Manhire Associates
CONSULTING ENGINEERS

Design Note

Project:	Whitworth Locks/Atrium Apartments	Project No.:	16046
Title:	Ventilation Ductwork Routes	Design Note	001
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1. Introduction

This Design Note considers the proposed ventilation ductwork route options relating to proposed A3/kitchen units within Whitwork Locks/Atrium Apartments, Manchester. The design note particularly considers the option of internal routing and the difficulties in forming voids and penetrations in existing building fabric.

2. Existing Buildings

The Atrium Apartments essentially consist of three interlinked buildings of slightly different construction 'vintage', and design. The buildings are known colloquially as: Dominion Left and Dominion Right; Central House, and; Johnson House. For the purposes of this Design Note, the exact age and type of the buildings is less important, but the buildings generally date from late C19th, and are quite typical of the appearance and form of buildings constructed for light industrial purposes in Manchester at that time.

Broadly speaking, the buildings consist of solid load bearing brickwork envelope walls, with an internal structure of cast iron columns, and cast iron and timber beams. The basement construction is either cast-iron or timber beams, or in some cases masonry (brick) jack arch vaults supporting on encased cast iron columns. Floors are generally constructed from very thick floor boards (3inches/75mm thick) sitting on and spanning between primary cast iron beams and secondary timber beams.

Foundations to columns where exposed are solid stone blocks. The roofs of all buildings are some form of timber truss with slate finishes.

Generally vertical access through the building is limited to stair wells and lift shafts. The lift shafts have often been installed within existing stair wells, or within appropriated brick shafts previously used as vertical access during the buildings industrial past.

3. Existing Building Condition- summary

The existing building was originally used for some form of light industry, as betrayed by the sizes and form of supporting structure within the floors and wall. Simply put, the 'design' of the build relied on the mass of the structural elements to resist the loadings in use.

The building has had a variety of uses over time, and there has been areas subject to significant 'cutting and carving' of the building fabric. There are instances where significant areas of existing building fabric have been removed and left in a poor condition. Brick vaulting to jack arch floors have been removed and poor remedial work completed. Beams have been cut and voids formed that have resulted in noticeable deflection and sagging. The purpose of this Design Note is not to describe all defects, but the condition of areas of the building can be summarised as being is a state of distress as a consequence of previous works.

4. Proposed Ventilation Ductwork Route- internal route option

It is understood that the requirement to mechanically vent the proposed A3 unit kitchens results in ductwork in the order of 1100mmx600mm. There are associated requirements for both fire stopping between floors and acoustic attenuation. It would seem reasonable that such requirements would add a minimum of 100-200mm to all sides of the proposed duct resulting in an effective cross-section of 1500mmx1000mm maximum.

The proposed A3 kitchen units are within Dominion Right basement and the proposed ductwork route is indicated to us as running along the soffit of the floor above toward Dominion Left, in the order of 26m in length. This route takes the duct through two primary load bearing walls, of which one has already been subject to some previous structural work.

5. Structural Commentary on proposed duct route

The structural performance of the building can be broken down into two elements:

a) Performance under gravity loads;

b) Performance under lateral loads. Lateral loads can be considered as wind load and loads derived from eccentricities within the building construction, and/or a combination of same;

There are also local effects of loading and stress that affect 'element' capacity.

A load bearing masonry building of this type relies on transfer of the floor loads to the solid masonry walls to transmit the loads to the ground. The masonry walls also rely on 'restraint' provided by the floor beams that are loading them to prevent out of plane buckling.

Further, buildings of this type and age rarely have foundations in the sense we now know them under load bearing walls. This note describes the stone block foundations seen under the concentrated loads of basement cast-iron columns, but no such foundation was provided for load bearing walls of this type. Therefore, where walls have already been cut and carved for additional entrances, the load from the building above will already be concentrated either side of these new openings within the masonry walls and transmitting increased loads to the ground as a consequence.

The proposed duct route would affect all of the points noted above.

We would be extremely concerned that the proposed route would affect the following:

a) Duct route clashes with both existing large section timber beams and cast iron beams. Trimming these beams would be difficult and uneconomic to achieve due to the spans of trimming elements back to vertical (column) structure required to effectively avoid the large depth of the proposed duct.

b) Further, the spans and effective floor area supported by any proposed trimmer beams would almost certainly overload both existing columns and stone block foundations leading to the requirement to underpin, and/or construct new foundations and 'collar' columns. This in turn affect gross internal floor area as the collar columns need to fit around both sides of the existing column to 'balance' loadings.

c) Breaking through primary load bearing masonry walls of between 2-3 bricks thick adjacent to existing openings would lead to both enlargement of the existing opening width (requiring new deeper lintel beams), and more seriously the concentration of load under the load bearing walls likely exceeding provable ground bearing capacity;

d) A very rough load appraisal would indicate either significant underpinning and/or the installation of mini-piles as the only possible solution, along with the likely rebuilding of basement load bearing walls to carry the concentrated load from above, further requiring extensive temporary support and likely foundations for that;

e) Where the duct exits the basement, it would appear to interrupt spans of existing beams which not only further compounds the issues of load path and load concentration alluded to above, but also raises significant concerns with respect to the broken restraint of the existing envelope walls at that level, and the local ability to transfer lateral loads.

6. Conclusions

Structural Engineers most often wish to demonstrate how they are able to solve problems and make difficult design conditions work economically. After review of the proposals, and noting both the size and extent of the potential proposed duct, it's route through the basement, and the effect on the existing building, on this occasion we have to conclude that not only would any solution be uneconomic, but also cause significant risks to the existing building.

The existing building shows some local signs of distress that is being addressed as part of the planned works. Some of those areas are within the basement near to the duct route where previous work has not been executed well. The provision of this duct would likely further compound these local issues affecting the planned remedial design in these areas, as well as requiring further solutions to both superstructure and sub-structure.

Therefore we conclude that alternative routes should be considered that do not affect the existing basement structure. We are unable to recommend that the route proposed could be economically or efficiently solved, and we would remain very concerned that unforeseen effects would occur if this proposal is taken forward.

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