2.3.7 The acoustic design of buildings & assets

Key terms

Term	Definition
Frequency	The cycles per second of a sound, expressed in hertz (Hz).
Pitch	A perceptual property that allows sounds to be ordered on a frequency-related scale. (The quality that makes it possible to judge sounds as "higher" and "lower".)
Wavelength	The distance between two successive crests of a sound wave.
Amplitude	The height of the sound wave.
Airborne sound	Sound waves travelling as vibrations through the air.
Impact sound	Sound that is created as a result of impact on a specific part of a building.

$$\text{Frequency} = \frac{\text{Velocity of sound wave (m/s)}}{\text{Wavelength (m)}}$$

Loudness – this is the energy in a sound wave; it is measured in decibels (dB), using a sound level meter.

- If the amplitude of a sound wave is large, the sound is said to be loud.
- If the amplitude doubles, the loudness is quadrupled.

Building acoustics

This refers to the science of controlling noise in buildings. It includes the minimisation of noise transmission from one space to another and the control of the characteristics of sound within spaces themselves.

Building acoustics are an important consideration in the design and construction of buildings, and can impact health and wellbeing, communication, and productivity.

Acoustics are particularly significant in spaces such as concert halls, recording studios, lecture theatres etc., where the quality of sound is critical.

Building regulations

Approved Document E provides guidance on the resistance to the passage of sound in domestic buildings, and in schools and flats. This guidance applies to new buildings, alterations to pre-existing premises and buildings being converted to flats.

The document provides guidance and sets minimum standards on soundproofing, including the transmission of sounds between walls, ceilings, windows, and floors. For airborne sound, the minimum insulation values specified for separating walls, floors, and stairs, as determined by the sound reduction index of the construction materials used are 43 – 45 dB. For impact sound insulation the specified minimum values for floors and stairs, as determined by the sound pressure levels in the adjacent space, are 62 – 64 dB.

The approved document also covers unwanted sound travel within different areas of a building, including the common areas within schools and buildings containing flats, and in-between connecting buildings.

Sound insulation

Sound transmission paths can be interrupted by sound insulation and by blocking air paths. The sound insulation of a material is governed by its mass, therefore dense concrete blocks are used to construct effective party walls between dwellings. However, sound insulation values may be affected by the quality of the workmanship and by flanking transmissions, where sound travels around the insulating element via an easier path.

Sound absorption

Sound absorption is the loss of sound energy when sound waves come into contact with an absorbent porous material such as ceiling tiles, wall panels, and floor coverings. As a result of this, the sound is not reflected back into the space and reverberation times are reduced.

Reverberation time is a measure of the time required for a sound to 'fade away' in an enclosed area after the source of the sound has stopped.

Noise nuisance

Noise nuisance is a noise disturbance that may have a negative effect on health or quality of life. The degree of the disturbance depends on properties such as volume, duration, repetition, frequency (pitch), 'normal' background noise levels and time of day.

Sources of potential disturbance

- Environmental noise, e.g., from transportation
- Neighbour noise, e.g., from adjacent buildings
- Neighbourhood noise, e.g., from industry, entertainment, and construction sites.

Noise nuisance may produce **economic impacts** such as decreasing property value and the loss of productivity, and **social impacts** such as sickness or absenteeism.

The noise profile of an area should be considered when designing buildings to minimise the potential impact of noise disturbance, either on the development or caused by it. Planning permissions may include conditions intended to reduce noise nuisance, and projects that require environmental impact assessments may require specific noise studies.

Construction noise assessments may be carried out, and noise should be monitored on site. If necessary, it may need to be reduced by restricting working hours and changing construction practices.

Local authorities who have a responsibility to tackle unreasonable noise disturbance and can serve a legal notice on the person responsible, take court action and apply for a Warrant of Entry which allows officers to seize noise-making equipment.