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Concrete Centre Limited

Bron Derw Residential Development, Colwyn Bay

P0818-REP01-LC

Sound Insulation Test Report

25 July 2005

PROJECT:	Bron Derw Residential Development, Colwyn Bay
CLIENT:	Concrete Centre Limited Riverside House 4 Meadows Business Park Station Approach Camberley Surrey GU17 9AB
DOCUMENT REFERENCE:	P0818-REP01-LC
SIGNED:	______________________ LEE COPLEY
CHECKED:	______________________ IAN ETCHELLS
DATE:	25 July 2005

CONTENTS

1.0 INTRODUCTION

Sol Acoustics has been commissioned by Concrete Centre Limited to measure the airborne and impact sound insulation between dwellings at 'Bron Derw' Residential Development, 115 Llandudno Road, Colwyn Bay and compare the results with the performance standards cited by Building Regulations 2000 Approved Document E for purpose built dwellings.

Airborne Sound Insulation tests were conducted in accordance with BS EN ISO 140-4:1998 and rated in accordance with BS EN ISO 717-1: 1997. Impact Sound Insulation tests were conducted in accordance with BS EN ISO 140-7: 1998 and rated in accordance with BS EN ISO 717-2: 1997.

A glossary of acoustic terms used in this report is given in Appendix A.

2.0 BUILDING REGULATIONS SOUND INSULATION REQUIREMENTS

The Building Regulations 2000 Approved Document E: "Resistance to the passage of sound" gives airborne and impact sound insulation performance standards for purpose built dwelling-houses and flats. These Performance standards are given in Table 1 below.

	Airborne sound insulation $D_{nT,w} + C_{tr}$ **dB**	**Impact sound insulation** $L'_{nT,w}$ **dB**
Purpose Built Dwelling-houses and flats		
Walls	≥ 45	-
Floors and stairs	≥ 45	≤ 62

Table 1: Building Regulations 2000 Approved Document E: Purpose built Dwelling-houses and flats - performance standards for separating walls, separating floors, and stairs that have a separating function.

3.0 TEST PROCEDURE AND ANALYSIS

Airborne Sound Insulation

To conduct airborne sound insulation tests, a noise source is placed in the “source room” and the resultant noise level in this room is measured. The room on the other side of the party construction is the “receiver room” and the noise transmitted to this room is measured. The difference between source and receiver noise levels is then measured in accordance with BS EN ISO 140-4: “Field Measurements of airborne sound insulation between rooms”. The resulting frequency-dependent level differences are converted into a single number characterising the acoustical performance using the method given in BS EN ISO 717-1: “Method for rating the airborne sound insulation in buildings and of interior building elements”. This single number rating is the ‘Weighted Standardised Level Difference’ ($D_{nT,W}$).

Impact Sound Insulation

To conduct impact sound insulation tests, a tapping machine is placed on the floor in the “source room”. The room directly below the floor is the “receiver room”. The noise level generated in the receiver room is measured in accordance with BS EN ISO 140-7: “Field Measurements of impact sound insulation of floors”. The resulting frequency-dependent noise levels are converted into a single number characterising the acoustical performance using the method given in BS EN ISO 717-2: “Method for rating the impact sound insulation”. This single number rating is the ‘Standardised Impact Sound Pressure Level’ ($L'_{nT,w}$). It should be noted that a decrease in $L'_{nT,w}$ indicates an improvement in acoustic performance.

Details of the tests are given in Appendix B. Appendices C and D summarise the calculation and rating methods for airborne and impact sound insulation tests respectively.

Sound insulation tests were conducted between the following pairs of rooms at 'Bron Derw', 115 Llandudno Road:

Separating Floors – Impact Sound Insulation Tests

1. Flat 4 Master Bedroom to Flat 2 Master Bedroom
2. Flat 4 Kitchen to Flat 2 Kitchen

Separating Floors – Airborne Sound Insulation Tests

1. Flat 4 Master Bedroom to Flat 2 Master Bedroom
2. Flat 4 Kitchen to Flat 2 Kitchen

Separating Walls – Airborne Sound Insulation Tests

1. Flat 4 Kitchen to Flat 3 Kitchen
2. Flat 2 Kitchen to Flat 1 Kitchen

4.0 DESCRIPTION OF TESTED CONSTRUCTIONS

The separating wall construction is understood to be as follows:

- 2 no. leaves of 100 mm thick concrete block separated by a 40mm cavity (the blockwork has been described as 'dense' but the actual density is unknown)
- One face of the wall lined with a single layer of plasterboard on adhesive dabs
- Independent drylining applied to the other face of the wall comprising a single layer of 12.5 mm thick plasterboard supported by 48mm metal C-studs, with 52mm 'E-Cousti' quilt placed between the studs.

Figure 1 illustrates the separating wall construction between adjacent dwellings.

Separating floors are understood to be as follows:

- A beam and block structural floor (100mm deep blocks - density unknown) topped with a 75mm thick screed
- The screed was overlaid with a 30 mm thick Kingspan insulation panel, 8mm thick 'E-Coustifloor' resilient layer and 18mm chipboard
- Ceilings comprised 15mm thick plasterboard fixed via resilient bars on 50mm timber battens to the underside of the concrete beams
- 52mm 'E-Cousti' quilt was fixed between the bottom flange of the beams. The 8mm resilient layer was folded around the edge of the chipboard flooring and returned beneath walls linings and skirting boards

Figure 2 illustrates the separating floor construction between adjacent dwellings.

External flanking walls are understood to have comprised of:

- 100 mm thick facing brick, a 50mm cavity and an internal leaf of 140mm thermal block (density unknown but assumed to be lightweight)
- Lined with 50 mm overall insulated plasterboard on adhesive dabs.

5.0 TEST RESULTS

Table 2 compares the measured impact sound insulation performance of the separating floors against the target performance requirements cited by Building Regulations 2000.

Table 3 compares the measured airborne sound insulation performance of the separating floors against the target performance requirements cited by Building Regulations 2000.

Table 4 compares the measured airborne sound insulation performance of the separating walls against the target performance requirements cited by Building Regulations 2000.

Full test certificates for the measurements are given in Appendix E.

Test Description	Test Result	Performance Standard cited by Building Regulations 2000 Approved Document E	Pass or Fail?
Flat 4 Master Bedroom to Flat 2 Master Bedroom	55dB $L'_{nT,w}$	≤ 62dB $L'_{nT,w}$	Pass
Flat 4 Kitchen to Flat 2 Kitchen	57dB $L'_{nT,w}$	≤ 62dB $L'_{nT,w}$	Pass

Table 2: Separating Floor Impact Sound Insulation Tests Results Compared With The Performance Requirements Cited by Building Regulations 2000 Approved Document E

Test Description	Test Result	Performance Standard cited by Building Regulations 2000 Approved Document E	Pass or Fail?
Flat 4 Master Bedroom to Flat 2 Master Bedroom	47dB $D_{nT,w} + C_{tr}$	≥ 45dB $D_{nT,w} + C_{tr}$	Pass
Flat 4 Kitchen to Flat 2 Kitchen	45dB $D_{nT,w} + C_{tr}$	≥ 45dB $D_{nT,w} + C_{tr}$	Pass

Table 3: Separating Floor Airborne Sound Insulation Tests Results Compared With The Performance Requirements Cited by Building Regulations 2000 Approved Document E

Test Description	Test Result	Performance Standard cited by Building Regulations 2000 Approved Document E	Pass or Fail?
Flat 4 Kitchen to Flat 3 Kitchen	51dB $D_{nT,w} + C_{tr}$	≥ 45dB $D_{nT,w} + C_{tr}$	Pass
Flat 2 Kitchen to Flat 1 Kitchen	51dB $D_{nT,w} + C_{tr}$	≥ 45dB $D_{nT,w} + C_{tr}$	Pass

Table 4: Separating Wall Airborne Sound Insulation Tests Results Compared With The Performance Requirements Cited by Building Regulations 2000 Approved Document E

6.0 DISCUSSION

The results in Tables 2 to 4 show that compliance with the performance standards cited by Building Regulations 2000 Approved Document E for purpose built dwelling-houses and flats has been achieved.

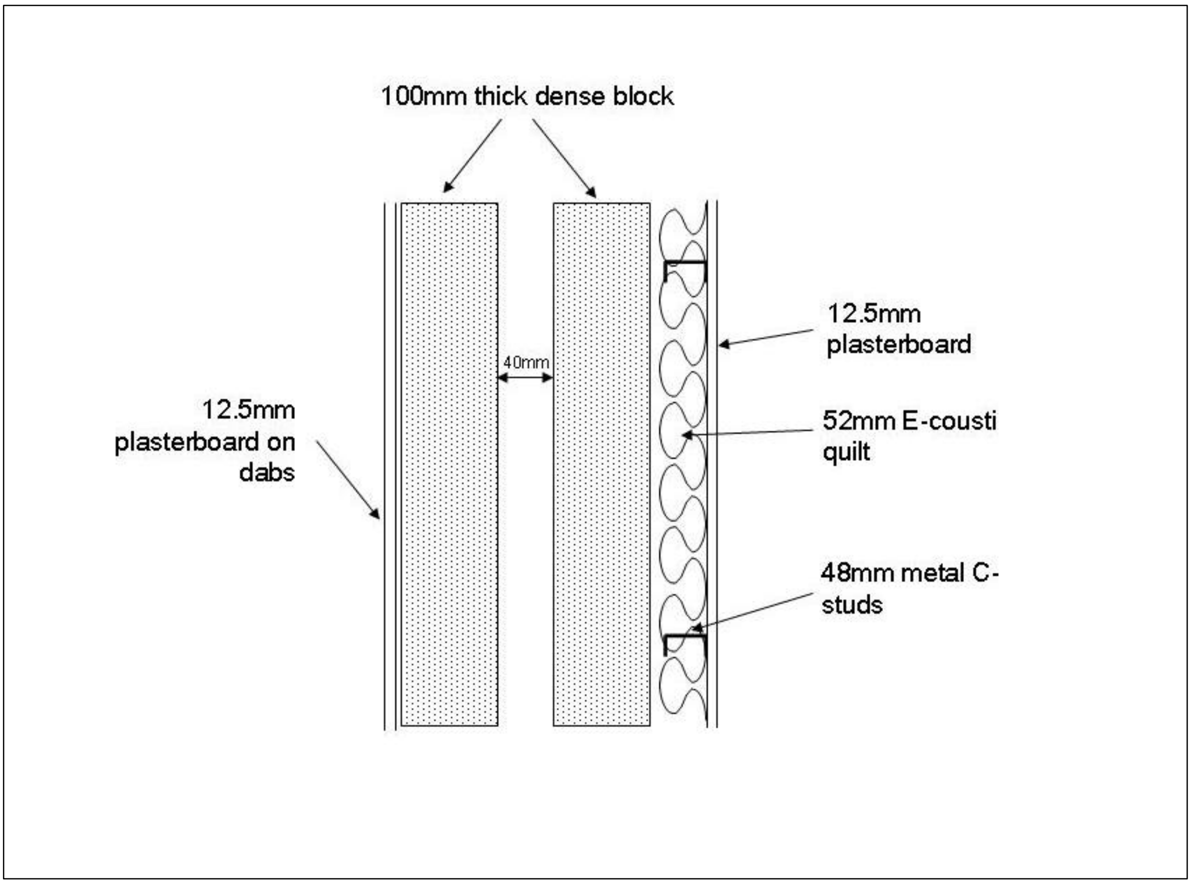


Figure 1: Separating wall construction between adjacent dwellings at 115 Llandudno Road, Colwyn Bay

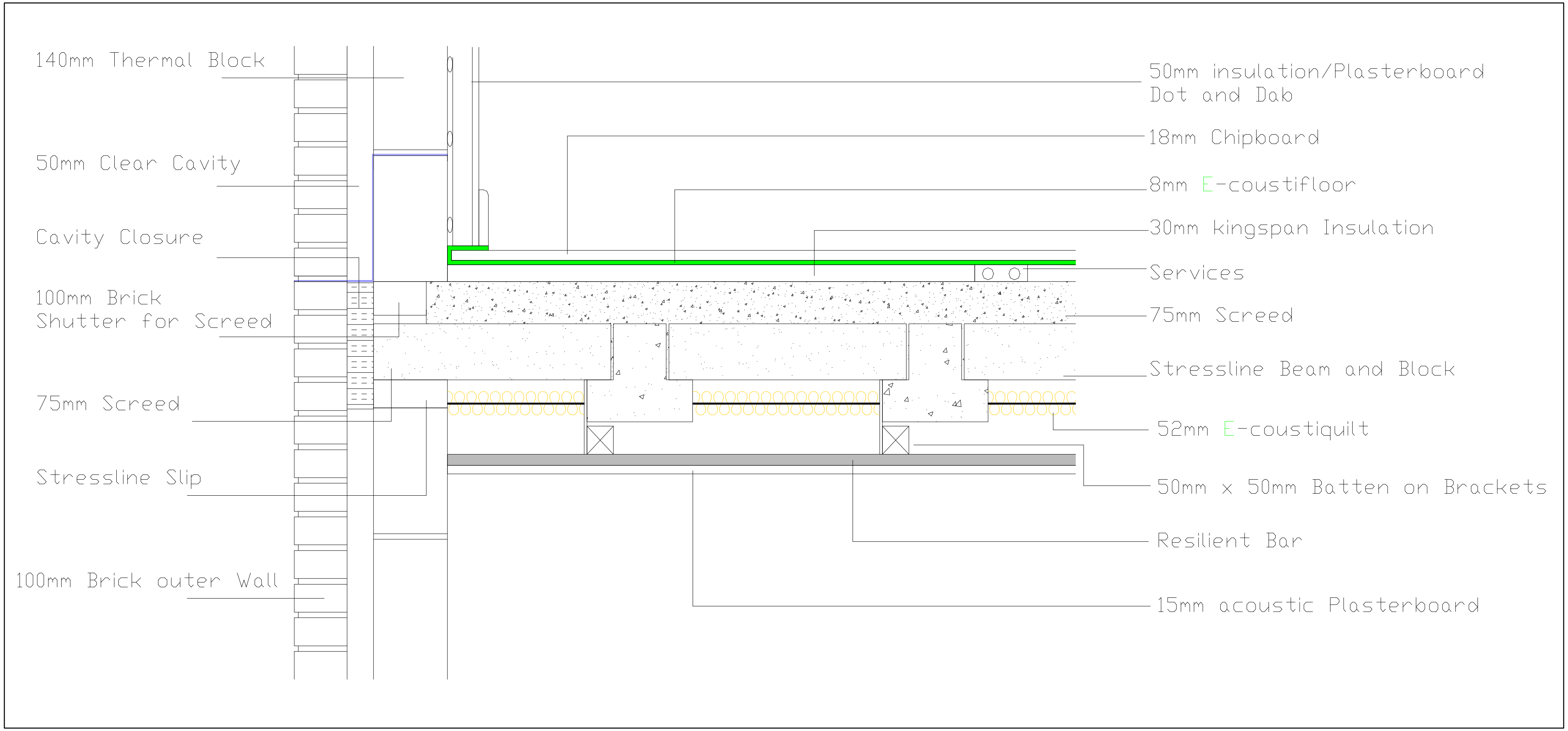


Figure 2: Separating floor construction between adjacent dwellings at 115 Llandudno Road, Colwyn Bay

APPENDIX A: GLOSSARY OF ACOUSTIC TERMS

DECIBEL (dB)

This is the unit used to quantify sound 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). We therefore use a logarithmic scale to describe sound pressure level, intensities and sound power levels. The logarithms used are to base 10. Hence, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in acoustic pressure in Pascals. Subjectively, this corresponds to a doubling in the perceived loudness of sound.

OCTAVE AND THIRD OCTAVE BANDS

The human ear is sensitive to sound over a range of frequencies between approximately 20Hz to 20000Hz (20kHz), and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands, and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid-frequency of each band is twice that of the band below it. For instance, the octave bands above and below the 500Hz octave band are 1kHz and 250 Hz respectively. For finer analysis, each octave band may be split into three one-third octave bands or in some cases, finer frequency bands (e.g. 1/12 octaves).

A-WEIGHTING

Normal hearing covers the frequency range from about 20Hz to 20kHz but sensitivity is greatest between approximately 500Hz and 8kHz. The "A-Weighting" is an electronic filter network incorporated in sound level meters that approximately corresponds to the frequency response of the ear. The unit of measurement of A-weighted sound level is dB(A).

APPENDIX B: TEST DETAILS

LOCATION

Bron Derw Residential Development, 115 Llandudno Road, Colwyn Bay

DATES OF TESTS

15 July 2005

PERSONNEL PRESENT DURING MEASUREMENTS

Lee Copley - Sol Acoustics

INSTRUMENTATION

Norsonic Type 118 IEC 60651 Type 1 Sound Level Meter (serial no. 28116)
Norsonic Type 1253 IEC 60942-1997 Class 1 Sound Calibrator (serial no. 27765)
Norsonic Nor-211 Tapping Machine
Mackie SRM450 Active Sound Reinforcement Speaker System
Neutrik Minirator MR1 Noise Generator
9mm calibre blank pistol

CALIBRATION PROCEDURE

Before and after the measurements the Norsonic Type 118 was check calibrated to an accuracy of ±0.3dB using the Norsonic Type 1251 Sound Calibrator. The calibrator produces a sound pressure level of 114 dB re $2x10^{-5}$ Pa @ 1kHz.

APPENDIX C: CALCULATION OF WEIGHTED STANDARDISED LEVEL DIFFERENCE

Standardised level difference (D_{nT}) is calculated using the formula given in BS EN ISO 140-4.

$D_{nT} = L_1 – L_2 + 10 \text{ Log}(T/T_o)\text{dB}$
Where:

- L_1 is the average sound pressure level in the source room
- L_2 is the average sound pressure level in the receiving room
- T is the reverberation time in the receiving room
- T_o is the reference reverberation time (0.5 seconds)

To calculate the Weighted Standardised Level Difference ($D_{nT,w}$) the reference curve defined in BS EN ISO 717-1: 1997 is compared with the results of the above calculation. The reference curve is shifted in steps of 1dB towards the measured curve until the mean favourable deviation is less than or equal to 2dB. The weighted level is then the value of the shifted reference curve at 500Hz.

The Weighted Standardised Level Difference ($D_{nT,w}$) is a true field measurement of a partitions' performance and includes all weaknesses and flanking paths. Where requirements are given as $D_{nT,w}$ values sound insulation tests are often required to show compliance.

APPENDIX D: CALCULATION OF WEIGHTED STANDARDISED IMPACT LEVEL

Standardised impact sound pressure level (L'_{nT}) is calculated using the formula given in BS EN ISO 140 part 7.

$L'_{nT} = L_1 + 10 \, Log(T/T_o)dB$

Where:

L_1	is the average sound pressure level in the receive room
T	is the reverberation time in the receiving room
T_o	is the reference reverberation time (0.5 seconds)

To calculate the Weighted Standardised Impact Sound Pressure Level ($L'_{nT,w}$) the reference curve defined in BS EN ISO 717 part 2: 1998 is compared with the results of the above calculation. The reference curve is shifted in steps of 1dB towards the measured curve until the mean favourable deviation is less than or equal to 2dB. The weighted level is then the value of the shifted reference curve at 500Hz.

The Weighted Standardised Impact Sound Pressure Level ($L'_{nT,w}$) is a true field measurement of a floors' performance and includes all weaknesses and flanking paths. Where requirements are given as $L'_{nT,w}$ values sound insulation tests are often required to show compliance.

APPENDIX E: TEST CERTIFICATES

Separating Floor Impact Sound Insulation Test Results

Flat 4 Master Bedroom to Flat 2 Master Bedroom	55dB $L'_{nT,w}$
Flat 4 Kitchen to Flat 2 Kitchen	57dB $L'_{nT,w}$

Separating Floor Airborne Sound Insulation Test Results

Flat 4 Master Bedroom to Flat 2 Master Bedroom	47dB $D_{nT,w} + C_{tr}$
Flat 4 Kitchen to Flat 2 Kitchen	45dB $D_{nT,w} + C_{tr}$

Separating Wall Airborne Sound Insulation Test Results

Flat 4 Kitchen to Flat 3 Kitchen	51dB $D_{nT,w} + C_{tr}$
Flat 2 Kitchen to Flat 1 Kitchen	51dB $D_{nT,w} + C_{tr}$

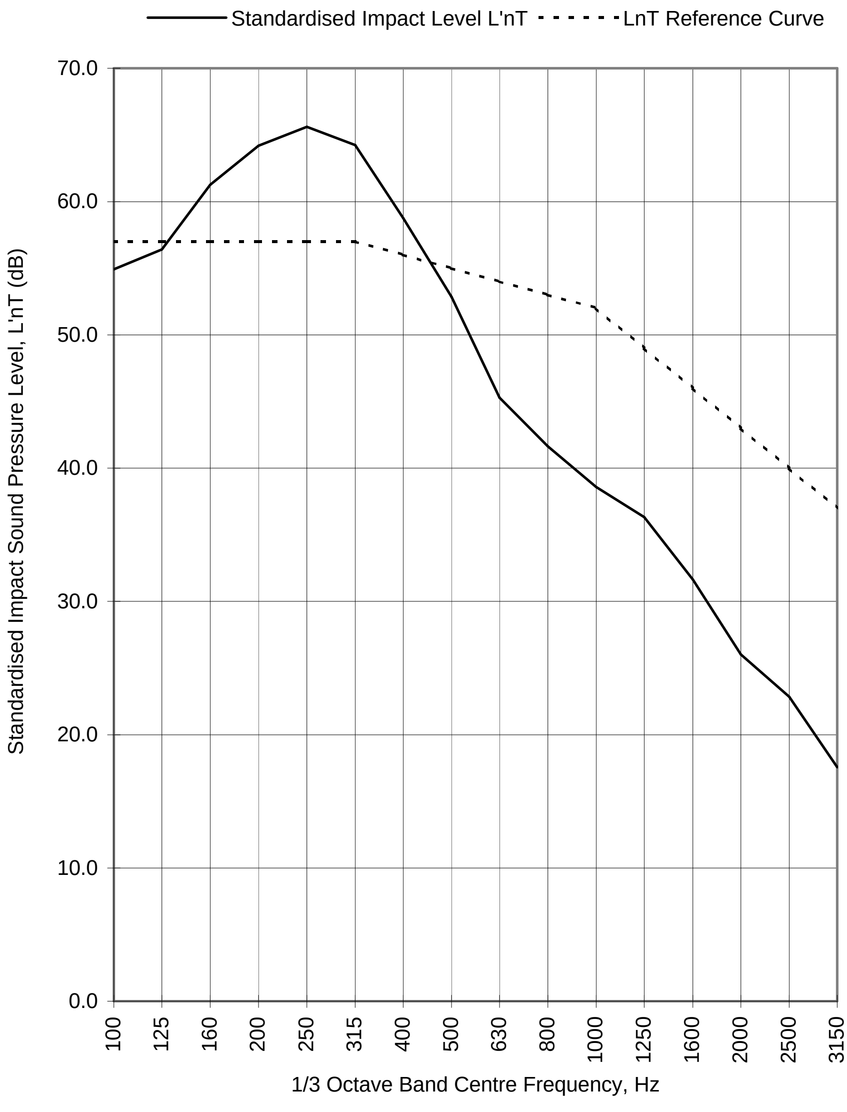
Calculation of Weighted Standardised Impact Level ($L'_{nT,w}$) to BS EN ISO 717-2

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Conrete Centre Ltd	Transmission Path:	Flat 4 Master Bedroom to Flat 2 Master Bedroom
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Floor

Description: Beam and block structural floor (100mm deep blocks - density unknown) topped with a 75mm thick screed. The screed was overlaid with a 30mm thick Kingspan insulation panel, 8mm thick E-Coustifloor resilient layer and 18mm chipboard. Ceilings comprised 15mm thick acoustic plasterboard fixed, via resilient bars on 50mm timber battens, to the underside of the concrete beams. 52mm E-Cousti quilt was fixed between the bottom flange of the beams. The 8mm resilient layer was folded around the edge of the chipboard flooring and returned beneath walls

1/3 Octave Band Centre Frequency Hz	Standardised Impact Level L'nT dB
100	54.9
125	56.4
160	61.3
200	64.2
250	65.6
315	64.2
400	58.8
500	52.9
630	45.3
800	41.6
1000	38.6
1250	36.3
1600	31.7
2000	26.0
2500	22.9
3150	17.6

L'_{nTw} = 55 dB



Rating according to BS EN ISO 717-2

$L'_{nT,w}$ (C_I) = 55 (1) dB

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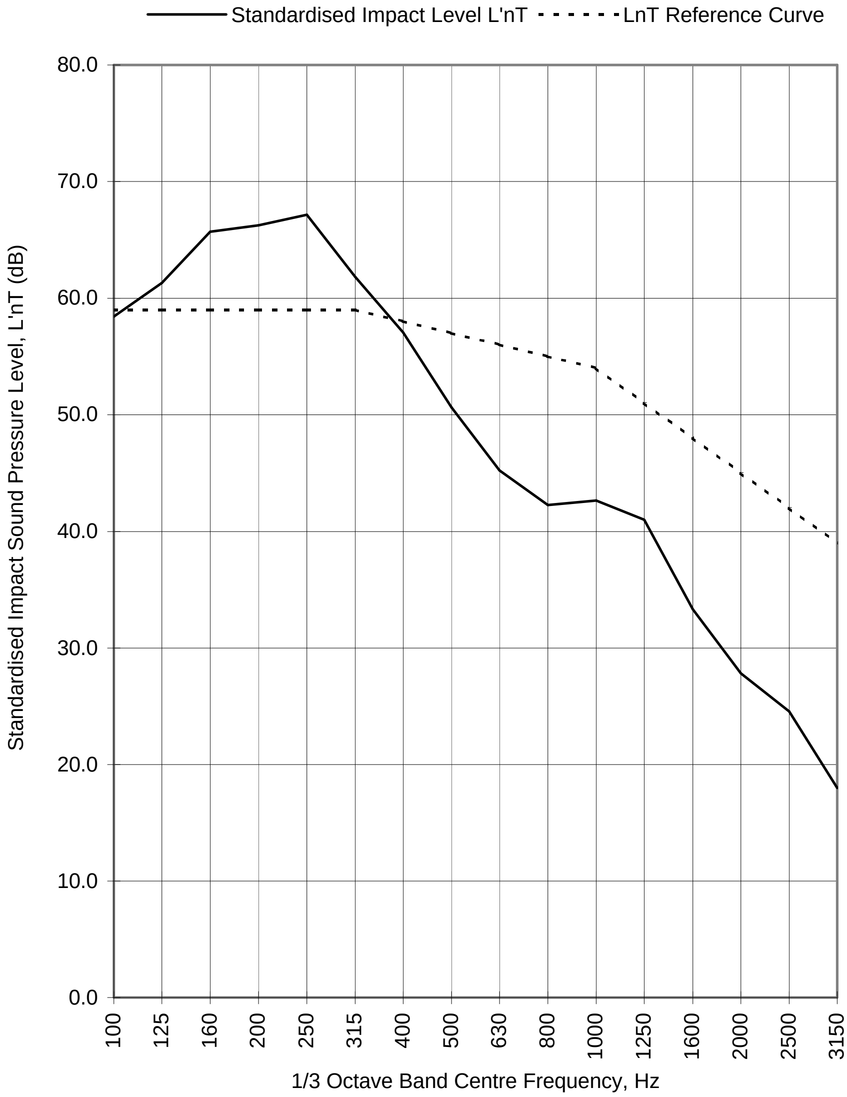
Calculation of Weighted Standardised Impact Level ($L'_{nT,w}$) to BS EN ISO 717-2

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Concrete Centre Ltd	Transmission Path:	Flat 4 Kitchen to Flat 2 Kitchen
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Floor
Description:	Beam and block structural floor (100mm deep blocks - density unknown) topped with a 75mm thick screed. The screed was overlaid with a 30mm thick Kingspan insulation panel, 8mm thick E-Coustifloor resilient layer and 18mm chipboard. Ceilings comprised 15mm thick acoustic plasterboard fixed, via resilient bars on 50mm timber battens, to the underside of the concrete beams. 52mm E-Cousti quilt was fixed between the bottom flange of the beams. The 8mm resilient layer was folded around the edge of the chipboard flooring and returned beneath walls		

1/3 Octave Band Centre Frequency Hz	Standardised Impact Level L'nT dB
100	58.4
125	61.3
160	65.7
200	66.2
250	67.2
315	61.9
400	57.1
500	50.6
630	45.2
800	42.3
1000	42.6
1250	41.0
1600	33.3
2000	27.8
2500	24.6
3150	18.0

L'_{nTw} = 57 dB



Rating according to BS EN ISO 717-2

$L'_{nT,w}$ (C_I) = 57 (0) dB

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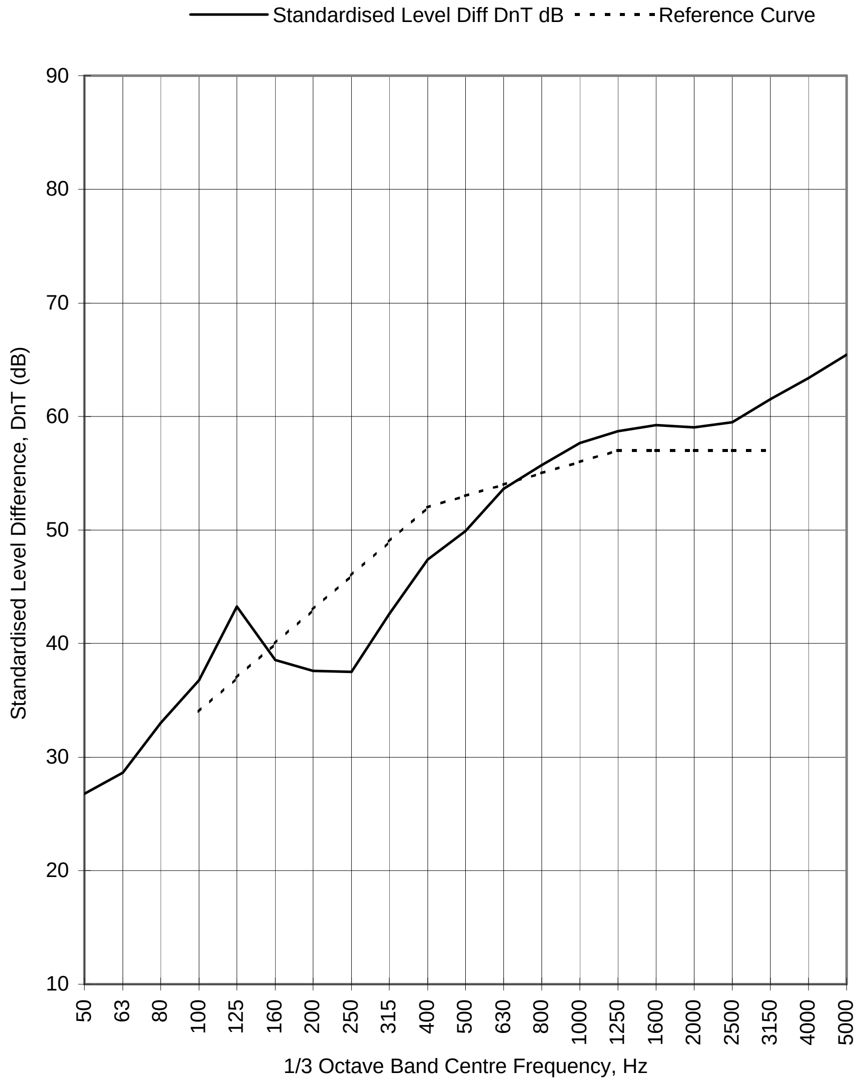
Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Concrete Centre Ltd	Transmission Path:	Flat 4 Master Bedroom to Flat 2 Master Bedroom
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Floor
Description:	Beam and block structural floor (100mm deep blocks - density unknown) topped with a 75mm thick screed. The screed was overlaid with a 30mm thick Kingspan insulation panel, 8mm thick E-Coustifloor resilient layer and 18mm chipboard. Ceilings comprised 15mm thick acoustic plasterboard fixed, via resilient bars on 50mm timber battens, to the underside of the concrete beams. 52mm E-Cousti quilt was fixed between the bottom flange of the beams. The 8mm resilient layer was folded around the edge of the chipboard flooring and returned beneath walls		

1/3 Octave Band Centre Frequency Hz	Standardised Level Diff D_{nT} dB
50	26.7
63	28.6
80	33.0
100	36.8
125	43.3
160	38.6
200	37.6
250	37.5
315	42.6
400	47.4
500	49.9
630	53.6
800	55.7
1000	57.7
1250	58.7
1600	59.2
2000	59.0
2500	59.5
3150	61.5
4000	63.4
5000	65.4



$D_{nT,w}$ = 53 dB

Rating according to BS EN ISO 717-1

$D_{nT,w}$ (C;C_{tr}) = 53 (-2 ; -6) dB

$C_{50-3150}$ =	-3	dB	$C_{50-5000}$ =	-2	dB	$C_{100-5000}$ =	-1	dB
$C_{tr, 50-3150}$ =	-9	dB	$C_{tr, 50-5000}$ =	-9	dB	$C_{tr\ 100-5000}$ =	-6	dB

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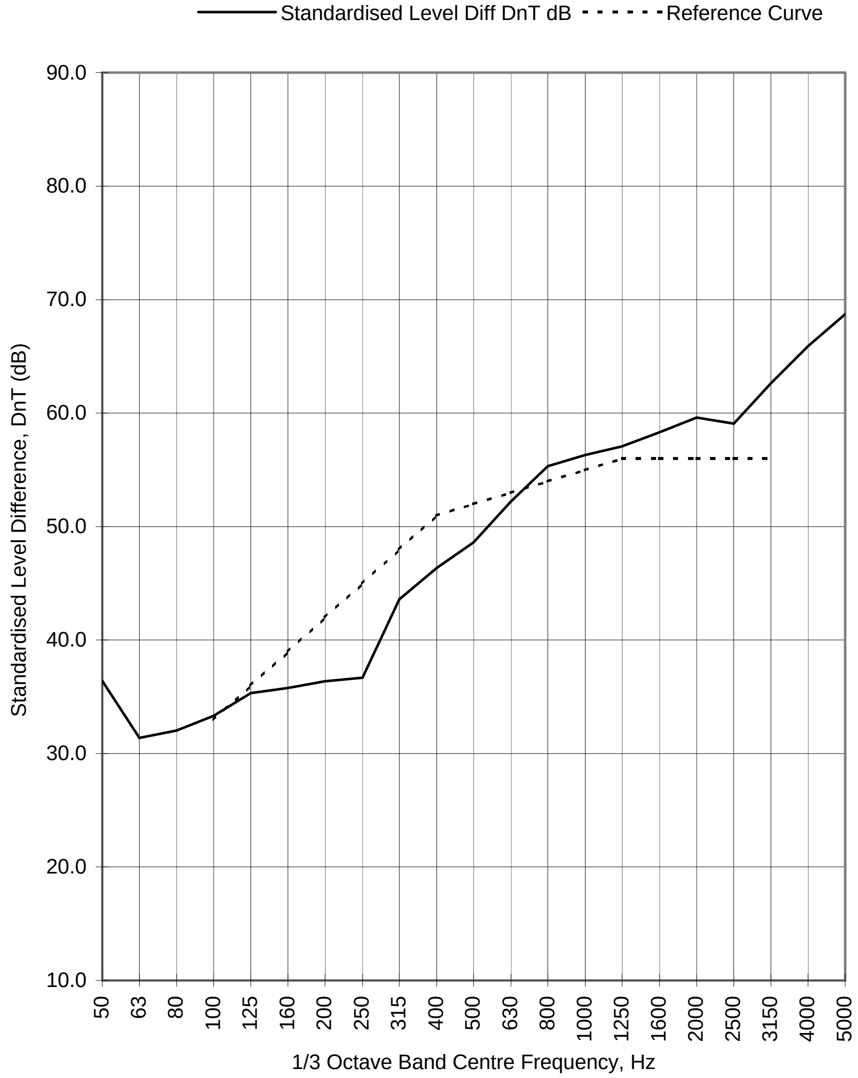
Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Concrete Centre Ltd	Transmission Path:	Flat 4 Kitchen to Flat 2 Kitchen
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Floor
	Beam and block structural floor (100mm deep blocks - density unknown) topped with a 75mm thick screed. The screed was overlaid with a 30mm thick Kingspan insulation panel, 8mm thick E-Coustifloor resilient layer and 18mm chipboard. Ceilings comprised 15mm thick acoustic plasterboard fixed, via resilient bars on 50mm timber battens, to the underside of the concrete beams. 52mm E-Cousti quilt was fixed between the bottom flange of the beams. The 8mm resilient layer was folded around the edge of the chipboard flooring and returned beneath walls		

1/3 Octave Band Centre Frequency Hz	Standardised Level Diff D_{nT} dB
50	36.4
63	31.4
80	32.0
100	33.3
125	35.3
160	35.8
200	36.3
250	36.7
315	43.6
400	46.4
500	48.6
630	52.2
800	55.3
1000	56.3
1250	57.1
1600	58.3
2000	59.6
2500	59.1
3150	62.6
4000	65.9
5000	68.7

$D_{nT,w}$ = 52 dB



Rating according to BS EN ISO 717-1

$D_{nT,w}$ (C;C_{tr}) = 52 (-2 ; -7) dB

$C_{50-3150}$ = -3 dB	$C_{50-5000}$ = -2 dB	$C_{100-5000}$ = -1 dB
$C_{tr,\ 50-3150}$ = -8 dB	$C_{tr,\ 50-5000}$ = -8 dB	$C_{tr\ 100-5000}$ = -7 dB

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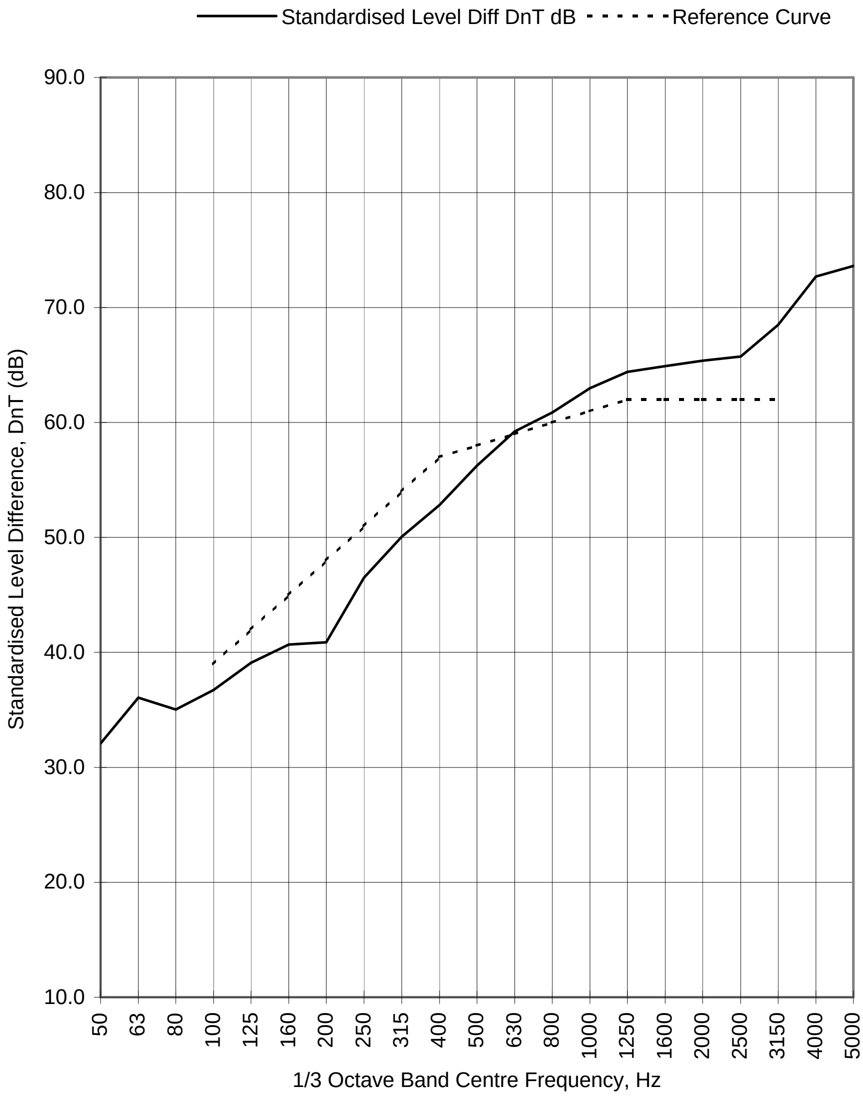
Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Concrete Centre Ltd	Transmission Path:	Flat 4 Kitchen to Flat 3 Kitchen
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Wall
	2 no. leaves of 100mm thick dense concrete block separated by a 40mm cavity. One face of the wall was lined with a single layer of plasterboard on adhesive dabs. An independent lining was applied to the other face of the wall comprising a single layer of 12.5mm thick plasterboard supported by 48mm metal C-studs. 52mm E-Cousti quilt placed between the studs		

1/3 Octave Band Centre Frequency Hz	Standardised Level Diff D_{nT} dB
50	32.1
63	36.0
80	35.0
100	36.7
125	39.1
160	40.7
200	40.9
250	46.5
315	50.0
400	52.8
500	56.2
630	59.2
800	60.8
1000	63.0
1250	64.4
1600	64.9
2000	65.4
2500	65.7
3150	68.5
4000	72.7
5000	≥ 73.6



$D_{nT,w}$ = 58 dB

Rating according to BS EN ISO 717-1

$D_{nT,w}$ ($C;C_{tr}$) = 58 (-2 ; -7) dB	**$C_{50-3150}$ = -3 dB**	**$C_{50-5000}$ = -2 dB**	**$C_{100-5000}$ = -1 dB**
	$C_{tr, 50-3150}$ = -10 dB	**$C_{tr, 50-5000}$ = -10 dB**	**$C_{tr\ 100-5000}$ = -7 dB**

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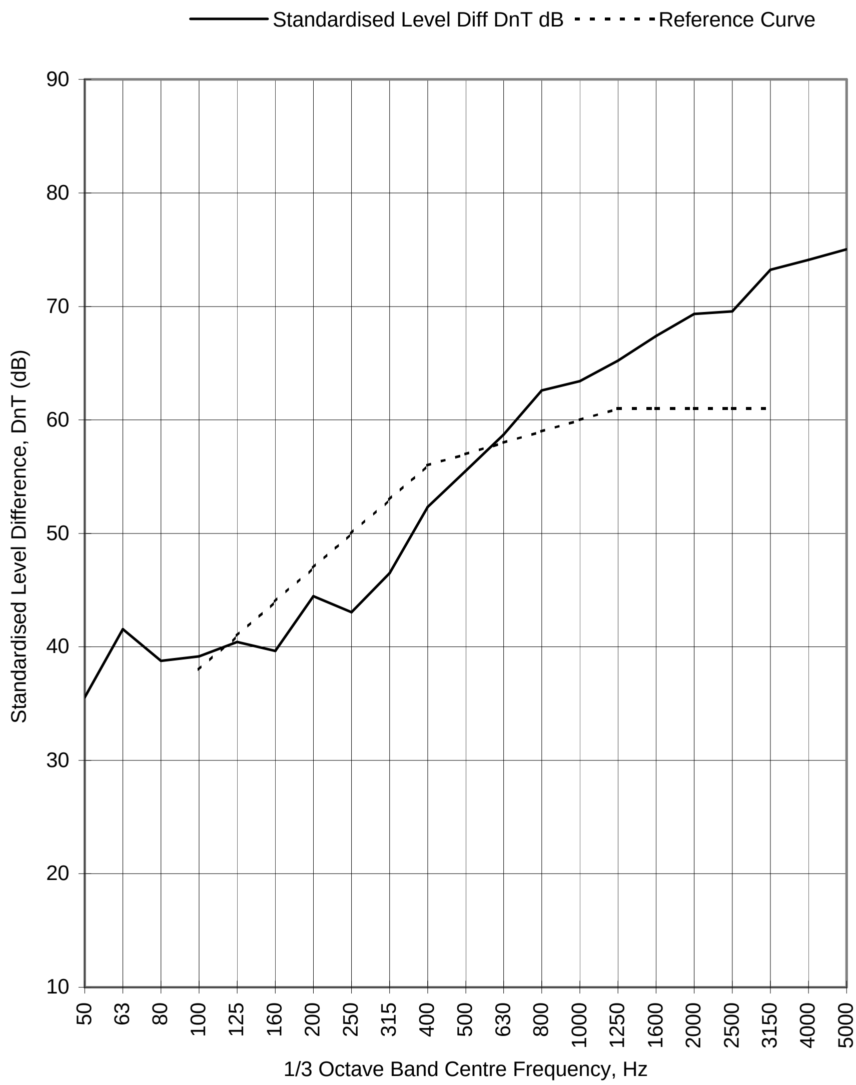
Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

Project No:	P0818	Date of Test:	15-Jul-05
Client:	Concrete Centre Ltd	Transmission Path:	Flat 2 Kitchen to Flat 1 Kitchen
Location:	'Bron Derw', 115 Llandudno Rd, Colwyn Bay	Building Element:	Party Wall
Description:	2 no. leaves of 100mm thick dense concrete block separated by a 40mm cavity. One face of the wall was lined with a single layer of plasterboard on adhesive dabs. An independent lining was applied to the other face of the wall comprising a single layer of 12.5mm thick plasterboard supported by 48mm metal C-studs. 52mm E-Cousti quilt placed between the studs		

1/3 Octave Band Centre Frequency Hz	Standardised Level Diff D_{nT} dB
50	≥ 35.5
63	41.6
80	38.8
100	39.1
125	40.4
160	39.6
200	44.5
250	43.0
315	46.5
400	52.3
500	55.5
630	58.7
800	62.6
1000	63.4
1250	65.2
1600	67.4
2000	69.3
2500	69.6
3150	73.2
4000	≥ 74.1
5000	≥ 75.0



$D_{nT,w}$ = 57 dB

Rating according to BS EN ISO 717-1

$D_{nT,w}$ (C;C_{tr}) = 57 (-2 ; -6) dB	**$C_{50-3150}$ =**	**-2**	**dB**	**$C_{50-5000}$ =**	**-1**	**dB**	**$C_{100-5000}$ =**	**-1**	**dB**
	$C_{tr, 50-3150}$ =	**-7**	**dB**	**$C_{tr, 50-5000}$ =**	**-7**	**dB**	**$C_{tr\ 100-5000}$ =**	**-6**	**dB**

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