THE CONCRETE CENTRE

CONTEMPORIS PHASE TWO APARTMENTS MERCHANTS ROAD CLIFTON BRISTOL

REPORT OF SOUND INSULATION

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REPORT OF SOUND INSULATION

1.0 CLIENT DETAILS

Hoare Lea Acoustics by full appointment have undertaken sound insulation tests for information purposes on behalf of The Concrete Centre, Riverside House, 4 Meadows Business Park, Camberley Surrey.
The development for which this report has been prepared is known as Contemporis Phase 2, Merchants Road, Clifton, Bristol.

2.0 TEST ORGANISATION DETAILS

The sound insulation tests were performed on 12th January 2006 at the development site by Jeremy Butt. Jeremy Butt is a fully accredited engineer responsible for being in charge of field testing.

3.0 CONSTRUCTION FORMS TESTED

Wall Construction

Render coat and plaster finish 13-15mm both sides.
215mm dense concrete block manufactured by Celcon (1950kg/m^3).

Floor Construction

250mm thick reinforced concrete from Cemex cast in-situ slab.
Metal framing system
15mm plasterboard

Sound insulation tests were conducted between the following pairs of rooms at the Contemporis Phase two development.

Separating Floors – Airborne Sound Insulation Tests

1. Living Room Flat 8 to Bedroom Flat 7.

2. Living Room Flat 14 to Bedroom Flat 13.

Separating Floors – Airborne Sound Insulation Tests

3. Bedroom Flat 7 to Bedroom Flat 13.

4. Living Room Flat 8 to Living Room Flat 14.

Separating Floors – Impact Sound Insulation Tests

5. Living Room Flat 14 to Living Room Flat 8 (Bare Concrete Floor).

6. Bedroom Flat 13 to Bedroom Flat 7 (Bare Concrete Floor).

7. Living Room Flat 14 to Living Room Flat 8 (Tiled Area).

4.0 BASIS OF ASSESSMENT

The Building Regulations Approved Document E[1,2] provides minimum design and in-situ performance standard requirements for various forms of residential accommodation. A summary of the in-situ performance standards forming the basis of assessment for the tests undertaken are provided in Appendix 1 attached.

For ease of reference acoustic terminology used in this report is provided in Appendix 2 attached.

The demises in which sound insulation tests were conducted at the Contemporis Phase 2 development site comprised of new build Flats

5.0 TEST METHODOLOGY

The airborne tests detailed in this report have been carried out in accordance with the measurement procedures of BS ENISO 140 -4:1998[3] for field measurements of airborne sound insulation.

The impact tests detailed in this report have been carried out in accordance with the measurement procedures of BS EN ISO 140-7:1998[4] for field measurements of impact sound pressure level.

All the procedures in Annex B of the Approved Document E[1,2] to the Building Regulations have been followed.

Table 1 below provides a summary of procedural settings for the sound insulation test undertaken using the fixed measurement position approach implemented on site for both airborne and impact test types.

Procedural Description	Number of Source Room Positions	Number of Receiver Room Positions	Number of Loudspeaker Positions	Averaging Time For Level Measurements
Airborne	(5+5)	(5+5)	(2)	(10s)
Impact	N/A	(2+2+2+2)	N/A	(10s)
Procedural Description	**Number of Reverberation Time Positions**	**Number of Decays At Each Reverberation Time Position**	**Number of Background Measurement Positions**	**Number of Tapping Machine Positions**
Airborne	(3+3)	(1)	(5)	N/A
Impact	(3+3)	(1)	(5)	(4)

Table 1: Measurement Procedure Settings

A pink noise source was used for all level measurements and as the interrupted source for all the reverberation time measurements.

6.0 TEST INSTRUMENTATION

The main details of instrumentation and equipment used during the sound insulation tests are given in Table 2 below.

Instrumentation Description	Type Number	Manufacturer	Date of Expiration Of Calibration	Calibration Certificate Number
Sound Level Meter	2260 SN:189994051	Bruel & Kjaer	27th September 2006	08970905
½" Microphone	4189 SN:230138911	Bruel & Kjaer	(SAME AS SLM)	(SAME AS SLM)
Building Acoustics Application Software	BZ7204	Bruel & Kjaer	N/A	N/A
Acoustic Calibrator	4231 SN:214758	Bruel & Kjaer	25th May 2006	12817
Noise Generator	Minirator MR1	Neutrik	N/A	N/A
Loudspeaker	ART 200A	RCF	N/A	N/A
Tapping Machine	3207 SN:2278422	Bruel & Kjaer	24th May 2006	5297/2

Table 2: Measurement Instrumentation Details

7.0 TEST RESULTS

The measured sound insulation and impact sound values have been rated in accordance with both BS EN ISO 717-1:1997[5] (airborne) and BS EN ISO 717-2:1997[6] (impact) for single number quantification.

Table 3 below provides the results of the field sound insulation tests undertaken. The measured levels have been compared to the requirements of Approved Document E of the Building Regulations 2000 to determine the 'Pass' or 'Fail' categorisation as required.

Source Room		Receiver Room		Measured $D_{nT,w} + C_{tr}$ dB	Measured $L'_{nT,w}$ dB	Approved Document E Requirement dB	Pass Or Fail
Description	Volume m^3	Description	Volume m^3				
Living Room Flat 8	84	Living Room Flat 7	84	53	-	45 (minimum)	Pass (1)
Living Room Flat 14	84	Bedroom Flat 13	29.5	53	-	45 (minimum)	Pass (2)
Bedroom Flat 7	29.5	Bedroom Flat 13	29.5	55	-	45 (minimum)	Pass (3)
Living Room Flat 8	84	Living Room Flat 14	84	58	-	45 (minimum)	Pass (4)
Living Room Flat 14	84	Living Room Flat 8	84	-	66	62 (minimum)	Fail (5)
Bedroom Flat 13	29.5	Bedroom Flat 7	29.5	-	71	62 (minimum)	Fail (6)
Living Room Flat 14	84	Living Room Flat 8	84	-	54	62 (minimum)	Pass (7)

Table 3: Comparison of Measured Levels of Sound Insulation

The numbers in parentheses relate to the test certificate reference shown in the appendices.

The impact test results failed to meet the requirements of Approved Document Part E as the purchaser of the Flat is to provide a resilient layer to an approved specification. The structure was built under the previous edition of Approved Document Part E 1994. As can be seen where the tiled area was provided with a resilient backing layer a pass was achieved. A resilient layer in accordance with Approved Document Part E would ensure that the requirements for impact noise were fully met.

8.0 OBSERVATIONS AND COMMENTS

During the testing there were some minor construction works being undertaken, measurements were taken during periods of no audible activity on site. The Living room party floor was provided with thirteen downlighters in the plasterboard suspended ceiling. The built in wardrobe doors were left open during the testing in the bedrooms.

9.0 SUMMARY AND CONCLUSIONS

Hoare Lea Acoustics by full appointment have undertaken sound insulation tests for Building Regulations compliance purposes on behalf of The Concrete Centre. The tests were undertaken by Jeremy Butt.

The development for which this report has been prepared is known as Contemporis Phase 2 in Clifton, Bristol.

The sound insulation tests were performed on Thursday 12th January 2006 at the development site.

The airborne tests all achieved a pass result with a significant margin above the requirements of Approved Document Part E.

The floor separating the Living rooms was provided with thirteen downlighters. The impact results did not achieve a pass except for the tiled area. The floors had no resilient layer applied as this is a fit out item, however a resilient layer in accordance with the Approved Document Part E should result in a pass being achieved.

10.0 REFERENCES

1 Approved Document E : 2003 Edition ‘Resistance to the passage of sound’, Office of the Deputy Prime Minister, TSO, 2003

2 Amendments 2004 to Approved Document E ‘Resistance to the passage of sound’, Office of the Deputy Prime Minister, TSO, 2004

3 BS EN ISO 140 ‘Acoustics – Measurement of sound insulation of buildings and of building elements’, Part 4 ‘Field measurements of airborne sound insulation between rooms’, British Standards Institution, 1998

4 BS EN ISO 140 ‘Acoustics – Measurement of sound insulation of buildings and of building elements’, Part 7 ‘Field measurements of impact sound insulation of floors’, British Standards Institution, 1998

(5/6) (BS EN ISO 717 ‘Acoustics – Rating of sound insulation in buildings and of building elements’, Part 1 ‘Airborne sound insulation’, British Standards Institution, 1997

BS EN ISO 717 'Acoustics – Rating of sound insulation in buildings and of building elements', Part 2 'Impact sound insulation', British Standards Institution, 1997)

(6) BS EN ISO 717 'Acoustics – Rating of sound insulation in buildings and of building elements', Part 2 'Impact sound insulation', British Standards Institution, 1997

FIGURES

FIGURE 1: Airborne Wall Test Living Room Flat 8 to Bedroom Flat 7

Client : The Concrete Centre Site : Contemperis Phase 2

Date : 12th January 2006 Engineer : J N Butt

Source Room
Liiving Room Flat 8
Volume 84 m^3

Receiver Room
Bedroom Flat 7
Volume 29.5 m^3

Airborne	Limit
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	37.0
63	29.8
80	40.5
100	**41.7**
125	**42.9**
160	**43.6**
200	**47.2**
250	**47.1**
315	**46.9**
400	**50.9**
500	**53.5**
630	**56.0**
800	**57.1**
1000	**58.7**
1250	**59.2**
1600	**60.3**
2000	**60.8**
2500	**60.2**
3150	**60.6**
4000	63.6
5000	65.0

$D_{nT,w} + C_{tr}$	53 dB
$D_{nT,w}$	57 dB
C_{tr}	-4 dB

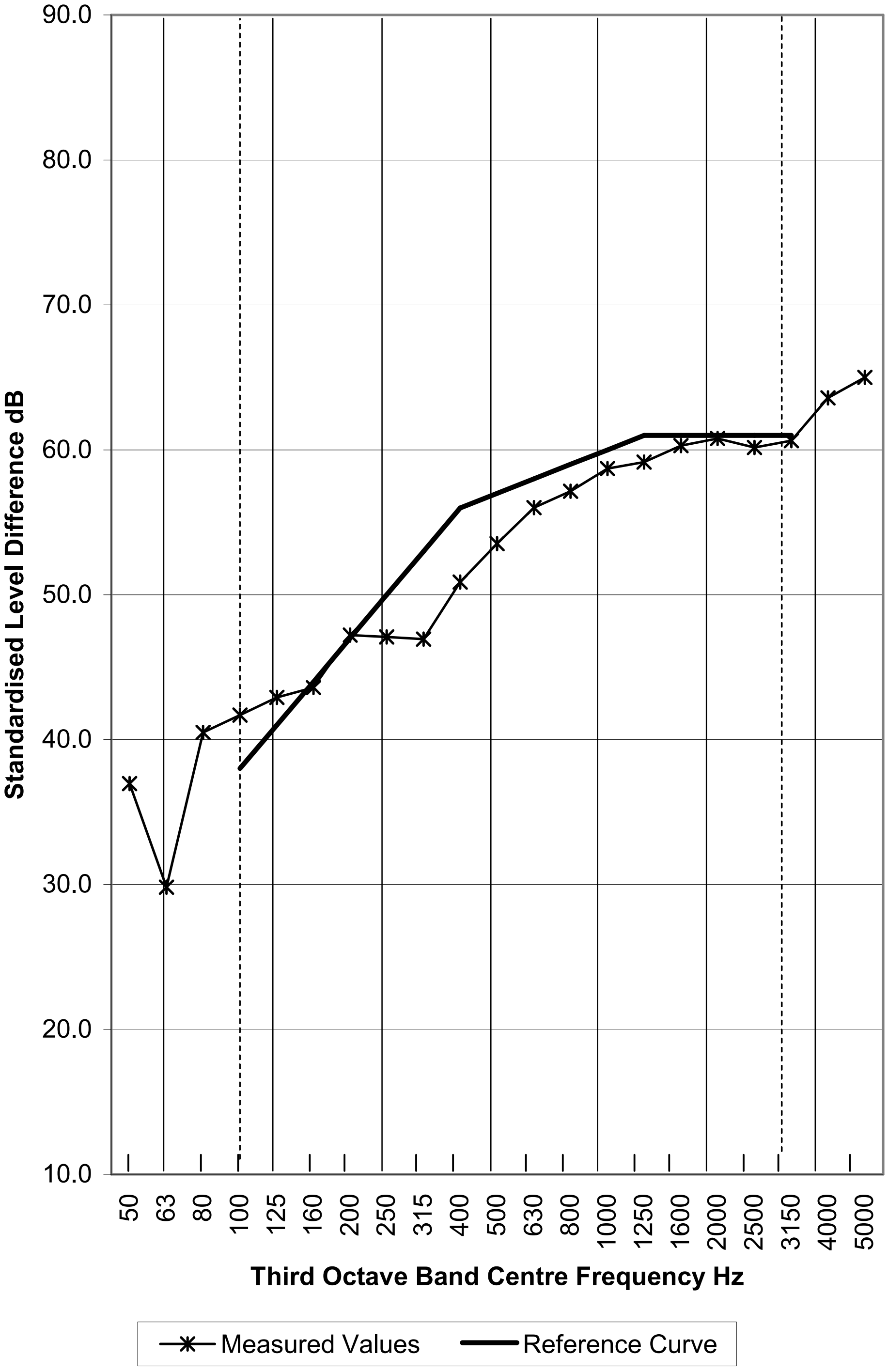


FIGURE 2: Airborne Wall Test Living Room Flat 14 to Bedroom Flat 13

Client : The Concrete Centre — Site : Contemperis Phase 2

Date : 12th January 2006 — Engineer : J N Butt

Source Room
Living Room Flat 14
Volume 84 m^3

Receiver Room
Bedroom Flat 13
Volume 29.5 m^3

Airborne	Limit
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	28.9
63	23.7
80	40.2
100	**42.9**
125	**46.1**
160	**46.1**
200	**46.4**
250	**48.0**
315	**48.6**
400	**52.6**
500	**52.9**
630	**55.0**
800	**56.6**
1000	**57.0**
1250	**57.8**
1600	**58.5**
2000	**59.5**
2500	**59.7**
3150	**60.4**
4000	62.3
5000	64.3

$D_{nT,w} + C_{tr}$	53 dB
$D_{nT,w}$	56 dB
C_{tr}	-3 dB

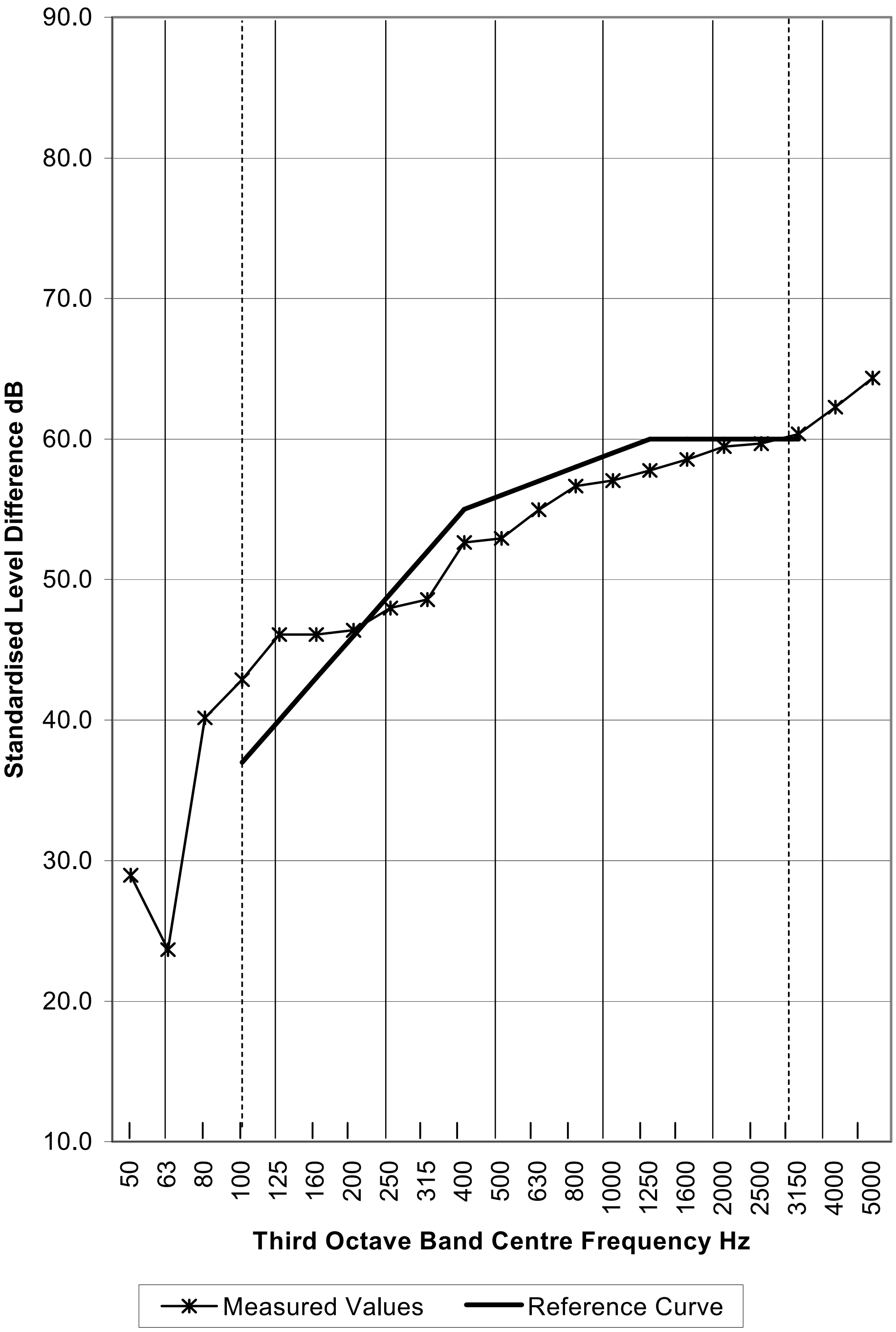


FIGURE 3: Airborne Floor Test Bedroom Flat 7 to Bedroom Flat 13

Client : The Concrete Centre

Site : Contemperis Phase 2

Date : 12th January 2006

Engineer : J N Butt

Source Room
Bedroom Flat 7

Volume 29.5m^3

Receiver Room
Bedroom Flat 13

Volume 29.5 m^3

Airborne	**Limit**
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	29.3
63	30.3
80	46.0
100	**47.4**
125	**46.6**
160	**52.6**
200	**51.2**
250	**53.2**
315	**53.1**
400	**55.4**
500	**57.4**
630	**59.6**
800	**61.3**
1000	**62.5**
1250	**64.4**
1600	**66.2**
2000	**65.7**
2500	**65.1**
3150	**66.7**
4000	69.9
5000	72.1

$D_{nT,w} + C_{tr}$	58 dB
$D_{nT,w}$	62 dB
C_{tr}	-4 dB

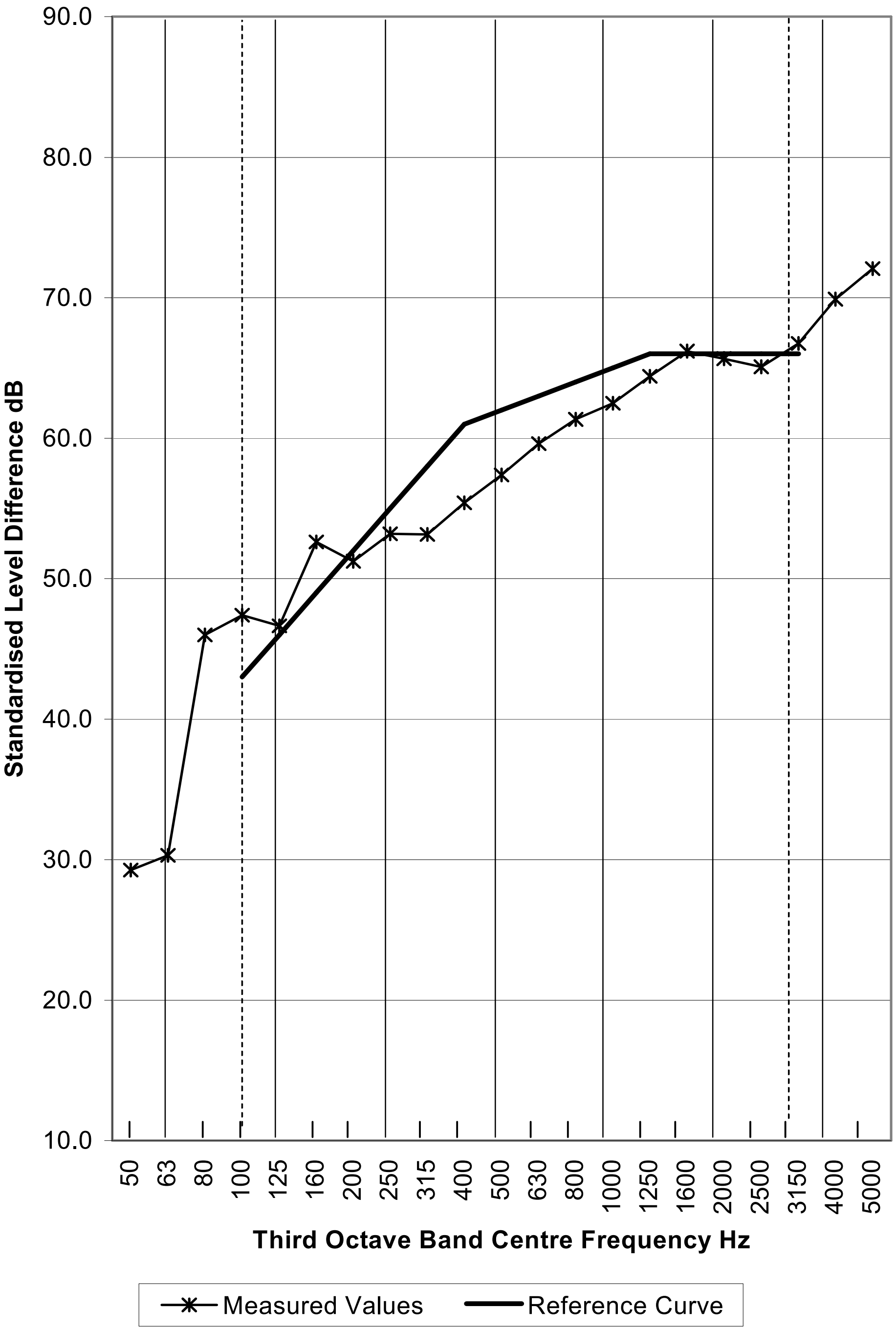


FIGURE 4: Airborne Floor Test Living Room Flat 8 to Living Room Flat 14

Client :	The Concrete Centre	Site :	Contemperis Phase 2
Date :	12th January 2006	Engineer :	J N Butt

Source Room
Living Room Flat 8
Volume 84 m^3

Receiver Room
Living Room Flat 14
Volume 84 m^3

Airborne	**Limit**
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	40.3
63	33.4
80	40.7
100	**40.1**
125	**40.4**
160	**48.4**
200	**49.4**
250	**52.8**
315	**53.8**
400	**55.2**
500	**57.9**
630	**60.0**
800	**62.3**
1000	**64.1**
1250	**65.3**
1600	**66.5**
2000	**67.4**
2500	**67.2**
3150	**68.6**
4000	71.4
5000	73.2

$D_{nT,w}$ + C_{tr}	**55 dB**
$D_{nT,w}$	**61 dB**
C_{tr}	**-6 dB**

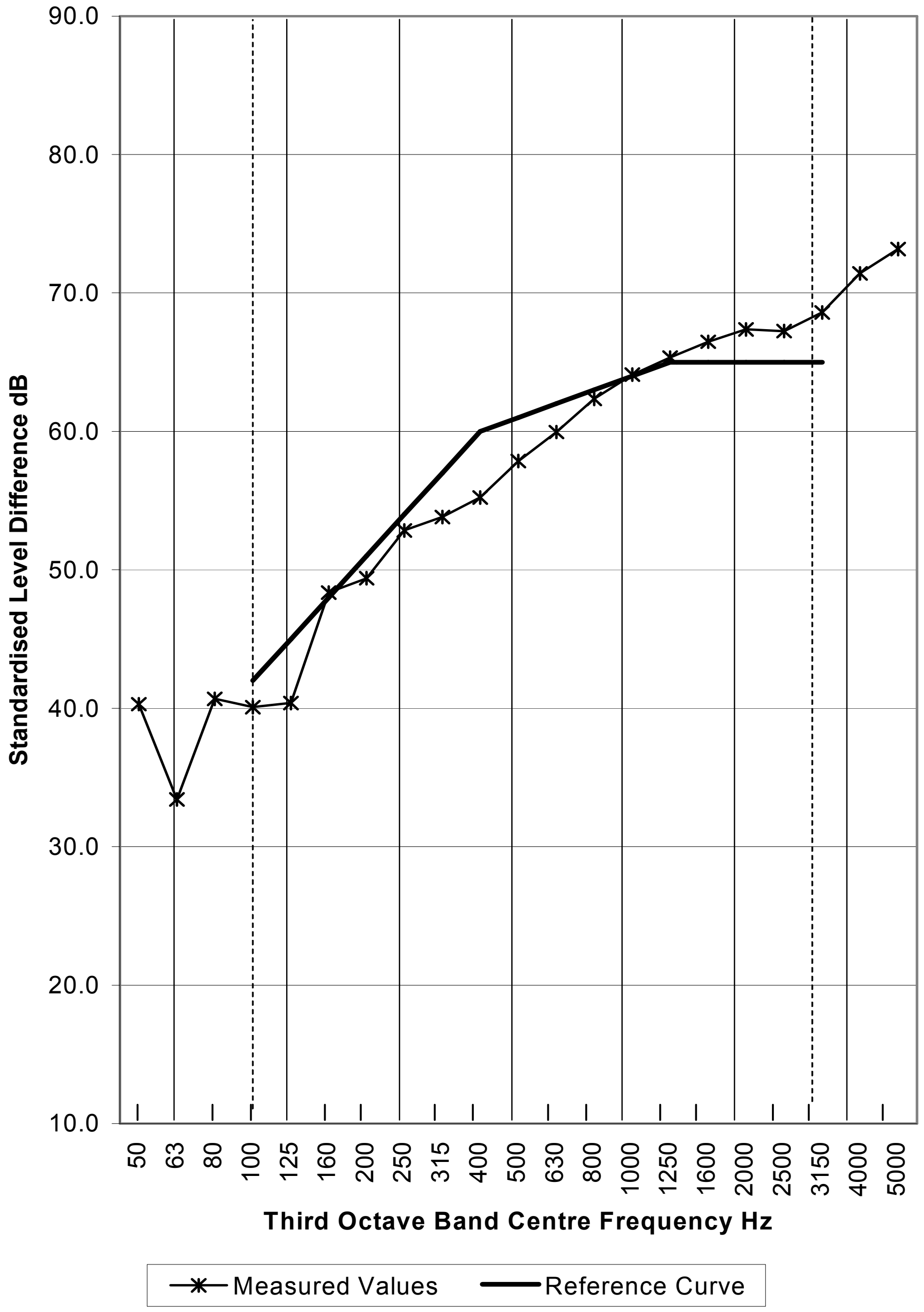


FIGURE 5: Impact Floor Test Living Room Flat 14 to Living Room Flat 8

Client :	The Concrete Centre	Site :	Contemperis Phase 2
Date :	12th January 2006	Engineer :	J N Butt

Source Room
Living Room Flat 14
Volume 84 m^3

Receiver Room
Living Room Flat 8
Volume 84 m^3

Impact Floor	**Limit**
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	43.3
63	42.2
80	44.9
100	**48.7**
125	**56.2**
160	**51.3**
200	**49.8**
250	**51.3**
315	**52.9**
400	**56.6**
500	**56.7**
630	**55.6**
800	**55.8**
1000	**56.3**
1250	**56.7**
1600	**57.4**
2000	**60.0**
2500	**62.1**
3150	**62.4**
4000	61.3
5000	59.3

$L'_{nT,w}$	**66 dB**

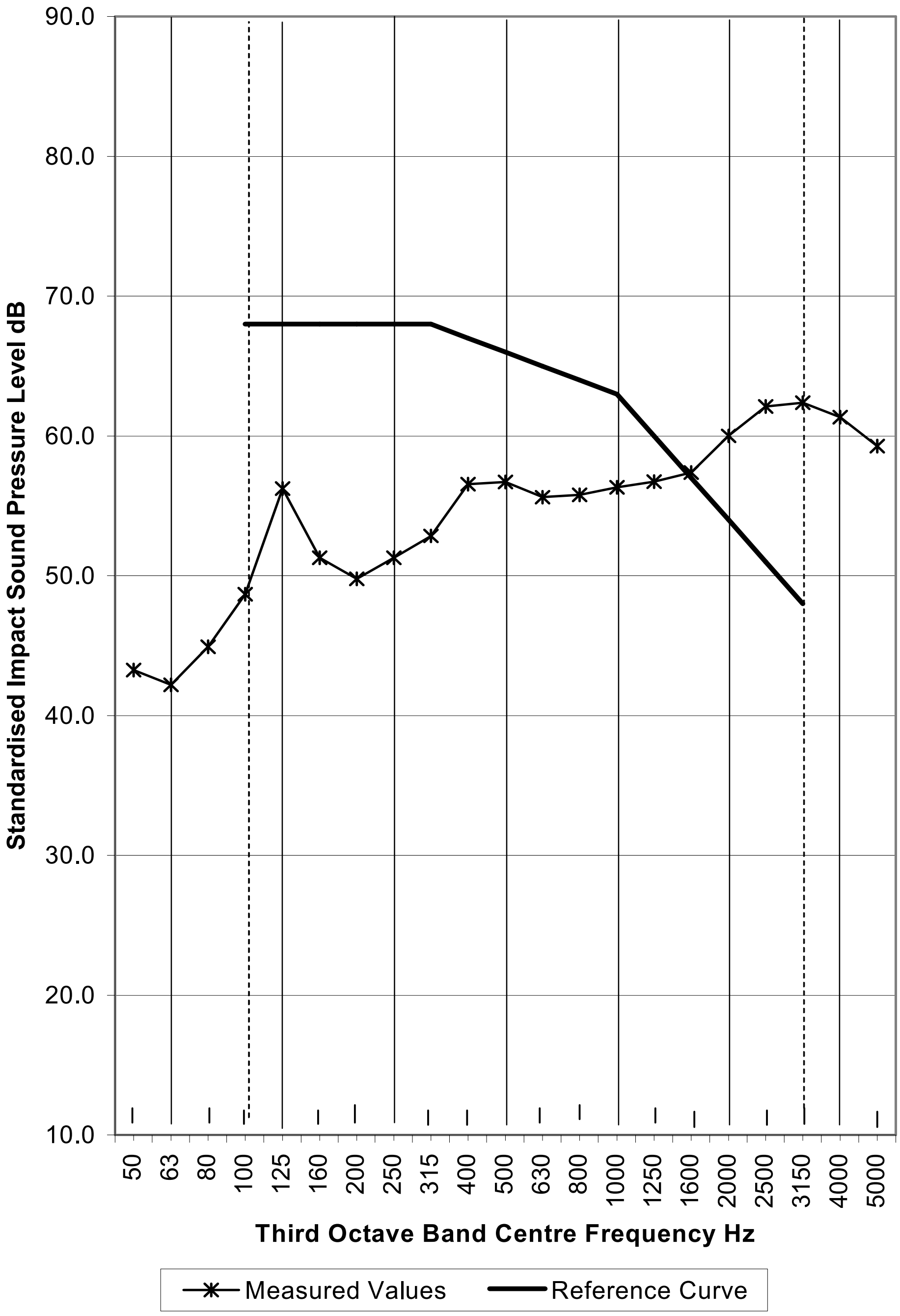


FIGURE 6: Impact Floor Test Bedroom Flat 13 to Bedroom Flat 7

Client : The Concrete Centre

Site : Contemperis Phase 2

Date : 12th January 2006

Engineer : J N Butt

Source Room
Bedroom Flat 13

Volume 29.5 m^3

Receiver Room
Bedroom Flat 7

Volume 29.5 m^3

Impact Floor	**Limit**
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	42.8
63	41.7
80	41.1
100	**44.9**
125	**55.8**
160	**52.9**
200	**52.4**
250	**54.5**
315	**58.7**
400	**59.5**
500	**60.0**
630	**58.8**
800	**60.3**
1000	**59.1**
1250	**59.5**
1600	**60.9**
2000	**63.8**
2500	**66.5**
3150	**66.8**
4000	65.6
5000	62.9

$L'_{nT,w}$	**71 dB**

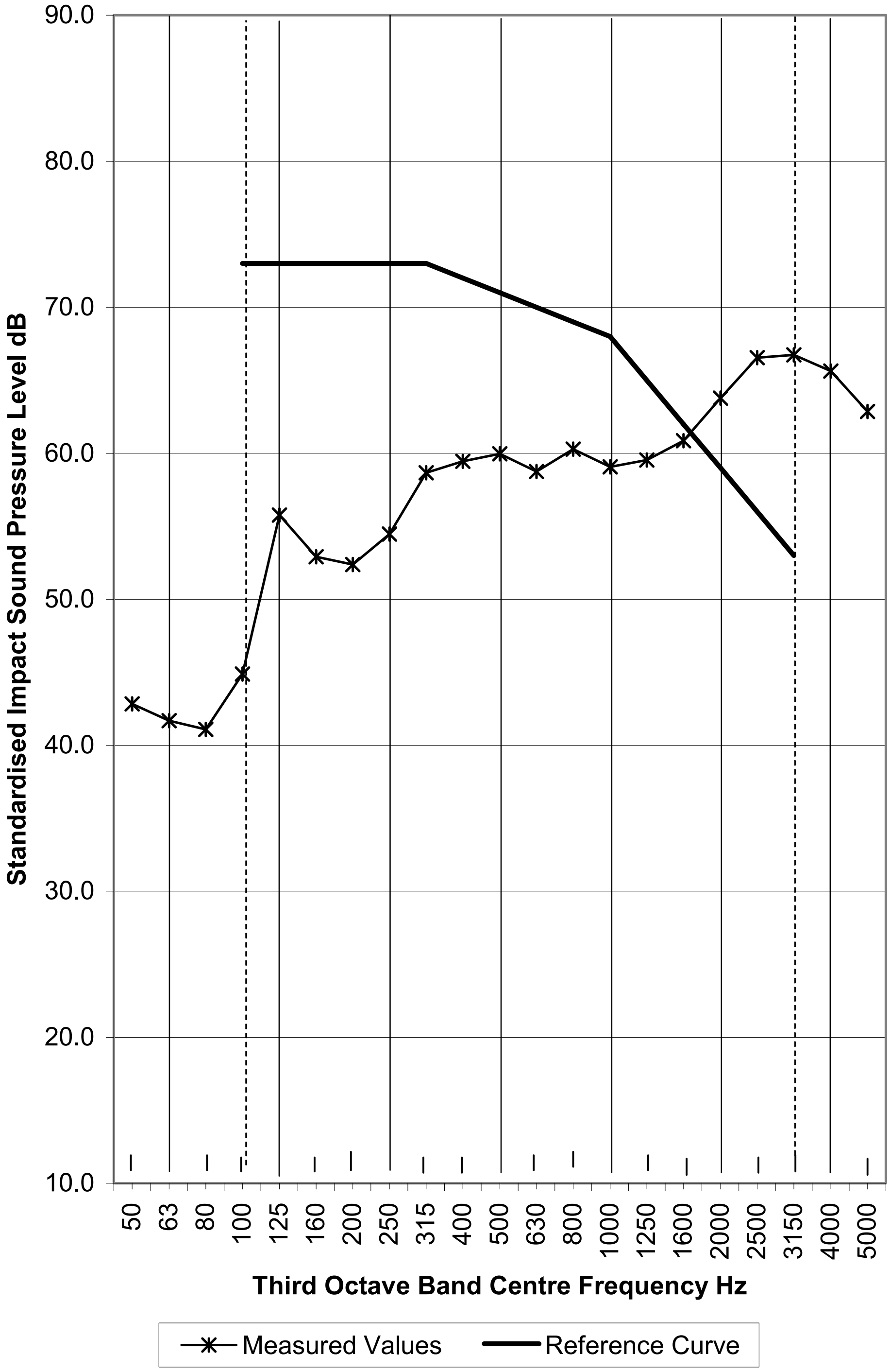


FIGURE 7: Impact Floor Test Kitchen Area of Living Room Flat 14 to Living Room Flat 8 (Tiled Floor)

Client :	The Concrete Centre	Site :	Contemperis Phase 2
Date :	12th January 2006	Engineer :	J N Butt

Source Room
Living Room Flat 14
Kitchen Area
Volume 84 m^3

Receiver Room
Living Room Flat 8

Volume 84 m^3

Impact Floor	**Limit**
Third Octave Band Frequency Hz	Third Octave Band D_{nT} dB
50	40.6
63	41.2
80	41.1
100	**47.7**
125	**55.4**
160	**51.3**
200	**50.6**
250	**52.6**
315	**52.4**
400	**54.3**
500	**55.1**
630	**53.8**
800	**52.9**
1000	**54.1**
1250	**53.4**
1600	**52.1**
2000	**47.0**
2500	**42.9**
3150	**40.2**
4000	33.9
5000	33.0

$L'_{nT,w}$	**54 dB**

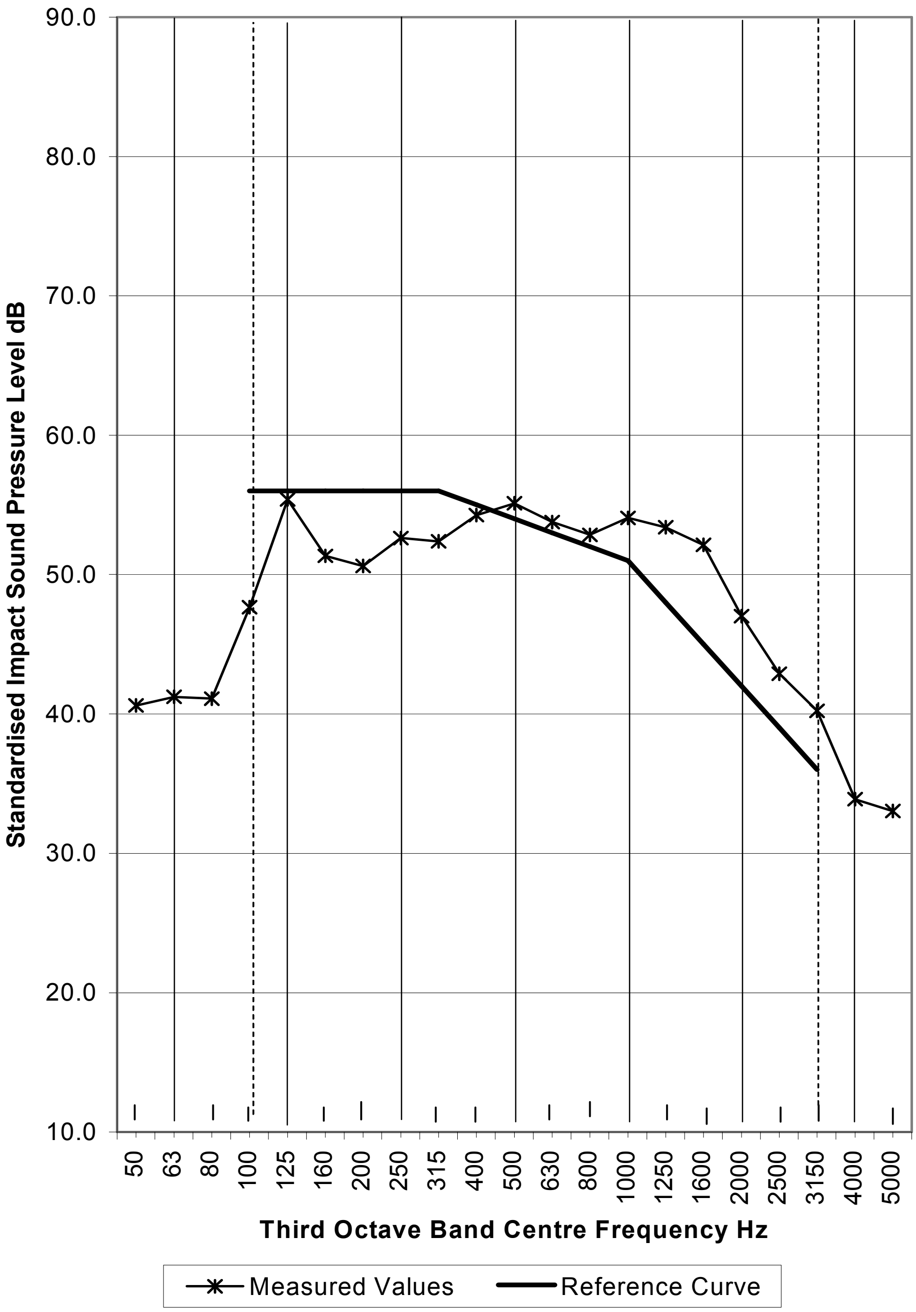
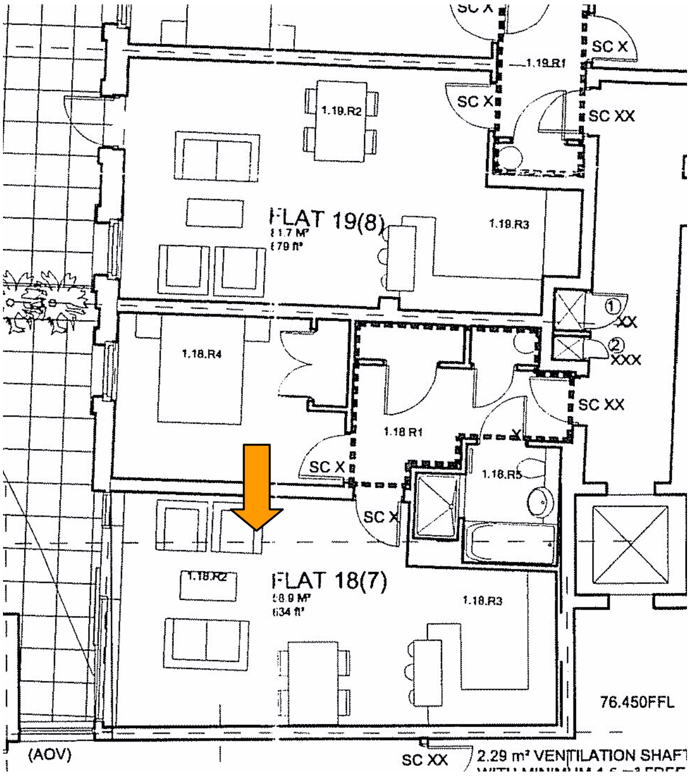


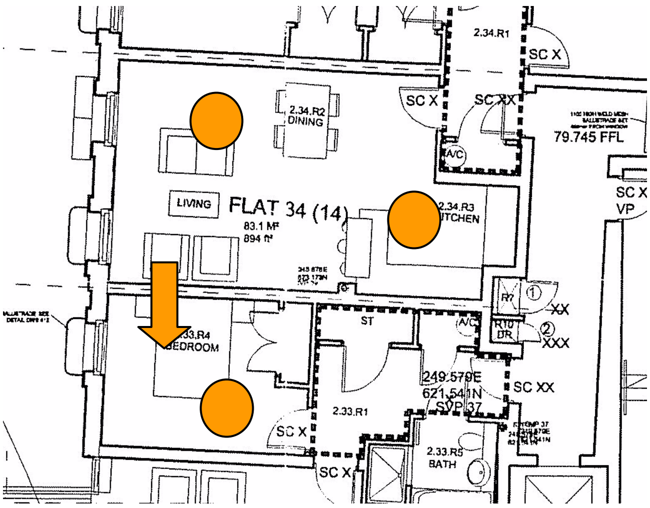
Figure 8: Test Locations



Ground Floor

Indicates airborne sound insulation test on wall

Indicates airborne and impact sound insulation test on floor



First Floor

APPENDICES

APPENDIX 1
APPROVED DOCUMENT E IN-SITU PERFORMANCE REQUIREMENTS

Protection against sound from other parts of the building and adjoining buildings

E1. Dwelling-houses, flats and rooms for residential purpose shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings.

In the Secretary of State's view the normal way of satisfying Requirement E1 will be to build separating walls, separating floors and stairs that have a separating function, together with the associated flanking construction, in such a way that they achieve the sound insulation values for dwellings-houses and flats set out in Table 1a, and the values for rooms for residential purposes set out in Table 1b. For walls that separate rooms for residential purposes from adjoining dwelling-houses and flats, the performance standards given in Table 1a should be achieved.

Table 1a: Dwellings-houses and flats – performance standards for separating walls, separating floors, and stairs that have a separating function.

Description of Area	**Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum Values)**	**Impact Sound Insulation $L'_{nT,w}$ dB (Maximum Values)**
Purpose built dwelling-houses and flats		
Walls	45	-
Floors and stairs	45	62
Dwelling-houses and flats formed by material change of use		
Walls	43	-
Floors and stairs	43	64

Table 1b: Rooms for residential purposes – performance standards for separating walls, separating floors, and stairs that have a separating function.

Description of Area	**Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum Values)**	**Impact Sound Insulation $L'_{nT,w}$ dB (Maximum Values)**
Purpose built dwelling-houses and flats		
Walls	43	-
Floors and stairs	45	62
Dwelling-houses and flats formed by material change of use		
Walls	43	-
Floors and stairs	43	64

APPENDIX 2
ACOUSTIC TERMINOLOGY

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithm's are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

Octave and Third Octave Bands

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

A-Weighting

The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB(A).

Level Difference, D

This is defined as the difference in decibels between the average sound pressure level in a source room on one side of a separating structure and the average sound pressure level in a receiving room on the other side. The level difference is an absolute measure of the sound insulation of a separating structure.

Standardised Level Difference, D_{nT}

This is a measure of the level difference, corresponding to a reference value of the reverberation time in the receiving room. A correction term of ten times the common logarithm (to base 10) of the ratio of the actual reverberation time to the reference reverberation time is added to the level difference, D. For residential dwellings the reference reverberation time is 0.5s. The D_{nT} is measured in decibels. It is used as an airborne noise measurement parameter in sound insulation tests.

Reverberation Time, T

The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60 dB decay can not be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

APPENDIX 2 (CONTINUED)
ACOUSTIC TERMINOLOGY

Standardised Impact Sound Pressure Level, L'_{nT}

This is a measure of the average noise level in a receiving room generated by use of a standard impact source on a separating floor reduced by a correction term corresponding to a reference value of the reverberation time. A correction of ten times the common logarithm (to base 10) of the ratio of the actual

reverberation time to the reference reverberation time is subtracted from the received average noise level. For residential dwellings the reference reverberation time is 0.5s. The L'_{nT} is measured in decibels. It is used as an impact noise measurement parameter in sound insulation tests.

Airborne Single Number Quantity Weighting

This is a weighting procedure defined in BS EN ISO 717, Part 1 for converting third octave band R, R', D and D_{nT} values to a single number quantity denoted as R_w, R'_w, D_w or $D_{nT,w}$. It is a decibel value.

Impact Single Number Quantity Weighting

This is a weighting procedure defined in BS EN ISO 717, Part 2 for converting third octave band L'_{nT} values to a single number quantity denoted in $L'_{nT,w}$. It is a decibel value.

Spectrum Adaptation Term C_{tr}

This is a correction factor calculated from the measured R_w, $R'_{w,}$, $D_{nT.w}$ and the corresponding third octave band R, R' and D_{nT} values. It uses a set of weighting levels in third octave bands derived from a road traffic noise spectrum. It is applied to airborne test results and is measured in dB.