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LABORATORY MEASUREMENT OF THE REDUCTION OF TRANSMITTED IMPACT SOUND PRESSURE LEVELS BY A FLOOR COVERING ON A HEAVYWEIGHT STANDARD FLOOR.

Measurement No: INR154

Date of Measurement: 26 February – 4 March, 2007

Commissioned by: Projex Group Pty Ltd
11A/1801 Botany Rd,
Banksmeadow,
NSW, 2019.
(PO Box 98, Matraville, 2136).

Summary

The reduction of impact sound pressure level (ΔL), the impact isolation class (IIC), $L_{n,w}$ and C_I, the weighted reduction in impact sound pressure level (ΔL_w) and the ΔL_{lin} value for two different terracotta tile/cement bed /rubber underlay floor-covering systems, have been measured.

The ΔL values reported are the decibel reductions in normalized impact sound pressure level (L_n) measured in a reverberant room beneath the test floor, achieved by the floor covering material compared to the bare test floor. The ΔL_w and ΔL_{lin} are single number ratings for the improvement in impact sound levels between the bare reference floor and the same floor with the floor covering material. ΔL_w is the difference between $L_{n,w}$ for the bare reference floor and $L_{n,w}$ for the reference floor plus the floor covering, as defined in AS ISO 717.2-2004. ΔL_{lin} is the difference between $L_{n,sum}$ for the bare reference floor and $L_{n,sum}$ for the reference floor plus the floor covering combination, as defined in AS ISO 717.2-2004. IIC (ASTM E989-89), $L_{n,w}$ and C_I AS ISO 717.2-2004 apply to the combination of the floor covering and the 150mm thick concrete test slab.

Method of Testing

(a) Specific

The measurement complies with the requirements of ISO 140-8:1997(E) *"Measurement of sound insulation in buildings and building elements – Part 8: Laboratory measurement of the reduction in transmitted impact noise by floor coverings on a standard floor"*. It also complies with ISO 140-6 *"Measurement of sound insulation in buildings and building elements – Part 6: Laboratory measurement of sound insulation of floors"*.

(b) General

The test-material is installed on a standard test-floor, this being a 150mm reinforced concrete slab satisfying the requirements of ISO 140-8. A standard tapping-machine is operated on the test-material, and again on the bare-floor. The reduction in the sound pressure levels produced in a chamber beneath the floor is reported. Measurements for each of the floor coverings are made at four different tapping machine positions on the standard test-floor and the average results reported.

Description of Materials Tested, and Mounting

Both floor-covering systems were tested on the same 150mm thick concrete slab which had its upper surface protected from adhesion damage by a 0.2 mm thick plastic sheet. The systems comprised, from the top down:

Floor "a". Projex Protectionmat.

- Terracotta Tiles (325 mm x 325 mm x 10 mm thick).
- Sand/cement mortar bed (40 mm thick).
- Projex Protectionmat (5 mm thick).

Floor "b". Projex Shockmat.

- Terracotta Tiles (325 mm x 325 mm x 10 mm thick).
- Sand/cement mortar bed (40 mm thick).
- Projex Shockmat (10 mm thick).

No grouting material was applied to the tiled surface.

Description of Test Floor and Test Facility

The standard floor used was a reinforced concrete floor with dimensions 3.66 m x 3.20 m x 0.150 m - this is in accordance with the requirements of ISO 140-8.

The tests were conducted with the standard floor-slab placed in an aperture between two purpose-built concrete rooms, all the bounding surfaces of which are 305 mm in thickness. The rooms were designed and built to minimise any structure-borne noise (induced by test signals) from outflanking sound passing through the test specimen.

The "sending" and the "receiving" rooms are both pentagonal in shape; the receiving room has a volume of 105 m^3 and a floor area of 32 m^2.

Environmental Conditions

The environmental conditions existing in the chambers during the testing were:

Temperature	21.7 – 22.0 deg C,
Relative Humidity	75 - 78%
Atmospheric pressure	1011 - 1014 hPa

Measuring Equipment

(a) Tapping Machine

The tapping-machine employed was a Brüel & Kjær type 3204. (A rotating cam allows five, 500 gm, steel hammer-heads to be raised, then dropped under gravity through 40 mm, at a rate of 10 impacts/s). The tapping machine fulfils the requirements of ISO 140.

(b) Microphone

The microphone used was a Brüel & Kjær type 4166 mounted on a Brüel & Kjær type 2619 preamplifier and was mounted at end of a rotating boom of radius 1.73 m which had a rotation period of 32 s.

(c) Calibration of Microphone Sensitivity

The gain of the microphone was adjusted to read absolute dB re 20 μPa prior to measurement by using a Brüel & Kjær type 4220 pistonphone. The pistonphone was calibrated by the National Measurement Laboratory of CSIRO in March 1997. This calibration was checked by comparison with a sound level meter calibrated at a NATA registered laboratory on 15 January 2003.

(d) Analysis Equipment

Microphone signals were analysed using a Norwegian Electronics type 830 Real-Time-Analyser (RTA). This enables measurements in each of the standard 1/3-octave bands simultaneously, and also can perform internal averaging of repeated measurements. The measured levels reported below are each the result of internally averaging 4 x 32 s integrals in the 100 Hz to 5000 Hz bands.

The reverberation times in the receiving room were measured by overlaying 60 decays using the internal program of the RTA.

Measured Impact Sound Pressure Levels

Table 1 presents the impact sound pressure level (L_i), corrected for background levels, for the specimen averaged over four different tapping machine positions as measured in the receiving room. The second column of that table gives the receiving room background sound pressure level (L_b).

Table 1. Measured impact sound pressure level (L_i), corrected for background levels, averaged over four different tapping machine positions for the reference-floor and the floor-covering laid over the reference-floor.

	Lb (dB)	Lio (dB)	Li (dB)	
Frequency (Hz)	Back Ground	Bare Floor	(a) 5mm Protectionmat.	(b) 10mm Shockmat.
100	15.0	65.1	65.5	68.3
125	21.0	68.4	67.5	68.9
160	24.3	70.6	71.8	71.7
200	10.8	76.4	75.2	74.8
250	17.1	77.5	72.8	71.4
315	14.7	79.0	70.1	69.3
400	16.0	75.9	66.0	65.8
500	15.9	76.3	63.6	61.0
630	11.7	77.3	60.7	57.8
800	13.0	77.7	55.0	55.1
1000	10.3	78.3	53.2	53.6
1250	9.5	79.1	51.6	51.4
1600	8.4	78.1	47.5	48.1
2000	8.1	76.8	44.3	44.2
2500	7.3	75.7	39.6	39.2
3150	7.3	74.8	33.9	33.1
4000	7.6	72.3	26.7	27.2
5000	8.3	69.5	19.7	19.7

Correction for Background Sound Pressure Level

ISO 140-6 & 8 both require the measured impact sound pressure level to be corrected if it is close to the background sound pressure level, however no corrections were necessary.

Normalised Impact Sound Pressure Level of Bare Floor

ISO 140-6 & 8 both require the reporting of the normalised impact sound pressure level for the bare floor, L_{no}. The normalised impact sound pressure levels are the levels that would be measured if exactly 10 m^2 of sound absorption was present in the receiving room at each frequency. Accordingly, this information is presented in table 2, together with the normalised impact sound pressure level for the test floors.

Table 2. Normalised impact sound pressure levels (dB) for the test floors.

	Normalised Impact Sound Pressure Level (L_n)		
Frequency (Hz)	Bare Floor	(a) 5mm Protectionmat.	(b) 10mm Shockmat.
100	56.9	57.3	60.7
125	59.7	58.8	60.5
160	62.6	63.8	64.0
200	68.2	67.0	66.6
250	69.8	65.1	63.6
315	71.9	63.0	62.2
400	68.9	59.0	58.8
500	69.9	57.2	54.6
630	71.2	54.6	51.7
800	72.0	49.3	49.4
1000	73.1	48.0	48.4
1250	74.3	46.8	46.6
1600	73.9	43.3	43.8
2000	73.2	40.7	40.6
2500	72.9	36.8	36.4
3150	72.6	31.7	30.9
4000	70.6	25.1	25.5
5000	68.5	18.7	18.7

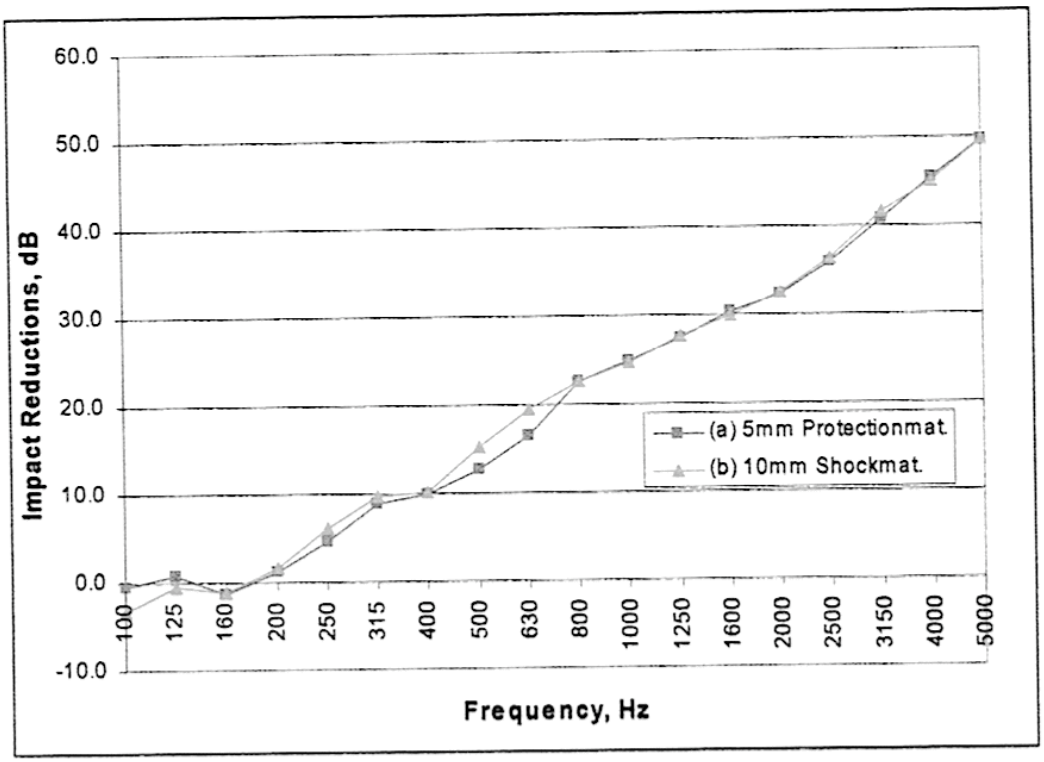
Results

The reduction of impact sound pressure level (ΔL), (i.e. the improvement in impact sound insulation) is given by the simple difference between the sound pressure level (L_{io}) measured for the bare floor, and the (L_i) measured for the test floors, corrected where appropriate for background levels. The impact isolation class (IIC) on the 150mm thick test slab, as defined in ASTM E989-89, the weighted reduction in impact sound pressure level ΔL_w, and ΔL_{lin}, as defined in AS ISO 717.2-2004, have also been determined for the test floors.

Table 3 presents the reduction of impact sound pressure level (ΔL) calculated for each measured third octave frequency band. The last five rows of the table give ΔL_w, ΔL_{lin}, IIC, $L_{n,w}$ and C_I respectively for the test floors. The bare floor yielded IIC 27, $L_{n,w}$ 79 and C_I -11.

Table 3. Reduction of impact sound pressure level (ΔL) for the floor-coverings.

	Reduction in Impact Level, ΔL (dB)	
Freq (Hz)	(a) 5mm Protectionmat.	(b) 10mm Shockmat.
100	-0.4	-3.2
125	0.9	-0.5
160	-1.2	-1.1
200	1.2	1.6
250	4.7	6.1
315	8.9	9.7
400	9.9	10.1
500	12.7	15.3
630	16.6	19.5
800	22.7	22.6
1000	25.1	24.7
1250	27.5	27.7
1600	30.6	30.0
2000	32.5	32.6
2500	36.1	36.5
3150	40.9	41.7
4000	45.6	45.1
5000	49.8	49.8
ΔL_w	**19**	**18**
ΔL_{lin}	**7**	**7**
IIC	**53**	**53**
$L_{n,w}$	**56**	**56**
C_I	**1**	**1**



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Officer conducting measurement