Design Guidance

1. The University wishes to achieve internal comfort conditions in the most energy efficient way. The designer should explore all available passive building envelope and fabric design solutions to avoid or minimise mechanical ventilation. Consideration should also be given to external and adjacent noise sources as this will also impact upon the ventilation solutions that can be used.

2. Where it is impractical to use natural ventilation alone use of mixed mode systems should be developed. These will include high efficiency heat recovery systems with all air handling units (both supply and extract fans) being provided with variable speed drives to aid commissioning and allow for minimum load/setback conditions to be achieved. The systems shall have inherently low specific fan power ratings.

3. Where mechanical ventilation is used, it shall be designed to meet the internal NR levels listed in the CIBSE Guide A Environmental Design. External noise breakout levels shall meet the requirements of the local planning department.

4. Where possible demand orientated systems using room or zoned occupancy detection and/or carbon dioxide monitoring to achieve good indoor air quality i.e. IDA level 2 or better as defined in EN ISO 7730 shall be used. The preferred method to achieve this is via Variable air volume boxes where there are multiple rooms served off a single system.

5. All air handling units (AHUs) shall be fully compliant with European Union Ecodesign Regulations 1253/2014 which applies to Non-Residential Units and 1254/2014 which applies Residential Units for 2018 (not 2016) efficiency requirements. All AHUs tendered and supplied to the client shall be certified as 2018 efficiency compliant.

6. Where naturally or mixed mode ventilated the occupied space comfort temperature should comply with the criteria set out in CIBSE TM52 for all University buildings and CIBSE TM59 for all student residences. This guidance benchmarks internal dry resultant temperatures against maximum adaptive temperatures created in the CIBSE ‘design summer year’ weather data. In addition to the standard CIBSE compliance requirement the building shall also meet the University of Leicester’s requirement of rooms not exceeding 26 degrees centigrade from more than 100 occupied hours per year. Unless the client’s data sheets state otherwise.

7. The CIBSE ‘design summer year’ should be used to bench test using modelling software and a report produced to predict (for each room) and highlight the internal periods liable to be above 26 degrees Centigrade. The overheating assessments shall be carried out at stage 2 such that the University can be consulted and consideration can be given to potential mechanical cooling. The overheating reports shall detail all design assumptions used during the modelling process to ensure the University are informed of these assumptions i.e. night purge routines and how purging is achieved.

8. The ventilation standards should meet the CIBSE guidance, Building Regulations, HTM (where appropriate), ACDP and the indoor comfort standard described above. The baseline standard for typical teaching spaces, offices and general-purpose areas is 12 litres per second per person.

9. Reference should be made to the detailed the University’s mechanical technical specification Part 2 and the University’s draft Fume Cupboard specification particularly for laboratory ventilation design.

10. Air handling plant component configurations should suit the delivery application served in terms of quality (to reflect the life expectancy needed for the space served), level of cleanliness (e.g. HTM compliant for health applications), level of resilience, low maintenance and energy efficient operation. Indoor plant should be specified to achieve a life expectancy of approximately 20 to 25 years before major replacement. Air handling units located
**Design Guidance**

externally shall be avoided and wherever practical these should be located internally. Where external air handling plant has been agreed with the university this should be weather proofed (minimise the number exposed perforations) so as to achieve a minimum life expectancy of approximately 15 years.

11. Modern insulated double skin good quality pentapost framed air handling units should be used. Galvanised steel plastisol coated frames and sandwich panels are to be used. Linings to cooling coils, access sections (adjacent the cooling coils) and humidifier sections (if required but should be avoided) should be high grade stainless steel.

12. The design of frost coil provision on air handling units should be on a risk based approach to the space(s) served. By default, frost protection should be provided as standard unless otherwise agreed with the University development and maintenance departments.

13. Where cooling coils are utilised on air handling units these shall be positioned on the positive pressure side of the unit (i.e. blow through) which follows the requirements HTM 03-01 in terms of coil positioning. All drain tray and drainage arrangements shall also follow the requirements of the HTM detailed in Chapter 4. Intermediate drain trays shall be installed on all coils above 1200mm high. All coil velocities shall not exceed 2m/s.

14. Coils construction and materials should match the application but generally copper tube with plastic coated aluminium finned types will suit most applications. But the designer must select the most appropriate combination for the application.

15. Unless there is a specific requirement for a high level of cleanliness all mechanically ventilated areas must have incoming fresh air filtered to a minimum standard of ‘G4’ for pre-filters and a minimum of ‘F7’ secondary filtration to BS EN 779. All secondary filers shall be positioned on the positive pressure side of the fan.

16. All filters shall be mounted in specialist frames and held into the frame by the direction of airflow. Face withdrawal must be used, sliding out of filter banks will not be accepted.

17. Fans should be high efficiency selected (min. 79%) using aerofoil blade centrifugal or plug fans. Motors ideally should be out of the air stream but this can be varied to suit the application with prior agreement with the University. Motors should be high performance high iron content low loss performance types suitably matched with the speed control frequency inverter serving it. Where the systems are deemed critical by the University, for example Laboratory supply air handling units these shall utilise belted run and standby motors. Any other systems shall be provided with spare motors that shall be mounted on a frame within the plantroom.

18. Acoustic performance is important to consider in detail particularly casing radiated noise and vibration.

19. Heat recovery should be provided to all plants with exception to dedicated kitchen ventilation systems to suit the following University order of preference (efficiencies listed are from Regulation 1253/2014):
   - Plate heat exchanger – minimum of 73% sensible efficiency.
   - Thermal Wheel – minimum of 73% sensible efficiency.
   - Run-around coil – minimum of 68% sensible efficiency.
   - All heat recovery systems shall be provided with fully modulating 0 to 100% bypass control.
   - Fan energy consumption shall also comply with Regulation 1253/2014.

20. Laboratory Ventilation
   - Laboratory areas should be placed under negative pressure in relation to the surrounding areas with ventilation plant configured to draw contaminated air away from occupied areas. The recommendations of both CIBSE and HSE must be adopted in all areas where experimental work is undertaken.
   - The University’s Director of Safety Services, Public Health Department and Advisory Committee on Dangerous Pathogens should be formally consulted with regards to the safe discharge of contaminated extract air from fume cupboards.
   - Fume cupboards should be designed to operate via variable volume as opposed to a constant volume. ONLY electronic fume cupboard controls shall be specified. Pneumatic controls should NOT be utilised.
   - The amount of clean extract from the laboratories shall vary depending upon the amount of fume cupboard air removed from the space. Supply ventilation and air change rates shall be calculated to offset heat gains and to provide make up air for fume cupboards.
   - All other standards regarding fume cupboards should comply with the latest European Standards
Design Guidance

21. Toilet Extract
   - A negative pressure will be created within any toilet area to control the spread of odours. Toilet extract systems should be designed on the basis of 8 Ach–1 when occupied. All toilet extract systems shall exhaust directly to the outside.
   - The toilet extract fans should consist of duty and standby motors complete with motor fault indication on the B.M.S front end and motor changeover operated via the BMS ‘front end’. Fault indication is paramount to avoid failure of both motors and fans.

22. Plant Rooms
   - Ventilation to all plant areas will be provided in accordance with the relevant design guidance and with the requirements of the equipment installed. Where possible air intakes should be located on the shaded north elevation of plant rooms.

23. Ventilation Ductwork Design
   - Ductwork shall be designed in accordance with the latest relevant B&ES specifications (e.g. DW143/144/151 and 172). Consideration should be given to the following design criteria with regard to ductwork installations:
     - Supply and extract velocities should not exceed:
       - 5 to 6 m/sec – main distribution routes and plant rooms
       - 5.5 to 4.5 m/sec – risers
       - 4.5 to 3 m/sec – spine/distribution ducts to floors (ceiling voids & exposed to view)
       - 3 to 2.5 m/sec – branch duct
       - Less than 2.0 m/sec – final run outs to grilles and diffusers
       - Maximum pressure drop per metre run should be limited to between 0.3 to 0.5 Pascal per metre (pa/m)
       - Balancing dampers should be installed as required
       - Velocities shall vary based on the areas it is serving. In certain cases, velocities stated above may need to be reduced depending on acoustic criteria for the spaces served. If an acoustician is appointed on a project they shall be consulted to agree and finalise design velocities.

24. Duct and AHU Air Leakage Testing
   - Allowance should be made for the air leakage testing of all air handling units and associated ventilation supply and extract ductwork. The test should be carried out in accordance with B&ES ductwork leakage testing specifications DW143/144 to class B medium pressure standard as a minimum or better depending upon application. Where specialist installations require negative pressure operation of AHU’s and associated ducting, those AHU’s and ducts shall also be tested under negative pressure to class B as a minimum or better depending upon application.

25. Distribution Strategy
   - Wherever possible all air handling plant should be located as close as possible to the areas it serves, with ductwork runs being kept to a minimum all for low pressure drop and low energy design properties.
   - Where possible, air intake’s to be positioned on north elevations to avoid solar gains. Supply and extract must be adequately spaced apart to avoid re-circulation issues.

26. Kitchen Ventilation installation
   - All kitchen ventilation and ductwork installations shall be fully in accordance with the requirements of the B&ES DW172 guidance.
   - Extract ductwork velocities in areas extracting from cooking areas shall be designed within the following velocities:
     - 6 to 9 m/sec – main runs
     - 5 to 7 m/sec – branch runs
     - 5 to 7 m/sec – spigots
     - 12 to 15m/sec – discharge efflux velocity
   - All extract fans utilised for extracting directly from cooking areas shall have the motors located outside the airstream, such as a bifurcated fan
27. Thermal Insulation

Thermal insulation shall be applied to ductwork in the following scenarios:

- All Ductwork shall be thermally insulated carrying heated, cooled, tempered or conditioned supply air or extracted air for re-use by recirculation or for extracted air forming part of a heat recovery system.
- Supply air handling plant including heater or cooler batteries and intake ductwork to plant, insulated and then vapour sealed to prevent condensation. A vapour barrier must be used on all ductwork systems where the air within the system is operating at temperatures below the surrounding ambient air e.g. where there is a warm void and the air within the ductwork is cooler. The vapour barrier should be applied such that it is continuous and gives protection to the whole surface of the insulation which it covers. Where the operating temperature of the equipment cycles above and below the temperature of the ambient air, it will be necessary to design a vapour barrier/breather system.
- Air extract ducting to atmosphere - where such ducting passes through occupied areas and contributes to the heat gain / loss of the occupied area.

All ductwork requiring insulation shall utilise full thickness insulated supports.

## Design Components

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>Ductwork</td>
<td></td>
<td>Galvanised mild steel to DW144. Plastic ductwork systems to DW151. Kitchen ventilation systems to DW172.</td>
</tr>
<tr>
<td></td>
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<td>No flexible ductwork distribution systems shall be used. Final connections to grilles shall be limited to 500mm maximum for flexible connections.</td>
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<td></td>
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<td>All ductwork that is located within the swimming pool, wet change area or that is in direct contact with the chemical rich environment shall be installed in galvanised ductwork shall be coated in a fusion bonded epoxy coating to protect all metal elements from corrosion. All brackets and fittings which are susceptible to corrosion shall also be epoxy coated. The epoxy coating shall be applied to both the internal and external complete surface areas of the ductwork. The colour of the epoxy coating shall be different between the supply (green) and extract (red).</td>
</tr>
<tr>
<td>Ductwork Fittings</td>
<td></td>
<td>Galvanised mild steel to DW144. Plastic ductwork systems to DW154. Kitchen ventilation systems to DW172.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Self tapping screws or self-adhesive tape is permitted on galvanised steel ductwork installations.</td>
</tr>
<tr>
<td>Dampers (Volume Control)</td>
<td>Actionair</td>
<td>Galvanised framed opposed blade volume control dampers. Blades shall be low profile aerofoil, stainless steel with drive mechanism enclosed and outside of air stream. All dampers need to be lockable.</td>
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<tr>
<td></td>
<td>Waterloo</td>
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<td>Lindab</td>
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<td>Trox</td>
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<tr>
<td>Dampers (Fire/Smoke)</td>
<td>Actionair Fireshield or Smokeshield PTC (as appropriate) Waterloo Trox</td>
<td>Fire and smoke dampers shall be of a suitable rating to ensure the integrity of the fire compartment line is maintained. Where standard fire dampers are utilised, these shall have self-latching replaceable fusible links. Damper blades shall be stainless steel with stainless steel bearing. Damper cases/frames shall be 18-gauge galvanised steel.</td>
</tr>
<tr>
<td>Access Doors</td>
<td>Actionair Fireshield or Smokeshield PTC (as appropriate) Waterloo Trox</td>
<td>Access doors to be double insulated and provided in accordance with HVCA publication TR19, DW144 and DW172. Provision of access doors shall also follow the practical recommendations detailed in the ‘ADCAS Guide to Ductwork Cleaning Requirements and Access Doors’.</td>
</tr>
<tr>
<td>Attenuators</td>
<td>TEK Ltd Trox Sound attenuators</td>
<td>Shall be galvanised mild steel complete with infill of rigid tissue faced Rockwool and treated to BS 476 Part 7. Critical applications may require the internal face of the attenuator to be lined. All Rockwool infill media within splitters shall be melinex lined and located behind perforated mesh.</td>
</tr>
<tr>
<td>Grilles and Diffusers</td>
<td>TEK Ltd Waterloo Krantz Gilberts</td>
<td>All Grilles and diffusers shall be supplied with opposed blade volume controls dampers, side entry plenum boxes and be power coated to suit the project architect’s requirements. Grille pressure drops to be limited to an absolute minimum. Ductwork flexible connections to plenum boxes shall not exceed 500mm. Flexible ductworks shall be semi rigid type. All plenum boxes shall be supported from structure utilising cleats. The grilles shall not be self-supporting off the ceiling installations. All grilles and diffusers shall be selected to ensure draughts do not occur and an even air distribution is achieved. Grilles and diffusers shall be selected to ensure design NR levels for the spaces they serve are not exceeded.</td>
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| Weather Louvres           | TEK Ltd Waterloo Gilberts Colt | All louvres shall be sized at a maximum face velocity of 1.5m/s to limit pressure drops. The louvres shall be to the following specification:  
• Be constructed from milled aluminium with mitred corners.  
• Be BSRIA HEVAC Class A Type  
• Be flanged or flangeless as agreed with the project architect.  
• Be fully weather proof.  
• Have 50% minimum free area.  
• Polyester powder coated to a colour agreed with the architect?  
• Be provided with secret fixings – drilled holes in the louvre flanges for fixing purposes are not acceptable.  
• Sized to a maximum face velocity of 1.5 m/s. |
| Frost Coil                |                         | Plain seamless copper tubes with no fins.                                                                                                                                                                |
| Heating / Cooling Coil    |                         | Plain seamless copper tube with aluminium fins plastic, not exceeding 300 per metre. Fins shall either be electro-tinned or polyester coated to suit application. Plastic coating of fins is not required for heating coils.  
Cooling coil face velocities shall not exceed those stated in HTM 03-01 (2m/s). The drain trays shall be fully HTM 03-01 compliant in accordance with best practice guidelines. Intermediate drain trays shall be included on all coils above 1200mm High. |
| Anti- Vibration Mountings | TEK Ltd Trox Sound attenuators | AV mountings shall be provided to all rotating equipment, fans, compressors etc. AV mounts shall achieve 98% efficiency as a minimum.                                                                 |


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<tr>
<td>AHU's / Fans</td>
<td>Larger AHUs</td>
<td>Fans shall be suitable for required application.</td>
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<td></td>
<td>Dalair</td>
<td>Wall fans – complete with remote switching.</td>
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<td></td>
<td>Barkell</td>
<td>AHU fans – backward curved centrifugal impellers. Inverter</td>
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<td></td>
<td>Birmingham Air Con.</td>
<td>Controlled plug fans</td>
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<td></td>
<td>Air Handling Systems</td>
<td>Curb fans – centrifugal type</td>
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<td></td>
<td>Moducel</td>
<td>In-line fans – centrifugal type wherever practical.</td>
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<tr>
<td></td>
<td>Smaller AHUs</td>
<td>Dirty extract fans – shall be twin fans with automatic changeover facility. The fans shall be EC type and on larger systems shall utilise Plug Fans</td>
</tr>
<tr>
<td></td>
<td>Nuaire</td>
<td>All fans shall be in compliance with latest Building Regulations (particularly the requirements of Part L2)</td>
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<tr>
<td></td>
<td>Vent Axia</td>
<td>Access panel to be hinged</td>
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<td></td>
<td>Central Fans</td>
<td>All dampers blades to be galvanised</td>
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<tr>
<td></td>
<td></td>
<td>All AHU's to be internally lit</td>
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<tr>
<td></td>
<td></td>
<td>Heating coils to be copper tube/aluminium fins plastic coated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooling coils to be copper/copper electrotinned.</td>
</tr>
</tbody>
</table>

Swimming Pool air handling units (AHU) shall be designed, procured and installed suitable for external environments and suitable for the high chemical rich air. Generally, the construction of the AHU's shall be as the general Air Handling Units but will include the following:

- Hot dip galvanized closed framework fixed with aluminium corners and internally insulated with mineral wool insulation.
- Hot dip galvanized sandwich panels with 50 mm insulation (Thermal transmission T3 / Thermal bridging TB3 / Air leakage L3 according to EN 1886).
- Internal partition wall is 30 mm thick and built from hot dip galvanised 1,25 mm sheet material insulated with mineral wool.
- All internal steel components including fans and panels are powder painted before assembly with corrosion class C4 paint.
- 70 μm powder paint finish on the outside panels for the installation of the air handling unit in external environments.
- All fasteners, bolts and nuts are stainless steel and protected against the corrosive air with class C4 paint.
- Highly efficient (double pass), epoxy-coated aluminium plate heat exchangers with high resistance to the corrosive swimming pool chemicals within the air stream.
- All heating coils with aluminium frame, pre-painted fins and epoxy painted.
- Damper motors IP 66 rated.