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LABORATORY MEASUREMENT OF AIRBORNE SOUND INSULATION

MEASUREMENT NO: TL474

DATE OF MEASUREMENT: 21 - 22 March, 2007

COMMISSIONED BY: Benex Technologies Pty Ltd
Lot 102 Canobolas Road,
Orange,
NSW, 2800.

SUMMARY

The sound insulation (*R*) of three (3) different wall systems, each constructed from proprietary light-weight building blocks manufactured using a mix incorporating concrete and polystyrene beads, has been determined.

The measurements were performed in compliance with the requirements of AS 1191-2002 "*Acoustics - Method for Laboratory Measurement of Airborne Sound Insulation of Building Elements*".

The Sound Transmission Class (STC) and the Weighted Sound Reduction Index (R_w) of the specimens were calculated using the procedures respectively specified by AS 1276-1979 and AS/NZS ISO 717.1:2004.

DESCRIPTION OF SPECIMENS

The walls tested were all constructed from light-weight building blocks manufactured by Benex Technologies Pty Ltd. Two types of blocks were used; both manufactured using a mix incorporating concrete and polystyrene beads:

- **H60 Hollow** core building block, with dimensions 599.5mm **(L)** x 199.5mm (W) x 199.5mm (H), and a mass of 13.6kg.
- **A60 Solid** core building block, with dimensions 599.5mm (L) x 99.5mm (W) x 199.5mm (H), and a mass of 12kg.

Both blocks are more fully described in the data sheet supplied by Benex Technologies, which is attached to this report.

Three walls specimens were tested; two of single leaf construction ·and one of dual leaf construction. The walls were assembled using Benex adhesive and each specimen was caulked around its perimeter. The variations tested were:

Wall "a". Bare H60 Hollow core block wall.

Wall "b". H60 Hollow core block wall with 10mm plasterboard daub fixed @ 400mm centres to one side.

Wall "c". Dual leaf wall consisting of H60 Hollow core block wall with 1Omm plasterboard daub fixed @ 400mm centres to exposed side; a 20mm airgap then a bare A60 Solid core block wall.

METHOD OF TEST

(a) Specific

The measurements were performed to comply with the requirements of AS 1191-2002 "Acoustics - Method for Laboratory Measurement of Airborne Sound Insulation of Building Elements".

(b) General

Each specimen was assembled into an 11.9 m^2 aperture provided in the common wall between a pair of purpose-built reverberation rooms. A steady level of broadband random-noise was generated in one of the rooms, and the resulting sound pressure levels (80 Hz to 10 kHz) were measured in both rooms. The differences between the sound pressure levels in the rooms were converted to sound reduction indices by correcting for the sound absorption characteristics of the receiving room.

DESCRIPTION OF TEST FACILITY

The transmission rooms in which the tests were conducted have been designed and built to be structurally independent from one another. This was done to minimise any structure-borne noise (induced by test signals) from outflanking the test specimen. The common wall between the rooms consists of two parallel concrete walls (each 305 mm thick) separated by a 50 mm air gap. A steel-lined test-aperture (3.23 m high x 3.68 m wide x 0.51 m deep) has been built into the common wall. To stop the steel aperture frorn rigidly bridging across the gap between the rooms, a 6 mm cut has been made around its perimeter adjacent to the air gap.

To enhance diffusion of sound both rooms have an irregular pentagonal floor plan and sloping ceilings. Also they each contain randomly oriented diffusing plates. The "source" room (that in which the sound source was placed) has a volume of 203 m^3, and a total surface area of 261 m^2. The "receiving" room has a volume of 205.7 – 205.8 m^3, and has a total surface area of 265 m^2. All external surfaces of the reverberation room pair are constructed of 305 mm thickness reinforced concrete, to exclude external noise.

INSTRUMENTATION AND EQUIPMENT

Test Signal, Amplifiers & Loudspeakers

The sound source used was the amplified signal originating from the noise generator built into a Norwegian Electronics type 830 Real Time Analyser. Its random noise output was passed into a Graphic Equaliser (Klark Teknik DN27). The Graphic Equaliser was used to trim the shape of the spectrum such that approximately equal sound levels were achieved across the bands eventually broadcast into the sending room. The broadband output from the graphic equaliser was split into two frequency bands by a custom-built cross-over network. The low frequency bands (80 Hz to 1.6 kHz) were amplified to about 4 V by a Power Amplifier (Crown DC300) and broadcast into the sending room from a 300 mm diameter loudspeaker (Rola 12UX) mounted on a flat 1 m^2 baffle, situated facing into one corner of the test room. The high frequency bands (2 kHz to 10 kHz) were likewise amplified by a Power Amplifier (Crown DC300A) to about 11 V before being delivered into a dodecahedral array of 50 mm diameter loudspeakers (Peerless direct radiator "tweeters").

Microphones, Preamplifiers & Microphone Power Supply

The same single microphone (Brüel & Kjær Type 4166) and preamplifier (Brüel & Kjær Type 2619) mounted at the end of a rotating microphone boom (Brüel & Kjær Type 3923) which had a radius of 1.73 m, was used in each room. This apparatus was moved between the two rooms as required. The microphone boom continuously rotated with a 32 s period during measurements. The microphone was powered from the NE 830 analyser and the sensitivity of the signal channel was adjusted to read absolute dB re 20 μPa prior to measurement in either room by using a Sound Level Calibrator (Brüel & Kjær Type 4220).

Measurement Instrumentation

All microphone signals were analysed using a Norwegian Electronics Type 830 Real Time Analyser

MEASUREMENT DETAILS

Measurement of Sound Levels

The sound pressure levels in both rooms were averaged over space (by allowing the microphone boom to rotate continuously during measurements), and time (by performing a 192 s integral of the sound level).

Absorption of receiving room

The average reverberation time of the receiving room was determined for each 1/3-octave frequency. The equivalent absorption area (A) at each frequency was then determined using the equation,

$$A = 0.161\ V / T_{60}$$

where V is the volume of the receiving room (205.7 – 205.8m^3), and T_{60} is the space averaged reverberation time of the room, s. The reverberation time values and the equivalent absorption area of receiving room are presented in Table 1.

Table 1. Measured reverberation times (T_{60}) and equivalent absorption area (A) of receiving room.

	Reverberation Times (T60), s			Equiv Absorp. Area (A) of Recvg.room, m^2		
Freq, Hz	Wall "a"	Wall "b"	Wall "c"	Wall "a"	Wall "b"	Wall "c"
100	9.86	9.54	9.64	3.4	3.5	3.5
125	10.29	9.00	8.84	3.3	3.7	3.8
160	10.37	9.78	9.85	3.2	3.4	3.4
200	10.91	9.79	9.48	3.1	3.4	3.5
250	9.65	8.45	8.57	3.5	4.0	3.9
315	8.41	6.98	7.31	4.0	4.8	4.6
400	8.08	6.01	6.40	4.2	5.6	5.2
500	7.47	5.33	5.86	4.5	6.3	5.7
630	7.04	5.15	5.49	4.8	6.5	6.1
800	6.34	4.83	5.02	5.3	6.9	6.7
1000	5.74	4.72	4.84	5.8	7.1	6.9
1250	5.20	4.48	4.63	6.5	7.5	7.2
1600	4.54	4.08	4.17	7.4	8.2	8.0
2000	3.92	3.60	3.66	8.6	9.3	9.2
2500	3.42	3.25	3.28	9.8	10.3	10.2
3150	3.02	2.86	2.89	11.1	11.7	11.6
4000	2.61	2.47	2.50	12.9	13.6	13.4
5000	2.17	2.10	2.12	15.5	16.0	15.8

Correction for Background levels

The background sound levels for all frequency bands were measured and compared against the signal levels reaching the receiving room. Table 2 shows the corrections to the receiving room sound pressure levels for those frequencies with less than the required 10 dB margin above background.

Table 2. Corrections applied to the receiving room SPL's for those frequencies with less than the required 10 dB above background.

	Background Corrections, dB.
Freq, Hz	Wall "c"
2500	0.4
3150	0.6
4000	0.5
5000	1.0

Precision of results

Table 3. 95% confidence limits for the repeatability of airborne sound reduction index results.

Band centre Frequency. Hz	95% Conf.limit on meas'd R values (±) dB
100 - 500	0.8
630 - 2500	0.5
3150 - 5000	0.9

Table 3 lists typical 95% confidence limits for the repeatability of airborne sound reduction index (R) results (for any given specimen). These values have been determined using the procedure outlined in AS 1191-1985 (i.e. In a once-off test, eight (8) independent R measurements were performed on a test wall - which had one strongly absorbent face - and the 95% confidence limits at each frequency were determined).

ENVIRONMENTAL CONDITIONS

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

Temperature	21.8 – 22.5 deg C
Relative Humidity	69 - 77%
Atmospheric pressure	1017 - 1019 hPa

ANALYSIS OF MEASUREMENTS

The airborne sound reduction index (R) is obtained by using the equation:

$$TL = L_{send} - L_{recv} + 10 \, Log_{10}(S/A) \, .$$

In this equation L_{send}, and L_{recv} are the SPL's measured in the sending and receiving rooms respectively, S is the area of the specimen and A is the equivalent absorption area of the receiving room (m^2) obtained from the reverberation time measurements detailed above.

TEST RESULTS

Table 4 presents the airborne sound reduction index (R) results. The final two rows in the table give the Sound Transmission Class (STC), the Weighted Sound Reduction Index (R_w) with the Spectral Adaption Terms (C; C_{tr}) as determined respectively by the Australian Standard AS 1276-1979, AS/NZS ISO 717.1:2004 and ISO 717-1:1996.

Table 4. Test results, STC and R_w ratings with Adaption Terms.

	Specimen R, dB		
Freq, Hz	Wall "a"	Wall "b"	Wall "c"
100	32.1	29.2	38.3
125	27.4	27.0	35.7
160	27.7	27.8	38.6
200	26.9	26.9	38.2
250	26.8	26.3	41.1
315	27.7	27.1	42.6
400	30.1	29.4	43.9
500	32.6	32.2	47.8
630	35.1	34.8	51.4
800	39.8	39.5	55.7
1000	36.3	40.0	59.1
1250	37.1	41.7	61.0
1600	42.7	47.9	66.0
2000	47.0	53.0	68.3
2500	48.5	55.4	70.0
3150	52.6	57.4	70.8
4000	55.4	56.7	70.2
5000	58.3	58.3	71.9
STC	**37**	**38**	**52**
R_w	**37**	**37**	**52**
C; C_{tr}	**-1; -3**	**0; -3**	**-1; -5**

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Officer conducting measurement

4 / 4 / 2007

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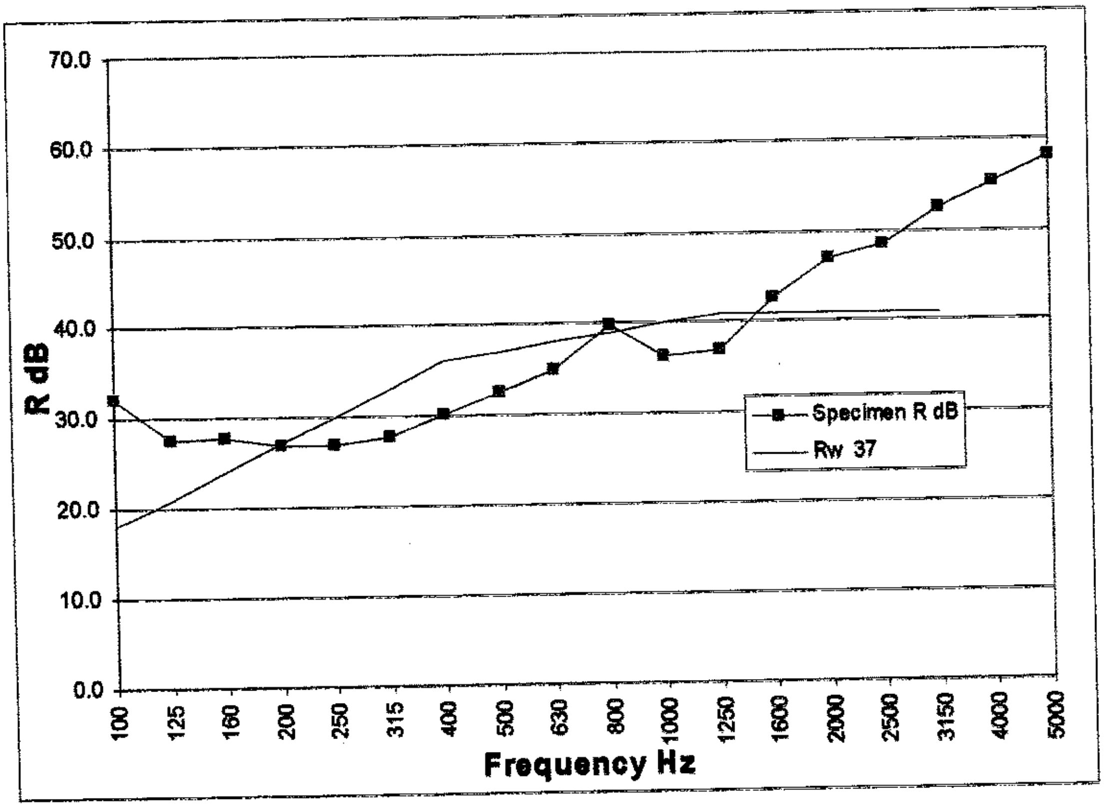
Checked by

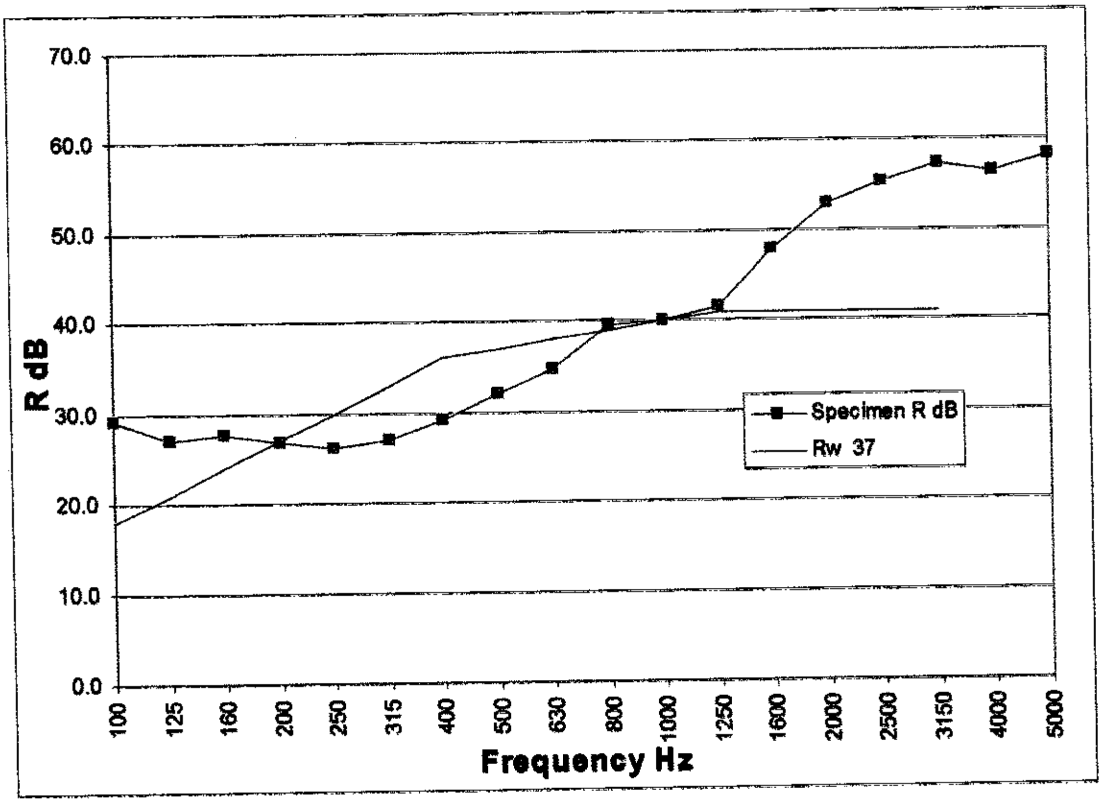
Ident: TL474a
Designation: Wall "a"
STC: 37
$R_w(C; C_{tr})$: 37 (-1; -3)

Frequency Hz	Sending SPL dB	Receiving SPL dB	Specimen R, dB
100	87.4	60.7	32.1
125	86.6	64.8	27.4
160	86.2	64.1	27.7
200	85.6	64.6	26.9
250	84.6	63.1	26.8
315	84.3	61.3	27.7
400	82.8	57.3	30.1
500	84.4	56.0	32.6
630	83.9	52.8	35.1
800	84.8	48.5	39.8
1000	85.0	51.8	36.3
1250	83.9	49.5	37.1
1600	83.4	42.8	42.7
2000	83.9	38.3	47.0
2500	83.6	35.9	48.5
3150	84.4	32.1	52.6
4000	85.7	30.0	55.4
5000	85.9	26.4	58.3



Ident: TL474b
Designation: Wall "b"
STC: 38
R_w (C; C_{tr}): 37 (0; -3)

Frequency Hz	Sending SPL dB	Receiving SPL dB	Specimen R, dB
100	86.9	63.0	29.2
125	86.9	64.9	27.0
160	86.5	64.1	27.8
200	86.0	64.5	26.9
250	84.4	62.9	26.3
315	84.1	60.9	27.1
400	82.8	56.7	29.4
500	84.6	55.2	32.2
630	83.8	51.6	34.8
800	84.7	47.5	39.5
1000	85.2	47.4	40.0
1250	84.0	44.3	41.7
1600	83.5	37.2	47.9
2000	83.8	31.9	53.0
2500	83.7	28.9	55.4
3150	84.3	26.9	57.4
4000	85.6	28.4	56.7
5000	85.8	26.2	58.3



Ident: **TL474c**
Designation: **Wall "c"**
STC: **52**
R_w (C; C_{tr}): **52 (-1; -5)**

Frequency Hz	Sending SPL dB	Receiving SPL dB	Specimen R, dB
100	87.2	54.2	38.3
125	87.2	56.5	35.7
160	87.6	54.4	38.6
200	87.0	54.1	38.2
250	86.2	49.9	41.1
315	85.8	47.3	42.6
400	82.7	42.4	43.9
500	85.3	40.7	47.8
630	84.9	36.4	51.4
800	84.8	31.6	55.7
1000	85.5	28.8	59.1
1250	84.2	25.4	61.0
1600	83.6	19.3	66.0
2000	84.1	16.9	68.3
2500	83.7	14.4	70.0
3150	84.3	13.6	70.8
4000	85.6	14.9	70.2
5000	85.9	12.7	71.9