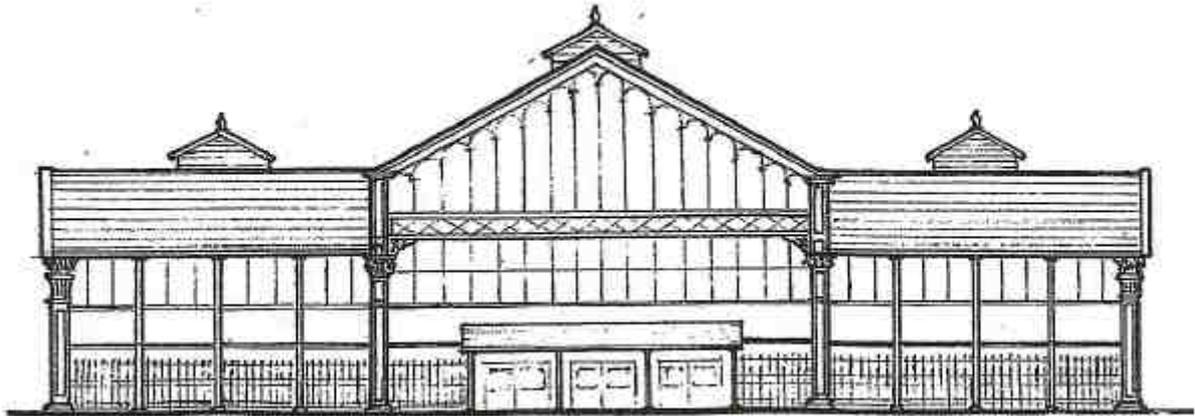


MANCHESTER ASSOCIATION OF ENGINEERS

An illustrated talk on the
CONVERSION
of
THE VICTORIAN CITY Hall
into the
AIR & SPACE MUSEUM

by **Hubert Dickson CEng. FInstrucE. MMAE**



Introduction

Numerous buildings, throughout their life span, are used for Various purposes other than that for which they were originally designed.

This is very much the case in respect of the 'listed' building which is now known as the Air and Space Gallery at the Museum of Science and Industry Manchester.

The paper/talk charts the changes in the structure and usage which have occurred, over the past 130 Years, to the building now housing the Air and Space Gallery. The fact that this Victorian building has remained standing, and continues to provide a worthwhile service to a wide section of the general public, is a testimony and tribute to the skills and abilities of its original designers, and ; those who have maintained, restored and, where necessary, enhanced the building throughout the 130 years of its existence

To understand the complexities of the building and appreciate the classic design of the structure, together with its architectural embellishments, we need to go back to the 19th century; to the point of its inception.

Background History

In 1876, the Manchester architectural practice of Mangnall and Littlewood was commissioned to design two open sided Market Halls in the Campfield area, on the south-west side of the city.

The site chosen for the halls was a parcel of land which, in the 13th century, had been the city's "fayre" ground, where regular trading events took place allowing people from the outlying areas to congregate and sell their produce, wares and home-made articles to the city dwellers and local merchants.

In 1820, however, the "fayre" ground was bisected by the erection of St. Matthew's Church, in the centre of the plot. (The church was designed by Charles Barry, `the architect responsible for the design of the Houses of Parliament) The church was opened in 1825, and demolished in 1952. The land on either side of the church was still used for trading and dealing, and, in the 1870's, it

was decided that covered areas should be provided for those still using the facilities as traders or buyers.

The two Market Halls, therefore, were designed as separate buildings, but similar in their style, construction and appearance. (See Fig. No.1)

These buildings were to be known as the Upper and Lower Campfield Market Halls; being positioned on Liverpool Road, either side of the church. The Market Hall nearest to Deansgate was denoted as Upper Market Hall, while the one set further along Liverpool Road, towards the west, was known as the Lower Market Hall. These two Market Halls opened for trading between 1878 and 1880.

Both buildings are still in existence to this day, and it is the Lower Campfield Market Hall, in particular, which is the subject of this paper/talk.

The Buildings

Historically, in England, most large towns had "Market Halls" rather than market places. These "Halls" were usually buildings of distinction; being of architectural design in decorative stonework, and standing in a prominent position near to the town centre.

In Manchester, in 1876, the task facing the architect was somewhat different; and there can be no doubt that when the practice of Mangnall and Littlewood deliberated over the design for the two new Market Halls, it must have been influenced by the fact that the gothic structure of Barry's St Matthew's church would continue to dominate the site.

Although the new buildings were to be open sided market halls, the architect endeavoured to produce an atmosphere of grandeur within the designs, which would equal that of the church.

Instinctively, the architect responded, and produced two "cathedral like" structures, with fifty foot wide cross aisles and curved arches forming the roof.

These arches were constructed to embrace the latest technology of wrought iron Latticeworks; providing an ambience of spaciousness and lightness, while rising 'up from the caps of slender cast iron columns to a height of 40 feet (12m) above the market floor. (See Fig.No. 2)

At the centre of the buildings, where the two main aisles intersect, forming a cross, the latticed arches span 75 feet (23m) diagonally across this intersection, thus achieving an internal dome like appearance.

The market halls are also provided with two side aisles which run either side of, and parallel with, the main aisle; extending the whole length of the buildings. The roofs to the side aisles are supported on wrought iron roof trusses of 35 feet (11m) span, embellished with ornate cast iron struts. The trusses are carried on the feet of the main arches and span onto lattice girders and/or cast iron Columns along the external sides of the buildings.

Atop each archway and side aisle, there is a raised lantern light which extends continuously along the length of the buildings. These lantern lights are supported by ornate cast iron frameworks, and are roofed over with patent glazing. The general roof covering is formed by slating, resting on battens, which in turn are fixed to 'herring boned' timber boarding. The underside of the boarding forms the ceiling to the halls, and is carried on stout wooden rafters, which span onto longitudinal WI lattice girders.

The architect has further enhanced the interior of the market halls by providing each column cap with 'Corinthian Capitals', stylised with acanthus leaves and floral decorations, all intricately sculptured in cast iron. Each face of the 'Capital' is surmounted by a rose motif, and this feature has also been used to embellish the vertical faces, both internally and externally, of the square shaped cast iron columns around the buildings.

In keeping with the standard tradition of the time, the floors to both market halls were constructed from large 'flag' stone paviers resting on punned earth. At the time the City Hall was created it was decided to make the Hall secure providing, around the open sides, an ornamental wrought iron railing. Each length of railing to be fixed between the intermediate external columns.

It is interesting to note, that, although many changes have taken place to the building throughout the years, this feature has been retained, in its original format, up to the present day.

The City Hall

At the end of the 19th Century, the "Manchester City Council were in control of the two Market Halls, and, in 1900, the City Council decided to close the Lower Campfield Market Hall, and redevelop the Building as an exhibition centre. Plans were drawn up for the complete revamping of the building, including the need to fill in the open sides of the original market hall, to provide a fully enclosed and weather tight structure.

Also incorporated, in the new design, was a small upper gallery, measuring 6 feet (1.8m) wide and set 10 feet (3m) above the ground floor level. This gallery was made continuous, to run around the full periphery of the new hall, with access staircases provided at each corner of the building.

The stone flagged floor remained untouched, but was eventually covered over with a screeded topping.

An entranceway into the exhibition hall was created in the east gable facade, and this feature was enhanced with an external, canopy-type, covered over porch way. (See Fig.No.3)

'the new 'City Hall' was opened in 1902.

Its success as an exhibition centre was immediate; offering displaying facilities, and ample floor space for Manchester's growing textile, engineering and commercial industries to advertise and show off their products.

The City Hall's popularity, in the early years, prompted the City Council to commission the enlargement of the upper gallery. This improvement took place in 1910. The existing gallery was taken down, to make room for the new balcony. This new balcony, like the previous gallery, was built around the entire periphery of the hall and cantilevered out over a row of new supporting cast iron columns; providing a 15 feet (5m) wide platform: thus adding an extra 10% of displaying area to the 30,000 sq.ft. (275 sq,m) already available.

Throughout the 1920's and 30's the City Council engaged the services of a company, specialising in promotional activities, to organise, manage and run the various exhibitions on their behalf.

This company was successful in maintaining a steady flow of annual trade shows, demonstrations and public orientated events/exhibitions, which were all popular and well attended. It is a known fact that one such exhibition ran until 7pm on Saturday 2nd September 1939 ; on which date, and at that time, the City Hall closed at the outbreak of World War II.

However, the hall did not remain idle during the years of conflict; its facilities were called into use on a number of occasions. It is recorded that, because of its size and spaciousness, the hall was used for the manufacture of "barrage balloons".

Remarkably, the City Hall survived the intense 'Manchester blitz and bombings in the early 1940's. It suffered only superficial damage to glazing and some external finishes.

When hostilities ceased in 1945, and life returned to normal, the City Hall was refurbished, and , by 1947, exhibitions were once again being held within its walls.

The next two decades were probably the most successful in the history of the City Hall as an exhibition centre. The increase in trade around Manchester, and the vitality of the docks at Salford, immediately following the war years, led to more 'trade' orientated exhibitions being presented. At this time the general public were

beginning to clamour for more 'contemporary' items around their homes, including furniture, fabrics and wall decorations; to this end, the organisers presented the "Brighter Homes" and "Ideal Homes" exhibitions at the hall. These exhibitions proved so popular with the public, they were repeated on an annual basis.

The City Hall, with its historical background and Victorian style of architecture, prompted the City Council to seek "listing" from English Heritage. Eventually, the building's attributes were obviously recognised by English Heritage and on the 17th May 1974, the City Hall was declared a Grade II Listed historical building. Shortly after being listed the boom in demand for exhibition space declined, owing to the economic downturn in the mid-1970's and sadly, in 1977 a catastrophe struck the City Hall.

During the course of one exhibition a fire broke out in the restaurant area at the end of the building and although dealt with quickly by the Fire Brigade, substantial damage was caused internally, and areas of the roof were affected. The City Hall was, therefore, CLOSED!

The Political Equation.

Following the fire and closure of the City Hall, there was a period of indecision, during which the Manchester City Council deliberated over what to do with the Victorian building.

Various options for its potential use were considered, but it soon became obvious that its days as an exhibition centre had run out.

Belle Vue had taken over to fulfil the demand for exhibition facilities in the Manchester area.

The new National Exhibition Centre, in Birmingham, had opened in 1976, and the Greater Manchester Council were already considering using the defunct Central Station railway building as a major exhibition events venue.

The Manchester City Council politicians were, therefore, faced with an enigmatic problem that had to be solved in some way.

In 1978, the City Council became so concerned about the demise of the City Hall, it actually considered demolishing the building and releasing the land for an alternative development. This was a serious proposal, so much so, that an Application for Consent to Demolish a listed Building had already been filled out. The Council, however, decided to put the application on hold, for the time being, until further proposals had been considered; thus, buying valuable time for the future of the City Hall.

At this time, Councillor Norman Morris was the Leader of the Manchester City Council, and he took a personal interest in the future of the City Hall. He was eager to find a positive new role for this fine Victorian building.

During 1975, a variety of suggestions were considered, including the idea of using the City Hall as a maintenance workshop for the North West Museum of Science and Industry, or, alternatively, making use of the space for storage of the museum's larger items of machinery, which were now becoming available as historical artefacts

One drastic suggestion was to excavate the floor area, inside this City Hall, in search of Roman ruins. Fortunately, this option was never adopted!

In its wisdom, the City Council decided, in 1979, to set up a special subcommittee to consider all possible, or feasible, ideas for the use of the City Hall. At the same time the City Architect was instructed to prepare an estimate of costs for the restoration of the building.

At this point in time, someone within the Town Hall put forward the suggestion that the City Hall might be converted into an "Air and Space Museum", which would portray the involvement of Manchester and the Northwest region in the development of flight and flying machines.

The idea was considered credible by Councillor Morris, and an approach was made to the Director of the RAF Museum, at Hendon, for information on how the project could be set up and moved forward. The Director was delighted to help the City Council, and offered to loan a number of planes and accessories, which he had in storage. These items could be made available for displaying in the proposed Manchester Air and Space Museum. The proposal was put to the City Council on January 1980, and was unanimously accepted.

In the meantime, the City Architect had produced the estimate of cost for the restoration of the building, with additional costings for the likely work needed to turn the City Hall into a viable Air and Space Museum.

These estimates of cost were set at £1.2 million with a further on cost of £0.65 million for fitting out the museum.

Subject to satisfactory financial arrangements being made to meet the costs, the City Council gave its approval to the proposed scheme. The 'political equation' had been solved and, henceforth, the City Hall would be known as the Manchester Air and Space Museum.

The Engineer's Problem

To enable the City Architect to produce his estimates of cost, it was essential for a survey to be made of the existing fabric and structure of the City Hall. Naturally, with a building of this character and age, a number of problems were identified. One such problem was that of movements at the head of the columns supporting the large wrought iron arches. The amount of movement varied from as little as ½ inch (15mm) to a significant 1 ½ inches (35mm) at some locations. The greatest single outward movement recorded was at the cap of the square cast iron columns supporting three separate arches, at the point where the two aisles met and converged. A displacement of 2 ¼ ins.(55mm) was noted at the end of the 75 feet (23m) span diagonal cross arches. (See Fig. No. 4)

Obviously, these movements gave cause for concern, basically because it was not clear when these movements had occurred; whether they were of recent origin or had, in fact, accumulated over a period of time. Nonetheless, the arches had spread out laterally, at their springing positions, and there was a possibility that they would continue to move in the future. If the building was to be restored, for long term usage's, then it was imperative that this movement should be investigated and, if possible, arrested.

At this stage, the City Architect's structural engineers carried out an analytical check on the design of the 50 ft. (15.3m) span wrought iron lattice arched member, and were astonished by their findings. Technically, the arched frameworks were found to be just adequate to carry the dead weight of the roof coverings, with little capacity left over to cope with incidental loadings, such as maintenance loads, heavy snow falls or strong gale force winds.

It is not known who was responsible for the engineering design of the Market Hall structures, but, by today's standards, they would fail to meet the requirements of the current British Standards in respect of incidental loadings.

It is known that the company of E.T.Bellhous & Co. of Manchester, were responsible for some of the cast iron work and wrought iron fabrications, but there is no documentary evidence to indicate that they were responsible for the overall Engineering design and analysis of the structures.

In 1876, the theory of arched structures was well documented, including the fact that a horizontal thrust occurs at the springing level of the arch when acting under loaded conditions, This horizontal thrust was usually resisted by a robust bulwark, or, where the arch was supported on a column capping, a metal tie would be introduced at the springing point, to prevent the tendency for the arch to spread.

In the case of the Market Hall/ City Hall structure, no metal tie bars were included in the initial construction process and the thrust from the arches, as they flexed, should, therefore, have been resisted by robust frameworks built at each side of the main aisles. This did not happen. (See fig.No.5)

The side aisles are single frameworks, roofed over by wrought iron trusses, with only slender members forming their frames; these provide little or no 'stiffness' to the overall integrity of the structure.

The structural engineer carried out a further site inspection of the frameworks, and discovered that a number of the sloping rafters of the side trusses were buckled, at, or adjacent to, the apex of the truss. The conclusion was, therefore made that the unrestrained horizontal force, from the arches, had passed into the adjacent roof trusses, and had been resisted, to some degree, by the rafter member, which had distorted under the additional compressive force.

The structural engineer reported these findings to the City Architect, and pointed out that these defects, having occurred, could not be rectified; but the situation could be resolved by following a set of remedial actions:-

- (i) To provide metal tie bars at the springing level of all the curved arches, to hold them in their present position, and prevent any further lateral movement taking place in the future.
- (ii) To introduce a restraining member at the apex of the side aisle trusses, to run across the ridge point and tie each rafter together to prevent further buckling taking place.
- (iii) Sore consideration was necessary, during the restoration process, to reducing the overall dead weight of the roof coverings, in order to meet the present day statutory requirements for superimposed loadings.
- (iv) If these recommendations were not accepted it could result in the structures being classed as unacceptable under current Building Regulations.

The City Council took note of these recommendations and agreed to the strengthening works being carried out, as quickly as possible, ahead of the restoration works. Accordingly, a sum of £70,000 was made available, to carry out the tying work to the structure, and also for the clearing of the drainage system. These holding works were commenced in the autumn of 1980.

Conflict of Interests

The holding works were well advanced when the Main Contract for the restoration work was handed to John Laing and Company early in 1981. At the same time, English Heritage were officially notified of the restoration proposals that were to be carried out on their Grade II Listed Building. Understandably, English Heritage wanted to ensure that the listing of the Victorian building was not compromised by any of the restoration/conservation works.

Accordingly, an independent architect was appointed, by English Heritage, to oversee the various items of work, and represent their views on site. During the architect's initial visit to the site, serious concerns were raised about the tying of the arches. The installation of the ties had been carried out prior to the architect's appointment, and it was pointed out that the ties were a contravention of the original 'listing' of the building. The architect considered the ties to be detrimental to the general ambience of spaciousness within the Hall, and may have impinged on the 'listing' criteria.

A request was made for the ties to be removed forthwith and the structure returned to its original state.

However, when the tenuous nature of the structure was pointed out to the architect, the decision was taken to seek the opinion of an independent engineer, in order to resolve this early conflict of interests. The English Heritage engineer reviewed the design analysis, and agreed with the views expressed by the City's structural engineer. The need to hold the structure against further movement was accepted, as was also the installation of the metal tie bars.

However, the English Heritage engineer put forward an alternative proposition; he suggested that the tying of the two diagonal arches, across the intersection of the aisles, may not be necessary. (These particular ties had not been fixed in position at this time - although the anchoring brackets for the ties were already fitted to the arches). The engineer's argument was that the ties already fixed to the shorter span arches formed a "square" of ties, around the intersection area, and should be sufficient to hold the springing points of the larger arches in position.

This opinion was countered by the Town Hall structural engineers, because the greatest movement had been recorded at the base of one of the diagonal arches, but as the Council did not wish to appear uncooperative, a compromise suggestion was agreed upon. The compromise proposal was to undertake a monitoring of the larger span arches, over a specific period of time; to assess if any significant movement was taking place. After a twelve month period no adverse movements had been detected at the cap level of the four square columns it was therefore conceded that the diagonal ties could be dispensed with, and would not be fitted across the intersection of the aisles.

A similar complaint was raised, by the English Heritage architect, regarding the restraining ties fitted across the apex points of the side aisle trusses, with a request for their removal; but the visual evidence of the buckled rafters, and the independent engineer's agreement to the installation of the ties quickly negated any further action over this particular complaint. Figure No. 6 Depicts the various parties involved in the restoration/conversion of the City Hall, and indicates the manner in which each party leaned or pulled towards their own agenda.

At the outset of the restoration proposals, the City Architect assigned two of his most experienced staff architects to undertake the task of overseeing the restoration works and co-ordinating the design of any conversion works required to meet the needs of the Air and Space Museum.

As work commenced on the site discussions were held between the English Heritage architect and the City Architect's representatives, to determine the nature and extent of the restoration work. It was at this point that further conflicts of interest became apparent and needed to be properly resolved before the works progressed too far.

One significant problem arose from the inability of the wrought iron arches to accept any additional loadings. In order to meet the present day statutory requirements, the structural engineer had found it necessary to impose a loading limit on the arches, which precluded the use of heavy natural slate from being used as a roofing material. Same lighter cladding material would have to be utilised as a substitute.

The English Heritage architect was insisting that the restoration works must be as the 'status-quo', i.e.. the roof must be restored as originally constructed. The Town Hall architects maintained that this was not possible, and a compromise was essential to move the works forward. Eventually, the issue was resolved by adopting mineral fibre slates, which were half the weight of natural slates, and would still provide an acceptable slate type finish to the roof.

The loading imposition was also contentious to the Air and Space design team, who had assumed that they would be able to suspend a number of their exhibits from the roof supporting beams and arches. However, under the imposition, heavy exhibits were prohibited, but smaller, Lighter items, such as kites and 'hang gliders' were considered to be acceptable.

A second major problem materialised when the Air and Space Museum accepted the offer of a Shackleton, four engined, aeroplane from the Ministry of Defence (via arrangements with the Director of the RAF Muse-

um). This huge aircraft, with a wing span of 119ft (36.5m), had to be brought into the building and manoeuvred into a salient spot. Getting the aircraft into the existing structure would be the problem. Originally, a large entrance door was located in the south gable wall, sited at the central position of the cross aisle. The entrance gave access for pantechincons to deliver large display items for exhibition purposes. Sadly, the existing entranceway was of insufficient size to accommodate the four engined aeroplane. The Council's architects were faced with no other alternative but to increase the size of the opening; and this is where the conflict arose.

The architects and the Air and Space team wanted to leave this enlarged entrance as a feature - to facilitate the removal and acceptance of the larger aircraft for display. The idea was to provide a demountable glazed frontage, which could be readily removed, and would also allow the passers-by to view the exhibits inside the museum.

The English Heritage architect rejected these proposed changes to the original Victorian facade; only agreeing to a compromise, whereby the features of the original facade would be rebuilt and retained, but the lower level would be infilled with clear glazing, instead of brickwork, and the wrought iron railings would not be replaced across the opening.

Other areas of minor conflicts emerged as the works progressed, mainly regarding the cast iron embellishments around the building, some of which had broken, cracked or simply disappeared. These defective embellishments were eventually made good, except for three or four of the larger ornate cast iron brackets, which supported the lattice girders across the end gables of the aisles. It was contended, by the iron founder responsible for remaking the defective embellishments, these large brackets were of such an intricate nature that it would not be possible to accurately reproduce the patterns without removing one of the remaining brackets from the building. This was not considered to be a viable option, and the existing modern brackets were, therefore, not replaced. (See photos No's 1 to 4) The pursuit of the various conflicts of interest tended to retard the progress of the work on site, until they were properly resolved, and so created problems for the Main Contractor, who found it difficult at times to maintain a steady flow of site work for his work force. However, every effort was made to meet the target deadline in 1983, and this was, happily, achieved.

Setting up the Air and Space Museum

Following its decision, in 1980; to revamp the City Hall building and create an Air and Space Museum, the City Council took a further move forward by setting up a special Trustee Committee, under the Chairmanship of Councillor Norman Morris; with other politicians and senior Council officers making up the committee. The Director of the RAF museum at Hendon was also included as an 'ex-officio' member of the committee.

The Trustee Committee was the driving force behind the new venture; being the decision making body which would oversee all the financial and legal aspects of the project. The committee quickly set the date for the opening of the Air and Space Museum as Easter 1983; and every effort was to be made to ensure that the target date would be achieved.

Figure No..7 depicts the interaction between the Trustee Committee and the Design teams. Two separate design teams were employed to create the new museum, and were drawn from independent sources. One was formed from the staff of the Royal Air Force Museum at Hendon, under the direction and control of the Director. This team concentrated on the types of aircraft that would be made available as exhibits, and also set down the proposed location and positioning of each aircraft within the display gallery; together with the arrangement of pathways, to be followed by the public, through the museum.

The second team was composed of the architectural staff assigned by the City Architect for the restoration works on the old hall. The team's task was to co-ordinate with the RAF design team to ensure that all the conversion works were feasible and compatible with the general ambience of this building, while also complying with the current statutory regulations. The team was also responsible for liaising with the English Heritage architect to make sure that none of the conversion works compromised the 'listing' of the building in any way.

At the end of 1981 the Ministry of Defence, through the Director of the RAF museum, made it known that a Shackleton four engined aeroplane was due to be decommissioned during 1982, and could be made available as an exhibit in the new museum at Manchester.

The problems associated with huge aircraft have been outlined earlier, but it is worth recording that, in order to bring the Shackleton into the building, it had to have each of its wings dismantled back to their intersection with the two inboard engines. This reduced this 119 ft (36.5m) overall wing span down to a manageable 46ft (14m); which was just sufficient to allow the plane to pass through the specially enlarged opening in the south gable.

Although the allocation of the Shackleton to the museum was good news, the conversion process did not run too smoothly for the Trustee Committee. In the spring of 1982, it was considered that the Ministry of Defence, and the administrators at Hendon, were "dragging their feet" over a number of legal and financial agreements relating to the leasing of some of the aircraft to be displayed.

The Trustee Committee were so perturbed, by the procrastination's, that it felt the whole museum project could be in jeopardy and recommended to the City Council that the conversion works should be put on hold until the situation could be clarified. The restoration work was to continue, but no further work was to be undertaken on the museum project.

Fortunately, the problems were resolved by the summer of 1982, and the conversion work was allowed to continue.

At about this time the Trustee Committee decided to appoint a Director/Curator for the Air and Space Museum, who would be able to take over the responsibility for the day-to-day management, organisation and running of the museum with immediate effect. Suitable applicants were interviewed for the post, and the Directorship was finally awarded to Peter Baston, a former curator with the North-west Museum of Science and Industry at Grosvenor Street.

Throughout the latter part of 1982 there was a flurry of activity as the conversion works were carried on at a pace. Under "Mr. Batson's direction the exhibition aircraft started to arrive and take up their appointed positions in the gallery. However, the Ministry of Defence again delayed matters by not decommissioning the Shackleton until the end of November 1982; thus creating a 'knock-on' effect with the progress of the restoration and conversion works. The Shackleton aircraft was finally delivered to the museum (in bits and pieces) at the turn of the year.

This unexpected delay caused the Main Contractor, John Laing, to be placed under intense pressure to complete their part of the restoration works within the target time.

With less than three months to the opening date, after the Shackleton had arrived, the contractor was faced with the task of re-forming and making good the enlarged entranceway, (to the satisfaction of both the English Heritage and the City architect's representatives plus the rebuilding of that portion of the balcony that had been removed in order to provide adequate access to the enlarged entranceway. This was no easy task, when all these works had to be undertaken at the same time, and in the same location, as the team of RAF fitters worked on the re-assembly of the Shackleton.

However, after almost six years of controversy, conflicts and administration uncertainties, the restoration and conversion works were finalised within the target time. All the aircraft were in their allotted positions, and the Shackleton was ready to be displayed as the museum's "piece de resistance".

The Manchester Air and Space Museum was officially opened on Tuesday 29th April 1983.

The Sting at the End of the Tale

Like all good stories, the Air and Space museum saga has a sting at the end of the tale. In the Spring of 1984, just twelve months after the official opening of the Museum, one of the major sponsors withdrew their financial support for the project.

This left the City Council facing an immediate deficit of around £50,000 towards the administration of the museum. The Council had no alternative but to accept the situation, and seek out another sponsor. This was not easy, and, after six months, the City Council requested the Finance Subcommittee and the Museum Trustee Committee to review the situation, and put forward proposals for the future funding of the museum.

By the end of 1984, the only viable option was to offer the new Air and Space Museum to the Greater Manchester Council, to be taken into, and become part of, the larger Museum of Science and Industry.

So, after spending over £2 million on restoration and conversion works, the City Council simply handed everything over to the Greater Manchester Council during December 1985.

Author's Footnote

This fine, 19th Century, Victorian building, with its fascinating historical structure, pre-dates all of the exhibits on display in the museum; and could continue to give service to the general public well into the 22nd Century.

Hubert Dickson CEng. FStructE. MMAE.

Appendix

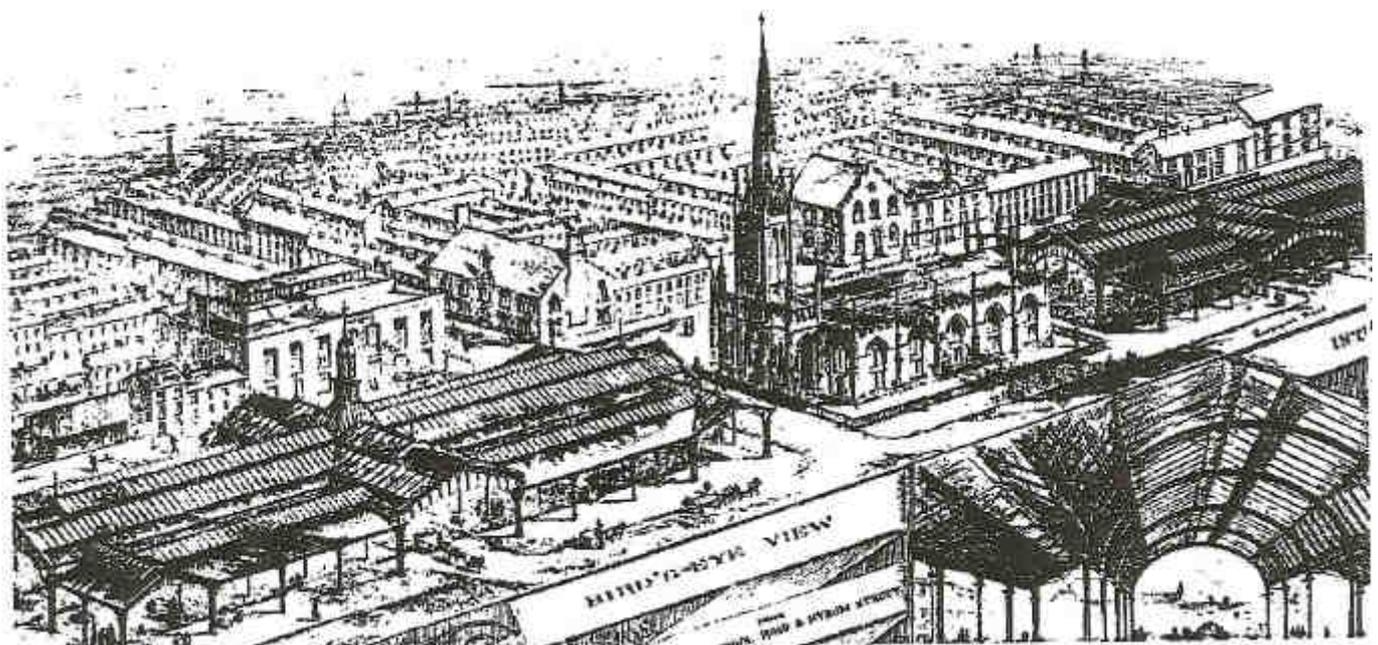


Fig 1



Fig 2

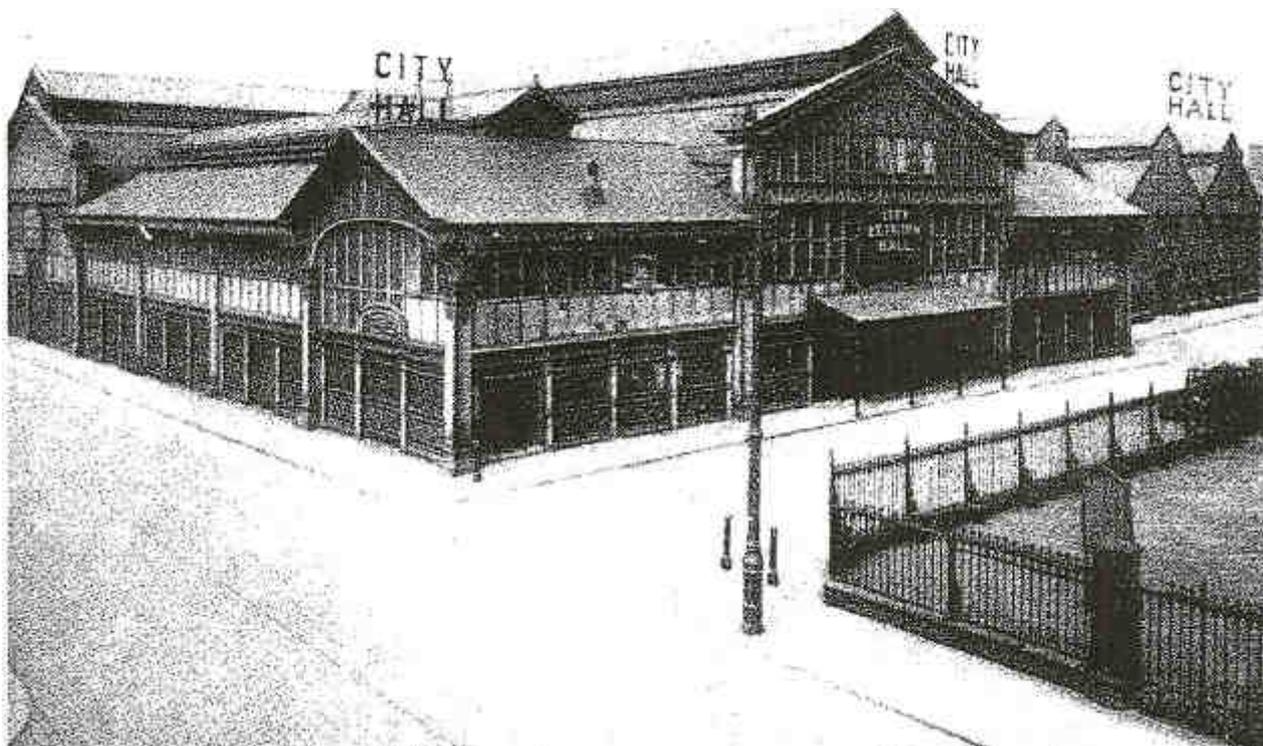
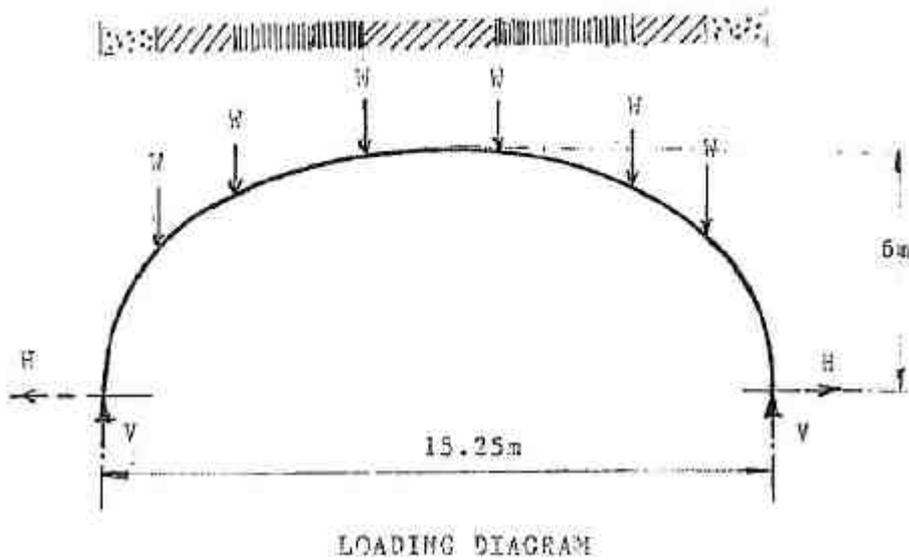
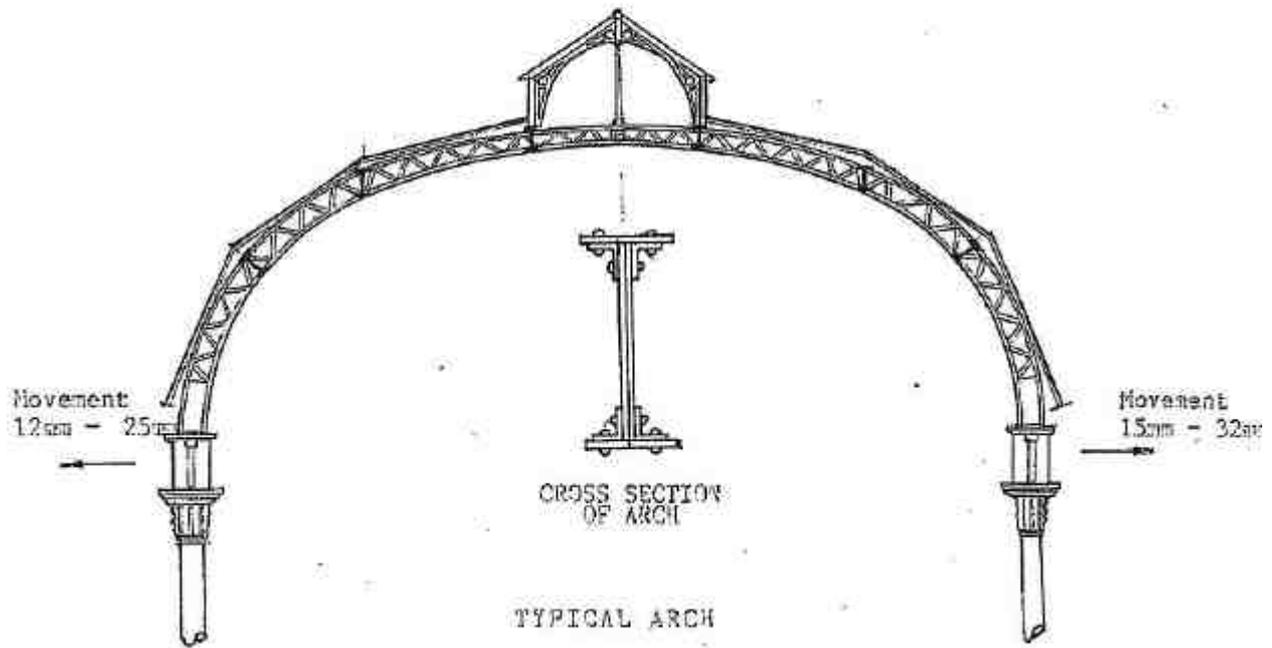


Fig 3

Fig 4

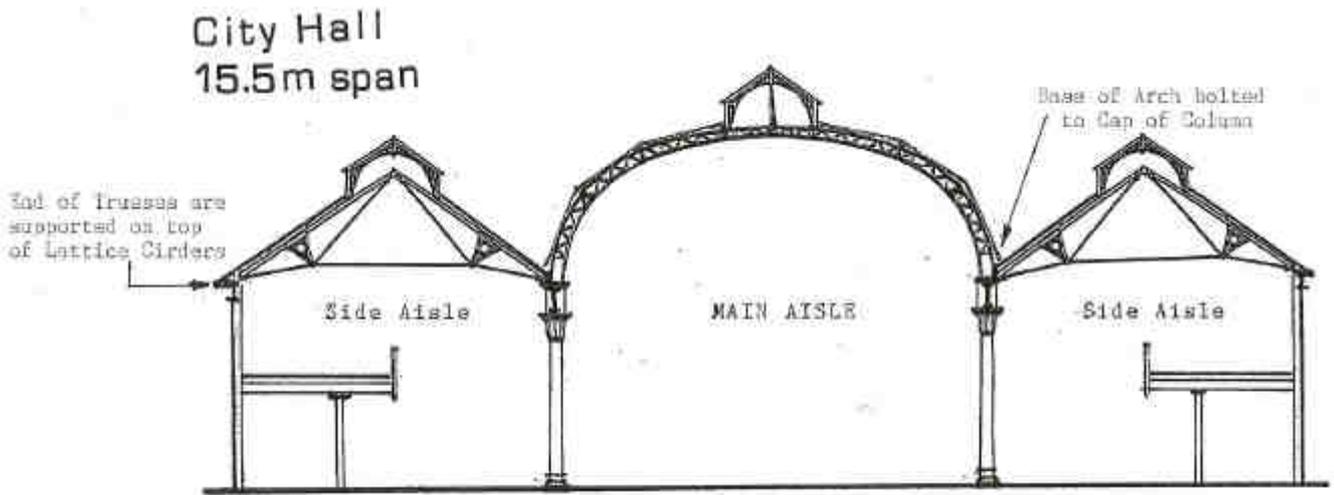
ANALYSIS of the ARCH



Variations in Superimposed Loadings

-  0° - 30° Intense 15 lbs/sq.ft
-  30° - 35° Moderate 13 lbs/sq.ft
-  50° - 57° Nominal 3 lbs/sq.ft

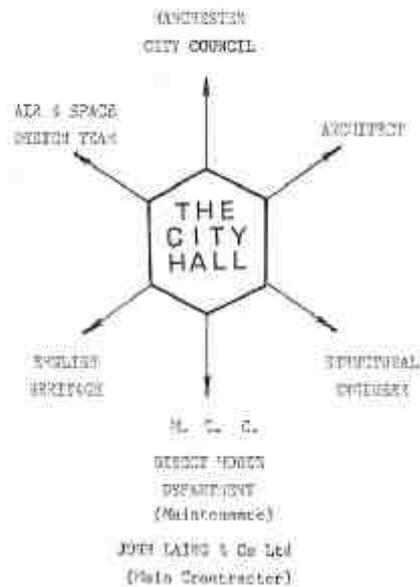
Fig 5



TYPICAL CROSS SECTION

Fig 6

CONFLICT OF INTERESTS

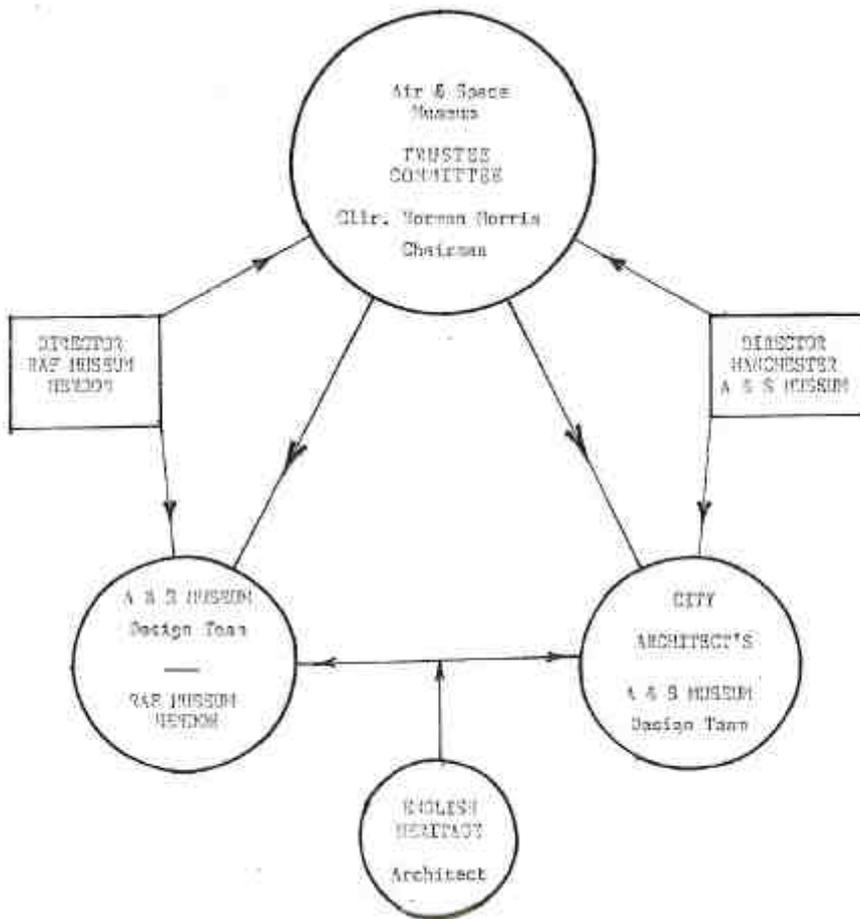


MANCHESTER AIR & SPACE MUSEUM

Fig 7

ADMINISTRATION - DESIGN - DISSEMINATE

INTERACTIVE MODEL



1



Corinthian Capital on a Square Column
Note the bases of three arches springing from
the column, with the tie bars and brackets.

2



View of Corinthian Capital on
Circular Column.

Note the W1 Lattice Girders
and base of the arch resting
on the column, with the tie
bar and bracket in position.



View of an ornate cast iron bracket supporting the Eastern Gable WI Lattice Girder.



④

Fabricated welded mild steel bracket on the Western Gable as a substitute for the original ornate cast iron supporting bracket.

5



View of South Gable
With the 'Historical Railings' replaced by
full height clear glazing.

6



External Columns.
Showing the 'rose'
embellishments and
'Historical Railings'.