none of the other entrants knew!

Suspicions might be raised further by the fact that Elmes was not announced as the winner of the second competition until 8th October 1840, 9 months after the closing date. Further suspicions might have been justified over the next few years when Elmes went on to design houses for a number of the members of the Building Committee, including the Lord Mayor! His winning entry for the Law Courts Building is clearly based on the Fitzwilliam Museum in Cambridge designed by George Basevi in 1835 and finished, following Basevi’s accidental death, by Elmes’ mentor, Charles Robert Cockerell, a close friend of Elmes’ father, James. (James Elmes was also an Architect who had written extensively about the buildings of 19th Century London, in particular the works of Sir Christopher Wren.)
Elmes’ Winning Assize Court Entry (1839)

Fitzwilliam Museum (1837) by George Basevi
It is traditional to think that Elmes was inspired by the classical buildings of Athens and Rome but the inspiration for Elmes’ competition entries was clearly neo-classical buildings, not classical buildings. It is difficult to see how he could have been influenced by classical buildings when he never visited Greece or Italy! Cockerell, on the other hand, had completed a ‘Grand Tour’ and spent several years in Greece, his travelling companion for most of the time being John Foster Junior. *Foster, with his father, was responsible for the design of a number of important buildings in 19th Century Liverpool. It was no coincidence that the building contractors for many of these were also called Foster since this was the family business.

*(By their corrupt machinations, the Fosters were partly responsible for the passing of the Municipal Reform Act in 1835, which largely eliminated the propensity for Councils to act as oligarchies and required them to be elected by ratepayers.)*

The interior of the Great Hall is considered to have been influenced by the Baths of Caracalla in Rome which may explain the sunken floor, but, again, this building had not been seen by Elmes and is, in any event, largely a disjointed ruin. However, Cockerell had produced a large painting of what he thought the interior of these baths would have looked like. Was this Elmes’ inspiration? It seems very likely.
In fact Elmes’ first entry for the Assize Court Building was so flawed in terms of its circulation, especially considering the necessity to separate the different parties involved in criminal trials, that it was passed over to Joseph Franklin, City Surveyor, for dissection and revision. Elmes was then permitted to submit a second version well after the deadline and it was this that won him the first prize of 300 Guineas. Elmes was then asked by the Council to explore different arrangements of the two buildings in relation to the site and Lime Street Station, it was also suggested that a new Daily Courts Building incorporating a Bridewell might be included in the development.

While Elmes was considering the various possibilities, the Concert Hall Committee realised that it had not raised enough capital for the building and approached the Law Courts Committee with the suggestion that the two buildings should be combined and the costs proportioned between them. Elmes was asked to consider the possibility of combining his two buildings into one and the various options were considered by a joint meeting of the two committees. This meeting agreed to the combining of the two buildings and it was only at that stage that Elmes began to design the building we see today. Elmes was by then 27 years old.
Eventually the Law Courts Committee agreed to undertake ‘the whole outlay of the erection and future management’ and all subscriptions made to the Concert Hall Committee were returned to the donors.

At a meeting with the Law Courts Committee in April 1841, Elmes requested that Dr David Boswell Reid of Edinburgh should be appointed as ‘Ventilator’ for the building. Reid had designed a very successful system for the Temporary House of Commons, which had been hastily erected in 1835 following the disastrous fire of October 1834. Reid had delivered many lectures on the subject of ventilation while he was in London and Elmes is likely to have attended some of these.

In 1844 Reid published a 350 page book ‘Illustrations on the Theory and Practice of Ventilation’ and the frontispiece of this carries a sketch of St George’s Hall with the proposed Daily Courts Building closing off the North end of the public forum. What is striking about this is the fact that at the rear of the Daily Courts Building is a ‘Tower of Wind’ about 200 feet (60m) high, which was to provide ventilation exhaust and chimney exhaust for both buildings. This involved all extract air and all chimney exhausts in St George’s Hall being taken down into the basement and then through tunnels under Shaw’s Brow (now William Brown Street) before passing up through this tower. A furnace would have been burned at the base of this tower to provide the necessary updraft, this was similar to the system employed in the Temporary House of Commons. A perspective sketch by Elmes shows the Daily Courts Building surmounted by a massive dome as an alternative, very similar in appearance to the dome on the Capitol in Washington, which was not built until at least 10 years later.
Elmes’ Perspective Showing Wind Tower Behind Daily Courts Building  
(Shown on the right is John Foster Senior’s facade to Lime Street Station)

The fact that Elmes requested Reid’s appointment as early as 1841 and that the above sketch appears in Reid’s book of 1844 discounts the suggestion of some writers that the building was originally designed without a ventilation system and that this was ‘added’ on the recommendation of Dr William Henry Duncan, the City’s Medical Officer of Health. Duncan was not appointed to that post until January 1847.

Elmes early diagrams clearly show all fireplace chimneys turning downwards and much of the basic building work on St George’s Hall had been done (in fact the principal floor level had been reached) when the plan to build the Daily Courts was abandoned and it is much to the credit of Elmes and Reid and to the cooperation between them, that the ventilation system in the finished building worked so effectively. However, Reid points out in his ‘Building Handbook’ that this late change in arrangements caused some difficulty with the provision of an adequate and controllable supply of air to some of the ancillary rooms, such as the Barristers’ Library and the Vice-Chancellor’s Court.

Reid’s System and its Operation

All of the features Reid had outlined in his book as essential for the successful application of ‘systematic ventilation’ were incorporated into the warming (or cooling) and ventilation arrangements for the principal spaces. The main driving force was a 10 hp (12kW) steam engine driving four vast paddle fans 10ft (3m) in diameter, with blades 5ft (1.5m) by 2ft 6in. (0.75m). By varying the speed of the steam engine and changing the number of fans operating at any one time, the air supply rate could be varied from 1 000 ft³/min to 50 000 ft³/min (0.5m³/s to 25m³/s).

The two main fresh-air intakes are on the East side of the building at either end of the East portico. At that time St John’s Church (and, more importantly, its graveyard) were still adjacent to the west side of the building and so Reid was desperate to avoid the possibility of
smells from the graveyard permeating into the building or coming in through the intakes of his ventilation system. Fountains operated under these main air intakes to ‘wash’ the air (in fact, although Reid had made provision for these two fountains, they were not installed until a few years later) and the air then passed through the vast undercroft before reaching the steam engine and fans. Reid was well aware of the temperature moderating influence of this labyrinth of masonry, was this, perhaps, its main function?

The undercroft is about 40ft (13m) high

The air was heated by means of two hot water boilers and two steam boilers, all fuelled by coke – Reid was very conscious of the health problems associated with chimney smoke in cities. The two main heating coils (the Great North and the Great South Water Apparatus) consisted of 72 x 4in. (100mm) steel pipes about 30ft (10m) long. There are two smaller coils for heating the Small Concert Room and the North Entrance Hall and one for the South Entrance Hall. This latter coil is now part of the display in the new Heritage Centre opened in 2007. In addition there were 27 pipe coils heated by the steam boilers. In very hot weather cold water from the Town Main could be passed through the heating coils to provide cooling and then discharged into the drain.

The Diagrams on the following page have been taken originally from Reid’s instruction manual given to Liverpool Council in 1855. These copies are from reproductions in a paper by William McKenzie, the first engineer employed to be in charge of the operational control of the system. The paper was delivered to the Institution of Mechanical Engineers in the Small Concert Room in 1863.
Fig. 1. Longitudinal Section of St. George's Hall, Liverpool.

Fig. 2. Basement Plan of St. George's Hall, Liverpool, at level of Upper Air Channels

Fig. 3. Basement Plan at level of Lower Air Channels

Plate 56.

MECHANICAL VENTILATION AND WARMING

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(Proceedings Inst. M.E. 1883, Pages 194)

Scale 1:500

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(Proceedings Inst. M.E. 1883, Pages 194)
Part Section from Reid’s Instructions

Main Air Intake at North End of East Portico
The steam coils were only to be used in extremely cold weather because of Reid’s belief that heating the supply air to a very high temperature was detrimental to comfort. However, in winter, the steam coils would be employed for pre-occupancy warm-up. This was effected by closing all the normal escape routes for vitiated air and re-circulating the air to the fan chamber by allowing the flow to be reversed through the low-level supply grilles in the Great Hall. Humidification was obtained by direct injection of steam into the air stream under the main heating coils. Reid insisted that this steam must come from a separate boiler used solely for that purpose and that only copper pipes were to be used in association with it.
A complicated system of ducts and ‘valves’ allowed treated air to be sent to any combination of the principal spaces or where a very rapid warm-up was required, all four fans could be made to operate on a single space. The ‘valves’ in this case are large doors of sized canvas over a timber frame. Wooden louvre dampers and canvas roller blinds were used for fine-tuning.

Supply from the main system into all the principal rooms is at low level but the system allowed supplementary (untreated) fresh air to be introduced directly as required. Vitiated air was encouraged to escape from the Great Hall into the roof space, the roof having louvres round all four sides (but below the parapet). Extract grilles, with openable flaps above, were skilfully incorporated into the ceiling decoration. The roof louvres were controlled so that only those facing away from the wind direction would be opened.

All other principal rooms and many of the ancillary spaces had their air extracted into four main vertical extract shafts, one next to each corner of the Great Hall. Each of these also contained a boiler flue. Fish-tail gas jets could be burned at the bottom of these, or in one case, a coke brazier, to boost the buoyancy of the air and increase the extract rate. Chimney flues from those rooms with fireplaces, were fed into a separate vertical flue alongside these shafts and again, when necessary, a coke brazier or gas jet could be ignited at the bottom of these vertical flues.
Position of Gas Jet in Extract Shaft

The rate of extract from the Court Rooms could be closely controlled by adjusting flaps in the roof space. For the two Courts and the Small Concert Room it was possible, in warm weather, to allow vitiated air to escape directly out of the roof space.
Reid provided extremely comprehensive instructions for the successful operation of the system. These run to about 12 pages, approximately A2, and include almost 50 diagrams of the necessary arrangements. They are a veritable ‘Building Handbook’ and must say something about Reid’s pride and satisfaction in the building since there was no equivalent publication for Parliament. They include reference to the importance of regular (and recorded) maintenance, guidelines on the most economic modes of operation for different occupational requirements, hints on how to make maximum advantage of the thermal capacity of the vaults under the Great Hall and a recommendation that a log be kept of the settings required to provide equitable conditions for different numbers and patterns of occupancy.

Reid even gave a detailed specification of the person who should be put in charge of ensuring the correct operation for optimum comfort and energy efficiency. He said:

‘Those who may in future have to direct the ventilation of this great building, are presumed to have given evidence of their having paid special attention to the subject of ventilation; and the more they may have attended questions of practical chemistry bearing on warming and ventilation, as well as to natural philosophy, architecture, apparatus and machinery, the more eligible they must be considered for the appointment in question’.

The first person to be appointed to operate Reid’s systems was William MacKenzie, a member of the Institution of Mechanical Engineers. MacKenzie delivered a Paper to the members of that Institution in the Small Concert Room of St George’s Hall in 1864, where he described the system in detail and gave an account of how successfully it had operated. This Paper discusses Reid’s instructions and diagrams and acknowledges the reproduction of the diagrams, even using the same numbers as Reid. The same may not be said for Charles Honiball whose paper in the Proceedings of The Institution of Heating & Ventilating Engineers in 1907 is blatantly plagiarised from MacKenzie’s Paper and in which Reid’s diagrams are renumbered and presented as if they were Honiball’s own!

**Sources**

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