

Unit 207

The internal environmental design of buildings

Unit summary

This unit is about the engineering principles applied to the design and specification of the internal environment experienced by occupants of habitable space.

Aims

The unit aims to develop understanding of the thermal, visual, aural and air quality needs of occupied spaces. It also aims to develop understanding of solar effects, weather and climate on the performance of environmental installations

Prerequisites

It is expected that candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examination.

Learning outcomes

There are **four** outcomes to this unit. The candidate will be able to:

- Specify optimum conditions for occupied space.
- Assess the impact of external environmental conditions on occupied spaces.
- Assess the fire hazards exhibited in buildings and develop fire plans and fire detection systems.
- Relate functional requirements of buildings to the environment

Guided learning hours

It is recommended that 300 hours should be allocated for this unit. 120 of those hours are actual taught hours. This may be on a full time or part time basis.

Key Skills

This unit contributes towards the Key Skills in the following areas:

N4.1

Develop a strategy for using application of number skills over an extended period of time.

N4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required in work involving:

- deductive and inferential reasoning;
- algebraic manipulation.

N4.3

Evaluate your overall strategy and present the outcomes from your work, including use of charts, diagrams and graphs to illustrate complex data.

Occupational Standards

This unit has been mapped to the following National Occupational Standards:

- 1.1.1 Identify the requirements of clients for engineering products or processes
- 1.1.2 Produce specifications for engineering products or processes
- 1.2.1 Identify and define areas of research
- 1.3.1 Undertake research into engineering products or processes
- 1.3.2 Evaluate the results of research
- 1.4.1 Establish a design brief for engineering products or processes
- 1.4.2 Develop a strategy for the design process
- 1.4.3 Create designs for engineering products or processes
- 1.4.4 Evaluate designs for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 2.1.2 Specify production methods and procedures to achieve production requirements
- 3.1.1 Determine the installation requirements for engineering products or processes
- 3.1.2 Specify installation methods and procedures to achieve installation requirements
- 8.1.1 Maintain and develop own engineering expertise

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Outcome 1

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Specify optimum conditions for occupied space.

Knowledge requirements

The candidate knows how to:

- 1 assess heat transmission through building shells
 - a thermal capacity
 - b decrement factor
 - c time lag
 - d periodic heat flow
 - e heat gain through glass
 - f internal heat gains
 - g total heat gain
 - h admittance factor
 - i cooling loads/heat sinks
- 2 assess methods of reducing heat gains and cooling loads
- 3 assess the effect of ventilation in occupied spaces
 - a air conditioning
 - b buoyancy driven ventilation
 - c natural ventilation
 - d air quality and control
- 4 assess heating systems in occupied spaces
 - a central heating
 - i radiators
 - ii convection heating
 - iii climate control systems
- 5 assess the transmission of vapour through building shells
 - a vapour barriers
 - b effect of moisture on building materials
 - c vapour pressure
 - d dew point temperature gradients
 - e interstitial and surface condensation
- 6 assess the flow of natural light through fenestration and its distribution by reflection
- 7 assess the properties of glazing materials
 - a light transmission
 - b light absorption
 - c light reflection
 - d heat absorption

- 8 assess the effects of blinds and curtains
- 9 assess the psychological and physiological impact of daylight in interiors
- 10 control glare from windows and roof lights
- 11 assess daylight performance
- 12 describe visual perception functions
 - a colour
 - b form
 - c light
- 13 apply Gestalt laws of perception of patterns and shapes
- 14 assess the nature of light
 - a transmission
 - b reflection
 - c absorption
- 15 determine the relationship between V_λ and P_λ and light output
- 16 assess the effect on visual performance of illuminance
 - a contrast
 - b size
 - c task
- 17 determine the nature and components of glare
- 18 use statistical data on availability of daylight
- 19 apply lighting units and laws of illumination
- 20 assess the production of visible, thermal and discharge radiation associated with light sources
- 21 select artificial lighting sources which are appropriate to the conditions
 - a discharge
 - b fluorescent
 - c incandescent
- 22 assess the energy consumption of lighting in buildings
- 23 determine the positioning of general and specific lighting in domestic and industrial buildings
- 24 measure artificial light values
- 25 assess the transmission of sound through building shells of various construction designs and materials
- 26 assess the attenuation of sound through
 - a walls
 - b floors
 - c ceilings
- 27 assess the acoustic properties of enclosed space
- 28 use design criteria for the internal aural environment
- 29 determine the sound absorption properties of building materials

- 30 assess noise and vibration attenuation
 - a generated externally
 - b generated within
- 31 investigate methods of improving the acoustics in enclosed spaces
 - a deadening
 - b amplifying
- 32 assess the physical damage of noise on occupants of buildings
- 33 check noise levels

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Outcome 2

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Assess the impact of external environmental conditions on occupied spaces.

Knowledge requirements

The candidate knows how to:

- 1 determine the composition of solar radiation
- 2 determine the heat generated by
 - a sunlight
 - b daylight
- 3 use statistics to estimate the availability of daylight
- 4 use climatology statistics for estimating
 - a annual temperature variations
 - b diurnal temperature variations
 - c mean temperatures
- 5 assess national and local climate conditions
- 6 interpret meteorological information in the derivation of external building design data
- 7 assess atmospheric pollution and pollution sources
 - a general traffic noise
 - b aircraft noise
 - c air quality

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Outcome 3

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Assess the fire hazards exhibited in buildings and develop fire plans and fire detection systems.

Knowledge requirements

The candidate knows how to:

- 1 check the fire resistant properties of building materials using technical specifications or applying standard tests
 - a combustibility
 - b ignitability
 - c flame propagation
 - d surface spread of flames
 - e production of
 - i toxic fumes
 - ii smoke
- 2 assess fire and smoke detection systems and alarm systems
- 3 assess the dangers of ignition and explosions of
 - a gases
 - b dusts
- 4 determine explosive limits
- 5 assess the fire ignition risks of
 - a open flame
 - b static electricity
 - c electric arcs
 - d spontaneous combustion
- 6 assess and select appropriate fire protection systems and the positioning of individual components

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Outcome 4

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Relate functional requirements of buildings to the environment

Knowledge requirements

The candidate knows how to:

- 1 develop building designs to clients briefs or user requirements
- 2 determine the functions of buildings and building performance
 - a domestic
 - b social
 - c commercial
 - d industrial

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Recommended reading list

Core texts	Author(s)	Publisher	ISBN
Building Services Engineering	Chadderton	Spon Press	0415315352
Heat and Mass Transfer in Building Services Design	Moss	Spon Press	0419226508
Air Conditioning Applications and Design	Jones	WP Butterworth-Heinemann	0340645547
Air Conditioning Engineering	Jones	WP Butterworth-Heinemann	0750650745
Engineering Principles of Industrial Ventilation		RJ John Wiley	0471637033
Essentials of Health and Safety at Work Health and Safety Exec,		HSE	071760716
Fire from First Principles Stollard	Abrahams	Spoon Press	0419152806
Lamps and Lighting Coaton	Marsden	Butterworth-Heinemann	0340646187
Solar Engineering of Thermal Processes	Duffie, Beckman	John Wiley	0471510564
Other useful texts			
Thermal Comfort Oseland	Humphreys	MA Building Research	