TROUP
BYWATERS
+ ANDERS

Report on Investigation into ventilation

Emerson House, Eccles

for

The Office of the Parliamentary Ombudsman

AS AT SEPTEMBER 2014.

COMMENTS ADDED BY MR JOHN DOOLEY TO POINT OUT WORST + MOST OBVIOUS "ERRORS".

Contents

1 Introduction

1.1 This report has been prepared by David Arnold a partner in Troup Bywaters + Anders, Consulting Engineers. It concerns investigations into a complaint of poor ventilation at a building known as Emerson House, Eccles, Greater Manchester (the "Building"). The Building is occupied by Urban Vision, a joint venture between Salford City Council, Capita and Galliford Try. I am instructed by the Office of the Parliamentary and Health Service Ombudsman ("PHSO").

1.2 The Claimant is a Mr Dooley an employee of Urban Vision. Mr Dooley says that he first complained to the HSE in February 2008 after Urban Vision failed to act on his concerns about poor ventilation at the Building. Mr Dooley complained again to the HSE on 18 September 2011, having by now left Urban Vision. He said that he understood from former colleagues that nothing had been done to address the issues he had raised.

1.3 HSE replied to Mr Dooley on 26 September 2011. They said that they investigated Mr Dooley's 2008 complaint. Their investigation had found that Urban Vision had already identified the problem and had started work to rectify the issue. HSE said that they had closed the complaint in July 2008, and that as the issues Mr Dooley had raised had been addressed, they would not investigate further.

1.4 Mr Dooley was very dissatisfied with this outcome, and HSE agreed to carry out a further investigation. In January 2012 they wrote to Mr Dooley saying that they had found the air supply rates to the building were adequate for the current occupancy levels. Their conclusions were based on a report by the Health and Safety Laboratory (the "HSE Lab") who had inspected the building. This report was not shared with Mr Dooley.

1.5 Mr Dooley continued to correspond with HSE and HSL but remained dissatisfied and complained to the Ombudsman in February 2013.

1.6 Mr Dooley complains that Health and Safety Executive's ("HSE's") investigation into the ventilation in an office block was flawed. Mr Dooley says that as a result of the flawed investigation, HSE did not enforce the Workplace Regulations. Mr Dooley is outraged at the way HSE have conducted their investigation. He would like them to carry out another inspection of the building's ventilation in accordance with the Workplace Regulations and the Chartered Institution of Building Services Engineers' (CIBSE) guidance.

Instructions

1.7 My instructions are to carry out a review, that will be seen as robust and independent by all parties concerned and prepare a report dealing specifically with the following matters:

1. Whether the methods used by the HSE in inspecting the ventilation of the building were appropriate. Provide advice as to whether the explanation provided by the HSE, in their email to PHSO of 16 August 2013, was reasonable.
2. Whether the HSE's conclusions were reasonable, and whether they took into account all the relevant factors.
3. Is the HSE's view that ventilation in the building was being managed by occupancy, reasonable?

Qualifications and Experience

1.8 I am a chartered engineer with over forty years' experience in heating, ventilating and air conditioning. I trained as a heating and ventilating engineer and hold the degrees of Master of Science in Architecture and Doctor of Philosophy. My experience includes the design, installation, commissioning and post-occupancy monitoring of ventilation and air conditioning systems in more than 20 buildings similar to this building. I include a brief CV at Appendix 1.

Basis of the Report

1.9 The report is based on inspections of the ventilation systems at the Building on Friday 28 March and Monday 23 June 2014 and the following documents provided by the PHSO:

1. HSE notes relating to initial complaint January 2008.
2. Report of air quality audit by WSP January 2008.
3. HSE notes re complaint from October 2011.
4. Mr Dooley's letter of complaint to HSE 18/9/11 (with attachment).
5. HSE's response to Mr Dooley 26/9/11.
6. Mr Dooley's undated response to HSE's letter of 26/9/11 (with attachments)
7. Email from Martin Dilworth, HSE, to Emerson Group 29/11/11.
8. Presumed response -details of staff audit from Emerson Group.
9. HSE letter to Mr Dooley (undated) with results of investigation.
10. HSE letter to Urban Vision with results of investigation.
11. HSE letter to Emerson Group with results of investigation.
12. HSE full investigation report (headed 'draft 4').
13. Formal complaint from Mr Dooley to HSE 31/1/12.

2 Technical Background

2.1 All new and existing workplaces have to comply with "The Workplace (Health, Safety and Welfare) Regulations 1992". It is a United Kingdom Statutory Instrument that stipulates general requirements on accommodation standards for nearly all workplaces. Regulation 6, Ventilation states, " *Effective and suitable provision shall be made to ensure that every enclosed workplace is ventilated by a sufficient quantity of fresh or purified air.*"

2.2 Approved Codes of Practice ("ACoP") give practical guidance on compliance with regulations. The ACoP for these regulations, ACoP L24 provides guidance on compliance with regulation 6. It advises, "*The fresh air supply rate should not normally fall below 5 to 8 litres per second, per occupant. Factors to be considered include the floor area per person, the processes and equipment involved, and whether the work is strenuous.*" And, "*More detailed guidance on ventilation is contained in HSE publications and in publications by the Chartered Institution of Building Services Engineers.*" The most recent guidance published by CIBSE is, "Indoor air quality and ventilation", CIBSE Knowledge Series: KS17, 2011.

2.3 The CIBSE publication advises that the provision of fresh air should be 10 litres per second (l/s) per person and refers to the 2010 edition of Part F of the Building Regulations, Ventilation, which also advises a total outdoor air supply rate for offices with no smoking and no significant pollutant sources of10 l/s per person. This refers to the total air supply to an office building not individual spaces.

2.4 The Building Regulations are not retrospective and the CIBSE recommendations are not mandatory but simply provided as good practice guidance for engineers designing and installation new systems.

2.5 Fresh air in this context is usually defined as outdoor air providing there are no local sources of contamination. Compliance with legislation can therefore be demonstrated by showing that rate of outdoor air does not normally fall below 5 to 8 litres per second, per occupant.

2.6 The fresh air can be provided by either natural means, opening windows and/or vents or mechanically using fans. Natural ventilation relies on wind pressure and temperature differences to move fresh air through a building. Mechanical ventilation uses fans to either or both supply and extract air. As natural ventilation relies on natural forces such as the wind the rate of ventilation is variable whereas the rate of ventilation by mechanical means is usually fairly constant.

YES – SO- - - -

REPORT EXTRACT

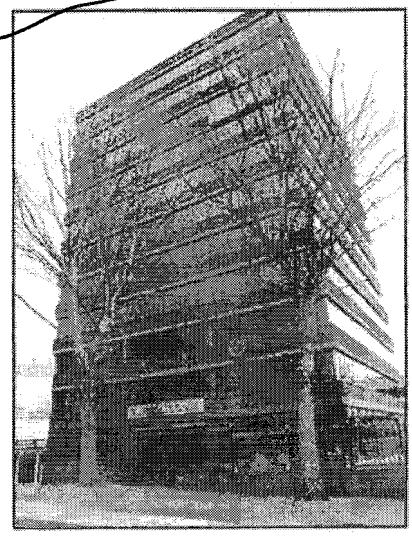

Figure 1 Exterior view of Building

2.7 This Building has mechanical ventilation with an extract fan on the roof connected to a vertical extract ventilation duct which extracts air from through ceiling grilles on each side of each office floor. Air that is extracted from each office level is replaced by air drawn through openings in the outside walls on all sides. The openings can be seen in the photograph in figure 1; a typical opening is circled in red.

2.8 As there are openings on all four sides, additional ventilation will be provided at most times by natural means by wind. This ventilation is of course variable and depends on the wind strength and direction. On a still day ventilation will be provided largely by the mechanical system, i.e. the extract fan on the roof and the ductwork connected to each office. The airflows are shown on the left in the diagram in figure 2. Air is drawn in on all four sides and exhausted through the roof unit. On a windy day more air will enter the openings on the windward side some of which will be drawn into the extract system but some will exhaust through openings on the opposite side of the Building. Even on still days ventilation can be provided by natural buoyancy, air entering vents being warmed and rising up through the building.

SO IS IT A DESIGNED NATURAL VENTILATION SCHEME — NO!

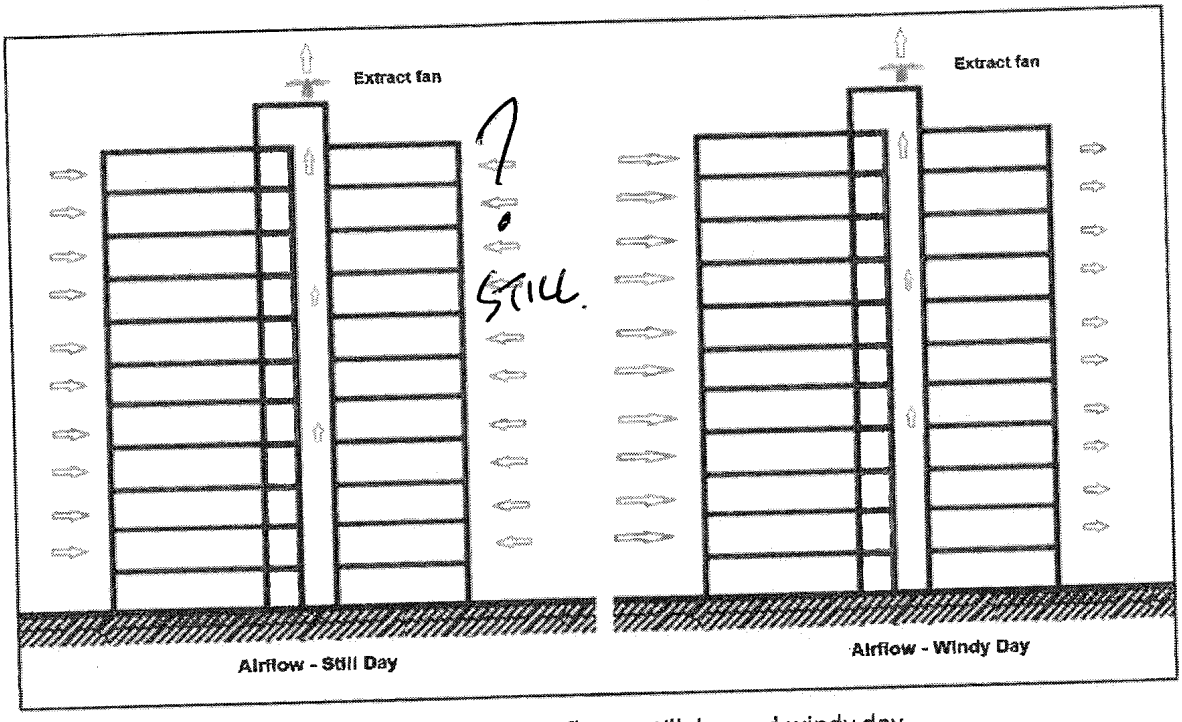

Figure 2 Ventilation airflow – still day and windy day

2.9 The use of perimeter air inlets and extract fans for ventilation was quite common in the 1960s and 70s around the time the Building was constructed and the heating and cooling system designed and installed.

IS THE DIAGRAM TO BE TAKEN SERIOUSLY — SEE PHOTOS...

THE MANY + VARIOUS CLAIMED AIRFLOWS DEPENDING ON WIND OR NO WIND SEEM MATTERS OF WISHFUL THINKING + BEAR NO RESEMBLANCE TO ANY VALID PHYSICAL PRINCIPLE OR CIBSE ETC GUIDANCE -----

3. Site Inspection

WHO?

3.1 I visited the Building on Friday 28 March and Monday 23 June 2014. I met the Building Manager and was shown around by him and a colleague. The Building Manager has worked at the Building for 14 years. He told me that no major works have been carried out on the building services during that time. The works that have been carried out are largely limited to new controls, chiller and the replacement of some fan coil units. The supply of heating and chilled water serving the fan coil units was changed around 2008 to improve temperature control.

NOT TRUE.

3.2 The heating and cooling is from fan coil units located in cases around the perimeter of the building. The air inlets are behind the fan coil unit casings. Figure 3 is a photograph of an empty office floor. It shows the perimeter casing and an extract air grille in the ceiling. These extract grilles are connected directly via ductwork to the roof extract fan. — BEING THE ORIGINAL RETURN AIR.

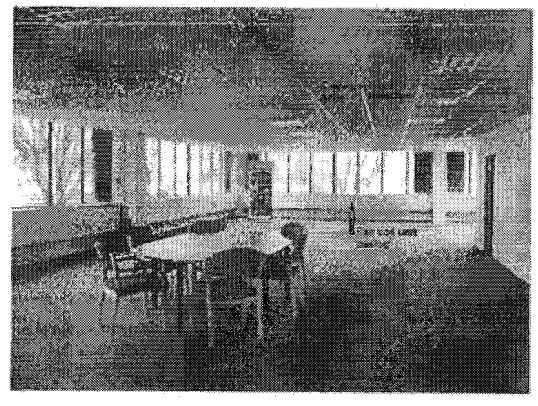

Figure 3 View of office floor

3.3 I checked the air inlets behind the casings and found, in one instance, the opening had been blocked by a piece of cardboard. It is not unusual with this form of ventilation to find occupants blocking vents. SEE JD INSPECTION FROM 2008.

3.4 I also checked the extract air ducts above ceilings and found in every case the duct is continuous from the ceiling grille on the office floor to the vertical extract duct.

3.5 I noted on some floors meeting rooms have been fitted against the perimeter outside wall. There is no means of allowing air to be transferred from the meeting room to the extract ventilation system. Therefore when the meeting rooms are in use with the doors closed the ventilation will be restricted.

Mtg Rooms

4 The HSE Lab Measurements and Advice

4.1 The HSE Lab visited the Building on November 17th 2011. The ventilation rate was measured in two ways a) one to measure the rate air change in two spaces and the other b) to measure the rate of air being extracted through the ceiling grilles on all floors occupied by Urban Vision Partnership.

OBVIOUS SHORT CIRCUITED AIR FROM EXIT / ENTRANCE DOOR + NOT A FRESH AIR VOLUME.

Method 1 - Air change rate measurement

4.3 The report states at 3.1, *"the air change rate in an open plan office on the fourth floor and in the staff canteen on the ninth floor were determined using a modified version of the concentration decay method described in MDHS 73."* I assume the reference to the fourth floor is an error as the results provided are for an open office on the seventh floor and staff canteen on the ninth floor.

— I SUGGEST THE WHOLE THING IS AN ERROR

4.4 I have not been able to obtain a copy of MDHS 73 as it has been withdrawn. The concentration decay method of measuring air changes in rooms is however standard and also described in the CIBSE publication KS 17. In simple terms a gas is released into a confined space such as an office; the concentration of this gas in air will be reduced by the space being ventilated and the rate at which it falls is recorded over time. The faster it is diluted the greater the air change rate. The results can then be converted into an air change rate. AGAIN DOORS OPEN TO STAIR WILL AFFECT OUTCOME.

4.5 This method measures the effect all ventilation to the space including that which is extracted by the mechanical system and any other ventilation provided by natural means, i.e. wind. ??

SO ON A STILL DAY RESULT NOT VALID - - -

4.6 Figure 3 in the report is a diagram showing the set up for the air change measurement on the seventh floor. It is reproduced as figure 4 below. I note there are meeting rooms on two sides of the space and assume the doors to these rooms were kept closed while the measurement was taken. The diagram indicates six air vents in the space but there are only four as the other two are in the meeting rooms. — WHAT INCOMPETENT NONSENSE!

MEETING ROOMS AGREED AS UNVENTILATED ANYWAY

4.7 The air change rate was calculated from the measurements as 2.1 air changes per hour. The report then states in the second paragraph at 3.1, *"From this data and an estimate of the volume of the office of 266 m^3 the volume flow rate was calculated to be approximately 550 m^3/h, (153 l/s). Whilst performing the measurement in this office there were 12 staff present, the calculated air change rate was equivalent to 12.8 l/s per occupant (litres per second per occupant). This assumes that all of the replacement air enters from outside via the inlet vents in the walls."*

4.8 I took the dimensions of the space and confirmed that 266 m^3 was a reasonable estimate of the volume. It is significant to note however that the ventilation rate of 12.8 l/s per occupant does not take into account ventilation of the meeting rooms on either side. During both of my visits to the building these rooms were fully occupied. On my second visit dividing doors in the meeting rooms at the top were open and the room was occupied by 14 people. Each of the three meeting rooms at the bottom of the diagram was occupied by two people.

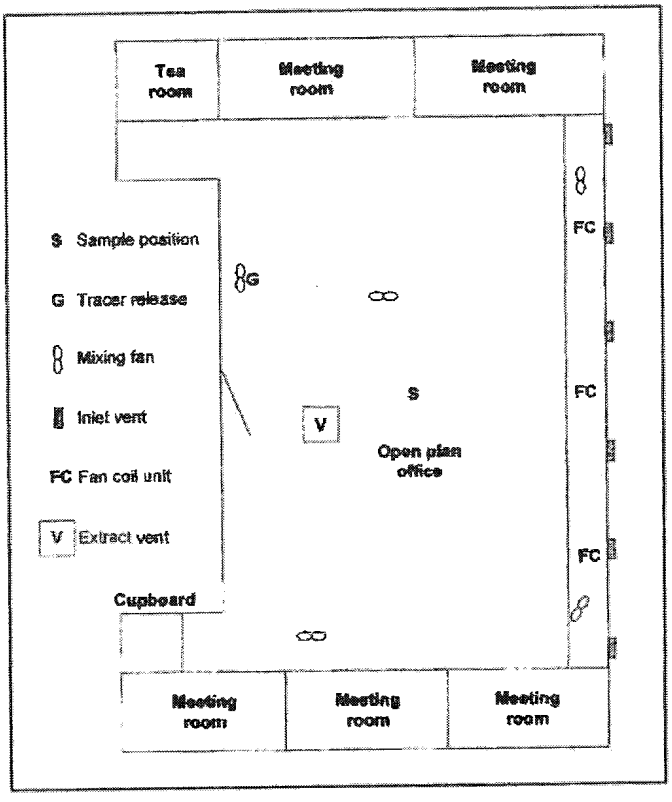

Figure 4 Diagram of Air change measurement (from HSL report ECM/2012/01

4.9 I note on the day these measurements were taken it was quite windy, with a wind speed of 15 km/h and a maximum of 28 km/h maximum in Manchester. This would have provided additional ventilation which would have been captured by the air change measurement method.

4.10 The air change rate in the staff canteen on the 9th floor was measured using the same technique and the result was 2.0 air changes per hour. The report states, *"this is equal to approximately 310 m^3/h calculated from an estimate of the room volume of 155 m^3. During the test there were no staff present so it was not possible to estimate the volume of fresh air supplied per occupant. However, based on a calculated volume flow rate of 310 m^3/h (86.1 l/s) this would provide sufficient fresh air for a maximum of 17 occupants at any one time based upon the minimum volume flow rate required by the building regulations(2)."* I note reference (2) refers to the Workplace health, safety and welfare regulations 1992 not the building regulations. I checked the dimensions of the canteen and the volume is greater, 175 as opposed to 155 m^3 which results in

a volume flow rate of 97 l/s or a maximum capacity at minimum fresh air of 19. I noted that the canteen has a maximum seating capacity of 30. TOTALLY WRONG + CONTRARY TO CIBSE GUIDANCE.

Method 2 – Extract airflow rate measurement

4.11 Measurement of the air extracted through grilles was carried out for the fully and partly occupied floors, 2 to 9. The measurements were taken using a balometer, which is an industry standard device. It is an anemometer in a hood that measures the rate airflow being extracted. The results from the HSE Lab report were shown in table 3.2 which are reproduced in table 1 below. The results of the measurements are also included at appendix 1 of the report. I note there are minor discrepancies between table 3.2 and appendix 1 but they are not material to the conclusions.

Floor	Flow rate per floor l/s	Max Occupancy	Supply per person at max l/s	Supply per person at average l/s
2	198	50	4	7.9
3	202	39	5.2	10
4	223	18	12.4	23.8
5	219	48	4.6	8.8
6	202	68	3	5.7
7	106	14	7.6	14.6
8	257	53	4.8	9.3
9	109	6	18.2	34.9
Total	1516	296	5.1	9.8

Table 1 Summary of measured extract air volumes

IMPRESSIVE ONLY TO THOSE WHO DON'T KNOW ----

4.12 I note that on the seventh floor the airflow measured through the extract grille was 106 l/s whereas the air change method indicated a rate of 153 l/s. I assume this was due in part to additional ventilation provided the wind on that day. Had it been feasible to use the air change method to measure the airflow in all spaces occupied by the Urban Vision Partnership it is likely in my opinion that rates measured would have been greater than measured by the second method a set out in table 1 above. ?

4.13 The total extract rate measure by HSL for all areas occupied by Urban Vision Partnership was 1516 l/s. I have checked this against the fan performance of the roof extract unit and with making an allowance for offices not occupied by Urban Vision and it appears realistic.

SHORT CIRCUIT ETC

IT WILL DEPENDING ON DOOR OPENING —

4.14 The HSE Lab report points out that *"the extract rate varies considerably across the building and on four floors (2nd, 5th, 6th and 8th) actually falls below 5 l/s per occupant based on maximum occupancy. However, based on 52 % occupancy the extract rate exceeds 5 l/s per occupant for every*

NOT ANY MEASURE OF FRESH AIR SUPPLY --

floor." I noted there were balancing dampers on the extract ducts above the ceiling. If the uneven distribution of ventilation was a problem the rates extracted from each floor can be adjusted to extract more or less air from individual floors to match occupancy.

ADJUSTING DAMPERS ON A FEEBLE ORIGINAL RETURN AIR SYSTEM WILL HAVE NO EFFECT ON A LARGE VOLUME SPACE.
DAMPERS ONLY INTENDED TO BALANCE ORIGINAL SYSTEM WHEN COMPLETE WITH A MECHANICAL SUPPLY.
A TYPICAL EXAMPLE OF A SEEMINGLY TECHNICAL POINT TO IMPRESS LAY PERSONS BUT COMPLETE NONSENSE IN TERMS OF BUILDING VENTILATION - - - - SEE PAGE 10 FOR A REPEAT OF THE SAME NONSENSE..

5 Opinion

5.1 I was instructed to deal specifically with the following matters:

1. Whether the methods used by the HSE in inspecting the ventilation of the building were appropriate. Provide advice as to whether the explanation provided by the HSE, in their email to PHSO of 16 August 2013, was reasonable.

2. Whether the HSE's conclusions were reasonable, and whether they took into account all the relevant factors.

3. Is the HSE's view that ventilation in the building was being managed by occupancy, reasonable?

Methods used by the HSE

5.2 The measurements carried out by HSE Lab to assess the ventilation at the Building, a) the decay method and b) using a hooded anemometer are both industry standard, consistent with CIBSE good practice recommendations and the most appropriate means of obtaining the most accurate results.

5.3 I have assumed that the complainant's reference to "CIBSE methods" relates to both the method used to measure and the required rate of fresh air per occupant. Whilst CIBSE good practice publications recommend a fresh air rate of 10 l/s second per person, this is not a mandatory or legal requirement. The Building Regulations recommend the same rate of fresh air but are not retrospective. In this case the correct methods for measuring the air were used and the criterion which the ventilation system has to meet is 5 to 8 l/s per person.

5.4 The measurements by HSL demonstrate satisfactorily that the criterion is met overall in the areas of the building occupied by the Urban Vision Partnership for the maximum occupancy of the building. As mentioned in section 4 of the report, *"the ventilation rate for individual floors showed some variability and on four floors fell below the minimum limit of 5 l/s per occupant."* A similar shortfall is likely in the meeting rooms on the seventh floor. Air change rates were measured for the open office space between the meeting rooms but the report does not specifically mention that whilst the ventilation in this space was 12.8 l/s per person the occupants of the meeting rooms were likely to receive a lower rate of ventilation as the rooms are only ventilated by the vents on the outside wall.

5.5 I have reviewed the email of 16 August 2013 from Rick Brunt of the HSE to Nicola Bowes and in my opinion the explanation, provided by the HSE, was reasonable albeit expressed in scientific terms.

5.6 I believe the HSE's conclusions were reasonable but that their report ought, for completeness, to have mentioned situations where the Urban Vision Partnership have partitioned spaces for meeting rooms. There are, for example, three such rooms on the seventh floor, either side of the open area where HSE

made air change measurements. With the doors to the rooms closed most ventilation is provided from the vents beneath the windows but there is no provision for air to be transferred to the extract system. It is unlikely that the minimum provision of 5 l/s per person would be achieved however the occupation of these rooms is transient. I do not therefore see this as a major omission.

MEETINGS LAST MANY HOURS!

5.7 I have been asked to comment on whether the HSE's view that ventilation in the building was being managed by occupancy is reasonable. I would not describe the ventilation in the building as being "managed by occupancy". This implies that Urban Vision Partnership adjust the number of people on each floor to match the ventilation and achieve the statutory minimum. This is clearly not the case. The building owner does however have the facility to adjust the rate of extract ventilation to any floor by adjusting the dampers referred to in paragraph 4.14. *

HSE ORIGINAL REPORT DOES LIMIT NUMBERS

5.8 I note the Complainant alleges that a separate mechanical fresh air supply system has been removed from the Building. I found no evidence to support this in my inspection. The current method of providing ventilation to the offices is identical to the original.

David Arnold, Troup Bywaters + Anders

SEE PHOTOS IN MY DOC
GROSS ERROR AND UNTRUE STATEMENT.

* IS THIS A JOKE? ADJUSTMENT OF dampers on low pressure extract adjusts ventilation rate at building perimeter! No need ever then for AHUs, supply ductwork, fans etc to ANY large multi-storey office????

TROUP BYWATERS + ANDERS

Full Name David Arnold

Date of Birth 18th June 1943

Place of Birth

United Kingdom

Academic Qualifications

Ph.D M.Sc(Arch)

Professional Qualifications

FREng C.Eng

Professional Memberships

MIMechE, FCIBSE, MConsE
Fellow ASHRAE (US)

Languages

English and French

Position in Firm

Partner

Normal Place of Work

Reading and London

Number of Years Experience

35+ Years

Overall Experience

David Arnold trained as a heating and ventilating engineer and qualified as a corporate member of the Institution of Heating and Ventilation Engineers (now CIBSE) in 1970.He has been a Partner of Troup Bywaters & Anders since 1973. His responsibilities have ranged from being intimately involved with the detail design, installation and commissioning of heating and ventilation systems, to taking overall responsibility for all engineering services in major projects. His specialist experience includes: heating, ventilating, air conditioning and refrigeration and has designed and advised on several different types of systems. He has a particular interest in analysing the performance and failures of air-conditioning and heating and ventilating systems and regularly acts as an expert advisor.

He is a past President of the CIBSE (1994/95), a past Chairman of the National Engineering Specification, a Fellow of the Royal Academy of Engineering and, has recently completed a second term as a Director of the American Society of Heating, Refrigeration & Air Conditioning Engineers. ASHRAE.

Experience with Litigation and Arbitration.

David Arnold regularly undertakes commissions for the preparation of Expert Witness Reports and has given evidence in the High Court and several arbitration hearings and mediation proceedings. His principal areas of expertise include the following:

- Advice on the design of heating, ventilating and air conditioning systems.
- Advice on the comparative performance of mechanical and electrical services relating to rent reviews.
- Advice on dilapidations relating to M & E Services.
- Advice on the responsibilities of Designers and Contractors and the standard of performance of their duties.
- Advice on the standards of workmanship of HVAC systems.
- Advice on the performance of heating & air-conditioning plant.
- Analysis and advice on claims relating to heating and cooling systems.
- Identifying and resolving problems on HVAC systems.

Practical and Design Experience.

David Arnold maintains his practical and design experience being involved in the design, installation, commissioning and post occupation monitoring of current projects. His practical experience includes the design of heating and air conditioning systems for a wide range of buildings including hospitals, education buildings and offices. He has been responsible for the design of most types of heating and air conditioning systems and had overall responsibility for all services including electrical engineering services and lifts. Past projects include, DTI HQ 1 Victoria St., Barclaycard HQ Northampton, Gloucester Business Park Basildon and Phase 6 at Broadgate. He also acts regularly