

# Acoustic Consultancy Report

90897/3/1/6

Acoustic Break-In Report

## Report Prepared For

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576 Oxford Road  
04 December 2018

## Report Author

A handwritten signature in black ink, appearing to read 'S. Shapley', with a long horizontal stroke extending to the left.

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## i) Executive Summary

A residential redevelopment is proposed at 576 Oxford Road, Reading.

A noise survey has been undertaken and the data assessed against Local Authority criteria to determine the sites suitability to accommodate the residential development.

The building envelope has been reviewed in order to assess its sound reduction performance in terms of internal noise level requirements set out in BS8233:2014.

This report concludes that:

With the building elements specified within this report, internal ambient noise levels can achieve the BS8233 design criteria.

## ii) Document History

| Issue | Date                          | Issue Details             | Issued By | Checked By |
|-------|-------------------------------|---------------------------|-----------|------------|
| 1     | 17 <sup>th</sup> October 2018 | Initial Issue             | SS        | MB         |
| 2     | 4 <sup>th</sup> December 2018 | Updated building elements | SS        | MB         |

## 1 Introduction

A residential redevelopment is proposed at 576 Oxford Street, Reading.

A noise survey has been undertaken and the data assessed against Local Authority criteria to determine the sites suitability to accommodate the residential development.

The building envelope has been reviewed in order to assess its sound reduction performance in terms of internal noise level requirements set out in BS8233:2014.

## 2 Noise Monitoring

### 2.1 Site Description

The site layout and measurement position are shown in Appendix A.

Photographs are shown in Appendix B.

### 2.2 Measurements

The noise monitoring took place from the 1<sup>st</sup> to 2<sup>nd</sup> October 2018. The predominant noise source was road traffic noise.

The measurement periods were considered sufficient to establish the highest noise levels at the site.

The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

| Weather            | Value |
|--------------------|-------|
| Average Wind Speed | 2m/s  |
| Wind Direction     | W     |
| Cloud Cover        | 50%   |
| Max. Temperature   | 19°C  |
| Min. Temperature   | 9°C   |
| Precipitation      | None  |

### 2.3 Survey Results

#### 2.3.1 Average $L_{Aeq}$

The average noise levels during the day and night time period are shown in the following table. Measurement data can be found in Appendix C. Values are façade levels.

Table 2: Averaged measured noise levels, dB re 2x10<sup>-5</sup> Pa

| Description                             | Indices               | Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |    | dB(A) |
|-----------------------------------------|-----------------------|-----------------------------------|-----|-----|-----|----|----|----|----|-------|
|                                         |                       | 63                                | 125 | 250 | 500 | 1k | 2k | 4k | 8k |       |
| Average day time sound pressure level   | L <sub>Aeq,16hr</sub> | 76                                | 73  | 69  | 65  | 69 | 67 | 55 | 45 | 73    |
| Average night time sound pressure level | L <sub>Aeq,8hr</sub>  | 70                                | 67  | 63  | 60  | 62 | 59 | 49 | 39 | 66    |

### 2.3.2 L<sub>AFMax</sub>

Table 3: Fifteenth Highest L<sub>AFMax</sub> at night, dB re 2x10<sup>-5</sup> Pa

| Description                                       | Indices            | dB(A) |
|---------------------------------------------------|--------------------|-------|
| MP1 - 15 <sup>th</sup> highest night time maximum | L <sub>AFMax</sub> | 82    |

## 3 Indoor ambient design criterion

### 3.1 Local Authority Criteria

Reading Borough Council has stated the following:

*“No development shall take place until a detailed scheme, informed by an assessment of the current noise environment, for protecting the dwellings from the external noise environment of the area has been submitted to and approved, in writing, by the Local Planning Authority.*

*The scheme itself shall be designed, specified and constructed so that the sound insulation performance of the structure and the layout of the dwellings are such that the indoor ambient noise levels do not exceed the values detailed in Table 4 of BS 8233:2014. Where opening windows will lead to an internal noise level increase of 5 dBA or greater above BS 8233:2014 recommended internal levels, the scheme shall include provision of alternative mechanical ventilation with minimum performance equivalent to a mechanical heat recovery (MVHR) system with cool air bypass as an alternative means of cooling and ventilation.*

*Noise from the system should not result in BS8233 internal levels being exceeded. Thereafter, the development shall not be carried out other than in accordance with the approved scheme which shall be completed before any part of the accommodation hereby approved is occupied, unless the Local Planning Authority otherwise agrees in writing.*

*Reason: to protect the amenity of future occupants of the proposed development and to comply with Policies CS34 (Pollution and Water Resources) and DM4 (Safeguarding Amenity).”*

### 3.2 BS8233:2014

Guidance is provided in BS8233:2014, this is shown in the following table:

Table 4: BS8233 Indoor ambient noise levels for dwellings, dB L<sub>Aeq,T</sub>

| Activity                   | Location         | Time period                  |                             |
|----------------------------|------------------|------------------------------|-----------------------------|
|                            |                  | 07:00 to 23:00               | 23:00 to 07:00              |
| Resting                    | Living Room      | 35 L <sub>Aeq,16 hour</sub>  | -                           |
| Dining                     | Dining Room/area | 40 L <sub>Aeq, 16 hour</sub> | -                           |
| Sleeping (daytime resting) | Bedroom          | 35 L <sub>Aeq, 16 hour</sub> | 30 L <sub>Aeq, 8 hour</sub> |

The levels provided in the above table assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern an appropriate alternative period may be used.

The measured levels are considered to follow normal diurnal fluctuations.

If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

### 3.3 World Health Organisation (WHO) Guidelines for Community Noise (1999)

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 5: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

| Specific Environment                                          | $L_{Aeq, T}$ dB | Time Base (hours) | $L_{Amax, fast}$ dB |
|---------------------------------------------------------------|-----------------|-------------------|---------------------|
| Outdoor living area (serious annoyance, daytime and evening)  | 55              | 16                | -                   |
| Outdoor living area (moderate annoyance, daytime and evening) | 50              | 16                | -                   |
| Dwelling, indoors                                             | 35              | 16                | -                   |
| Inside bedrooms                                               | 30              | 8                 | 45                  |
| Outside bedrooms                                              | 45              | 8                 | 60                  |

A secondary criterion of 45dB  $L_{Amax}$  is also considered in relation noise. WHO only considers it appropriate to provide a criterion for the internal  $L_{Amax}$  level during the night-time period as it is a useful parameter to assess sleep disturbance. It is recommended that internal noise levels should not exceed 45dB  $L_{Amax}$  during the night and the document states that:

***'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB  $L_{Amax}$  more than 10 – 15 times per night'***

### 3.4 Recommended Design Rating Level

On the basis of the above the recommended residential and commercial design rating level should therefore be:

Table 6: Internal ambient noise criteria, dB  $L_{Aeq, T}$

| Location          | BS8233 Design      |                   |
|-------------------|--------------------|-------------------|
|                   | 07:00 – 23:00      | 23:00 – 07:00     |
| Residential Areas | 35 $L_{Aeq, 16hr}$ | 30 $L_{Aeq, 8hr}$ |

## 4 Internal Ambient Noise Assessment

### 4.1 Façade noise Break-In

The assessment outlined within this section uses the assumed glazing and construction detail performance shown below. The building elements used in the following table can be found in Appendix D.

Table 7: Sound Reduction Index data used, dB

| Description                                                                                                                       | Octave Band Centre Frequency (Hz) |     |     |     |    |    |    | Rw<br>(D <sub>new</sub> ) | Rw+Ctr<br>(D <sub>new</sub> ) |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----|-----|-----|----|----|----|---------------------------|-------------------------------|
|                                                                                                                                   | 63                                | 125 | 250 | 500 | 1k | 2k | 4k |                           |                               |
| Wall Construction: 100mm Brick / timber stud with resilient bar filled with 60mm fibreglass / 10mm plaster board / 12.5 wallboard | 25                                | 40  | 45  | 46  | 53 | 60 | 66 | 52                        | 49                            |
| Roof Construction: Roofing tiles / timber joists with resilient bar / 2x 12.5mm SoundBloc                                         | 34                                | 46  | 54  | 60  | 65 | 62 | 67 | 63                        | 58                            |
| Second Floor Glazing (6 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™)                                                           | 28                                | 25  | 27  | 38  | 48 | 47 | 55 | 41                        | 35                            |
| First Floor Glazing (10 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™)                                                           | 31                                | 28  | 31  | 42  | 45 | 50 | 58 | 44                        | 38                            |
| Vent – based on typical vent achieving a D <sub>new</sub> 50dB                                                                    | 25                                | 33  | 40  | 45  | 56 | 67 | 75 | 50<br>(D <sub>new</sub> ) | 45<br>(D <sub>new</sub> )     |

## 4.2 Calculated Internal Ambient Noise Levels

The predicted internal ambient noise levels are shown in the table below. Calculations use the building elements shown in the table above and Appendix D.

Table 8: Predicted indoor ambient noise levels, dB L<sub>Aeq, T</sub>

| Location                      | Predicted Noise Level     |                    | BS8233 Design             |                          |                    |
|-------------------------------|---------------------------|--------------------|---------------------------|--------------------------|--------------------|
|                               | L <sub>Aeq, T</sub>       | L <sub>AFmax</sub> | 07:00 – 23:00             | 23:00 – 07:00            | L <sub>AFmax</sub> |
| 2 <sup>nd</sup> Floor Bedroom | 35 L <sub>Aeq, 16hr</sub> | -                  | 35 L <sub>Aeq, 16hr</sub> | -                        | -                  |
|                               | 29 L <sub>Aeq, 8hr</sub>  | 44                 | -                         | 30 L <sub>Aeq, 8hr</sub> | 45                 |
| 1 <sup>st</sup> Floor Bedroom | 35 L <sub>Aeq, 16hr</sub> | -                  | 35 L <sub>Aeq, 16hr</sub> | -                        | -                  |
|                               | 29 L <sub>Aeq, 8hr</sub>  | 44                 | -                         | 30 L <sub>Aeq, 8hr</sub> | 45                 |

## 5 Conclusion

A noise survey has been undertaken and the data assessed against Local Authority criteria to determine the sites suitability to accommodate the development.

This report concludes that:

With the building elements specified within this report, internal ambient noise levels can achieve the BS8233 design criteria.

## Appendix A: Site Plan

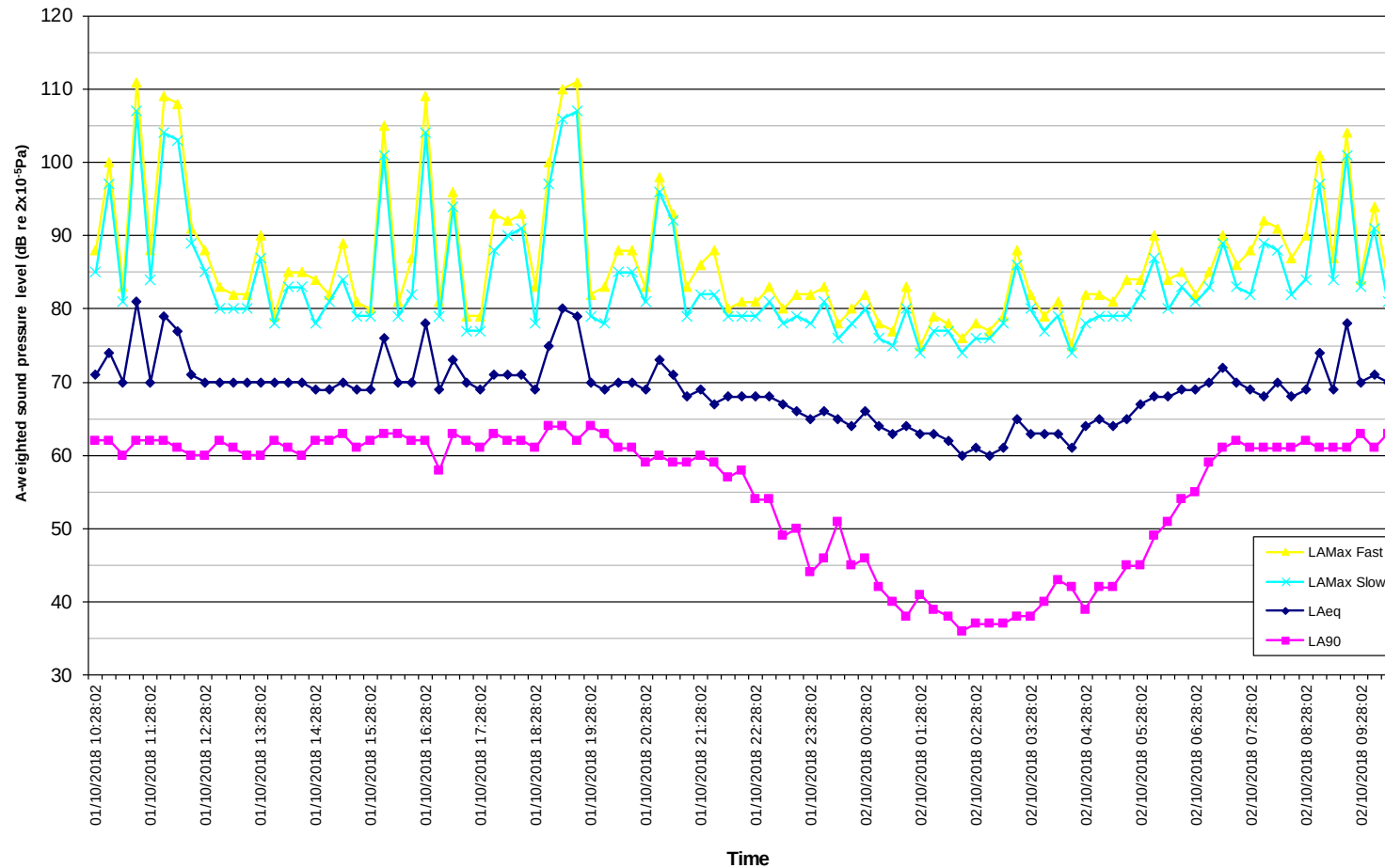


## Appendix B: Photographs



Measurement Position

## Appendix C: Measurement Data



Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 86548

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890, complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

## Appendix D: Construction Specifications

Glazing:

### Sound insulation data for Pilkington Optiphon™

| Glass                                                                                      | Sound reduction index (dB)       |     |     |      |      |      |                                      |                |                    |                                  |
|--------------------------------------------------------------------------------------------|----------------------------------|-----|-----|------|------|------|--------------------------------------|----------------|--------------------|----------------------------------|
|                                                                                            | Octaveband Centre Frequency (Hz) |     |     |      |      |      | R <sub>w</sub> (C; C <sub>tr</sub> ) | R <sub>w</sub> | R <sub>w</sub> + C | R <sub>w</sub> + C <sub>tr</sub> |
|                                                                                            | 125                              | 250 | 500 | 1000 | 2000 | 4000 |                                      |                |                    |                                  |
| Single glazing                                                                             |                                  |     |     |      |      |      |                                      |                |                    |                                  |
| 6.8 mm Pilkington <b>Optiphon™</b>                                                         | 22                               | 26  | 31  | 37   | 40   | 40   | 36 (-1; -4)                          | 36             | 35                 | 32                               |
| 8.8 mm Pilkington <b>Optiphon™</b>                                                         | 27                               | 29  | 34  | 38   | 40   | 43   | 37 (0; -2)                           | 37             | 37                 | 35                               |
| 10.8 mm Pilkington <b>Optiphon™</b>                                                        | 26                               | 30  | 35  | 39   | 40   | 46   | 38 (-1; -3)                          | 38             | 37                 | 35                               |
| 12.8 mm Pilkington <b>Optiphon™</b>                                                        | 29                               | 32  | 36  | 41   | 42   | 51   | 40 (-1; -3)                          | 40             | 39                 | 37                               |
| 16.8 mm Pilkington <b>Optiphon™</b>                                                        | 31                               | 33  | 38  | 41   | 43   | 54   | 41 (-1; -3)                          | 41             | 40                 | 38                               |
| Insulating glass units                                                                     |                                  |     |     |      |      |      |                                      |                |                    |                                  |
| 6 mm / 16 mm argon /<br>6.8 mm Pilkington <b>Optiphon™</b>                                 | 21                               | 28  | 37  | 48   | 48   | 54   | 40 (-2; -6)                          | 40             | 38                 | 34                               |
| 6 mm / 16 mm argon /<br>8.8 mm Pilkington <b>Optiphon™</b>                                 | 25                               | 27  | 38  | 48   | 47   | 55   | 41 (-2; -6)                          | 41             | 39                 | 35                               |
| 8 mm / 16 mm argon /<br>8.8 mm Pilkington <b>Optiphon™</b>                                 | 21                               | 30  | 39  | 47   | 50   | 55   | 42 (-3; -8)                          | 42             | 39                 | 34                               |
| 10 mm / 16 mm argon /<br>8.8 mm Pilkington <b>Optiphon™</b>                                | 28                               | 31  | 42  | 45   | 50   | 58   | 44 (-2; -6)                          | 44             | 42                 | 38                               |
| 10 mm / 20 mm argon /<br>8.8 mm Pilkington <b>Optiphon™</b>                                | 28                               | 36  | 43  | 47   | 49   | 58   | 46 (-2; -6)                          | 46             | 44                 | 40                               |
| 8.8 mm Pilkington <b>Optiphon™</b> / 16 mm argon /<br>12.8 mm Pilkington <b>Optiphon™</b>  | 28                               | 36  | 45  | 53   | 56   | 64   | 48 (-2; -7)                          | 48             | 46                 | 41                               |
| 10.8 mm Pilkington <b>Optiphon™</b> / 24 mm argon /<br>16.8 mm Pilkington <b>Optiphon™</b> | 35                               | 41  | 48  | 53   | 55   | 65   | 52 (-2; -6)                          | 52             | 50                 | 46                               |
| 12.8 mm Pilkington <b>Optiphon™</b> / 20 mm argon /<br>16.8 mm Pilkington <b>Optiphon™</b> | 35                               | 45  | 49  | 50   | 54   | 65   | 51 (-1; -4)                          | 51             | 50                 | 47                               |

Measurements undertaken in accordance with BS EN ISO 10140 and  $R_w (C; C_{tr})$  determined in accordance with BS EN ISO 717-1.

For insulating glass units, there is little difference in the sound insulation for cavity widths in the range 6 to 16 mm.

To calculate performance data for Pilkington products, please use our Spectrum online calculator at <https://spectrum.pilkington.com/>

For glass combinations to achieve an  $R_w$  value higher than 52 dB, please contact us for more details.

**First Floor Windows**

**Second Floor Windows**

## Wall Construction:

### Sound Insulation Prediction (v9.0.11)

Program copyright Marshall Day Acoustics 2017  
margin of error is generally within  $R_w \pm 3$  dB  
- Key No. 0394

Job Name:

Job No.:

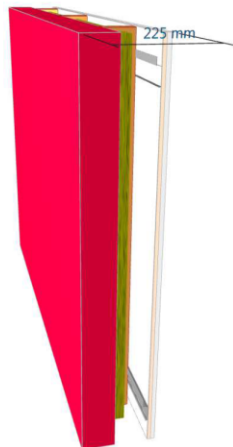
Date: 15/10/2018

File Name: Wall Construction ixl

Initials: sam.shapley



Notes:



$R_w$  56 dB  
C 0 dB  
Ctr -3 dB

Mass-air-mass resonant frequency = 44 Hz

Panel Size = 2.7 m x 4.0 m

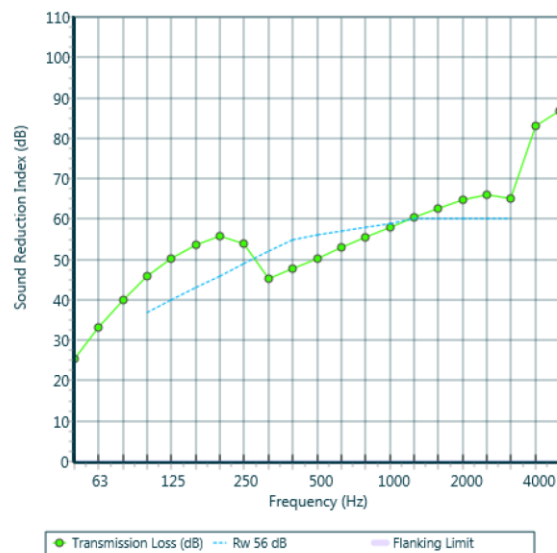
Partition surface mass = 176 kg/m<sup>2</sup>

### System description

Panel 1 : 1 x 100 mm Brick

Frame: Timber stud + Resilient rail/bar (90 mm x 45 mm); Cavity Width 102 mm; Stud spacing 600 mm; 1 x Fibreglass (10kg/m<sup>3</sup>) Thickness 60 mm  
Panel 2 : 1 x 10 mm Plasterboard + 1 x 12.5 mm Gyproc Wallboard 12.5mm

| freq.(Hz) | TL(dB) | TL(dB) |
|-----------|--------|--------|
| 50        | 25     |        |
| 63        | 33     | 29     |
| 80        | 40     |        |
| 100       | 46     |        |
| 125       | 50     | 49     |
| 160       | 54     |        |
| 200       | 56     |        |
| 250       | 54     | 49     |
| 315       | 45     |        |
| 400       | 48     |        |
| 500       | 50     | 50     |
| 630       | 53     |        |
| 800       | 55     |        |
| 1000      | 58     | 57     |
| 1250      | 60     |        |
| 1600      | 63     |        |
| 2000      | 65     | 64     |
| 2500      | 66     |        |
| 3150      | 65     |        |
| 4000      | 83     | 70     |
| 5000      | 87     |        |



## Roof Construction:

### Sound Insulation Prediction (v9.0.11)

Program copyright Marshall Day Acoustics 2017

margin of error is generally within  $R_w \pm 3$  dB

- Key No. 0394

Job Name:

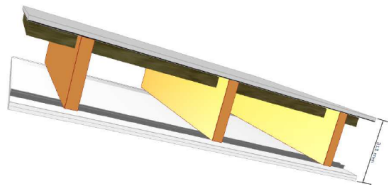
Job No.:

Date: 15/10/2018

File Name:

Initials: sam.shapley

Notes:



$R_w$  63 dB  
C -2 dB  
Ctr -5 dB

Mass-air-mass resonant frequency = 26 Hz

Panel Size = 2.7 m x 4.0 m

Partition surface mass = 61.7 kg/m<sup>2</sup>

### System description

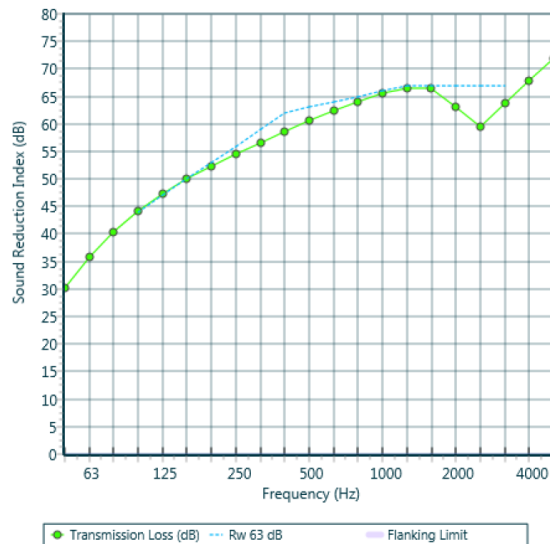
Panel 1 : 1 x 14 mm Roofing tiles

+ 1 x 4 mm Nuraply waterproof membrane

Frame: Solid Joist with resilient rail (2.5E2 mm x 45 mm); Cavity Width 268 mm, Stud spacing 600 mm, 1 x Rockwool (33kg/m<sup>3</sup>) Thickness 50 mm

Panel 2 : 2 x 12.5 mm Gyproc SoundBloc 12.5mm

| freq.(Hz) | TL(dB) | TL(dB) |
|-----------|--------|--------|
| 50        | 30     |        |
| 63        | 36     | 34     |
| 80        | 40     |        |
| 100       | 44     |        |
| 125       | 47     | 46     |
| 160       | 50     |        |
| 200       | 52     |        |
| 250       | 54     | 54     |
| 315       | 57     |        |
| 400       | 59     |        |
| 500       | 61     | 60     |
| 630       | 62     |        |
| 800       | 64     |        |
| 1000      | 66     | 65     |
| 1250      | 66     |        |
| 1600      | 66     |        |
| 2000      | 63     | 62     |
| 2500      | 60     |        |
| 3150      | 64     |        |
| 4000      | 68     | 67     |
| 5000      | 72     |        |



## Appendix E: Facade Assessment

### 2<sup>nd</sup> Floor Daytime

| Façade noise Break-in façade 1  |                      | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|---------------------------------|----------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                              | Free Field Source Lp | 76         | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity & Façade correction | -6                   | -6         | -6    | -6    | -6    | -6    | -6    | -6    | -6    | -     |
| Façade Length (m)               | 6.00                 | 35         | 35    | 35    | 35    | 35    | 35    | 35    | 35    |       |
| Façade Height (m)               | 5.80                 | 67         | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |
| Façade Area                     | 34.80                | S/V        | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |       |
| Room Length (m)                 | 5.90                 | 10log(S/V) | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  |       |
| Room Height (m)                 | 3.00                 | 11         | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                  | 3.80                 | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                          | 67.26                | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                             | 0.50                 | L2         | 76    | 73    | 69    | 64    | 68    | 66    | 54    | 44    |
| Sound Reduction                 |                      | R          | 33    | 37    | 43    | 54    | 60    | 59    | 65    | 55    |
| Flanking/Tolerance              |                      |            | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                      |                      |            | 47    | 39    | 29    | 13    | 12    | 11    | -8    | -18   |
|                                 | 31                   | NR         | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    |
|                                 |                      | Excess     | -13   | -10   | -12   | -22   | -19   | -17   | -34   | -42   |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

#### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Freq |     |     |     |      |      |      | R <sub>w</sub> |
|---------------------------------|------|----------------|--------------------------------------------------|-----|-----|-----|------|------|------|----------------|
|                                 |      |                | 63                                               | 125 | 250 | 500 | 1000 | 2000 | 4000 |                |
| Tiled Roof                      | 33.4 | m <sup>2</sup> | 34                                               | 46  | 54  | 60  | 65   | 62   | 67   | 62             |
| Glazing                         | 1.4  | m <sup>2</sup> | 24                                               | 24  | 29  | 41  | 47   | 47   | 55   | 42             |
| Composite Sound Reduction Index |      |                | 33                                               | 37  | 43  | 54  | 60   | 59   | 65   | 55             |

| Façade noise Break-in vent   |                      | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|------------------------------|----------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                           | Free Field Source Lp | 76         | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity correction       | -6                   | -6         | -6    | -6    | -6    | -6    | -6    | -6    | -6    | -     |
| Room Length (m)              | 5.90                 | Volume (V) | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |
| Room Height (m)              | 3.00                 | 10log(V)   | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  |       |
| Room Width (m)               | 3.80                 | 21         | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                       | 67.26                | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                          | 0.50                 | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction              |                      | Dne        | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 50    |
| L2 Room Lp                   |                      |            | 46    | 35    | 23    | 14    | 7     | -6    | -26   | -30   |
| L2 = L1-Dne-10logV+21+10logT |                      |            |       |       |       |       |       |       |       |       |

| Façade noise Break-in façade and vent |    | 63     | 125 | 250 | 500 | 1k  | 2k  | 4k  | 8k  | dB(A) |
|---------------------------------------|----|--------|-----|-----|-----|-----|-----|-----|-----|-------|
| L2 Room Lp façade and vent            |    | 49     | 40  | 30  | 17  | 13  | 11  | -8  | -18 | 28    |
|                                       | 25 | NR     | 55  | 44  | 35  | 29  | 25  | 22  | 20  | 18    |
|                                       |    | Excess | -6  | -4  | -5  | -13 | -12 | -11 | -27 | -35   |

| Façades  | Description  | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | dB(A) |
|----------|--------------|---------------------------------|----|-----|-----|-----|----|----|----|----|-------|
| Façade 1 | Pitched Roof |                                 | -6 | 49  | 40  | 30  | 17 | 13 | 11 | -8 | 28    |
| Façade 2 | Side wall    |                                 | -9 | 51  | 47  | 38  | 24 | 20 | 17 | -3 | 35    |
| Total    |              |                                 |    | 53  | 48  | 39  | 25 | 21 | 18 | 5  | 35    |

| Façade noise Break-in façade 2  |                      | 63              | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|---------------------------------|----------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                              | Free Field Source Lp | 76              | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity & Façade correction | -9                   | -9              | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Façade Length (m)               | 12.80                | Façade Area (S) | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       |
| Façade Height (m)               | 6.50                 | Volume (V)      | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |
| Façade Area                     | 83.20                | S/V             | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   |       |
| Room Length (m)                 | 5.90                 | 10log(S/V)      | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   |       |
| Room Height (m)                 | 3.00                 | 11              | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                  | 3.80                 | Rev time        | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                          | 67.26                | 10logT          | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                             | 0.50                 | L2              | 77    | 74    | 69    | 65    | 69    | 67    | 55    | 45    |
| Sound Reduction                 |                      | R               | 29    | 30    | 34    | 44    | 52    | 53    | 61    | 46    |
| Flanking/Tolerance              |                      |                 | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                      |                      |                 | 51    | 47    | 38    | 24    | 20    | 17    | -3    | -13   |
|                                 |                      | NR              | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    |
|                                 |                      | Excess          | -9    | -2    | -3    | -11   | -11   | -11   | -28   | -37   |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

#### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Freq |     |     |     |      |      |      | R <sub>w</sub> |
|---------------------------------|------|----------------|--------------------------------------------------|-----|-----|-----|------|------|------|----------------|
|                                 |      |                | 63                                               | 125 | 250 | 500 | 1000 | 2000 | 4000 |                |
| Wall                            | 5.0  | m <sup>2</sup> | 38                                               | 43  | 42  | 46  | 57   | 67   | 78   | 52             |
| Glazing                         | 1.8  | m <sup>2</sup> | 24                                               | 24  | 29  | 41  | 47   | 47   | 55   | 42             |
| Composite Sound Reduction Index |      |                | 29                                               | 30  | 34  | 44  | 52   | 53   | 61   | 46             |

| Façade noise Break-in vent   |                      | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|------------------------------|----------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                           | Free Field Source Lp | 76         | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity correction       | -9                   | -9         | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Room Length (m)              | 5.90                 | Volume (V) | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |
| Room Height (m)              | 3.00                 | 10log(V)   | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  |       |
| Room Width (m)               | 3.80                 | 21         | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                       | 67.26                | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                          | 0.50                 | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction              |                      | Dne        | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 50    |
| L2 Room Lp                   |                      |            | 43    | 32    | 20    | 11    | 4     | -9    | -29   | -33   |
| L2 = L1-Dne-10logV+21+10logT |                      |            |       |       |       |       |       |       |       |       |

| Façade noise Break-in façade and vent |  | 63     | 125 | 250 | 500 | 1k | 2k | 4k | 8k  | dB(A) |
|---------------------------------------|--|--------|-----|-----|-----|----|----|----|-----|-------|
| L2 Room Lp façade and vent            |  | 51     | 47  | 38  | 24  | 20 | 17 | -3 | -13 | 35    |
|                                       |  | NR     | 55  | 44  | 35  | 29 | 25 | 22 | 20  | 18    |
|                                       |  | Excess | -4  | 3   | 3   | -5 | -5 | -5 | -22 | -31   |

## 2<sup>nd</sup> Floor Night-time

| Façade noise Break-in façade 1  |       |            |       |       |       |       |       |       |          |
|---------------------------------|-------|------------|-------|-------|-------|-------|-------|-------|----------|
| L1                              |       | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k dB(A) |
| Free Field Source Lp            |       | 70         | 67    | 63    | 60    | 62    | 59    | 49    | 39       |
| Directivity & Façade correction | -6    | -6         | -6    | -6    | -6    | -6    | -6    | -6    | -        |
| Façade Length (m)               | 6.00  | 35         | 35    | 35    | 35    | 35    | 35    | 35    | 35       |
| Façade Height (m)               | 5.80  | 67         | 67    | 67    | 67    | 67    | 67    | 67    | 67       |
| Façade Area                     | 34.80 | S/V        | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5      |
| Room Length (m)                 | 5.90  | 10log(S/V) | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9     |
| Room Height (m)                 | 3.00  | 11         | 11    | 11    | 11    | 11    | 11    | 11    | 11       |
| Room Width (m)                  | 3.80  | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50     |
| Volume                          | 67.26 | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01    |
| Tmf                             | 0.50  | L2         | 70    | 67    | 63    | 59    | 61    | 58    | 48       |
| Sound Reduction                 |       | R          | 33    | 37    | 43    | 54    | 60    | 59    | 65       |
| Flanking/Tolerance              |       |            | 3     | 3     | 3     | 3     | 3     | 3     | 3        |
| L2 Room Lp                      |       | 41         | 33    | 23    | 8     | 5     | 3     | -14   | -24      |
|                                 | 25    | NR         | 55    | 44    | 35    | 29    | 25    | 22    | 20       |
|                                 |       | Excess     | -15   | -11   | -12   | -21   | -20   | -19   | -33      |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Freq |     |     |     |      |      |      | R <sub>w</sub> |
|---------------------------------|------|----------------|--------------------------------------------------|-----|-----|-----|------|------|------|----------------|
|                                 |      |                | 63                                               | 125 | 250 | 500 | 1000 | 2000 | 4000 |                |
| Tiled Roof                      | 33.4 | m <sup>2</sup> | 34                                               | 46  | 54  | 60  | 65   | 62   | 67   | 62             |
| Glazing                         | 1.4  | m <sup>2</sup> | 24                                               | 24  | 29  | 41  | 47   | 47   | 55   | 42             |
| Composite Sound Reduction Index |      |                | 33                                               | 37  | 43  | 54  | 60   | 59   | 65   | 55             |

| Façade noise Break-in vent |       |            |       |       |       |       |       |       |          |
|----------------------------|-------|------------|-------|-------|-------|-------|-------|-------|----------|
| L1                         |       | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k dB(A) |
| Free Field Source Lp       |       | 70         | 67    | 63    | 60    | 62    | 59    | 49    | 39       |
| Directivity correction     | -6    | -6         | -6    | -6    | -6    | -6    | -6    | -6    | -        |
| Room Length (m)            | 5.90  | Volume (V) | 67    | 67    | 67    | 67    | 67    | 67    | 67       |
| Room Height (m)            | 3.00  | 10log(V)   | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3     |
| Room Width (m)             | 3.80  | 21         | 21    | 21    | 21    | 21    | 21    | 21    | 21       |
| Volume                     | 67.26 | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50     |
| Tmf                        | 0.50  | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01    |
| Sound Reduction            |       | Dne        | 25    | 33    | 40    | 45    | 56    | 67    | 75       |
| L2 Room Lp                 |       | 40         | 29    | 17    | 9     | 0     | -14   | -32   | -36      |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |    |        |     |     |     |     |     |     |          |
|---------------------------------------|----|--------|-----|-----|-----|-----|-----|-----|----------|
| L2 Room Lp façade and vent            |    | 63     | 125 | 250 | 500 | 1k  | 2k  | 4k  | 8k dB(A) |
|                                       |    | 43     | 34  | 24  | 12  | 6   | 3   | -14 | -24      |
|                                       | 25 | NR     | 55  | 44  | 35  | 29  | 25  | 22  | 20       |
|                                       |    | Excess | -12 | -10 | -11 | -18 | -19 | -19 | -33      |

| Façades  | Description  | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
|----------|--------------|---------------------------------|----|-----|-----|-----|----|----|-----|-----|-------|
| Façade 1 | Pitched Roof | -6                              | 43 | 34  | 24  | 12  | 6  | 3  | -14 | -24 | 22    |
| Façade 2 | Side wall    | -9                              | 45 | 41  | 32  | 19  | 13 | 9  | -9  | -19 | 28    |
| Total    |              |                                 | 47 | 42  | 33  | 20  | 14 | 11 | 5   | 4   | 29    |

| Façade noise Break-in façade 2  |       |            |       |       |       |       |       |       |          |
|---------------------------------|-------|------------|-------|-------|-------|-------|-------|-------|----------|
| L1                              |       | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k dB(A) |
| Free Field Source Lp            |       | 70         | 67    | 63    | 60    | 62    | 59    | 49    | 39       |
| Directivity & Façade correction | -9    | -9         | -9    | -9    | -9    | -9    | -9    | -9    | -        |
| Façade Length (m)               | 12.80 | 83         | 83    | 83    | 83    | 83    | 83    | 83    | 83       |
| Façade Height (m)               | 6.50  | 67         | 67    | 67    | 67    | 67    | 67    | 67    | 67       |
| Façade Area                     | 83.20 | S/V        | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2      |
| Room Length (m)                 | 5.90  | 10log(S/V) | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9      |
| Room Height (m)                 | 3.00  | 11         | 11    | 11    | 11    | 11    | 11    | 11    | 11       |
| Room Width (m)                  | 3.80  | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50     |
| Volume                          | 67.26 | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01    |
| Tmf                             | 0.50  | L2         | 71    | 68    | 63    | 60    | 62    | 59    | 49       |
| Sound Reduction                 |       | R          | 29    | 30    | 34    | 44    | 52    | 53    | 61       |
| Flanking/Tolerance              |       |            | 3     | 3     | 3     | 3     | 3     | 3     | 3        |
| L2 Room Lp                      |       | 45         | 41    | 32    | 19    | 13    | 9     | -9    | -19      |
|                                 |       | NR         | 55    | 44    | 35    | 29    | 25    | 22    | 20       |
|                                 |       | Excess     | -11   | -3    | -3    | -10   | -12   | -13   | -28      |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre F |     |     |     |      |      |      | R <sub>w</sub> |
|---------------------------------|------|----------------|-----------------------------------------------|-----|-----|-----|------|------|------|----------------|
|                                 |      |                | 63                                            | 125 | 250 | 500 | 1000 | 2000 | 4000 |                |
| Wall                            | 5.0  | m <sup>2</sup> | 38                                            | 43  | 42  | 46  | 57   | 67   | 78   | 52             |
| Glazing                         | 1.8  | m <sup>2</sup> | 24                                            | 24  | 29  | 41  | 47   | 47   | 55   | 42             |
| Composite Sound Reduction Index |      |                | 29                                            | 30  | 34  | 44  | 52   | 53   | 61   | 46             |

| Façade noise Break-in vent |       |            |       |       |       |       |       |       |          |
|----------------------------|-------|------------|-------|-------|-------|-------|-------|-------|----------|
| L1                         |       | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k dB(A) |
| Free Field Source Lp       |       | 70         | 67    | 63    | 60    | 62    | 59    | 49    | 39       |
| Directivity correction     | -9    | -9         | -9    | -9    | -9    | -9    | -9    | -9    | -        |
| Room Length (m)            | 5.90  | Volume (V) | 67    | 67    | 67    | 67    | 67    | 67    | 67       |
| Room Height (m)            | 3.00  | 10log(V)   | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3     |
| Room Width (m)             | 3.80  | 21         | 21    | 21    | 21    | 21    | 21    | 21    | 21       |
| Volume                     | 67.26 | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50     |
| Tmf                        | 0.50  | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01    |
| Sound Reduction            |       | Dne        | 25    | 33    | 40    | 45    | 56    | 67    | 75       |
| L2 Room Lp                 |       | 37         | 26    | 14    | 6     | -3    | -17   | -35   | -39      |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |  |        |     |     |     |     |     |     |          |
|---------------------------------------|--|--------|-----|-----|-----|-----|-----|-----|----------|
| L2 Room Lp façade and vent            |  | 63     | 125 | 250 | 500 | 1k  | 2k  | 4k  | 8k dB(A) |
|                                       |  | 45     | 41  | 32  | 19  | 13  | 9   | -9  | -19      |
|                                       |  | NR     | 55  | 44  | 35  | 29  | 25  | 22  | 20       |
|                                       |  | Excess | -10 | -3  | -3  | -10 | -12 | -13 | -28      |

## 2<sup>nd</sup> Floor Maximum

| Façade noise Break-in façade 1  |       | 63                   | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |    |
|---------------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| L1                              |       | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82 |
| Directivity & Façade correction | -6    | Correction           | -6    | -6    | -6    | -6    | -6    | -6    | -6    | -     |    |
| Façade Length (m)               | 6.00  | Façade Area (S)      | 35    | 35    | 35    | 35    | 35    | 35    | 35    | -     |    |
| Façade Height (m)               | 5.80  | Volume (V)           | 67    | 67    | 67    | 67    | 67    | 67    | 67    | -     |    |
| Façade Area                     | 34.80 | S/V                  | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | -     |    |
| Room Length (m)                 | 5.90  | 10log(S/V)           | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -2.9  | -     |    |
| Room Height (m)                 | 3.00  | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | -     |    |
| Room Width (m)                  | 3.80  | Rev time             | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | -     |    |
| Volume                          | 67.26 | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -     |    |
| Tmf                             | 0.50  | L2                   | 85    | 82    | 78    | 73    | 77    | 75    | 63    | 53    | 81 |
| Sound Reduction                 |       | R                    | 33    | 37    | 43    | 54    | 60    | 59    | 65    | 65    | 55 |
| Flanking/Tolerance              |       |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |    |
| L2 Room Lp                      |       |                      | 56    | 48    | 38    | 22    | 21    | 20    | 1     | -9    | 35 |
|                                 | 25    | NR                   | 55    | 44    | 35    | 29    | 25    | 22    | 20    | 18    | 35 |
|                                 |       | Excess               | 0     | 4     | 3     | -7    | -4    | -2    | -18   | -27   | 1  |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Freq |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|--------------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 |      |                | 63                                               | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Tiled Roof                      | 33.4 | m <sup>2</sup> | 34                                               | 46  | 54  | 60  | 65   | 62   | 67   | 62 |                |
| Glazing                         | 1.4  | m <sup>2</sup> | 24                                               | 24  | 29  | 41  | 47   | 47   | 55   | 42 |                |
| Composite Sound Reduction Index |      |                | 33                                               | 37  | 43  | 54  | 60   | 59   | 65   | 55 |                |

| Façade noise Break-in vent |       |                      |       |       |       |       |       |       |       |       |       |
|----------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         |       | Free Field Source Lp | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
| Directivity correction     | -6    | Correction           | -6    | -6    | -6    | -6    | -6    | -6    | -6    | -6    | -     |
| Room Length (m)            | 5.90  | Volume (V)           | 67    | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |
| Room Height (m)            | 3.00  | 10log(V)             | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  |       |
| Room Width (m)             | 3.80  | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | 67.26 | Rev time             | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 0.50  | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            |       | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |       |                      | 55    | 44    | 32    | 23    | 16    | 3     | -17   | -21   | 32    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

|                                       |        |    |     |     |     |    |    |     |     |       |
|---------------------------------------|--------|----|-----|-----|-----|----|----|-----|-----|-------|
| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
| L2 Room Lp façade and vent            |        | 58 | 49  | 39  | 26  | 22 | 20 | 1   | -9  | 37    |
| 25                                    | NR     | 55 | 44  | 35  | 29  | 25 | 22 | 20  | 18  | 35    |
|                                       | Excess | 3  | 5   | 4   | -4  | -3 | -2 | -18 | -26 | 2     |

| Façades  | Description  | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | dB(A) |
|----------|--------------|---------------------------------|----|-----|-----|-----|----|----|----|----|-------|
| Façade 1 | Pitched Roof | -6                              | 58 | 49  | 39  | 26  | 22 | 20 | 1  | -9 | 37    |
| Façade 2 | Side wall    | -9                              | 60 | 56  | 47  | 33  | 29 | 26 | 6  | -4 | 43    |
| Total    |              |                                 | 62 | 57  | 48  | 34  | 30 | 27 | 9  | 5  | 44    |

| Façade noise Break-in façade 2  |       | 63                   | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |    |
|---------------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| L1                              |       | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82 |
| Directivity & Façade correction | -9    | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |    |
| Façade Length (m)               | 12.80 | Façade Area (S)      | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       |    |
| Façade Height (m)               | 6.50  | Volume (V)           | 67    | 67    | 67    | 67    | 67    | 67    | 67    |       |    |
| Façade Area                     | 83.20 | S/V                  | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   | 1.2   |       |    |
| Room Length (m)                 | 5.90  | 10log(S/V)           | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   | 0.9   |       |    |
| Room Height (m)                 | 3.00  | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |    |
| Room Width (m)                  | 3.80  | Rev time             | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | -     |    |
| Volume                          | 67.26 | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -     |    |
| Tmf                             | 0.50  | L2                   | 86    | 83    | 78    | 74    | 78    | 76    | 64    | 54    | 82 |
| Sound Reduction                 |       | R                    | 29    | 30    | 34    | 44    | 52    | 53    | 61    | 61    | 46 |
| Flanking/Tolerance              |       |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |    |
| L2 Room Lp                      |       |                      | 60    | 56    | 47    | 33    | 29    | 26    | 6     | -4    | 43 |
|                                 |       | NR                   | 55    | 44    | 35    | 29    | 25    | 22    | 20    | 18    | 35 |
|                                 |       | Excess               | 4     | 12    | 12    | 4     | 4     | 4     | -13   | -22   | 9  |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre F |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|-----------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 |      |                | 63                                            | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Wall                            | 5.0  | m <sup>2</sup> | 38                                            | 43  | 42  | 46  | 57   | 67   | 78   | 52 |                |
| Glazing                         | 1.8  | m <sup>2</sup> | 24                                            | 24  | 29  | 41  | 47   | 47   | 55   | 42 |                |
| Composite Sound Reduction Index |      |                | 29                                            | 30  | 34  | 44  | 52   | 53   | 61   | 46 |                |

| Façade noise Break-in vent |       |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|----------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         |       | Free Field Source Lp | 70    | 67    | 63    | 60    | 62    | 59    | 49    | 39    | 66    |
| Directivity correction     | -9    | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Room Length (m)            | 5.90  | Volume (V)           | 67    | 67    | 67    | 67    | 67    | 67    | 67    | 67    | -     |
| Room Height (m)            | 3.00  | 10log(V)             | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  | 18.3  |       |
| Room Width (m)             | 3.80  | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | 67.26 | Rev time             | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 0.50  | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            |       | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |       |                      | 37    | 26    | 14    | 6     | -3    | -17   | -35   | -39   | 14    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

|                                       |        |     |     |     |    |    |    |     |       |    |
|---------------------------------------|--------|-----|-----|-----|----|----|----|-----|-------|----|
| Façade noise Break-in façade and vent | 63     | 125 | 250 | 500 | 1k | 2k | 4k | 8k  | dB(A) |    |
| L2 Room Lp façade and vent            | 60     | 56  | 47  | 33  | 29 | 26 | 6  | -4  | 43    |    |
|                                       | NR     | 55  | 44  | 35  | 29 | 25 | 22 | 20  | 18    | 35 |
|                                       | Excess | 5   | 12  | 12  | 4  | 4  | 4  | -13 | -22   | 9  |

# 1<sup>st</sup> Floor Daytime:

| Façade noise Break-in façade 1 |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|--------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                             | Free Field Source Lp | 76    | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Façade correction              | Correction           | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -     |
| Façade Length (m)              | Façade Area (S)      | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    |       |
| Façade Height (m)              | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Façade Area                    | S/V                  | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   |       |
| Room Length (m)                | 10log(S/V)           | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  |       |
| Room Height (m)                | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                 | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                         | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                            | L2                   | 79    | 76    | 72    | 68    | 72    | 70    | 58    | 48    | 76    |
| Sound Reduction                | R                    | 29    | 37    | 46    | 50    | 56    | 61    | 68    | 68    | 54    |
| Flanking/Tolerance             |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                     |                      | 53    | 42    | 30    | 21    | 19    | 12    | -7    | -17   | 31    |
|                                | NR                   | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    | 40    |
|                                | Excess               | -7    | -7    | -11   | -14   | -12   | -16   | -33   | -41   | -10   |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

## Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Frequenc |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|------------------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 | 6.2  | m <sup>2</sup> | 63                                                   | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Wall                            |      |                | 29                                                   | 49  | 49  | 50  | 57   | 64   | 70   | 56 |                |
| Glazing                         | 1.0  | m <sup>2</sup> | 30                                                   | 29  | 39  | 49  | 52   | 55   | 63   | 49 |                |
| Composite Sound Reduction Index |      |                | 29                                                   | 37  | 46  | 50  | 56   | 61   | 68   | 54 |                |

| Façade noise Break-in vent |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|----------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         | Free Field Source Lp | 76    | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity correction     | Correction           | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -     |
| Room Length (m)            | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Room Height (m)            | 10log(V)             | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |       |
| Room Width (m)             | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |                      | 52    | 41    | 30    | 21    | 14    | 1     | -19   | -23   | 29    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k | 2k  | 4k  | 8k  | dB(A) |
|---------------------------------------|--------|----|-----|-----|-----|----|-----|-----|-----|-------|
| L2 Room Lp façade and vent            |        | 55 | 44  | 33  | 24  | 20 | 12  | -7  | -16 | 33    |
|                                       | NR     | 55 | 44  | 35  | 29  | 25 | 22  | 20  | 18  | 35    |
|                                       | Excess | 0  | 1   | -3  | -5  | -5 | -10 | -26 | -34 | -2    |

| Façades  | Description | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k  | dB(A) |
|----------|-------------|---------------------------------|----|-----|-----|-----|----|----|----|-----|-------|
| Façade 1 | Wall        | -3                              | 55 | 44  | 33  | 24  | 20 | 12 | -7 | -16 | 33    |
| Façade 2 | Side wall   | -9                              | 54 | 42  | 31  | 23  | 20 | 12 | -6 | -16 | 32    |
| Total    |             |                                 | 58 | 46  | 35  | 27  | 23 | 16 | 9  | 8   | 35    |

| Façade noise Break-in façade 2  |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|---------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                              | Free Field Source Lp | 76    | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity & Façade correction | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Façade Length (m)               | Façade Area (S)      | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       |
| Façade Height (m)               | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Façade Area                     | S/V                  | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   |       |
| Room Length (m)                 | 10log(S/V)           | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   |       |
| Room Height (m)                 | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                  | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                          | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                             | L2                   | 80    | 77    | 73    | 69    | 73    | 71    | 59    | 49    | 77    |
| Sound Reduction                 | R                    | 29    | 38    | 46    | 50    | 56    | 62    | 68    | 68    | 55    |
| Flanking/Tolerance              |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                      |                      | 54    | 42    | 30    | 22    | 20    | 12    | -6    | -16   | 31    |
|                                 | NR                   | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    | 40    |
|                                 | Excess               | -6    | -7    | -11   | -13   | -11   | -16   | -32   | -40   | -9    |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

## Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre F |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|-----------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 | 8.9  | m <sup>2</sup> | 63                                            | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Wall                            |      |                | 29                                            | 49  | 49  | 50  | 57   | 64   | 70   | 56 |                |
| Glazing                         | 1.1  | m <sup>2</sup> | 30                                            | 29  | 39  | 49  | 52   | 55   | 63   | 49 |                |
| Composite Sound Reduction Index |      |                | 29                                            | 38  | 46  | 50  | 56   | 62   | 68   | 55 |                |

| Façade noise Break-in vent |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|----------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         | Free Field Source Lp | 76    | 73    | 69    | 65    | 69    | 67    | 55    | 45    | 73    |
| Directivity correction     | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Room Length (m)            | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Room Height (m)            | 10log(V)             | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |       |
| Room Width (m)             | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |                      | 46    | 35    | 24    | 15    | 8     | -5    | -25   | -29   | 23    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
|---------------------------------------|--------|----|-----|-----|-----|----|----|-----|-----|-------|
| L2 Room Lp façade and vent            |        | 54 | 42  | 31  | 23  | 20 | 12 | -6  | -16 | 32    |
|                                       | NR     | 55 | 44  | 35  | 29  | 25 | 22 | 20  | 18  | 35    |
|                                       | Excess | -1 | -1  | -4  | -6  | -5 | -9 | -26 | -34 | -3    |

## 1<sup>st</sup> Floor Night-time:

| Façade noise Break-in façade 1 |       | 63                   | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |    |
|--------------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| L1                             |       | Free Field Source Lp | 70    | 67    | 63    | 60    | 62    | 59    | 49    | 39    | 66 |
| Façade correction              | -3    | Correction           | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -  |
| Façade Length (m)              | 5.80  | Façade Area (S)      | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    |    |
| Façade Height (m)              | 3.00  | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |    |
| Façade Area                    | 17.40 | S/V                  | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   |    |
| Room Length (m)                | 3.00  | 10log(S/V)           | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  |    |
| Room Height (m)                | 2.40  |                      | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |    |
| Room Width (m)                 | 3.70  | Rev time             | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -  |
| Volume                         | 26.64 | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -  |
| Tmf                            | 0.50  | L2                   | 74    | 71    | 67    | 63    | 65    | 62    | 52    | 42    | 69 |
| Sound Reduction                |       | R                    | 29    | 37    | 46    | 50    | 56    | 61    | 68    | 68    | 54 |
| Flanking/Tolerance             |       |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |    |
| L2 Room Lp                     |       |                      | 48    | 37    | 24    | 16    | 12    | 4     | -13   | -23   | 25 |
|                                | 25    | NR                   | 55    | 44    | 35    | 29    | 25    | 22    | 20    | 18    | 35 |
|                                |       | Excess               | -7    | -7    | -11   | -13   | -13   | -18   | -32   | -41   | -9 |

$$L2 = L1 - R + 10\log(S/V) + 11 + 10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Freq |     |     |     |      |      |      |  | R <sub>w</sub> |
|---------------------------------|------|----------------|--------------------------------------------------|-----|-----|-----|------|------|------|--|----------------|
|                                 |      |                | 63                                               | 125 | 250 | 500 | 1000 | 2000 | 4000 |  |                |
| Wall                            | 6.2  | m <sup>2</sup> | 29                                               | 49  | 49  | 50  | 57   | 64   | 70   |  | 56             |
| Glazing                         | 1.0  | m <sup>2</sup> | 30                                               | 29  | 39  | 49  | 52   | 55   | 63   |  | 49             |
| Composite Sound Reduction Index |      |                | 29                                               | 37  | 46  | 50  | 56   | 61   | 68   |  | 54             |

| Façade noise Break-in vent   |                      | 63         | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |    |
|------------------------------|----------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| L1                           | Free Field Source Lp | 70         | 67    | 63    | 60    | 62    | 59    | 49    | 39    | 66    |    |
| Directivity correction       | -3                   | Correction | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -     |    |
| Room Length (m)              | 3.00                 | Volume (V) | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |    |
| Room Height (m)              | 2.40                 | 10log(V)   | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |       |    |
| Room Width (m)               | 3.70                 | 21         | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |    |
| Volume                       | 26.64                | Rev time   | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  |       |    |
| Tmf                          | 0.50                 | 10logT     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 |       |    |
| Sound Reduction              |                      | Dne        | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50 |
| L2 Room Lp                   |                      |            | 47    | 36    | 24    | 16    | 7     | -7    | -25   | -29   | 24 |
| L2 = L1-Dne-10logV+21+10logT |                      |            |       |       |       |       |       |       |       |       |    |

$$L2 = L1 - Dne - 10\log V + 21 + 10\log T$$

| Façade noise Break-in façade and vent |    | 63     | 125 | 250 | 500 | 1k  | 2k  | 4k  | 8k  | dB(A) |    |
|---------------------------------------|----|--------|-----|-----|-----|-----|-----|-----|-----|-------|----|
| L2 Room Lp façade and vent            |    | 51     | 39  | 27  | 19  | 13  | 4   | -13 | -22 | 28    |    |
|                                       | 25 | NR     | 55  | 44  | 35  | 29  | 25  | 22  | 20  | 18    | 35 |
|                                       |    | Excess | -5  | -5  | -8  | -10 | -12 | -18 | -32 | -40   | -7 |

| Façades  | Description | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
|----------|-------------|---------------------------------|----|-----|-----|-----|----|----|-----|-----|-------|
| Façade 1 | Wall        | -3                              | 51 | 39  | 27  | 19  | 13 | 4  | -13 | -22 | 28    |
| Façade 2 | Side wall   | -9                              | 50 | 37  | 25  | 18  | 13 | 4  | -12 | -22 | 27    |
| Total    |             |                                 | 53 | 41  | 29  | 22  | 17 | 11 | 9   | 8   | 30    |

| Façade noise Break-in façade 2  |       |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|---------------------------------|-------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                              |       | Free Field Source Lp | 70    | 67    | 63    | 60    | 62    | 59    | 49    | 39    | 66    |
| Directivity & Façade correction | -9    | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Façade Length (m)               | 12.80 | Façade Area (S)      | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       |
| Façade Height (m)               | 6.50  | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Façade Area                     | 83.20 | S/V                  | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   |       |
| Room Length (m)                 | 3.70  | 10log(S/V)           | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   |       |
| Room Height (m)                 | 2.40  | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                  | 3.00  | Revtime              | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                          | 26.64 | 10logT               | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                             | 0.50  | L2                   | 75    | 72    | 67    | 64    | 66    | 63    | 53    | 43    | 70    |
| Sound Reduction                 |       | R                    | 29    | 38    | 46    | 50    | 56    | 62    | 68    | 68    | 55    |
| Flanking/Tolerance              |       |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                      |       |                      | 49    | 36    | 24    | 17    | 13    | 4     | -12   | -22   | 26    |
|                                 |       | NR                   | 55    | 44    | 35    | 29    | 25    | 22    | 20    | 18    | 35    |
|                                 |       | Excess               | -6    | -7    | -11   | -12   | -12   | -18   | -32   | -40   | -9    |

$$L2 = L1 - R + 10\log(S/V) + 11 + 10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre F |     |     |     |      |      |      |  | R <sub>w</sub> |
|---------------------------------|------|----------------|-----------------------------------------------|-----|-----|-----|------|------|------|--|----------------|
|                                 |      |                | 63                                            | 125 | 250 | 500 | 1000 | 2000 | 4000 |  |                |
| Wall                            | 8.9  | m <sup>2</sup> | 29                                            | 49  | 49  | 50  | 57   | 64   | 70   |  | 56             |
| Glazing                         | 1.1  | m <sup>2</sup> | 30                                            | 29  | 39  | 49  | 52   | 55   | 63   |  | 49             |
| Composite Sound Reduction Index |      |                | 29                                            | 38  | 46  | 50  | 56   | 62   | 68   |  | 55             |

| Façade noise Break-in vent   |  |                      | 63    | 125        | 250 | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |    |    |
|------------------------------|--|----------------------|-------|------------|-----|-------|-------|-------|-------|-------|-------|----|----|
| L1                           |  | Free Field Source Lp | 70    | 67         | 63  | 60    | 62    | 59    | 49    | 39    | 66    |    |    |
| Directivity correction       |  |                      | -9    | -9         | -9  | -9    | -9    | -9    | -9    | -9    | -     |    |    |
| Room Length (m)              |  |                      | 3.70  | Correction |     | 27    | 27    | 27    | 27    | 27    | 27    |    |    |
| Room Height (m)              |  |                      | 2.40  | Volume (V) |     | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |    |    |
| Room Width (m)               |  |                      | 3.00  | 10log(V)   |     | 21    | 21    | 21    | 21    | 21    | 21    |    |    |
| Volume                       |  |                      | 26.64 | 21         |     | 21    | 21    | 21    | 21    | 21    | 21    |    |    |
| Tmf                          |  |                      | 0.50  | Rev time   |     | 0.65  | 0.60  | 0.55  | 0.50  | 0.50  | 0.50  |    |    |
| Sound Reduction              |  |                      |       | 10logT     |     | -1.87 | -2.22 | -2.60 | -3.01 | -3.01 | -3.01 |    |    |
|                              |  |                      |       | Dne        |     | 25    | 33    | 40    | 45    | 56    | 67    | 75 | 69 |
| L2 Room Lp                   |  |                      | 41    | 30         | 18  | 10    | 1     | -13   | -31   | -35   | 18    |    |    |
| L2 = L1-Dne-10logV+21+10logT |  |                      |       |            |     |       |       |       |       |       |       |    |    |

$$L2 = L1 - Dne - 10\log V + 21 + 10\log T$$

| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k  | 2k  | 4k  | 8k  | dB(A) |    |
|---------------------------------------|--------|----|-----|-----|-----|-----|-----|-----|-----|-------|----|
| L2 Room Lp façade and vent            |        | 50 | 37  | 25  | 18  | 13  | 4   | -12 | -22 | 27    |    |
|                                       |        | NR | 55  | 44  | 35  | 29  | 25  | 22  | 20  | 18    | 35 |
|                                       | Excess | -6 | -7  | -10 | -11 | -12 | -17 | -32 | -40 | -8    |    |

## 1<sup>st</sup> Floor Maximum

| Façade noise Break-in façade 1 |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|--------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                             | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82    |
| Façade correction              | Correction           | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -     |
| Façade Length (m)              | Façade Area (S)      | 17    | 17    | 17    | 17    | 17    | 17    | 17    | 17    |       |
| Façade Height (m)              | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Façade Area                    | S/V                  | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   | 0.7   |       |
| Room Length (m)                | 10log(S/V)           | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  | -1.8  |       |
| Room Height (m)                | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                 | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                         | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                            | L2                   | 88    | 85    | 81    | 77    | 81    | 79    | 67    | 57    | 85    |
| Sound Reduction                | R                    | 29    | 37    | 46    | 50    | 56    | 61    | 68    | 68    | 54    |
| Flanking/Tolerance             |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                     |                      | 62    | 51    | 39    | 30    | 28    | 21    | 2     | -8    | 40    |
|                                | 31                   |       |       |       |       |       |       |       |       |       |
|                                | NR                   | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    | 40    |
|                                | Excess               | 2     | 2     | -2    | -5    | -3    | -7    | -24   | -32   | -1    |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre Frequenc |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|------------------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 | 6.2  | m <sup>2</sup> | 63                                                   | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Wall                            |      |                | 29                                                   | 49  | 49  | 50  | 57   | 64   | 70   | 56 |                |
| Glazing                         | 1.0  | m <sup>2</sup> | 30                                                   | 29  | 39  | 49  | 52   | 55   | 63   | 49 |                |
| Composite Sound Reduction Index |      |                | 29                                                   | 37  | 46  | 50  | 56   | 61   | 68   | 54 |                |

| Façade noise Break-in vent |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|----------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82    |
| Directivity correction     | Correction           | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -3    | -     |
| Room Length (m)            | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Room Height (m)            | 10log(V)             | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |       |
| Room Width (m)             | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |                      | 61    | 50    | 39    | 30    | 23    | 10    | -10   | -14   | 38    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
|---------------------------------------|--------|----|-----|-----|-----|----|----|-----|-----|-------|
| L2 Room Lp façade and vent            |        | 64 | 53  | 42  | 33  | 29 | 21 | 2   | -7  | 42    |
|                                       | 25     |    |     |     |     |    |    |     |     |       |
|                                       | NR     | 55 | 44  | 35  | 29  | 25 | 22 | 20  | 18  | 35    |
|                                       | Excess | 9  | 10  | 6   | 4   | 4  | -1 | -17 | -25 | 7     |

| Façades  | Description | Directivity & Façade correction | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | dB(A) |
|----------|-------------|---------------------------------|----|-----|-----|-----|----|----|----|----|-------|
| Façade 1 | Wall        | -3                              | 64 | 53  | 42  | 33  | 29 | 21 | 2  | -7 | 42    |
| Façade 2 | Side wall   | -9                              | 63 | 51  | 40  | 32  | 29 | 21 | 3  | -7 | 41    |
| Total    |             |                                 | 67 | 55  | 44  | 35  | 32 | 25 | 10 | 9  | 44    |

| Façade noise Break-in façade 2  |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|---------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                              | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82    |
| Directivity & Façade correction | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Façade Length (m)               | Façade Area (S)      | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       |
| Façade Height (m)               | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Façade Area                     | S/V                  | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   | 3.1   |       |
| Room Length (m)                 | 10log(S/V)           | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   | 4.9   |       |
| Room Height (m)                 | 11                   | 11    | 11    | 11    | 11    | 11    | 11    | 11    | 11    |       |
| Room Width (m)                  | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | -     |
| Volume                          | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -     |
| Tmf                             | L2                   | 89    | 86    | 82    | 78    | 82    | 80    | 68    | 58    | 86    |
| Sound Reduction                 | R                    | 29    | 38    | 46    | 50    | 56    | 62    | 68    | 68    | 55    |
| Flanking/Tolerance              |                      | 3     | 3     | 3     | 3     | 3     | 3     | 3     | 3     |       |
| L2 Room Lp                      |                      | 63    | 51    | 39    | 31    | 29    | 21    | 3     | -7    | 40    |
|                                 |                      |       |       |       |       |       |       |       |       |       |
|                                 | NR                   | 60    | 49    | 41    | 35    | 31    | 28    | 26    | 24    | 40    |
|                                 | Excess               | 3     | 2     | -2    | -4    | -2    | -7    | -23   | -31   | 0     |

$$L2 = L1-R+10\log(S/V)+11+10\log T$$

### Partition Dimensions and Material Data:

| Description                     | Area | Units          | Sound Reduction Index at Octave Band Centre F |     |     |     |      |      |      |    | R <sub>w</sub> |
|---------------------------------|------|----------------|-----------------------------------------------|-----|-----|-----|------|------|------|----|----------------|
|                                 | 8.9  | m <sup>2</sup> | 63                                            | 125 | 250 | 500 | 1000 | 2000 | 4000 |    |                |
| Wall                            |      |                | 29                                            | 49  | 49  | 50  | 57   | 64   | 70   | 56 |                |
| Glazing                         | 1.1  | m <sup>2</sup> | 30                                            | 29  | 39  | 49  | 52   | 55   | 63   | 49 |                |
| Composite Sound Reduction Index |      |                | 29                                            | 38  | 46  | 50  | 56   | 62   | 68   | 55 |                |

| Façade noise Break-in vent |                      | 63    | 125   | 250   | 500   | 1k    | 2k    | 4k    | 8k    | dB(A) |
|----------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L1                         | Free Field Source Lp | 85    | 82    | 78    | 74    | 78    | 76    | 64    | 54    | 82    |
| Directivity correction     | Correction           | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -9    | -     |
| Room Length (m)            | Volume (V)           | 27    | 27    | 27    | 27    | 27    | 27    | 27    | 27    |       |
| Room Height (m)            | 10log(V)             | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  | 14.3  |       |
| Room Width (m)             | 21                   | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       |
| Volume                     | Rev time             | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  | 0.50  |       |
| Tmf                        | 10logT               | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 | -3.01 |       |
| Sound Reduction            | Dne                  | 25    | 33    | 40    | 45    | 56    | 67    | 75    | 69    | 50    |
| L2 Room Lp                 |                      | 55    | 44    | 33    | 24    | 17    | 4     | -16   | -20   | 32    |

$$L2 = L1-Dne-10\log V+21+10\log T$$

| Façade noise Break-in façade and vent |        | 63 | 125 | 250 | 500 | 1k | 2k | 4k  | 8k  | dB(A) |
|---------------------------------------|--------|----|-----|-----|-----|----|----|-----|-----|-------|
| L2 Room Lp façade and vent            |        | 63 | 51  | 40  | 32  | 29 | 21 | 3   | -7  | 41    |
|                                       |        |    |     |     |     |    |    |     |     |       |
|                                       | NR     | 55 | 44  | 35  | 29  | 25 | 22 | 20  | 18  | 35    |
|                                       | Excess | 8  | 8   | 5   | 3   | 4  | 0  | -17 | -25 | 6     |

## Appendix E: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

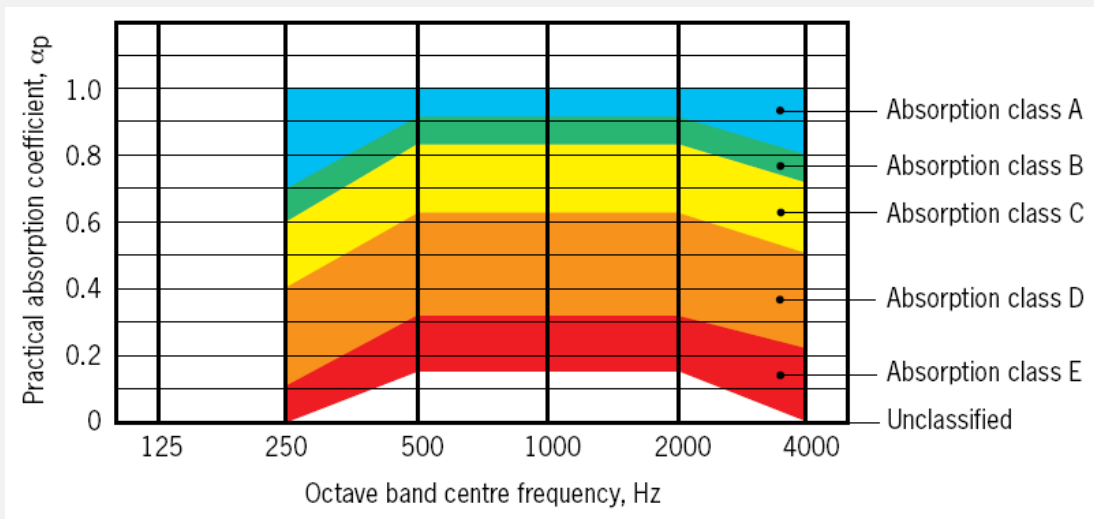
### 'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

### Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



### Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

### Airborne Noise

Noise transmitted through air.

## Ambient Noise

The total noise level including all 'normally experienced' noise sources.

## dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB  $\neq$  60 dB

30 dB + 30 dB = 33 dB

## $D_{nTw} + C_{tr}$

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D

Is simply  $L1 - L2$ .

$D_{nT}$

Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.

$D_{nTw}$

Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.

$C_{tr}$

Is a correction factor applied to the  $D_{nTw}$  to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

## Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

## Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in  $L'_{nTw}$ .

## Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

#### **$L_{A90, T}$**

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

#### **$L_{Aeq, T}$**

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

#### **$L_{Amax}$**

The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.

#### **$L_{Amin}$**

The 'A' weighted minimum measured noise level.

#### **$L'_{nTw}$**

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

#### **L**

Is the spatially averaged impact sound pressure level measured in a receive room.

#### **$L'_{nT}$**

Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.

#### **$L'_{nTw}$**

Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

#### **NR**

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

#### **Octave**

The interval between a frequency in Hz ( $f$ ) and either half or double that frequency ( $0.5f$  or  $2f$ ).

## **Pa**

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

## **Reverberation Time, $T_{mf}$ , RT60, RT30 or RT20**

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time,  $T_{mf}$  which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

## **$R_w$**

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

## **Sound Power Level**

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to  $10^{-12}$  W or 1pW.

## **Sound Pressure Level**

A noise level measured or given at a distance from a source or a number of sources. Referenced to  $2 \times 10^{-5}$  Pa.

## **Speech Intelligibility, Speech Transmission Index (STI)**

Speech intelligibility is the measure of how well a speaker's voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

## **Subjective Effect of Changes in Sound Pressure Level**

A basic example to illustrate the assessment of difference in noise levels follows.

A background noise survey is undertaken that yields a lowest background noise level of  $L_{A90}$  30 dB.

As the existing background noise level is low, a rating level for new plant noise of  $L_{Aeq,T}$  30 dB is set.

After calculation, the plant noise is predicted to achieve  $L_{Aeq,T}$  30 dB at the nearest residential property.

After the addition of the plant predicted noise level (or Rating Level), the new overall ambient noise level will be 33 dB. The background noise level measured originally will therefore be increased by 3 dB. In terms of the subjective impression of an increase of this order, the change in levels will be 'just perceptible'.

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

| Difference between background noise and rating levels | Increase in ambient noise level in 'real terms' | Change in apparent loudness |
|-------------------------------------------------------|-------------------------------------------------|-----------------------------|
| + 10 dB                                               | + 10 dB                                         | Twice as loud               |
| + 5 dB                                                | + 6 dB                                          | Clearly noticeable          |
| 0 dB                                                  | + 3 dB                                          | Just perceptible            |
| -10 dB                                                | 0 dB                                            | No change                   |

## W

Watts, the SI unit to describe power, after engineer James Watt.