Comparison of EN 12354-1 to -4 of 2000 with EN 12354-1 to -4 of 2017

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Summary

To compare the European Standards EN 12354-1 to EN 12354-4 of 2000 with the new European/International Standards EN ISO 12354-1 to EN ISO 12354-4 of 2017 is the main objective of this paper. Such a comparison will allow to list and to understand the main changes in order to guide the necessary changes in the associated calculation procedures to predict the acoustic performance of buildings.

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1. Introduction

The comparison of the two versions (2000 and 2017) of the standard is done in the following chapters, divided in the four parts of the standard (EN 12354-1 [1,2], EN 12354-2 [3,4], EN 12354-3 [4,5] and EN 12354-4 [6,7]).

2. EN 12354-1

For this standard [1,2] the following subchapters are divided according with the main sections of EN ISO 12354-1:2017 [1].

2.1 Introduction

The chapter "*Introduction*" just exists on the 2017 version [1], but the main contends come from the "*Foreword*" chapter of 2000 version [2].

2.2 Scope

Both, the detail model of 2017 version [1] and 2000 version [2], can be used for 1/3 octave bands, or octave band, between 100/125 Hz and 3150/2000 Hz. Both can be extended to low and/or high frequencies, if related information is available. Both versions include a simplified model, using single number ratings. The new content, of [1], in the "*Scope*" chapter, is: "*... a method to determine uncertainty is proposed for the simplified model (see Annex K)*".

2.3 Normative references

The normative references of the new version [1] are mostly the upgrade of the normative references of the old version [2]. Highlight for the change from "prEN ISO 10848-1" [2] to the series "EN ISO 10848-1" to "EN ISO 10848-4" [1] (last version of these standards 2017).

2.4 Terms and definitions

The chapter "*3 Terms and definitions*" of [1] correspond, more or less, to the chapter "*3 Relevant quantities*" of [2]. The complete new "terms" of [1] (not included in [2]) are: Type A and Type B element ("*An element may only be defined as Type A over part, or parts of the frequency range*"):

- Type A: "*element with a structural reverberation time that is primarily determined by the connected elements ..., and a decrease in vibration level of less than 6 dB across the element in the direction perpendicular to the junction line (up to at least the 1000 Hz one-third-octave band)*".
  "*…Examples include cast in situ concrete, solid wood (including cross laminated timber panels), glass, plastic, metal, bricks/blocks/slabs with a finish/topping (e.g. plaster, parge coat, screed, concrete) that mechanically connects them together*"

- Type B: "*any element that is not a Type A element*".
  "*Examples typically include plasterboard/timber cladding on timber or metal frames*".

Other change is the fact that the "*3.3.5 Direction-averaged junction velocity level difference*" of [2] appears on [1] also as "3.2.7 *Normalized direction-averaged vibration level difference*".

2.5 Calculation models

The [1] and [2] references are very similar in the chapter "*4 Calculation models*". The main differences are:

- In chapter "*4.2.2 Transfer of input data to in situ values*" of [1] is said, as in the same chapter of [2]: "*There is some evidence to indicate that the improvement for airborne direct transmission is also a reasonable estimate for the improvement for flanking transmission*". The new text in [2] is: "*An exception is lightweight basic elements, for which there are indications that using the same values for flanking transmission as for airborne direct transmission can no longer be assumed*".
- The chapter "*4.2.2 Transfer of input data to in situ values*" is divided, just in [1] (not in [2]), in three subchapters: "*4.2.2.1 General*", "*4.2.2.2 Type A elements*" (elements where the *in situ* values depends on the structural reverberation time) and "*4.2.2.3 Type B elements*" (elements where $R_{situ} = R$).
- The chapter "*4.2.3 Determination of direct and flanking transmission in situ*" is divided (just in [1] not in [2]) in three subchapters: "*4.2.3.1 General*", "*4.2.3.2 Type A elements*" and "*4.2.3.3 Type B elements*".
- The chapter "*4.2.4 Interpretation for several types of elements*" of [2] was moved to the new "*Annex J: Guidelines for practical use*" of [1].
- The chapter "*4.2.4 Limitations*" of [1] is similar to the chapter "*4.2.5 Limitations*" of [2], except the fact that in [1], for the case of: "*With very large floors, floors with columns and lightweight internal walls, the floor of a room can no longer be considered as an independent element*," [1] refers to the Annex J for proposed solutions.
- The chapter "*4.3 Detailed model for airborne transmission*" is similar in [1] and in [2], but in [1] refers to "*Annex H: Determination of indirect airborne transmission from performance of system elements*" and in [2] refers to "*Annex F: Determination of indirect transmission*".
- The chapter "*4.4 Simplified model*" of [1] includes also transmission through a small technical element, not only structure-borne transmission like in chapter "*4.4 Simplified model for structure-borne transmission*" of [2].
- The chapter "*4.4.2 Calculation procedure*" of [1] is similar to the chapter "*4.4.1 Calculation procedure*" of [2], but includes the following text not included on [2]: "*For lightweight constructions, the weighted flanking sound reduction index $R_{ij,w}$ for any path Ff, Df or Fd shall be determined from the corresponding weighted flanking normalized level difference $D_{n,f,ij,w}$ using Formula (21) …*".
- The Chapter "4.*4.3 Input data*" of [1] is similar to the chapter "*4.4.2 Input data*" of [2], but in [1] is included the "*weighted normalized flanking sound level difference for transmission path Ff: $D_{n,f,Ff,w}$"* not include in [2].

2.6 Accuracy

The chapters "5 Accuracy" of [1] and [2] are similar but in [1] is included the following text not included in [2]: "*Uncertainty for the simplified model can be estimated using the method propose in Annex K …*".

2.7 Annexes

The following annexes just exist in [1]:

- "*Annex G: Determination of normalized flanking level difference*".
- "*Annex I: Sound insulation in the low frequency range*".
- "*Annex J: Guidelines for practical use*".
- "*Annex K: Estimation of uncertainty*".

The following annexes exist in [1] and in [2], but with the following main changes:

- "*Annex B: Sound reduction index for monolithic elements*" of [2] is now "*Annex B: Sound reduction index*" of [1] with:

  - Information how to obtain sound reduction index for non monolithic elements.
  - Different formula for calculation of transmission factor for $f < f_c$.
  - Example of radiation efficiency in one-third octave band (Table B.1).
  - Calculated sound reduction index in one-third-octave bands for some homogeneous structures (Table B.2). In [2] was in octave bands.
  - Typical material properties for:
    - Concrete.
    - Calcium silicate blocks.
    - Autoclaved aerated concrete blocks.
    - Lightweight aggregate blocks.
    - Dense aggregate blocks.
    - Bricks.
    - Plasterboard (natural gypsum).
    - Plasterboard (flue gas and natural gypsum).
    - Chipboard

    For [2] was just:
    - Concrete.
    - Calcium silicate.
    - Lightweight concrete.
    - Autoclaved aerated concrete.
- "*Annex C: Structural reverberation time*" of [2] is now "*Annex C: Structural reverberation time: Type A elements*".
- "*Annex D: Sound reduction index improvement of additional layers*" has the same name in [1] and in [2], but in [2] there is a new formula to calculate the weighted sound reduction index improvement by a lining below 200 Hz (Table D.1; in [2] was Table D.3).
- "*Annex E: Vibration reduction index for junctions*" of [2] is now divided in two annexes in [1]:
  - "*Annex E: Vibration transmission over junctions: case of heavy buildings*".
  - "*Annex F: Vibration transmission over junctions: case of lightweight buildings*".
- "*Annex H: Calculation Examples*" of [2] is now "*Annex L: Calculation Examples*" of [1], and in [1] includes also examples for lightweight buildings.

3. EN 12354-2

The maim differences exposed in chapter "*1 EN 12354-1*" of this paper, namely the difference of Type A and Type B elements exposed on the new version, occurs also in EN ISO 12354-2:2017 [3] relatively to EN 12354-2:2000 [4].
Must be highlight also the fact that the simplified method of [3] is not anymore based on a Table (Table 1 of [4]) with values for *K*, but in formulas similar to the detailed model, but using index values, as occur on the simplified model of EN 12354-1 [1,2].
Must be highlight also the following annexes that just exist in [3]:

- "*Annex E: Impact sound insulation in the low frequency range*".
- "*Annex F: Impact sound performance of stairs*".

"Annex E: Calculation Examples" of [4] is now "*Annex G: Calculation Examples*" of [3], and in [3] includes also examples for lightweight buildings.

4. EN 12354-3

Since can be typically depreciated the junction contributions in the façade calculation, the EN ISO 12354-3:2017 [5] is very similar to the EN 12354-3:2000 [6], without the differences of Type A and Type B elements exposed in EN 12354-1 [1,2] and EN 12354-2 [3,4].
The main change is the new "*Annex F: Guidelines for practical use*" in [5].

5. EN 12354-4

The EN ISO 12354-4:2017 [7] is very similar to the EN 12354-4:2000 [8], where the main changes are the update of the references.

6. Conclusions

In the light of the above, there are significant changes between previous versions [2,4,6,8] and new versions [1,3,5,7], in particular the distinction between cases of heavy and lightweight buildings, which should be duly taken into account in the alterations on the calculation procedures for include the new standards approach.

References

[1] EN ISO 12354-1: Building acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 1: Airborne sound insulation between rooms, 2017.

[2] EN 12354-1: Building Acoustics, Estimation of acoustic performance ofbuildings from the performance of elements, Part 1: Airborne sound insulation between rooms, 2000.

[3] EN ISO 12354-2: Building acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 2: Impact sound insulation between rooms, 2017.

[4] EN 12354-2: Building acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 2: Impact sound insulation between rooms, 2000.

[5] EN ISO 12354-3: Building acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 3: Airborne sound insulation against outdoor sound, 2017.

[6] EN 12354-3: Building acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 3: Airborne sound insulation against outdoor sound, 2000.

[7] EN ISO 12354-4: Building Acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 4: Transmission of indoor sound to the outside, 2017.

[8] EN 12354-4: Building Acoustics, Estimation of acoustic performance of buildings from the performance of elements, Part 4: Transmission of indoor sound to the outside, 2000.