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Concrete Centre Limited

The Frame Residential Development, Sport City, Manchester

P0818-REP01-IE

Sound Insulation Test Report

2 August 2005

| | |
|---|---|
| PROJECT: | The Frame Residential Development, Sportcity, Manchester |
| CLIENT: | Concrete Centre Limited<br>Riverside House<br>4 Meadows Business Park<br>Station Approach<br>Camberley<br>Surrey<br>GU17 9AB |
| DOCUMENT REFERENCE: | P0818-REP01-IE |
| SIGNED: | ______________________<br>IAN ETCHELLS |
| CHECKED: | ______________________<br>SIMON WEBSTER |
| DATE: | 2 August 2005 |

**CONTENTS**

## 1.0 INTRODUCTION

Sol Acoustics has been commissioned by The Concrete Centre to measure the airborne and impact sound insulation between dwellings at The Frame Residential Development, Sportcity, Manchester 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 The Frame, development:

**Separating Floors – Impact Sound Insulation Tests**

1. Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge
2. Apartment 12 bedroom 1 to Apartment 5 bedroom 1

**Separating Floors – Airborne Sound Insulation Tests**

1. Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge
2. Apartment 12 bedroom 1 to Apartment 5 bedroom 1

**Separating Walls – Airborne Sound Insulation Tests**

1. Apartment 9 kitchen/lounge to Apartment 8 bedroom 2
2. Apartment 12 bedroom 1 to Apartment 11 bedroom 2

## 4.0 DESCRIPTION OF TESTED CONSTRUCTIONS

Separating walls are understood to be as follows:

- 150mm thick pre-cast reinforced concrete panel
- One face of the wall lined with a single layer of 12.5mm plasterboard (8.5kg/$m^2$) on 38mm x 25mm battens
- Drylining applied to the other face of the wall comprising 2 layers of 12.5 mm thick plasterboard (8.5kg/$m^2$) supported by Gyproc channel system with 70mm Isowool in cavity.

Separating floors are understood to be as follows:

- 200mm thick hollow-core pre-cast concrete slab
- 65mm (nominal) Isocrete Gyvlon screed laid on Regupol E48 resilient layer. Resilient layer returned around perimeter of screed.
- Suspended ceiling comprising 12.5mm thick plasterboard (8.5kg/$m^2$) using Casoline MF metal channel support system.

Figure 2 illustrates the separating wall and floor constructions between adjacent dwellings.

External flanking walls are understood to have comprised:

- 150mm thick pre-cast reinforced concrete panel lined with 12.5mm plasterboard (8.5kg/$m^2$) on Gyproc channel system.
- Combination of external timber and metal rain screen cladding systems.

## 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? |
|---|---|---|---|
| Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge | 49dB $L'_{nT,w}$ | ≤ 62dB $L'_{nT,w}$ | Pass |
| Apartment 12 bedroom 1 to Apartment 5 bedroom 1 | 50dB $L'_{nT,w}$ | ≤ 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? |
|---|---|---|---|
| Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge | 50dB $D_{nT,w} + C_{tr}$ | ≥ 45dB $D_{nT,w} + C_{tr}$ | Pass |
| Apartment 12 bedroom 1 to Apartment 5 bedroom 1 | 54dB $D_{nT,w} + C_{tr}$ | ≥ 45dB $D_{nT,w} + C_{tr}$ | Pass |

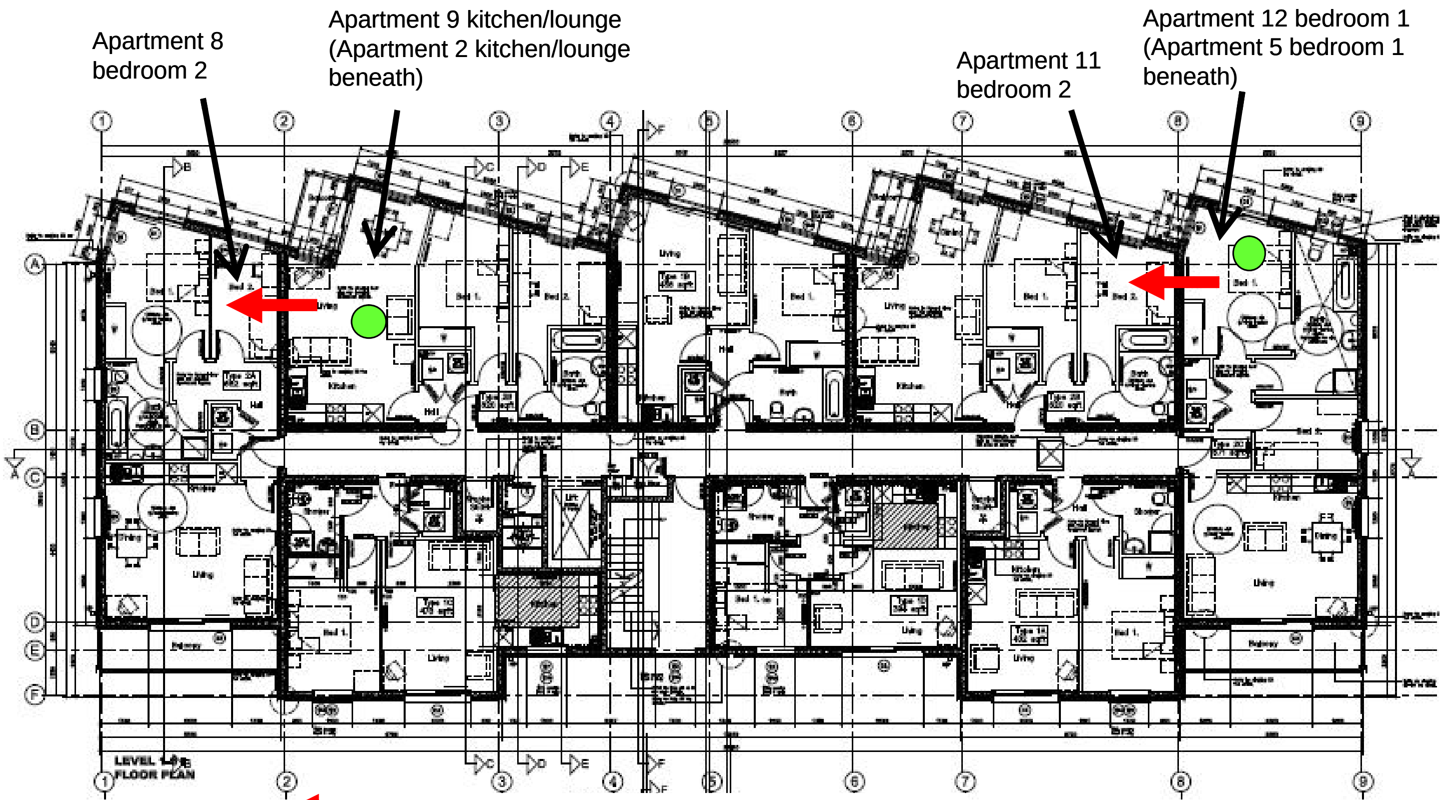
**Table 3:** Separating Floor Airborne Sound Insulation Tests Results Compared With The Performance Requirements Cited by Building Regulations 2000 Approved Document E

| Test Description | Test Result | Performance Standard cited by Building Regulations 2000 Approved Document E | Pass or Fail? |
|---|---|---|---|
| Apartment 9 kitchen/lounge to Apartment 8 bedroom 2 | 51dB $D_{nT,w} + C_{tr}$ | ≥ 45dB $D_{nT,w} + C_{tr}$ | Pass |
| Apartment 12 bedroom 1 to Apartment 11 bedroom 2 | 56dB $D_{nT,w} + C_{tr}$ | ≥ 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 have been achieved.




Indicates airborne sound insulation test on party wall

Indicates airborne and impact sound insulation tests on party floor

**Figure 1:** First floor layout of The Frame showing location of tested walls and floors

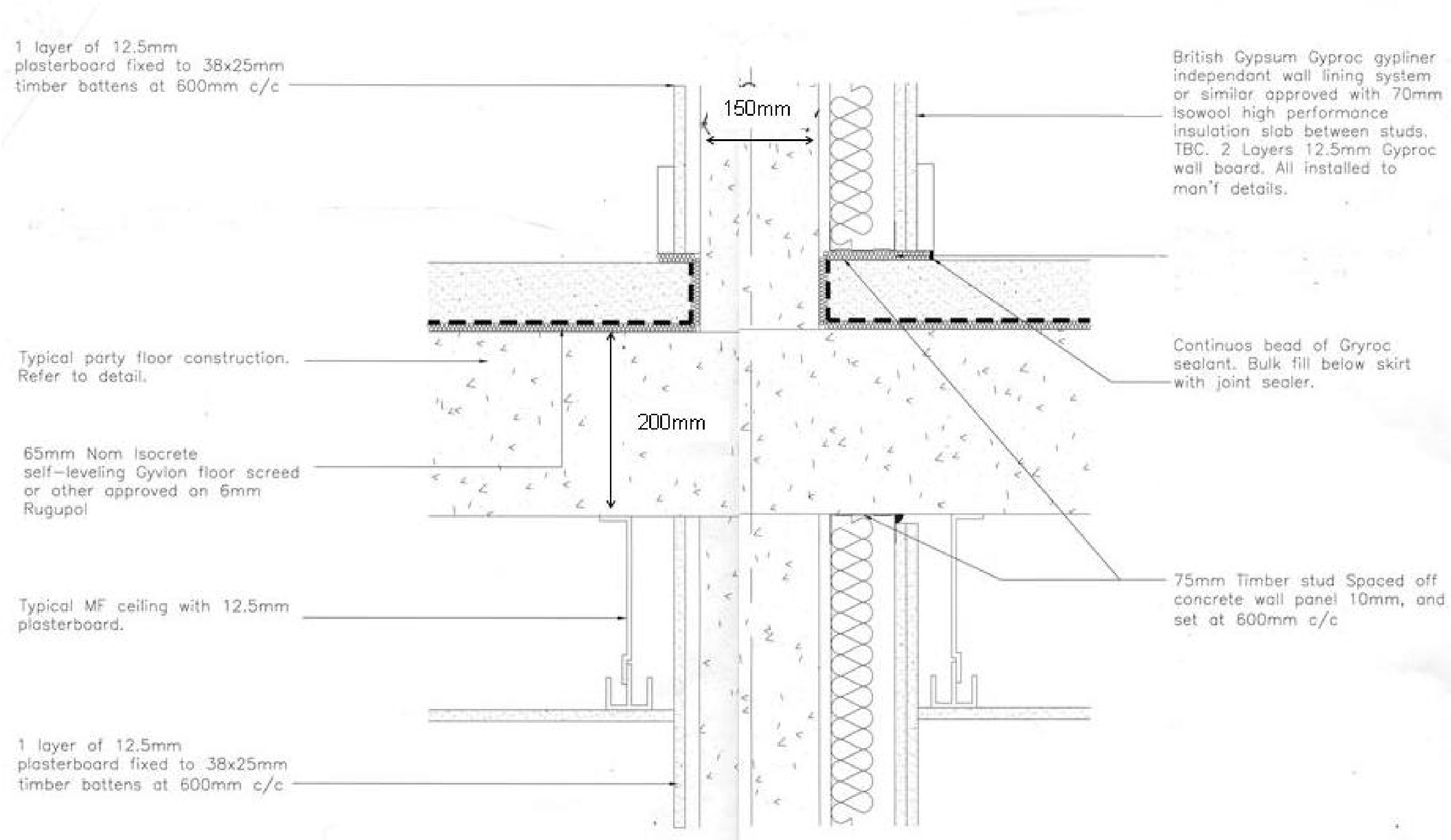



**Figure 2:** Separating wall and floor constructions between adjacent dwellings at The Frame, Sportcity, Manchester

(detail courtesy of Countryside Properties Limited)

## 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

The Frame Residential Development, Sportcity, Manchester

### DATES OF TESTS

20 July 2005

### PERSONNEL PRESENT DURING MEASUREMENTS

Ian Etchells - Sol Acoustics
Simon Webster - 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 $2 \times 10^{-5}$ 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 floor's 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

| | |
|---|---|
| Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge | 49dB $L'_{nT,w}$ |
| Apartment 12 bedroom 1 to Apartment 5 bedroom 1 | 50dB $L'_{nT,w}$ |

### Separating Floor Airborne Sound Insulation Test Results

| | |
|---|---|
| Apartment 9 kitchen/lounge to Apartment 2 kitchen/lounge | 50dB $D_{nT,w} + C_{tr}$ |
| Apartment 12 bedroom 1 to Apartment 5 bedroom 1 | 54dB $D_{nT,w} + C_{tr}$ |

### Separating Wall Airborne Sound Insulation Test Results

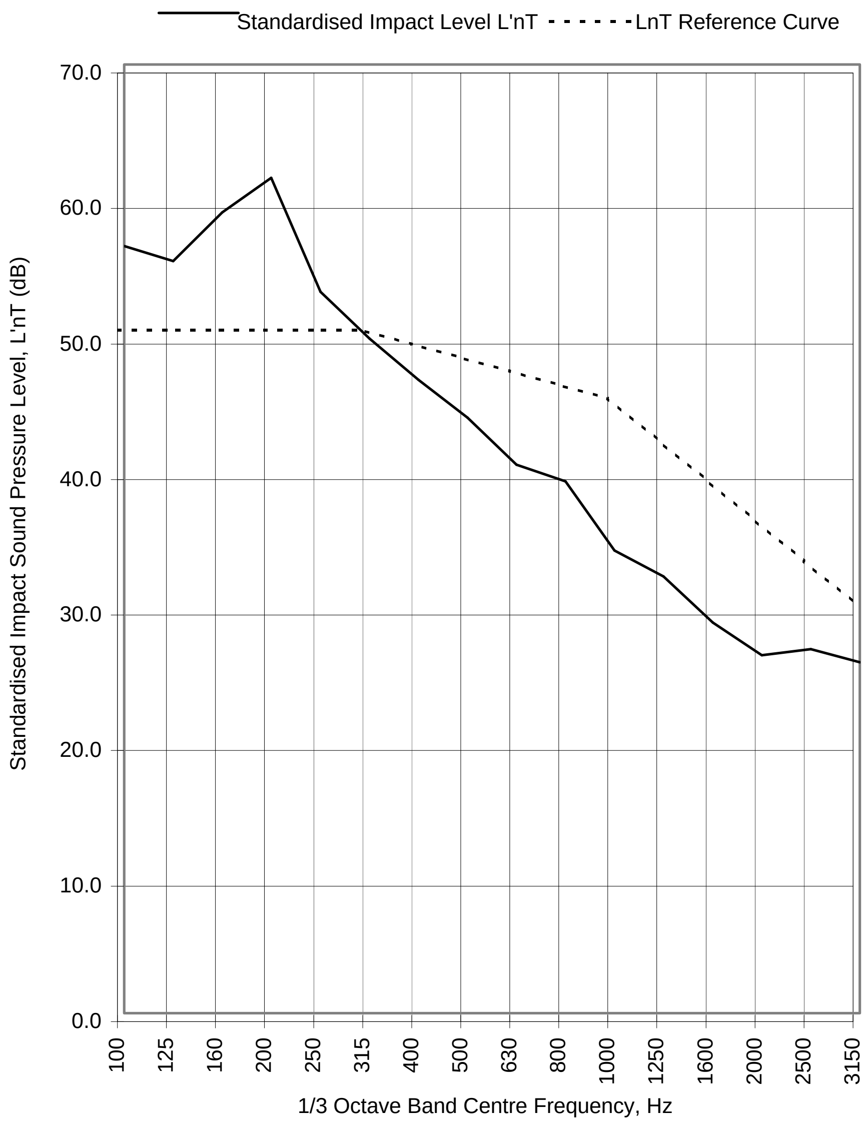
| | |
|---|---|
| Apartment 9 kitchen/lounge to Apartment 8 bedroom 2 | 51dB $D_{nT,w} + C_{tr}$ |
| Apartment 12 bedroom 1 to Apartment 11 bedroom 2 | 56dB $D_{nT,w} + C_{tr}$ |

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

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Cente | Transmission Path: | Apartment 9 Kitchen - lounge to Apartment 2 kitchen - lounge |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Floor |
| Description: | 200mm pre-cast hollow-core concrete slab with 65mm Gyvlon screed lying on Regupol E48 resilient layer. MF ceiling comprising single layer of 12.5mm plasterboard | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Impact Level L'nT dB |
|---|---|
| 100 | 56.6 |
| 125 | 55.5 |
| 160 | 59.1 |
| 200 | 61.6 |
| 250 | 53.2 |
| 315 | 49.8 |
| 400 | 46.7 |
| 500 | 43.9 |
| 630 | 40.5 |
| 800 | 39.2 |
| 1000 | 34.1 |
| 1250 | 32.2 |
| 1600 | 28.8 |
| 2000 | 26.4 |
| 2500 | 26.9 |
| 3150 | 25.9 |

**$L'_{nTw}$ = 49 dB**




Rating according to BS EN ISO 717-2

**$L'_{nT,w}$ ($C_1$) = 49 ( 1 ) dB**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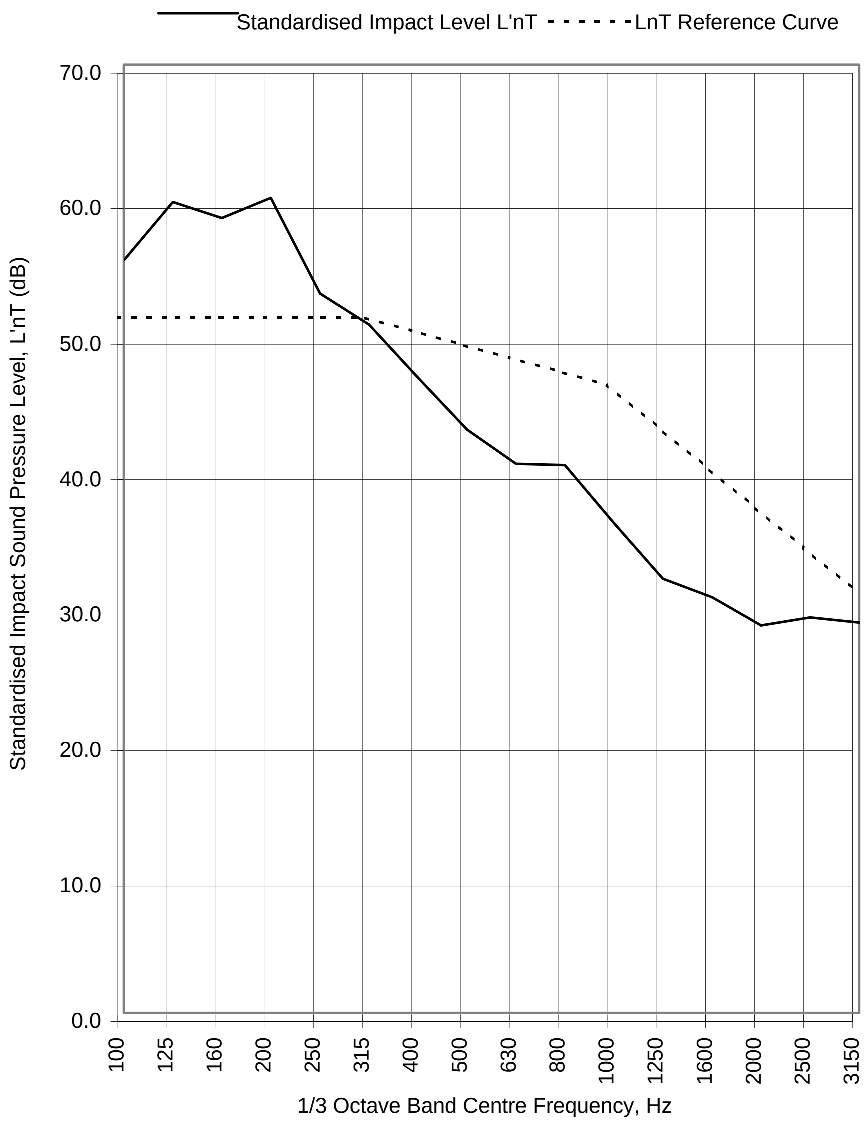
**Calculation of Weighted Standardised Impact Level ($L'_{nT,w}$)**
**to BS EN ISO 717-2**

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Cente | Transmission Path: | Apartment 12 Bedroom 1 to Apartment 5 Bedroom 1 |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Floor |
| Description: | 200mm pre-cast hollow-core concrete slab with 65mm Gyvlon screed lying on Regupol E48 resilient layer. MF ceiling comprising single layer of 12.5mm plasterboard | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Impact Level L'nT dB |
|---|---|
| 100 | 55.6 |
| 125 | 59.9 |
| 160 | 58.7 |
| 200 | 60.2 |
| 250 | 53.1 |
| 315 | 50.8 |
| 400 | 46.9 |
| 500 | 43.1 |
| 630 | 40.5 |
| 800 | 40.4 |
| 1000 | 36.2 |
| 1250 | 32.1 |
| 1600 | 30.7 |
| 2000 | 28.6 |
| 2500 | 29.2 |
| 3150 | 28.8 |

**$L'_{nTw}$ = 50 dB**




Rating according to BS EN ISO 717-2

**$L'_{nT,w}$ ($C_I$) = 50 ( 0 ) dB**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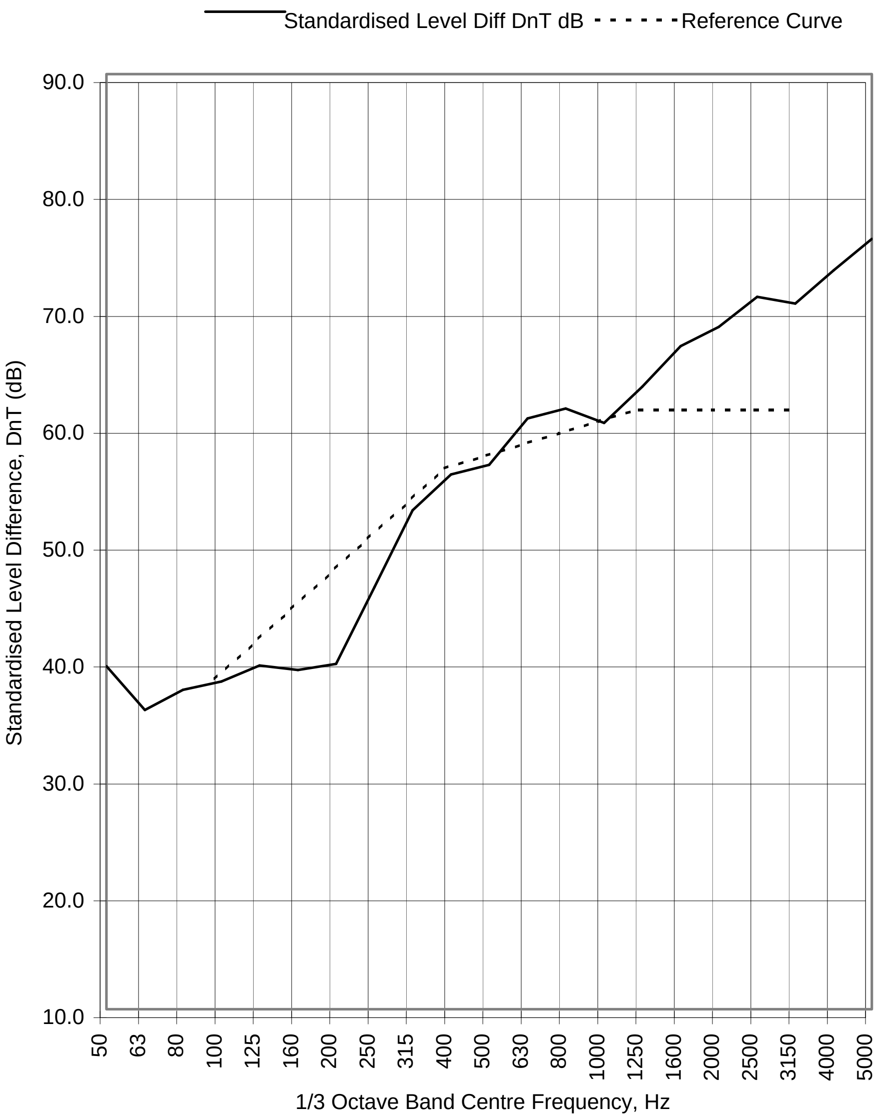
**Calculation of Weighted Standardised Level Difference ($D_{nT,w}$)**
**to BS EN ISO 717-1**

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Centre | Transmission Path: | Apartment 9 kitchen - lounge to apartment 2 kitchen lounge |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Floor |
| Description: | 200mm pre-cast hollow-core concrete slab with 65mm Gyvlon screed lying on Regupol E48 resilient layer. MF ceiling comprising single layer of 12.5mm plasterboard | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Level Diff $D_{nT}$ dB |
|---|---|
| 50 | 39.4 |
| 63 | 35.6 |
| 80 | 37.3 |
| 100 | 38.0 |
| 125 | 39.4 |
| 160 | 39.0 |
| 200 | 39.5 |
| 250 | 46.1 |
| 315 | 52.7 |
| 400 | 55.7 |
| 500 | 56.6 |
| 630 | 60.6 |
| 800 | 61.4 |
| 1000 | 60.1 |
| 1250 | 63.3 |
| 1600 | 66.7 |
| 2000 | ≥ 68.4 |
| 2500 | ≥ 71.0 |
| 3150 | ≥ 70.4 |
| 4000 | ≥ 73.2 |
| 5000 | ≥ 75.9 |




**$D_{nT,w}$ ³ 58 dB**

Rating according to BS EN ISO 717-1

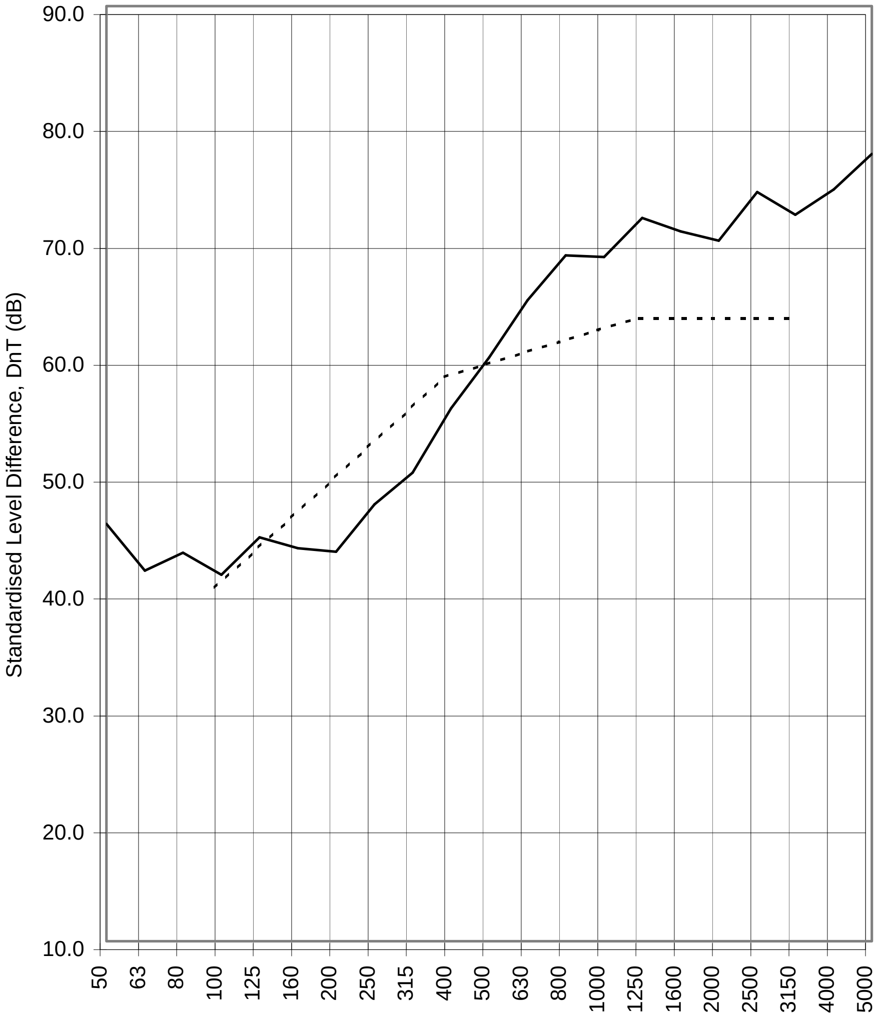
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **$D_{nT,w}$ ($C$;$C_{tr}$) = 58 ( -3 ; -8 ) dB** | **$C_{50-3150}$ =** | **-3** | **dB** | **$C_{50-5000}$ =** | **-2** | **dB** | **$C_{100-5000}$ =** | **-2 dB** |
| | **$C_{tr, 50-3150}$ =** | **-9** | **dB** | **$C_{tr, 50-5000}$ =** | **-9** | **dB** | **$C_{tr\ 100-5000}$ =** | **-8 dB** |

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

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Centre | Transmission Path: | Apartment 12 Bedroom 1 to Apartment 5, Bedroom 1 |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Floor |
| Description: | 200mm pre-cast hollow-core concrete slab with 65mm Gyvlon screed lying on Regupol E48 resilient layer. MF ceiling comprising single layer of 12.5mm plasterboard | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Level Diff $D_{nT}$ dB |
|---|---|
| 50 | 45.7 |
| 63 | 41.7 |
| 80 | 43.2 |
| 100 | 41.3 |
| 125 | 44.5 |
| 160 | 43.6 |
| 200 | 43.3 |
| 250 | 47.4 |
| 315 | 50.1 |
| 400 | 55.6 |
| 500 | 59.9 |
| 630 | 64.8 |
| 800 | 68.7 |
| 1000 | ≥ 68.5 |
| 1250 | ≥ 71.9 |
| 1600 | ≥ 70.7 |
| 2000 | ≥ 69.9 |
| 2500 | ≥ 74.1 |
| 3150 | ≥ 72.2 |
| 4000 | ≥ 74.3 |
| 5000 | ≥ 77.4 |

**$D_{nT,w}$ 3 60 dB**




Rating according to BS EN ISO 717-1

**$D_{nT,w}$ ($C$;$C_{tr}$) = 60 ( -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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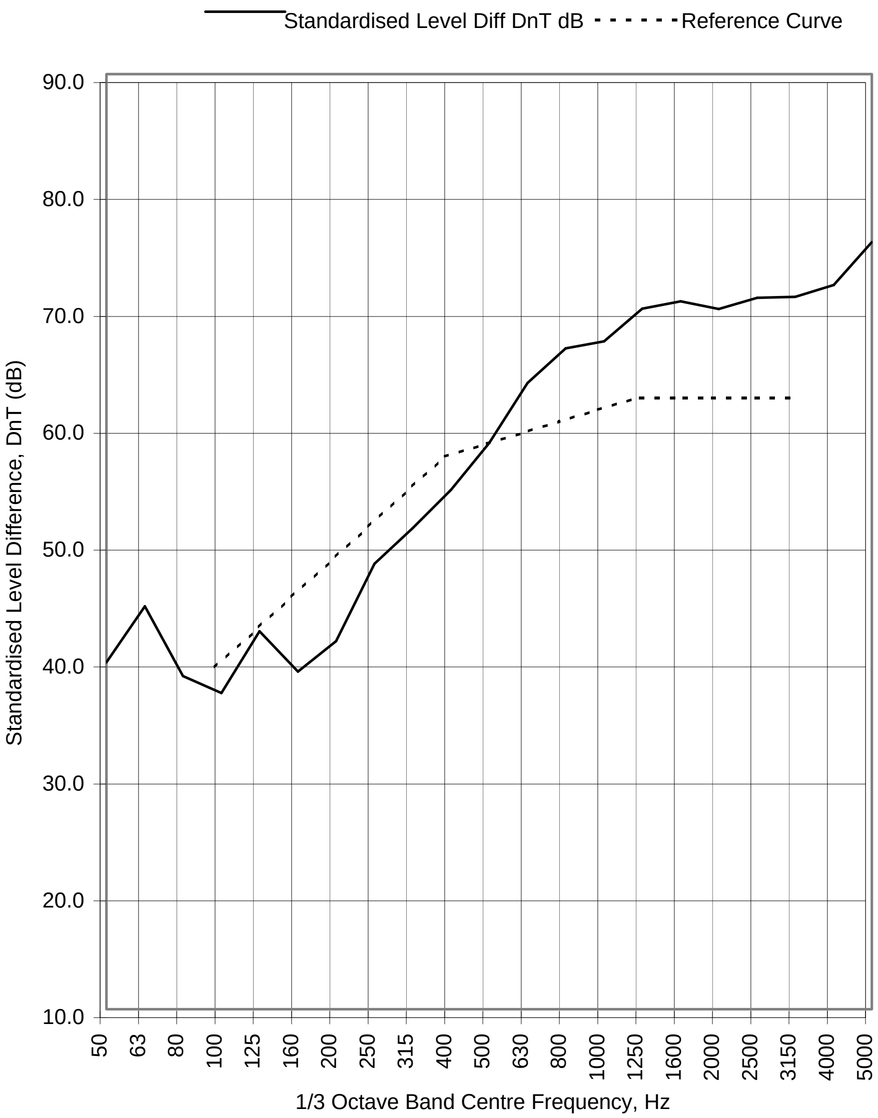
## Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Centre | Transmission Path: | Apartment 9 Kitchen/lounge to Apartment 8, Bedroom 2 |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Wall |
| Description: | 150mm precast concrete panel lined on one side with 12.5mm plasterboard on 38x25mm battens and on other side by two layers of 12.5mm plasterboard on Gypliner system with 70mm Isowool insulation in cavity. | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Level Diff $D_{nT}$ dB |
|---|---|
| 50 | 39.7 |
| 63 | 44.5 |
| 80 | 38.5 |
| 100 | 37.0 |
| 125 | 42.3 |
| 160 | 38.9 |
| 200 | 41.5 |
| 250 | 48.1 |
| 315 | 51.2 |
| 400 | 54.4 |
| 500 | ≥ 58.4 |
| 630 | ≥ 63.6 |
| 800 | ≥ 66.5 |
| 1000 | ≥ 67.1 |
| 1250 | ≥ 69.9 |
| 1600 | ≥ 70.6 |
| 2000 | ≥ 69.9 |
| 2500 | ≥ 70.9 |
| 3150 | ≥ 70.9 |
| 4000 | ≥ 72.0 |
| 5000 | ≥ 75.6 |




**$D_{nT,w}$ 3 59 dB**

Rating according to BS EN ISO 717-1

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **$D_{nT,w}$ ($C$;$C_{tr}$) = 59 ( -3 ; -8 ) dB** | **$C_{50\text{-}3150}$ =** | **-3** | **dB** | **$C_{50\text{-}5000}$ =** | **-2** | **dB** | **$C_{100\text{-}5000}$ =** | **-2** | **dB** |
| | **$C_{tr,\ 50\text{-}3150}$ =** | **-9** | **dB** | **$C_{tr,\ 50\text{-}5000}$ =** | **-9** | **dB** | **$C_{tr\ 100\text{-}5000}$ =** | **-8** | **dB** |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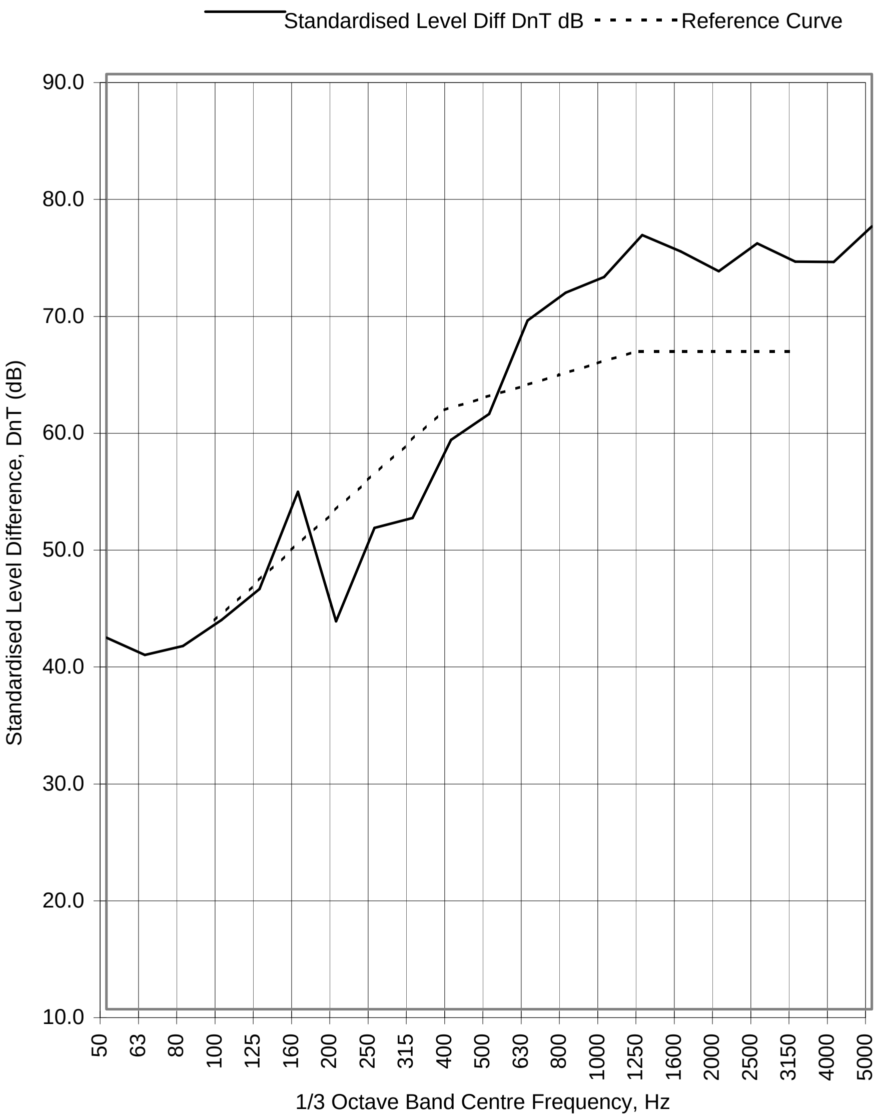
## Calculation of Weighted Standardised Level Difference ($D_{nT,w}$) to BS EN ISO 717-1

| | | | |
|---|---|---|---|
| Project No: | P0818 | Date of Test: | 20-Jul-05 |
| Client: | The Concrete Centre | Transmission Path: | Apartment 12 Bedroom 1 to Apartment 11, Bedroom 2 |
| Location: | The Frame, Sportcity, Manchester | Building Element: | Party Wall |
| Description: | 150mm precast concrete panel lined on one side with 12.5mm plasterboard on 38x25mm battens and on other side by two layers of 12.5mm plasterboard on Gypliner system with 70mm Isowool insulation in cavity. | | |

| 1/3 Octave Band Centre Frequency Hz | Standardised Level Diff $D_{nT}$ dB |
|---|---|
| 50 | 41.8 |
| 63 | 40.3 |
| 80 | 41.1 |
| 100 | 43.3 |
| 125 | 45.9 |
| 160 | 54.3 |
| 200 | 43.2 |
| 250 | 51.2 |
| 315 | 52.0 |
| 400 | 58.7 |
| 500 | 60.9 |
| 630 | 68.9 |
| 800 | ≥ 71.3 |
| 1000 | ≥ 72.6 |
| 1250 | ≥ 76.2 |
| 1600 | ≥ 74.8 |
| 2000 | ≥ 73.1 |
| 2500 | ≥ 75.5 |
| 3150 | ≥ 74.0 |
| 4000 | 73.9 |
| 5000 | ≥ 77.0 |

**$D_{nT,w}$ 3 63 dB**




Rating according to BS EN ISO 717-1

**$D_{nT,w}$ ($C$;$C_{tr}$) = 63 ( -2 ; -7 ) 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 | $C_{tr\ 100-5000}$ = | -7 | dB |

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