

## Unit 68: Ventilation and Air Conditioning Design in Building Services Engineering

Unit code: H/600/0375

QCF Level: 3

Credit value: 10

Guided learning hours: 60

### Unit aim

This unit aims to give learners the opportunity to develop their knowledge and understanding of ventilation and air conditioning design and develop skills in designing and specifying effective and efficient installations for a variety of buildings.

### Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes	Assessment criteria
1 Be able to establish ventilation, warm air heating and air conditioning requirements for buildings	1.1 Produce pre-design appraisals of the ventilation, warm air heating and air conditioning requirements of a building
	1.2 Establish ventilation, warm air heating and air conditioning design data and parameters for buildings.
	1.3 Estimate cooling loads using tabulated data and rules of thumb.
2 Understand the operational characteristics of ventilation and air conditioning equipment, plant and materials	2.1 Describe the operational characteristics of commonly used plant and equipment associated with ventilation, warm air heating and air conditioning installations.
	2.2 Explain how the operational features of ventilation and air conditioning plant and equipment influence their application.

3 Be able to design ventilation, warm air heating and simple single zone air conditioning installations.	3.1 Select appropriate plant, materials and equipment to meet the needs of the air systems in buildings.
	3.2 Plan ductwork installation configurations and design air-based system layouts.
	3.3 Plan a simple air handling unit plant room and central plant arrangements and configurations.
	3.4 Produce appropriate design drawings of proposed air-based installations.
4 Be able to size, select and specify ventilation and air conditioning systems, ductwork, plant and equipment.	4.1 Calculate mass/volumetric flow rates, duct sizes and resistances for air supply and extract ductwork.
	4.2 Perform the calculations required to select fans for ductwork installations.
	5.1 Select heater/cooler batteries, humidifiers, air terminal devices and other plant to meet the needs of ventilation, warm air heating and air conditioning installations.

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## Unit content

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### **1 Be able to establish ventilation, warm air heating and air conditioning requirements for buildings**

*Requirements:* purpose of ventilation; reasons for providing comfort and process ventilation; client, user and environmental requirements and considerations; health and safety and other statutory requirements; identification of locations with specific ventilation requirements; types of contaminant; reasons for providing air conditioning in buildings; user and environmental requirements and considerations; sources of heat gain to buildings; identification of locations requiring air conditioning; advantages and disadvantages of warm air heating as an alternative to LTHW and other heating distribution media; identifying zones and locations suitable for warm air heating; establishing performance requirements for proposed installations

*Design conditions:* methods of specifying ventilation rates; selection of ventilation rates for specific locations; occupational exposure limits (OEL), workplace exposure limits (WEL), maximum exposure limits (MEL) for single specific contaminants; selection of internal and external design conditions for warm air heated and air conditioned rooms; impact of room air velocity and temperature on comfort

*Cooling loads:* estimation of heat gains and cooling loads using tabulated data and established 'rules-of-thumb'

*Ventilation systems:* operating principles; applications and key performance characteristics of natural ventilation; mechanical ventilation; comfort cooling/warm air heating/air conditioning and mixed mode ventilation systems; energy and environmental implications of ventilation and air conditioning installations; energy implications of alternative systems; selecting ventilation and air conditioning strategies; local exhaust ventilation (LEV)

### **2 Understand the operational characteristics of ventilation and air conditioning equipment, plant and materials**

*Air terminal devices:* characteristics, terminology, operational features, materials, installation requirements and application of supply and extract air terminal devices; control of quantity and direction of air discharge in supply and extract devices; operational features, installation requirements, materials and suction dynamics of booths, canopies, hoods and other extract devices used in commercial kitchens and industrial applications; grease filters, grease removal and fire prevention in kitchen canopies

*Ductwork and jointing systems:* ductwork shapes and materials used for HVAC systems; characteristics and features of jointing, assembly and installation procedures; relationship between physical properties of ductwork materials and their application; flexible and fire-rated ductwork; criteria for selection of materials and shape; published standards and specification for ductwork

*Ductwork ancillary components:* requirement for, characteristics, operational features and selection criteria of various types of ductwork items eg volume control dampers, fire and smoke dampers, access doors, flexible connections, test points

Air handling plant – fans: types of fan; characteristics, operational features and application of fans; types of drive; installation requirements and ductwork connections

*Heater/cooler batteries:* types, materials, characteristics, operational features and application of heater batteries; chilled water and direct expansion cooling coils; installation requirements and ductwork connections

*Heat recovery devices:* types of heat recovery device; characteristics, operational features and application of heat recovery devices; installation requirements and ductwork connections

*Air cleaning devices:* terminology and definitions associated with filters and air cleaning devices; group and class of filter; filter testing methods; types, characteristics, operational features and application of filters and dust collection/removal devices for air handling systems; installation requirements and ductwork connections

*Humidifiers:* types of humidifier; characteristics, operational features and application of humidifiers; installation requirements and ductwork connections; water supply; maintenance and health and safety implications of humidifiers

*Refrigeration plant:* principles, components and application of vapour compression refrigeration systems; application of refrigeration in air conditioning systems; operation, features and application of heat pumps

*Air handling units:* configurations and features of simple, composite air handling units (AHUs), local exhaust ventilation systems, dust collection and packaged air conditioning systems; control requirements and arrangements for ventilation and warm air heating installations

### **3 Be able to design ventilation, warm air heating and simple single zone air conditioning installations**

*Design of HVAC installations:* layout of supply air devices to achieve good room air distribution; location of extract devices for effective operation; relationship between supply and extract devices in balanced supply and extract systems; design of simple local exhaust ventilation and other industrial/commercial process ventilation; ductwork systems and arrangements for comfort/process ventilation; warm air heating and air conditioning installations; features of good ductwork design; prevention of noise problems; accommodation of ductwork within buildings; use of ductwork design and installation standards and codes; criteria and methods for zoning installations; designing for energy efficiency; prevention of spread of smoke and fire via ductwork installations; provision for maintenance and testing ductwork

*Design of air handling plant:* space requirements; types of accommodation for air handling units; refrigeration/chiller plant and fans; location of air intake and discharge points; structural and builder work requirements to accommodate air handling plant and ductwork

*Provision for maintenance and commissioning:* reasons for commissioning duct networks; location of flow regulation devices

*Design drawings:* communication of detailed designs; use of drawing symbols and annotation; production of appropriate drawings and sketches

### **4 Be able to size, select and specify ventilation and air conditioning systems, ductwork, plant and equipment**

*Air flow rates and supply conditions:* calculation of air flow rates for mechanical supply and extract ventilation systems; supply air conditions, mass and volumetric flow rates to

maintain design room conditions for warm air heating and single zone air conditioning applications; plotting summer and winter psychrometric cycles for simple air conditioning applications; balance between fresh air and thermal requirements in warm air heating and air conditioning installations; determining re-circulation rates

*Air terminal devices:* selection of supply air terminal devices and booths, canopies, hoods and other extract devices using manufacturer information; throw, resistance and noise characteristics; production of air terminal device specifications and schedules

*Ductwork:* selection of ductwork design parameters; use of manual calculations and computer software to determine duct sizes by use of constant pressure drop and/or constant velocity methods, total, static and velocity pressure in ductwork; total resistance of index circuits; methods of producing balanced systems and absorbing excess pressure at branches; establishing commissioning data for ductwork distribution networks

*Fans:* application of margins; determining fan duty; selection of fans from manufacturer data; efficiency and operational features; production of fan schedules; establishing commissioning data

*Air conditioning plant:* use of psychrometric cycles to determine cooler coil, heater battery, frost coil and humidifier duties; selection of plant and components from manufacturer data; production of plant specifications and schedule

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