

# Unit 3: Science & Materials

Level:	4
Credits:	15
Ofqual Code:	L/618/8082

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## Introduction

Science and material performance are intrinsically linked through the need to create structures and spaces that perform in both mechanical operation and in providing human comfort.

This unit aims to support students in making material choices to achieve the desired outcomes of a brief. This is approached from the perspective of materials being fit for purpose; as defined by testing standards and properties but also by consideration of the environmental impact and sustainability. Students will consider health and safety alongside the need to meet legislative requirements.

The topics covered in this unit include: health and safety; storage and use of materials; handling and problems associated with misuse and unprotected use; environmental and sustainable consideration in material choices; human comfort performance parameters. Material choice is developed through the understanding of testing procedures to establish conformity to standards and define performance properties. The performance of materials to satisfy regulations and provide appropriate comfort levels is addressed through design and calculations.

On successful completion of this unit, students will be able to make informed decisions regarding material choices, based on understanding the structural behaviour of materials established through recognised testing methods, sustainability, context of build and health and safety. Students will be able to perform the calculations necessary to establish anticipated performance of the materials in use and therefore determine their compliance with regulations and suitability.

## Learning Outcomes

By the end of this unit, students will be able to:

- LO1 Review health and safety regulations and legislation associated with the storage, handling and use of materials on a construction site
- LO2 Discuss the environmental and sustainability factors that inform the material choices for a given construction project
- LO3 Present material choices for a given project using performance properties, experimental data, sustainability and environmental consideration
- LO4 Evaluate the performance of a given project in respect of its human comfort requirements.

## Essential Content

### LO1 Review health and safety regulations and legislation associated with the storage, handling and use of materials on a construction site

#### *Regulations and guidance*

Health and safety management regulations

Construction design management regulations

Provision and use of equipment regulations

Control and management of hazardous materials through storage, movement and use

#### *Materials handling and installation*

Risk assessments and method statements (qualitative and quantitative)

Materials storage (e.g., moving materials safely, working in confined spaces, working at height)

Occupational health risks associated with materials (e.g., asbestos-related and respiratory disease, dermatitis and skin problems, musculoskeletal disorders, hand arm vibration)

Personal Protective Equipment (PPE)

### LO2 Discuss the environmental and sustainability factors that inform the material choices for a given construction project

#### *Environmental considerations*

Lifecycle assessment

Environmental profile methodology

Environmental product declaration and certification

Embodied energy

Waste management: the economics and technologies of construction waste disposal

#### *Sustainability*

Resource availability and depletion: renewable and non-renewable materials

Reuse and recycling of construction and demolition waste

Waste and Resources Action Programme (WRAP)

*Environmental assessment methods*

Building Research Establishment Environmental Assessment Method (BREEAM)

Leadership in Energy and Environmental Design (LEED)

Green Star

Estidama, or other forms of environmental assessment

Construction Industry Research Information Association (CIRIA)

**LO3 Present material choices for a given project using performance properties, experimental data, sustainability and environmental consideration**

*Material testing*

Testing methods

Interpreting results of tested material data.

Codes and standards

*Structural behaviours*

Performance properties (e.g., strength, elasticity, toughness, hardness, creep, fatigue, porosity, brittleness, density, thermal conductivity, durability)

Inherent material properties.

Relationship between material properties, behaviour and use

**LO4 Evaluate the performance of a given project in respect of its human comfort requirements**

*Thermal*

Heat loss

Heat gain

Thermal control (e.g., passive, active)

*Illumination*

Natural light

Artificial light

Heat gain through sunlight/exposure

*Acoustics and vibration*

Equipment noise/vibration (e.g., ventilation fans, air conditioning systems)

Road noise/vibration

## Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<b>LO1</b> Review health and safety regulations and legislation associated with the storage, handling and use of materials on a construction site		<b>D1</b> Evaluate how multiple regulations and legislation may apply to a given site activity, highlighting how to plan and manage for safe handling and use of materials and processes.
<p><b>P1</b> Discuss the regulations associated with the storage, handling and use of materials.</p> <p><b>P2</b> Describe strategies to safely manage the storage, handling and use of a selection of vocationally typical construction materials.</p>	<p><b>M1</b> Analyse how risk assessments are used to address hazards posed by selected materials or activities.</p>	
<b>LO2</b> Discuss the environmental and sustainability factors that inform the material choices for a given construction project		<b>D2</b> Illustrate how the use of sustainable practices and considerations for material choice can improve the environmental rating of the completed project.
<p><b>P3</b> Explain material environmental profiling and lifecycle assessment, based on a material choice.</p> <p><b>P4</b> Discuss the benefits of product declaration and environmental certification.</p>	<p><b>M2</b> Produce a waste management plan for a given project, considering a typical range of relevant waste materials.</p>	
<b>LO3</b> Present material choices for a given project using performance properties, experimental data, sustainability and environmental consideration		
<p><b>P5</b> Select construction materials for a given project based on testing results and their performance properties in use.</p> <p><b>P6</b> Present the results of relevant testing procedures to identify performance characteristics of selected construction materials.</p>	<p><b>M3</b> Assess the selection of structural materials, based on comparison of loading and performance and behaviour in alternative material choices.</p>	

Pass	Merit	Distinction
<b>LO4</b> Evaluate the performance of a given project in respect of its human comfort requirements		<b>D3</b> Evaluate how the use of passive or active strategies can minimise energy, materials, water and land use.
<b>P7</b> Define a material selection strategy with regard to human comfort requirements.  <b>P8</b> Identify materials for a selected area within a project and explain how these contribute to human comfort.	<b>M4</b> Perform calculations (e.g., lux levels, u-values, acoustic performance, air changes) to support the provision of human comfort for a given project.	

## Recommended Resources

### Print resources

- BLANC, A. (1994), *Internal Components*, Longman Publishing Group
- BUXTON, P. (2018), *Metric Handbook*, Routledge
- CASINI, M. (2016), *Smart Buildings*, Woodhead Publishing
- DEAN, Y. (2016), *Materials Technology*, Routledge
- DORAN, D., CATHER, B. (2013), *Construction Materials Reference Book*, Routledge
- EVERETT, A. (1994), *Mitchell's Materials*, Routledge
- KHATIB, J. (2016), *Sustainability of Construction Materials*, Woodhead Publishing
- LYONS, A. (2014), *Materials for Architects and Builders*, Routledge
- MCDONOUGH, W., BRAUNGART, M. (2010), *Cradle to Cradle: Remaking the Way We Make Things*, North Point Press
- SOMAYAJI, S. (2001), *Civil Engineering Materials*, Pearson College Division
- THOMAS, R. (2006), *Environmental Design*, Taylor & Francis

### Links

This unit links to the following related units:

- Unit 2: Construction Technology
- Unit 9: Principles of Heating, Ventilation and Air Conditioning
- Unit 14: Principles of Refurbishment
- Unit 15: Principles of Alternative Energy
- Unit 28: Group Project (Pearson-set)
- Unit 33: Construction Technology for Complex Buildings Projects
- Unit 35: Sustainable Methods of Construction
- Unit 36: Value Engineering & Cost Control
- Unit 45: Advanced Materials.