# SIMPLE PRESENTATION OF EXPECTED IMPACT SOUND LEVELS FOR A TESTED FLOORING LAID ON 35 STANDARDIZED CONRETE SLABS, USING EN 12354

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Simmons, Christian

*simmons akustik & utveckling ab*

Krokslätts Fabriker 1

SE-431 37 Molndal

SWEDEN

Tel: +46 31 27 66 00

Fax: +46 31 27 66 00

E-mail: info@simmons.se

Web: www.simmons.se

**ABSTRACT**

Manufacturers of floorings may now use a new tool to present the expected impact sound levels when their product is applied on a specific slab *in situ*. EN 12354 is used to make estimates of the performance of 35 typical concrete slabs equipped with the tested flooring. The result is a compact table, giving a broad overview valid for this flooring as applied in typical Swedish dwelling and institutional buildings, thus facilitating for building manufacturers, marketing departments, engineers and architects. The list of slabs has been proposed for an update of the Swedish sound classification standard SS 02 52 67, giving reference to the Scope of EN 12354 parts 1 and 2. New types of building may be added to the list using EN 12354.

**INTRODUCTION**

The Swedish manufacturers of floorings have asked for a simple tool that has been developed. It may be used to present the expected sound class for a tested flooring. This tool, the “impact sound guidelines”, is intended to facilitate for architects and contractors to choose a flooring that meets the sound requirements, given a specified massive slab floor. The tool takes the frequency dependence of both the slab and the flooring into account, according to the detailed model of EN 12354-2. There are several reasons for this initiative.

The Swedish requirements on impact sound insulation are stated in the Swedish standards SS 02 52 67 (sound classification of dwellings) and SS 02 52 68 (sound classification of public spaces in buildings). Both refer to the weighted normalised impact sound pressure level $L'_{nw}$ with or without the spectrum adaption term $C_{i,50\text{-}2500}$. The frequency range is thus extended downwards to 50 Hz. The impact sound reduction of the flooring may be included when

conformity tests are being made, according to the standard. This implies that the impact sound improvement $\Delta L$ of a flooring has to be tested and declared in the frequency range 50-3150 Hz. The widely used classification of impact sound improvement of floorings (according to SS 02 52 67 encl. B) is however based on the standardised frequency range 100-3150 Hz.

The variation of slab thickness and boundary condititons (i.e. whether the supporting walls allow vibrational energy to leave the slab) imply that the impact sound level of the slabs vary considerably (c.f. Figure 1). The reasons for this is described in an ICA paper [ 2 ]. A combination of a thick concrete slab (with high structural losses) and a flooring with a modest impact sound improvement may fulfill a high sound class. Another slab may require a high performance flooring to fulfill even the basic requirement. Therefore, the previous classification of floorings based on a typical (but not standardised) thin concrete slab with a low structural loss factor is too conservative to be feasible to new building applications.

There are several types of floorings used in the Scandinavian countries, ranging from thin carpets with a medium or soft cushioning foam backing, floating parquets on a thin polyethene foam to heavyweight floating concrete floors. From experience, it is known that the deterioration of the airborne and impact sound insulation at the fundamental resonance frequency of floating floors must be considered with the actual type of slab. The use of the "simplified method" of EN 12354 (using weighted values only) is less reliable, considering our local circumstances, than the detailed method where all calculations are carried out in third octave bands. Reference [ 5 ] describes other properties of constructions typical to the Scandinavian countries.

## 35 TYPICAL SLABS USED IN THE IMPACT SOUND GUIDELINES

The most common types of Swedish buildings erected over the past 60 years have been described in reference 3 (in Swedish). From this publication, 35 cases were selected and generalized with respect to room sizes, types of slab and number of supporting heavyweight concrete wall structures. Some examples are presented in Table 1 and Figure 1. A complete list will be published in SS 02 52 67 after it has been notified at CEN.

*Table 1. Typical cases in Swedish buildings, examples, from ref. [ 2 ].*

| ID | Slab type, cm concrete | House type, typical period | No of heavy wall supports | Room type | Note |
|---|---|---|---|---|---|
| 1b | 10 cm (with render on wood panel) | — " — | 3. | Common room 5x4 $m^2$. | 1. |
| 1c | 10 cm (top layer removed) | — " — | 2. | Space 2x2 $m^2$. | 2 |
| 2a | 14 cm | 1930-1940, brick or aerated concrete in facade | 3. | Common room 5x4 $m^2$. | 3. |
| 2b | 16 cm | —"— | 3. | Common room 5x4 $m^2$. | 4. |
| 3a | 12 cm | 1950, light weight facades | 2, in parallel | Common room 5x4 $m^2$. | |
| 6a | 18 cm | 1960, light weight facades | 2, in parallel | Open plan 5x10 $m^2$. | |
| 10c | 25 cm | 1990-, cast in situ | 3. | Common room, 5x4 $m^2$, | |
| 10e | 27 cm | 1990-, office type, precast slabs, steel columns | 0 | Space 2x3 $m^2$ | |
| 11c | 20 cm HD/F120 255 kg/$m^2$, 9 m | — " — | 2. | Common room, 5x4 $m^2$. | 5. |
| 11f | — " — | — " — | 1. | Space 2x3 $m^2$ | |

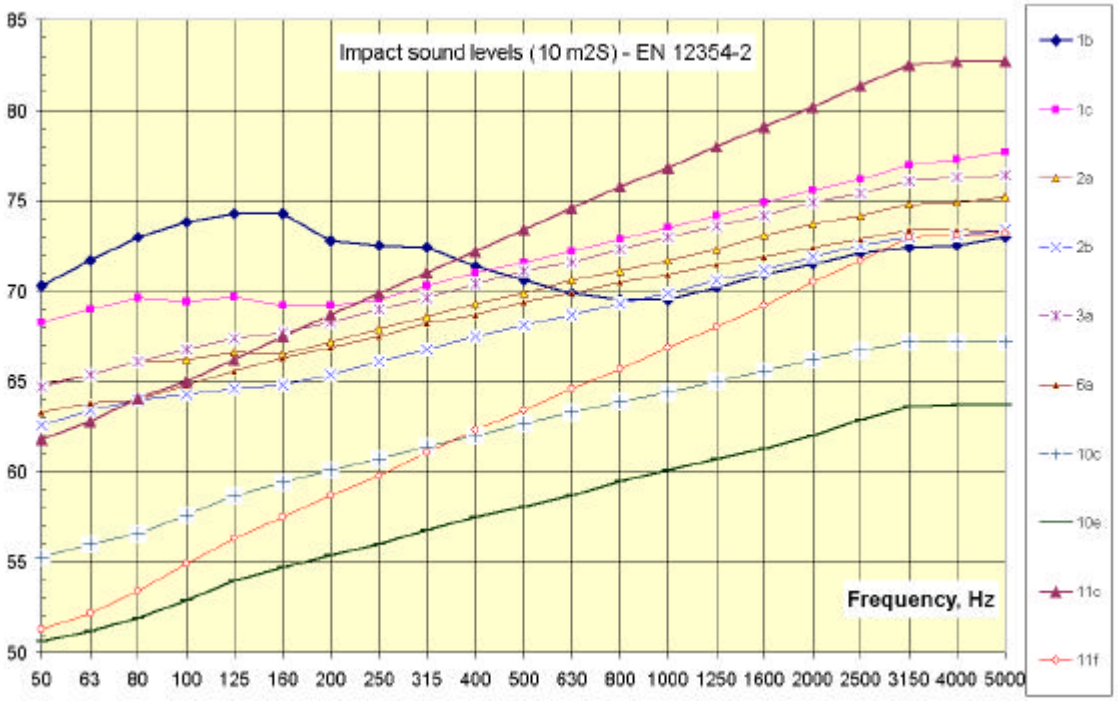


*Figure 1. Impact sound pressure levels of the cases given in Table 1. The variation in level and shape of the curves indicates that the performance of a specific flooring will depend on the slab and boundary condtitions.*

## CALCULATIONS OF IMPACT SOUND PRESSURE LEVEL WITH FLOORING

For each case in Table 1, the normalised impact sound pressure without flooring was calculated using the BASTIAN® software (which is based on EN 12354-2), ref. [ 4 ]. To facilitate the application of the guidelines, a margin was included by increasing all of the calculated values by 3 dB. This margin is by no means "safe" but merely choosen as a reasonable margin, as it is based on common practice. The margin may need to be revised when further empirical experience has been achieved. The resulting values are given in Table 2.

The calculation with and without flooring is illustrated by Figure 1. The calculation procedure is straight forward. Given the reduction of impact sound insulation, determined according to EN ISO 140-8, the impact sound level of the 35 slabs with the flooring is estimated in each frequency band (50-3150 Hz) by subtracting the values in Table 1 with the reduction values. From these estimated values, the weighted impact sound pressure level $L'_{nw}$ and the spectrum adaption terms ($C_i$ ; $C_{i,50\text{-}2500}$) may readily be calculated.

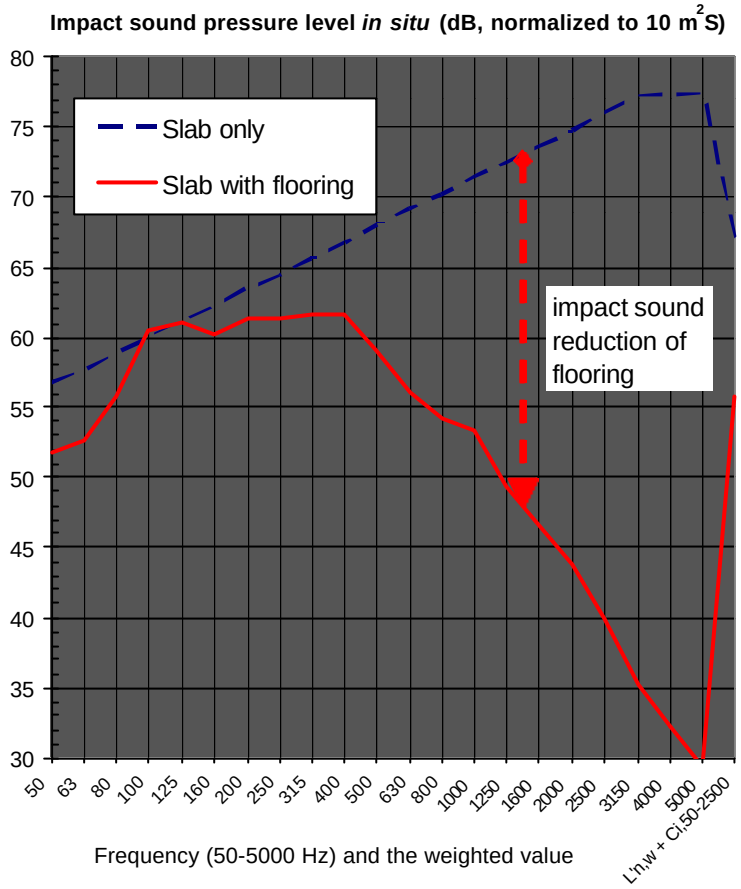


*Figure 2: Calculated impact sound pressure level, vertical direction (normalised). With (—) and without (- -) flooring with elastic foam backing. Slab floor: Hollow precast concrete slab 200 mm with 25 mm cast topping concrete, 385 kg/m$^2$. Common room, size 5 x 4 m$^2$. One concrete partition wall 200 mm (continous), one light weight facade and 2 interior light weight walls. With the demonstrated flooring, sound class C is fulfilled ($L'_{nw} + C_{i,50\text{-}3150}$ 56 dB, the requirement is 58 dB). Airborne sound insulation in this case: $R'_w + C_{50\text{-}3150}$ 55 dB, the requirement is 52 dB.*

*Table 2. Impact sound pressure levels for cases listed in Table 1.*

| Frequency / Slab type | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1b | 73,3 | 74,7 | 76,0 | 76,8 | 77,3 | 77,3 | 75,8 | 75,5 | 75,4 | 74,4 | 73,6 | 72,9 | 72,5 | 72,5 | 73,2 | 73,9 | 74,5 | 75,1 | 75,4 |
| 1c | 71,3 | 72,0 | 72,6 | 72,4 | 72,7 | 72,2 | 72,2 | 72,5 | 73,3 | 74,0 | 74,6 | 75,2 | 75,9 | 76,5 | 77,2 | 77,9 | 78,6 | 79,2 | 80,0 |
| 2a | 67,8 | 68,4 | 69,1 | 69,2 | 69,6 | 69,5 | 70,2 | 70,9 | 71,6 | 72,3 | 72,9 | 73,6 | 74,1 | 74,7 | 75,3 | 76,1 | 76,7 | 77,2 | 77,8 |
| 2b | 65,6 | 66,4 | 67,0 | 67,3 | 67,6 | 67,8 | 68,4 | 69,1 | 69,8 | 70,5 | 71,1 | 71,7 | 72,3 | 72,9 | 73,6 | 74,2 | 74,9 | 75,5 | 76,0 |
| 3a | 67,7 | 68,4 | 69,1 | 69,8 | 70,4 | 70,7 | 71,3 | 72,0 | 72,6 | 73,4 | 74,1 | 74,6 | 75,3 | 76,0 | 76,6 | 77,2 | 77,9 | 78,4 | 79,1 |
| 6a | 66,3 | 66,8 | 67,0 | 67,8 | 68,6 | 69,3 | 69,9 | 70,5 | 71,2 | 71,7 | 72,4 | 72,9 | 73,5 | 73,9 | 74,5 | 74,9 | 75,4 | 75,9 | 76,4 |
| 10c | 58,3 | 59,0 | 59,6 | 60,6 | 61,7 | 62,4 | 63,1 | 63,7 | 64,4 | 65,0 | 65,7 | 66,3 | 66,9 | 67,4 | 68,0 | 68,6 | 69,2 | 69,7 | 70,2 |
| 10e | 53,6 | 54,2 | 54,9 | 55,9 | 57,0 | 57,7 | 58,4 | 59,0 | 59,8 | 60,5 | 61,1 | 61,7 | 62,5 | 63,1 | 63,7 | 64,3 | 65,0 | 65,9 | 66,6 |
| 11c | 64,8 | 65,8 | 67,1 | 68,0 | 69,2 | 70,5 | 71,7 | 72,9 | 74,0 | 75,2 | 76,4 | 77,6 | 78,8 | 79,8 | 81,0 | 82,1 | 83,2 | 84,4 | 85,5 |
| 11f | 54,3 | 55,2 | 56,4 | 57,9 | 59,3 | 60,5 | 61,7 | 62,8 | 64,1 | 65,3 | 66,4 | 67,6 | 68,7 | 69,9 | 71,0 | 72,2 | 73,5 | 74,7 | 76,0 |

## AIRBORNE SOUND INSULATION

The airborne sound insulation is not affected by thin carpets attached to the slab. Heavy floating floors and light weight floors floating on joists (access floors) increase the airborne sound insulation in the frequency range 50-3150 Hz, however some constructions may show a small deterioration (-1;-3 dB) in the range 50-100 Hz. Light weight parquet floors, floating on a thin layer of foam or paper (2-10 mm) reduce the airborne sound insulation (-3;-8 dB) at the fundamental resonance frequency. In case a partition wall is lightweight (e.g. plaster boards on studs), the slab transmits energy efficiently between the rooms. The reduction of the weighted airborne sound insulation $R'_W + C_{50\text{-}3150}$ may be in the order of 5-8 dB as compared to the slab with no flooring. To take such problems into account, a detailed calculation is recommended, e.g. according to EN 12354 part 1. An informative note in the proposed standard gives this recommendation.

The sound insulation of floating floors may be reduced considerably by structural bridges. Therefore, another informative note recommends manufacturers to take appropriate action with respect to guidelines and work instructions. The flooring must be suspended on the elastic layers and must not be in any contact with the building structure.

## REFERENCES


[ 1 ] EN 12354. Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements – Part 2. Impact sound insulation.

[ 2 ] Simmons, Christian. Systematic comparison of sound insulation measured in situ with values calculated according to EN 12354 yields confident data of the acoustical properties of building elements. Proceedings of the International Congress on Acoustics (ICA), Rome 2001.

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[ 4 ] BASTIAN®. Isover AG (www.isover.de). Version 1.1. Users manual.

[ 5 ] Pedersen, D.B. Nordtest report 1346-97. Delta Acoustics & Vibration, Århus 1998.