Impact Sound Testing of Floor Covering on a Heavyweight Standard Floor

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SUMMARY

The impact sound characteristics $L_{n,w}$, C_I and IIC, ΔL_w and ΔL_{lin} a loose laid vinyl floor covering on a 150 mm concrete slab have been measured.

The floor system consisted of a 150 mm concrete slab covered with the floor covering under test, loose laid directly on top of the slab with no underlay or adhesive materials.

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 150 mm thick concrete test slab.

1. TEST SPECIMENS

1.1 Materials

The test specimen was a PVC based floor covering material with a plasticized PVC backing; the material was supplied in the form of discrete planks which are installed by simply laying them over the slab butted against each other. The planks do not interlock, and no other products or materials are used to secure them in place when they are installed.

The materials are described as:-

Trade Name:	KARNDEAN LOOSE LAY PLANK
Description:	PVC Planks with textured surface, woodgrain appearance and plasticized PVC backing
Dimensions:	1050 mm (l) x 250 mm (w) x 4.5 mm (thick)
Mass per unit area:	7260 g/m^2

1.2 Installation

- The specimen material was laid over a standard concrete test slab measuring 3.68 m x 3.22 m x 150 mm thick
- The specimen floor covering materials covered the entire 3.68 x 3.22 m area of the slab
- All test materials were installed by the test laboratory's staff
- No adhesives or other materials were used in the laying of the test material

2. METHOD OF TEST

2.1 General

The test-material is installed onto 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 the floor covering are made at nine different tapping machine positions on the standard test-floor and the average results reported.

2.2 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"*.

3. TEST LABORATORY

3.1 Description Of Test Floor And Test Facility

The standard floor used was a reinforced concrete floor with dimensions 3.66 x 3.22 x 0.15 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.

The underside of the concrete test slab forms part of the ceiling of the receiving chamber; no intermediate ceiling was present beneath the test slab.

3.2 Environmental Conditions

Table 1 gives the environmental conditions in the measuring chamber when the tests were carried out.

Table 1, Environmental Conditions

15 July 2011, Laboratory Conditions	
Dry Bulb Temp, °C	12
Relative Humidity, %	66
Barometer, hPa	1031

4. INSTRUMENTATION AND EQUIPMENT

4.1 Tapping Machine

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

4.2 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 1.35 m which had a rotation period of 32 s.

4.3 Calibration of Microphone Sensitivity

Sensitivity of the microphone and measuring system was calibrated prior to commencement of measurements by using a Brüel & Kjær type 4220 pistonphone to give absolute dB re 20 μPa. The pistonphone was calibrated by a NATA registered laboratory in April 2011.

4.4 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 averaging 9 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.

5. MEASUREMENT DETAILS

5.1 Measured Impact Sound Pressure Levels

Table 2 presents the impact sound pressure level (L_i), corrected for background levels, for the Bare Floor (L_{io}) and the test specimens averaged over nine different tapping machine positions as measured in the receiving room.

5.2 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. In this series of tests, background corrections were not required. The 1/3-octave impact sound levels are presented in Table 2.

Table 2, Impact sound levels (L_i), and background corrections.

Freq (Hz)	L_{io} (dB) Bare Floor		L_i (dB) Specimen with KARNDEAN LOOSE-LAY PLANK floor covering	
100	67.6	-	66.0	-
125	70.9	-	68.8	-
160	69.9	-	68.0	-
200	73.5	-	71.4	-
250	74.5	-	72.1	-
315	76.9	-	73.7	-
400	77.5	-	73.7	-
500	76.3	-	71.2	-
630	77.4	-	69.9	-
800	77.0	-	67.5	-
1000	77.1	-	66.7	-
1250	77.9	-	66.8	-
1600	78.2	-	65.4	-
2000	77.1	-	61.1	-
2500	75.7	-	55.5	-
3150	74.2	-	48.9	-
4000	71.7	-	38.8	-
5000	68.4	-	27.8	-
		⇧		⇧
		Size of background corrections (dB).		
L_i data in this table includes corrections made for background level.				

5.3 Normalized Impact Sound Pressure Levels

ISO 140-6 & 8 both require the reporting of the normalized impact sound pressure level for the bare floor, L_{no}. The normalized 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 3, together with the normalized impact sound pressure level for the test floor.

Table 3, Normalized impact sound pressure levels (dB) for the test floors.

Freq (Hz)	L_{no} (dB)	L_n (dB) Specimen
	Bare Floor	with KARNDEAN LOOSE-LAY PLANK floor covering
100	57.6	55.9
125	61.2	59.1
160	60.7	58.8
200	65.0	62.8
250	66.6	64.2
315	69.9	66.7
400	70.9	67.1
500	69.9	64.8
630	71.3	63.8
800	71.1	61.6
1000	71.7	61.4
1250	73.0	61.9
1600	73.9	61.2
2000	73.6	57.6
2500	72.9	52.7
3150	72.2	46.8
4000	70.4	37.5
5000	68.1	27.4

6. TEST RESULTS

Impact Sound Pressure Level for the Bare Slab, Reduction (ΔL), and Performance Index Numbers for the Test Floor

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 each test floor, 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, has also been determined for the test floor.

Table 4 presents the impact sound pressure levels, and the reduction (ΔL) with the test floor, calculated for each measured 1/3-octave frequency band. The last six rows of the table give ΔL_w, ΔL_{lin}, IIC, $L_{n,w}$, C_l and ($L_{n,w} + C_i$) respectively for the test floor.

Table 4. Impact sound levels, reduction (ΔL), and performance index numbers for the test floor.

Freq (Hz)	Bare 150 mm Concrete Slab	Test Specimen, 150 mm Slab with KARNDEAN LOOSE-LAY PLANK floor covering	
	Normalized Impact Level, L_{no} (dB)	Normalized Impact Level, L_n (dB)	Reduction with floor covering, ΔL (dB)
100	57.6	55.9	1.7
125	61.2	59.1	2.1
160	60.7	58.8	1.9
200	65.0	62.8	2.2
250	66.6	64.2	2.4
315	69.9	66.7	3.2
400	70.9	67.1	3.8
500	69.9	64.8	5.1
630	71.3	63.8	7.5
800	71.1	61.6	9.5
1000	71.7	61.4	10.4
1250	73.0	61.9	11.1
1600	73.9	61.2	12.8
2000	73.6	57.6	16.0
2500	72.9	52.7	20.2
3150	72.2	46.8	25.4
4000	70.4	37.5	32.9
5000	68.1	27.4	40.7
ΔL_w	-	-	14
ΔL_{lin}	-	-	6
IIC	28	46	-
$L_{n,w}$	79	64	-
C_l	-12	-5	-
$L_{n,w} + C_l$	67	59	-

Officer conducting measurement: Mr. David Truett

Report reviewed by: Dr. Christopher Preston

Date report issued: 16 August 2011

Results of Floor-Impact Acoustic Testing

Floor Material Tested: "KARNDEAN LOOSE-LAY PLANK"

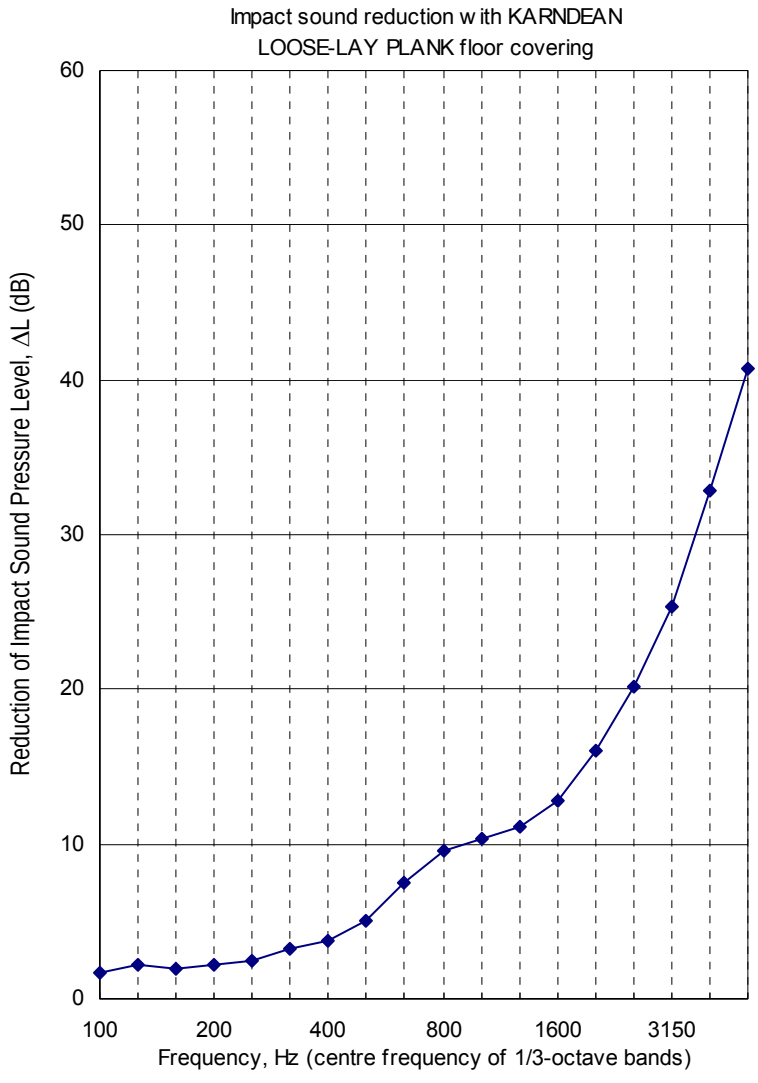
Type of Material: PVC (woodgrain appearance) with plasticized PVC backing
Form: Loose laid planks, non interlocking, 1050 mm x 250 mm
Thickness: 4.5 mm
Mass per unit area: 7260 g/m^2
Underlying floor: Reinforced concrete slab, 3.68 m (l) x 3.22 m (w) x 150 mm (thick)

Test Conditions

Date of Test: 15 July 2011
Temperature: 12 °C
Barometric Pressure: 1031 hPa
Relative Humidity: 66%

Results

Freq (Hz)	Normalized Impact SPL		Improvement ΔL
	Bare Floor	With Floor Covering	
100	57.6	55.9	1.7
125	61.2	59.1	2.1
160	60.7	58.8	1.9
200	65.0	62.8	2.2
250	66.6	64.2	2.4
315	69.9	66.7	3.2
400	70.9	67.1	3.8
500	69.9	64.8	5.1
630	71.3	63.8	7.5
800	71.1	61.6	9.5
1000	71.7	61.4	10.4
1250	73.0	61.9	11.1
1600	73.9	61.2	12.8
2000	73.6	57.6	16.0
2500	72.9	52.7	20.2
3150	72.2	46.8	25.4
4000	70.4	37.5	32.9
5000	68.1	27.4	40.7
ΔL_w	-	-	14
ΔL_{lin}	-	-	6
IIC	28	46	-
$L_{n,w}$	79	64	-
C_I	-12	-5	-
$L_{n,w} + C_i$	67	59	-



These are the results of testing carried out at CSIRO Acoustic Laboratories, 37 Graham Rd, Highett, Australia 3190 in accordance with the Australian and ISO standards AS ISO 140.6-2006 and AS ISO 140.8-2006. Calculations have been carried out in accordance with AS ISO 717.2-2004 and ASTM E989-89. This appendix may serve as a statement of results for the particular floor materials described; full details are contained in CSIRO Report INR172/R2.

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