PROSPECTS FOR A TEST METHOD FOR RATING FLOOR TOPPINGS ON JOIST FLOORS

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1. INTRODUCTION

Recently ASTM issued a new test method, E2179[1], for rating floor coverings or toppings. A standard tapping machine is operated on a bare concrete slab and on a topping to be evaluated. The reduction in impact noise in the room below is used to calculate the change in impact insulation class (IIC) relative to an imaginary reference concrete slab. The foundation on which this test method rests is that the improvement is independent of the concrete slab thickness. E2179 is almost identical to ISO 140-8[2].

Users are warned in E2179 not to use the improvement spectrum to estimate improvements that the topping might produce on a joist floor with a wood subfloor. The improvements are not the same as those for a concrete slab[3].

This paper describes some of the current efforts to develop a similar test procedure for toppings on joist floors and some of the problems that need to be resolved.

2. TOPPINGS ON DIFFERENT JOIST FLOORS

For impact noise improvements from a test method for joist floors to be useful, they need to be applicable to any joist floor. To find whether this is true in practice, eight resilient materials were placed in turn below a 1.2 m square piece of OSB on six different joist floor systems and the reductions in impact sound pressure level were measured[4]. The basic floor system incorporated 200 mm deep steel joists, resilient metal channels, glass fibre batts, a plywood subfloor, and a 13 mm gypsum board ceiling. Either one or two layers were used in the subfloor and the ceiling and in one case, no ceiling was installed. The latter case was included with the hope that this simple floor might be acceptable as a standard floor in a new test method. Figure 1 is typical of the results obtained and shows that the improvement obtained depends quite strongly on the structure of the floor system. The results obtained suggest that any improvement spectrum from a test method will not be applicable to all kinds of joist floors.

3. USE OF A SMALL WOOD ASSEMBLY ON A CONCRETE SLAB

A major practical obstacle for testing toppings on joist floors is that the standard joist floor must be constructed or available each time a topping system is to be evaluated. For many laboratories, this means complete construction of the standard floor each time tests are to be run — a costly procedure. To eliminate the need for construction of a complete joist floor, Jonasson[5,6] suggested that a small assembly comprising only some studs and a subfloor could be used on top of a concrete slab. Toppings would then be placed on top of this for evaluation. His experiments revealed problems that needed further work. A short test of his method in another laboratory[7] was also not encouraging.

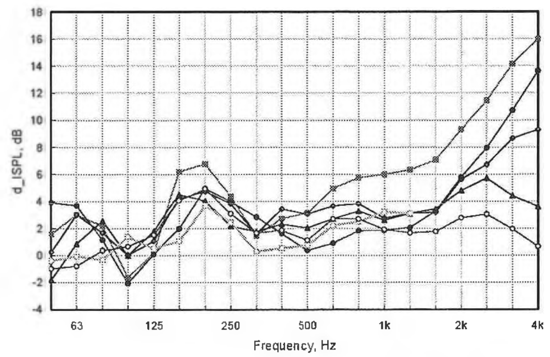

Figure 1: Reduction in impact sound pressure level (d_ISPL) for 15 mm OSB on 6 mm cork placed on six floor systems.

4. RESULTS FROM JAPAN, ISO TC43 WG22

ISO working group 22 is developing a test method for toppings on joist floors. In the current draft, any one of three standard floors can be used in a laboratory. As part of the work of the group, five different toppings (Table 1) were placed on the three standard floors and the improvements measured in a single laboratory. Analysis[4] of the test data circulated within the task group reveals some of the difficulties to be resolved before a new test method can be prepared.

For four of the five toppings, the improvements obtained on each standard floor agreed well up to about 500 Hz; above that differences of around 10 dB were common. In one case, the improvements for each standard floor agreed well at all frequencies. Figure 2 shows one set of improvements for a vinyl floor covering.

The differences in the improvement spectra above 500 Hz become unimportant when the spectra are subtracted from the levels for a bare joist floor and the improved IIC or $L_{n,w}$ ratings are calculated. Once this is done, the single number rating is determined entirely by levels at frequencies below about 250 Hz. This suggests that a test method that required measurements in frequency range from 50 to 500 Hz could give reproducible and useful results. This might be true when the topping surface is not too hard and a resilient layer is present. Toppings that include ceramic tiles on the upper surface and that create more high frequency noise may lead to quite different conclusions; this needs to be investigated.

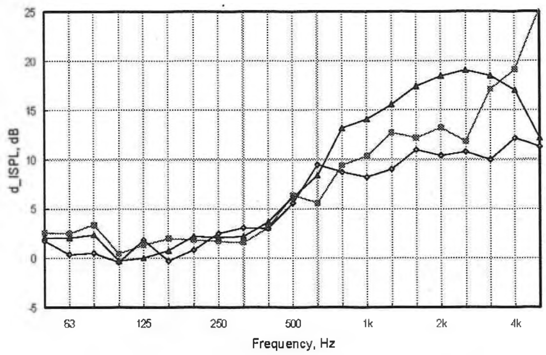

Figure 2: Reduction in impact sound pressure level (d_ISPL) for vinyl floor covering on three proposed standard floors.

5. ISO AND ASTM RATINGS

Differences between the ISO 717-2[7] and the ASTM E989[8] rating procedures also need to be addressed. E989 limits adverse deviations to 8 dB; the ISO $L_{n,w}$ procedure does not. ISO 717-2 also suggests that a better rating, at least for toppings on concrete floors, is the energy sum of the impact levels over the frequency range of interest minus 15 dB. The frequency range to be used is defined to be the same as for IIC or $L_{n,w}$, but extending the range down to 50 Hz is suggested.

Table 1 shows single number ratings calculated for the five toppings tested on the three proposed standard floors, denoted J, C, and G. In addition to IIC and $L_{n,w}$, the table shows reductions in the unweighted energy sums for the two frequency ranges indicated. Examination of this table reveals several problems.

Considering the first three toppings and any of the ratings one sees that range for tests on the three standard floors can be as much as 2 dB. Also, these toppings are not ranked consistently when tested on the three different floors. The uncertainty for measurements in different laboratories is almost certainly higher. Limiting the test method to using only a single standard floor would be preferable but not useful in all countries since typical constructions vary from place to place.

The conflict among the rating systems in the last two rows of Table 1 for the toppings incorporating the floating floor raises serious doubts about the value of current rating systems and how they relate to subjective reactions. The floating wood floor with the rubber/cork mat on top has ISO ratings that range from -1 to +17 and none are close to the IIC rating.

6. SUMMARY

Preparing a new test method for joist floors will be a difficult task. Some of the difficulties might be reduced by specifying only a single standard floor for Canadian or US use. Many of the thin toppings sold today would get improvement ratings close to zero, which is perhaps worth knowing about since it seems to represent reality for these toppings on joist floors. It is known that low frequency noise is a common problem with joist floors and the IIC rating does not address low frequencies directly. So, an essential component of a new test procedure is a new rating that deals with low frequency noise transmission.

REFERENCES

1 ASTM E2179-01. Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors.

2 ISO 140-8 Acoustics - Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight floor.

3 Warnock, A.C.C. *Impact Sound Measurements on Floors Covered with Small Patches of Resilient Materials or Floating Assemblies*, IRC-IR-802, March, 2001

4 See papers http://www.nrc.ca/~warnock/ASTME33/e3303.html

5 Jonasson, H. *A simplified method to determine impact sound improvement on lightweight floors*, INCE 2001.

6 Kartous, N.M.S. and Jonasson, H. *Impact noise improvement in lightweight floors*. ICA 2001.

7 ISO 717-2 Rating of sound insulation in buildings and of building elements — Part 2: Impact sound insulation.

8 ASTM E989 *Standard Classification for Determination of Impact Insulation Class (IIC)*.

Table 1: Improvement ratings for five toppings tested on three different floor systems (J, C, G) in a single laboratory.

	$\Delta L_{n,w}$			ΔIIC			ΔL_{sum} (50-3150 Hz)			ΔL_{sum} (100-3150 Hz)		
Topping	**J**	**C**	**G**	**J**	**C**	**G**	**J**	**C**	**G**	**J**	**C**	**G**
Vinyl	3	2	2	2	2	1	2	1	2	2	1	1
Rubber/cork	1	2	1	-1	-3	-3	-2	-4	-2	-1	-1	-2
Rubber/cork on vinyl	2	3	4	0	-1	-1	-2	-3	0	0	0	0
Floating wood	12	12	12	2	3	3	5	2	1	6	7	6
Rubber/cork on Floating wood	17	15	14	6	6	5	3	-1	1	10	10	8