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Guidance on sound insulation and noise reduction for buildings

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 78, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 28 February 2014. It was prepared by Technical Committee B/564, *Noise control on building sites*, and Subcommittee EH/1/6, *Building acoustics*. A list of organizations represented on these committees can be obtained on request to their secretaries.

Supersession

This British Standard supersedes BS 8233:1999, which is withdrawn.

Information about this document

This British Standard draws on the results of research and experience to provide information on the design of buildings that have internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations. This document is intended for use by non-specialist designers and constructors of buildings and those concerned with building control, planning and environmental health.

This is a full revision of the standard. The principal changes have been made to reflect:

- changes to the legislative framework since publication of the 1999 edition;
- revisions to Building Regulations Approved Document E [1];
- the publication of specialist documents for specific sectors, such as healthcare and education;
- the publication in England of the National Planning Policy Framework [2] in March 2012, with the concurrent withdrawal of numerous individual planning guidance and policy statement documents, including those specifically relating to noise;
- a reappraisal of the tabular content with respect to setting targets for various classes of living space in the light of research findings; and
- the need to transfer some of the more detailed information from the main text to annexes.

BS 8233:1999 was, like its predecessor CP3 Chapter III:1972, published as a code of practice. However, it was decided to publish this edition as a guide because the text largely comprises guidance that does not support claims of compliance.

Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

0 Introduction

Noise control in and around buildings is discussed in this British Standard guide on an objective and quantifiable basis as far as is currently possible. For many common situations, this guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria for most people. However, it is necessary to remember that people vary widely in their sensitivity to noise, and the levels suggested might need to be adjusted to suit local circumstances. Moreover, noise levels refer only to the physical characteristics of sound and cannot differentiate between pleasant and unpleasant sounds. Important though psychological factors are, it is not practicable to consider them in this guide.

NOTE The standard is intended to be used routinely where noise sources are brought to existing noise-sensitive buildings.

Attention is drawn to the fact that measures taken to control sound might also impinge on fire precautions and other health and safety requirements. All such requirements need to be considered together at an early stage of the design.

1 Scope

This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

This British Standard does not cover:

a) specialist applications, such as auditoria and cinemas (for cinemas, see BS ISO 9568);

b) vibration control, except where it is evident in the form of radiated sound; or

c) noise that breaks out from the building that might affect external receptors.

NOTE Annex A describes some of the simpler types of noise calculation. A method of rating noise is described in Annex B. Methods of measurement of sound insulation are described in Annex C. Annex D outlines some special problems requiring expert advice. Annex E describes airborne and impact sound insulation. Annex F sets out the legislative framework applicable to noise producing developments. Annex G provides example calculations for resolving a typical design problem. Examples of design criteria adopted by various hotel groups are included for reference in Annex H.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4142, *Methods for rating and assessing industrial and commercial sound* [1)]

BS 5502-32, *Buildings and structures for agriculture – Part 32: Guide to noise attenuation*

BS EN 20354, *Acoustics – Measurement of sound absorption in a reverberation room*

[1)] Revision in preparation.

BS EN 60942, *Electroacoustics – Sound calibrators*

BS EN 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

BS EN 61672-2, *Electroacoustics – Sound level meters – Part 2: Pattern evaluation tests*

BS EN ISO 140, *Acoustics – Measurement of sound insulation in buildings and of building elements*

BS EN ISO 140-4, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 4: Field measurements of airborne sound insulation between rooms*

BS EN ISO 140-7, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 7: Field measurements of impact sound insulation of floors*

BS EN ISO 10140-1, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 1: Application rules for specific products*

BS EN ISO 10140-2, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurement of airborne sound insulation*

BS EN ISO 10140-3, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 3: Measurement of impact sound insulation*

BS EN ISO 10140-4, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 4: Measurement procedures and requirements*

BS EN ISO 10140-5, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 5: Requirements for test facilities and equipment*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1.1 A-weighted sound pressure

p_A

value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

NOTE The A-weighting network modifies the electrical response of a sound level meter with frequency in approximately the same way as the sensitivity of the human hearing system.

3.1.2 A-weighted sound pressure level

L_{pA}

quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

p_A is the A-weighted sound pressure in pascals (Pa);

p_0 is the reference sound pressure (20 μPa)

*NOTE Measurements of A-weighted sound pressure level can be made with a meter and correlate roughly with subjective assessments of loudness. They are usually made to assist in judging the effects of noise on people. The size of A-weighting, in 1/3 octave bands, is shown in Annex A (see **A.5**). An increase or decrease in level of 10 dBA corresponds roughly to a doubling or halving of loudness.*

3.1.3 background sound
underlying level of sound over a period, *T*, which might in part be an indication of relative quietness at a given location

3.1.4 break-in
noise transmission into a structure from outside

3.1.5 break-out
noise transmission from inside a structure to the outside

3.1.6 cross-talk
noise transmission between one room and another room or space via a duct or other path

3.1.7 C_{tr}
correction term applied against the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$) to provide a weighting against low frequency performance

NOTE The reference values used within the C_{tr} calculation are based on urban traffic noise.

3.1.8 equivalent continuous A-weighted sound pressure level
$L_{Aeq,T}$

value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, *T*, has the same mean-squared sound pressure as the sound under consideration that varies with time

NOTE 1 This is given by the following formula.

$$L_{\mathrm{Aeq},T} = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{p_{\mathrm{A}}{}^2(\mathrm{t})}{p_0{}^2}\,\mathrm{d}t\right]$$

where:

$p_A(t)$ *is the instantaneous A-weighted sound pressure in pascals (Pa);*

p_0 *is the reference sound pressure (20 μPa).*

NOTE 2 Equivalent continuous A-weighted sound pressure level is mainly used for the assessment of environmental noise and occupational noise exposure.

3.1.9 equivalent sound absorption area of a room
A

hypothetical area of a totally absorbing surface without diffraction effects, expressed in square metres (m^2), which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration

3.1.10 facade level
sound pressure level 1 m in front of the facade

NOTE Facade level measurements of L_{pA} are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.

3.1.11 free-field level
sound pressure level away from reflecting surfaces

NOTE Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source). Estimates of noise from aircraft overhead usually include a correction of 2 dB to allow for reflections from the ground.

3.1.12 impact sound pressure level
L_i

average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent

NOTE For additional information on impact sound pressure level and the standard tapping machine see Annex C and BS EN ISO 140-7.

3.1.13 indoor ambient noise
noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants

NOTE The location(s) within the room at which the ambient indoor noise is to be measured or calculated ought to be considered.

3.1.14 noise criteria
numerical indices used to define design goals in a given space

3.1.15 noise rating
NR

graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves

NOTE Noise rating is described in Annex B.

3.1.16 normalized impact sound pressure level
L_n

impact sound pressure level normalized for a standard absorption area in the receiving room

NOTE Normalized impact sound pressure level is usually used to characterize the insulation of a floor in a laboratory against impact sound in a stated frequency band (see Annex C and BS EN ISO 140-7).

3.1.17 octave band
band of frequencies in which the upper limit of the band is twice the frequency of the lower limit

3.1.18 percentile level
$L_{AN,T}$

A-weighted sound pressure level obtained using time-weighting "F", which is exceeded for N% of a specified time interval

EXAMPLE

$L_{A90,1h}$ is the A-weighted level exceeded for 90% of 1 h.