RECENT ADVANCEMENTS IN BELGIAN BUILDING ACOUSTICAL STANDARDS

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ABSTRACT

Belgium is currently revising its building acoustical standards. In this paper, an overview is given of the changes and new approaches. For dwellings, 3 acoustic comfort classes have been defined by adding a superior class. To ensure a sufficient low frequency airborne and impact sound insulation in lightweight constructions, additional requirements are imposed on the low frequency laboratory performance of dwelling separating elements. Specific requirements hold between apartments and common circulation areas. A new optional way of evaluating façade sound insulation by measuring indoor sound levels is introduced. To estimate the outdoor sound levels, the use of noise maps with internationally defined noise indicators is made possible. Service equipment noise requirements are simplified and an additional requirement on noise emission towards neighboring properties is introduced. Requirements between spaces in non-residential buildings are based on a classification according to their noise sensitivity and noise production.

1. INTRODUCTION

Until 2008, the Belgian building acoustical requirements were specified in two standards covering all building types: NBN S 01-400 [1] with sound insulation criteria and NBN S 01-401 [2] with limits for equipment noise and noise originating from the outside. Both standards are being restructured into a new series regrouped per building type: part 1 for residential buildings [3], part 2 for school buildings [4] and part 3 for other non-residential buildings [5]. Part 1 was first issued in 2008 [3] and is currently being revised [6] while Part 3 is still in a drafting stage. Hence, all values related to requirements in this paper are still subject to change.

2. REVISED REQUIREMENTS FOR DWELLINGS

2.1 Acoustic comfort classes

The draft standard for residential buildings [6] specifies criteria for 3 comfort classes A, B and C. The minimum class to be obtained is class C. However, between spaces of two different newly built residential buildings, the minimum airborne and impact sound insulation must comply with class B. These are in general 4 dB stricter compared to class C. Table 1 and 2 summarize the *in-situ* airborne and impact sound insulation requirements. When verifying the *in-situ* airborne and impact sound insulation, a measurement tolerance of 2 dB is allowed, that is further enlarged to 5 dB for spaces smaller than 25 m³.

In an informative annex, it is explained how these three comfort classes will usually be perceived by the occupants as a function of the prevalent background noise. As examples, the airborne sound insulation towards speech and the impact sound insulation with respect to walking noises, playing of kids and the shifting of small furniture are elaborated.

	Class A	Class B	Class C
	D_A (= $D_{nT,w}$ + C) ≥		
From a space outside the dwelling	62 dB	58 dB	54 dB
Within the same dwelling towards bedrooms or study rooms	44 dB	38 dB	34 dB

Table 1. *In-situ* airborne sound insulation requirements.

	Class A	Class B	Class C
	$L'_{nT,w}$ ≤		
From a space outside the dwelling	43 dB	47 dB	51 dB
Within the same dwelling towards bedrooms or study rooms	54 dB	58 dB	58 dB

Table 2. *In-situ* impact sound insulation requirements.

2.2 Low frequency laboratory requirements

The requirements in Table 1 and 2 are expressed using single number quantities covering a frequency range starting from the 100 Hz third-octave band. For heavyweight constructions, these requirements correlate well with the comfort level perceived by the occupants. Hower, for lightweight constructions, often considerable sound insulation dips may occur in the frequency range of 50 to 100 Hz due to mass-air-mass resonances caused by lightweigt elements containing (too) narrow cavities (as illustrated in Figure 1), leading to low-frequency complaints even in situations where all *in-situ* requirements according to Table 1 and 2 are fulfilled. Hence, to exclude these poor designs from the market, low frequency requirements are further needed.

Due to a poor reproducability of low-frequency *in-situ* sound insulation measurements and a more complicated *in-situ* evaluation method for small spaces [7, 8], it was decided to include complementary low frequency *laboratory* requirements for dwelling separating construction elements. These are expressed in terms of single number quantities covering a frequency range starting from the 50 Hz third-octave band and are summarized in Table 3. Alternatively, compliance with these low-frequency requirements may also be proven based on a prediction report issued by a suitably qualified acoustician.

	Class A	Class B	Class C
	$R_{A,50}$ (= R_w + $C_{50\text{-}3150}$) ≥		
For dwelling separating constructions elements	59 dB	55 dB	51 dB
	$L_{I,50}$ (= $L_{n,w}$ + $C_{I,50\text{-}2500}$) ≤		
For dwelling separating construction elements	48 dB	52 dB	56 dB

Table 3. Complementary *laboratory* airborne and impact sound insulation requirements for dwelling separating construction elements.

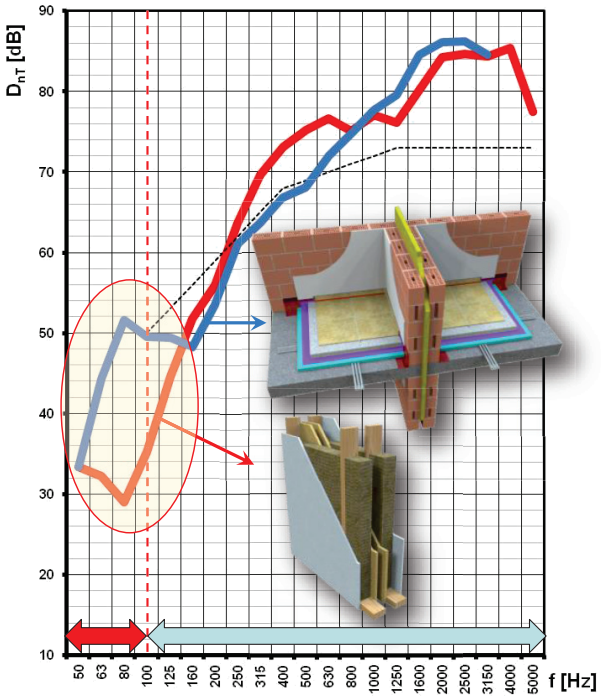

Figure 1. Comparison between *in-situ* measured sound insulation spectra of a heavy-weight anchorless cavity wall (blue line) and a lightweight poorly designed cavity wall (red line) with comparable D_A values.

2.3 Common circulation areas

Between common circulation areas and apartments, the requirements in line 1 of Table 1 are lowered by 4 dB. In this case, intermediate spaces will generally be necessary to fulfill this requirement (Figure 2, top). If there is only a single door towards common circulation spaces, these requirements can exceptionally be lowered by 14 dB instead (Figure 2, below). In this last case however, the possible lack of acoustic comfort must be reported in writing to the client before the start of the construction works and the client for his part must report this in writing to future tenants before concluding the purchase or rental agreement.

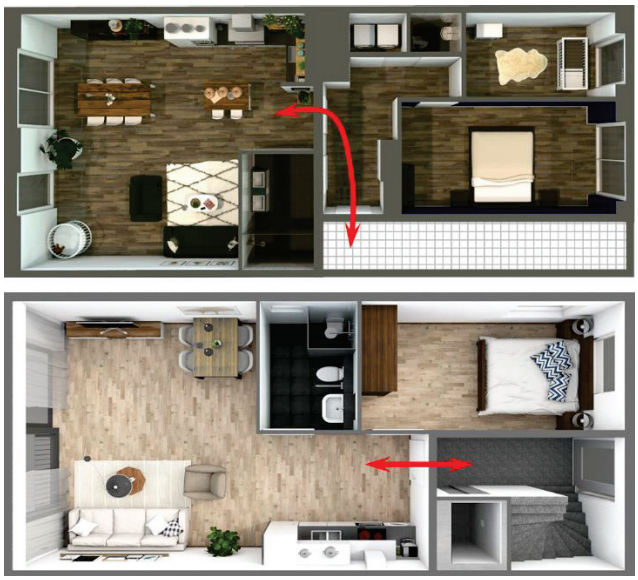

Figure 2. Plan view of apartments separated from a common circulation area by an intermediate space (top) and by a single door (below).

2.4 Façade sound insulation

In Belgium, façade sound insulation requirements depend on the outside sound pressure level due to traffic, industrial, commercial or equipment noise, before each façade pane of a space to be protected. These levels are to be evaluated during at least 30 minutes on a moment that is to be considered representative for the possible nuisance caused by the outdoor noise. The requirements aim at A-weighted indoor sound pressure levels not exceeding 34 dB in class C (minimum requirement) and 30 dB in class A and B for “day spaces” and 28 dB / 25 dB respectively for bedrooms at night. Minimal façade sound insulation requirements (that do not depend on the outdoor noise level) are also specified: D_{Atr} (= $D_{2m,nT,w}$ + C_{tr}) ≥ 28 dB for class C and D_{Atr} ≥ 32 dB for class A and B. Finally, bedroom façade panes exposed to considerable nightly peak noise levels caused by passages of air, rail or road traffic have a minimum requirement of D_{Atr} ≥ 34 dB for all classes. For these bedroom cases, complementary design guidelines to ensure a suitable protection are provided as well.

In informative annexes, guidelines are specified on how to determine the outside noise levels for road traffic noise sources based on the actual traffic situation and on how to determine the required acoustical performances of façade elements (like windows and ventilation grids) in

the project phase, based on the required façade pane insulation.

To avoid laborious in-situ evaluations of both outside noise levels and façade pane sound insulation, it is allowed to prove compliance by comparing the measured specific indoor sound pressure level originating from the outdoor noise sources, to the target indoor sound pressure levels, as far as this is technically possible.

A further new element in the draft standard [6] is the possibility to calculate the above mentioned outside sound pressure level through guidelines based on publicly available internationally defined noise map indicators like L_{den}, L_{day} and L_{night} for cases where traffic noise is the dominating outside noise source.

2.5 Simplified equipment noise requirements

In the 2008 standard [3], service equipment noise requirements are limiting both absolute noise levels as well as the allowed exceeding of prevalent background noise levels, depending on the type and localization of the equipment. In the second case, it is often impossible to make a suitable design because the expected background noise level is mostly unknown. Therefore, it was decided in the new draft [6] to specify service equipment noise limits only in terms of specific noise levels, $L_{Aeq,nT}$ for stationary service equipment or $L_{AF,max,nT}$ for transient service equipment. If stationary equipment noise contains tonal components, a 5 dB penalty is applied to the measured level.

Because service equipment noise is usually perceived less annoying when originating from equipment, pipes and ducts operated exclusively by the dwelling's occupants, more relaxed requirements are set compared to these applicable to noise originating from service equipment, pipes and ducts shared or operated by neighbors.

When verifying the *in-situ* service equipment noise levels, a measurement tolerance of 1 dB is allowed, that is further enlarged to 3 dB for spaces smaller than 25 m³.

2.6 New noise emission requirements

The equivalent A-weighted sound pressure level emitted by service equipment towards neighboring buildings is limited to 40 dB on the building plot boundary. This new requirement is only applicable if no stricter local requirements prevail.

3. NEW REQUIREMENTS FOR NON-RESIDENTIAL BUILDINGS

3.1 Scope

Non-residential buildings in the draft standard [5] include dwellings for short stay (like holiday dwellings) and dwellings depending on common kitchens and/or common sanitary spaces (like student lodgings, rooms in boarding schools or retirement homes). Service flats and studios fall under the scope of the draft standard for residential buildings [6], as discussed in section 2.

3.2 Acoustic comfort classes

The draft standard [5] specifies minimum requirements to be met if no stricter local regulations apply. However, when the initiator of the building project expresses particular wishes for enhanced acoustic performance or when the future occupants are promised enhanced acoustic properties by the seller or landlord, stricter requirements need to be applied. In these cases, the requirements for airborne and impact sound insulation become 4 dB stricter. Similarly, the reverberation requirements become 20% stricter when enhanced acoustic performance is applicable.

3.3 Airborne and impact sound insulation

Generic airborne and impact sound insulation requirements are determined based on a classification of space typologies that can typically be found in non-residential buildings according to their typical airborne and impact sound production and their acoustic sensitivity. These generic requirements are overruled by requirements specified in tables for a set of building types: hotels, offices, retirement homes, student lodgings and hospitals. In these dedicated tables, requirements are set between some prevalent combinations of space typologies. Furthermore, specific requirements concerning speech privacy are also included in these tables for spaces where confidentiality is important.

Additionally, requirements between non-residential buildings and adjacent buildings or between non-residential parts and dwelling parts in the same building are set as a function of the expected airborne and impact sound production in the non-residential building (part).

In an informative annex, further guidelines are given on how to obtain a good privacy between rooms considering the background noise level in the receiving room. Further, the influence of the background noise level on the subjective appreciation of the impact sound insulation performance are clarified for walking noises, playing kids and the shifting of small furniture.

3.4 Façade sound insulation

The façade sound insulation requirements in [5] aim at indoor sound pressure levels corresponding to the noise limits for stationary service equipment, which in turn depend on the acoustic sensitivity of the space.

Guidelines on how to determine the outside noise levels for road traffic noise sources based on the actual traffic situation or for any traffic noise type based on publicly available internationally defined noise map indicators like L_{den}, L_{day} and L_{night} are included in an informative annex. Further, guidelines are specified on how to determine the required acoustical performance of façade elements (like windows and ventilation grids) in the project phase, based on the required façade pane

sound insulation. Finally, guidelines for additional façade sound insulation requirements in the case of structural nocturnal air or rail traffic noise are also elaborated in an informative annex.

3.5 Service equipment noise

Service equipment noise limits are specified in terms of maximum background noise corrected standardized noise levels $L_{Aeq,nT}$ for stationary service equipment and $L_{AF,max,nT}$ for transient service equipment. If stationary equipment noise contains tonal components, a 5 dB penalty is applied to the measured level. As in the revised standard for dwellings [6], the equivalent A-weighted sound pressure level emitted by service equipment towards neighboring buildings is also limited on the building plot boundary.

3.6 Sound absorption and reverberation

To avoid excessive reverberation, design requirements are defined for prevalent spaces in non-residential buildings. They are expressed as a minimal room-averaged weighted sound absorption coefficient $\overline{\alpha_w}$ or a minimal total weighted equivalent sound absorption area A_w as a percentage of the walkable area in that room. Alternatively, maximal nominal reverberation times are specified to be measured in unfurnished spaces or furnished spaces (for open plan offices, call centres and hospital bedrooms).

In informative annexes, guidelines to obtain good acoustical conditions in open plan offices and in eating and dining facilities are extensively elaborated.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

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