

Project:	Twickenham Rediscovered	Date:	17/11/2017
Client:	Slender Winter Partnership Ltd	Ref:	17/11/2017



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1.0 Introduction

It is proposed to build new residential accommodation upon a parcel of land in Twickenham bordered to the east by Water Lane and the south by The Embankment, within the London Borough of Richmond upon Thames.

The client has requested that this practice recommend target internal noise levels for the proposed residential areas of the development based on the transmission of external transportation noise sources to internal areas of the proposed residential apartments.

1.1 Noise Policy Statement for England (NPSE) March 2010

The Government published the Noise Policy Statement for England (NPSE) in March 2010, with the aim of providing clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level.

The aims of the Government's noise policy are:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- 1) Avoid significant adverse impacts on health and quality of life;
- 2) Mitigate and minimise adverse impacts on health and quality of life; and
- 3) Where possible, contribute to the improvement of health and quality of life.

The terms "quality of life" and "wellbeing" are often used interchangeably in the assessment of noise effects.

In its aims, the Policy uses the key phrases "Significant adverse" and "adverse". In clarifying what these mean the Policy notes that "...there are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the WHO. They are:

NOEL – No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected."

The Policy extends these concepts to include:

SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

It is further noted that NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

The Policy notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is for a project to identify relevant SOAELs taking account the different sources of exposure and different receptors.

It can be seen that the test of significance in relation to government policy is a question of degree, and that a significant noise level will be somewhere above a level where the onset of adverse effect might be expected - i.e. SOAELs will always be greater in magnitude than LOAELs and LOAELs are greater than NOELs. In other words, as exposure to a sound source increases, there will start to be some level of effect on a receptor, and, as the exposure increases, the severity of the effect or effects increase with further increase in exposure to the level where the effect becomes significant.

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It is also worth noting that the second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. The aim is that “all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.”

1.2 National Planning Practice Guidance – Noise (August 2013)

Noise needs to be considered when new developments would be sensitive to the prevailing acoustic environment. When determining noise impact, Local Authorities’ plan making and decision taking should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or is likely to occur;
- Whether or not an adverse effect is occurring or is likely to occur; and
- Whether or not a good standard of amenity can be achieved

The practice guidance sets out a noise exposure hierarchy, based on four principal factors; perception, examples of outcomes, increasing effect level and actions, thus:

Table 1: Noise exposure hierarchy

Perception	Example of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up the volume of the television speaking more loudly, closing the windows for some time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a significant change in behaviour and/or attitude, e.g. having to keep windows closed for most of the time, avoiding certain activities during the periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening: loss of appetite,	Unacceptable Adverse Effect	Prevent

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	significant, medically definable harm e.g. auditory and non-auditory		
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The subjective nature of noise means that there is not a simple relationship between noise levels and the impact of those affected. This will depend on how factors combine in any particular situation, including:

- the source and absolute level of the noise together with the time of day it occurs;
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content of the noise and its general character (whether the noise contains particular tonal characteristics or other particular features).

More specific factors to consider, when relevant, include:

- where applicable, the cumulative effect of more than one noise source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases, a suitable alternative means of ventilation is likely to be necessary.

In respect of mitigating noise, the approach to be adopted will depend on the nature of the development and the character of the location. For noise sensitive developments, measures can include designing the development to reduce the impact of the noise from the local environment and optimising the sound insulation provided by the glazing.

2.0 Guidance on Assessment of Noise Levels

2.1 World Health Organisation

The World Health Organisation (WHO) document “Guidelines for Community Noise” provided a review of the effects of noise and a description of the principles of health criteria.

The WHO document presents guideline values arranged according to specific environments and critical health effects. Noise indices to be adopted and the accompanying time base to be used for the assessment are also presented.

The guideline values consider all health effects for a specific environment. An adverse health effect refers to any temporary or long-term impairment of physical, psychological or social functioning associated with noise exposure.

The specific noise limits were set for each health “using the lowest noise level that produces an adverse health effect”

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Table 2: WHO Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	L _{Aeq} (dB)	Time base (hours)	L _{Amax} fast (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime and evening	35	16	-
	Sleep disturbance, night time	30	8	45

For noise events, the guideline value was set at 45 dB L_{pAmax}, with research cited in the text advising that this value should not be exceeded by more than 10 to 15 times per night to ensure “good sleep”.

2.2 BS 8233:2014: “Guidance on sound insulation and noise reduction for buildings”

The standard draws on the results of research and experience to provide information on the design of buildings that have internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

Indoor ambient noise levels for dwellings are set out at Section 7.7.2, Table 4, reproduced below:

Figure 1: Indoor ambient noise levels for dwellings (from BS8233:2014, Table 4)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB L _{Aeq,16hour}	—
Dining	Dining room/area	40 dB L _{Aeq,16hour}	—
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hour}	30 dB L _{Aeq,8hour}

A series of notes provide context to the guideline values of Table 4 within BS8233:2014

Note 1 advises that the indoor ambient noise levels are “the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.”

Note 3 states “These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year’s Eve.”

Note 4 deals with individual events and advises that “Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or L_{Amax,F}, depending on the character and number of events per night. Sporadic noise events could require separate values”.

Note 7 provides a rider to the guideline values of Table 4, “Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved”.

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3.0 Proposed Design Intent

Table 3: Proposed indoor ambient noise levels for dwellings

Dwelling	Time	Level
Indoor ambient noise level living areas	07:00 to 23:00	35 dB L _{Aeq,16h}
Indoor ambient noise level for bedrooms	23:00 to 07:00	30 dB L _{Aeq,8h} *
Indoor maximum noise level for bedrooms	23:00 to 07:00	45 dB L _{AFmax} *

* With respect to night maximum noise, it should be noted that it is standard design practice to adopt a typical maximum noise level and not the worst-case; it is proposed that the stipulated 45 dB L_{AFmax} criterion relate to the 95th percentile of the sample of night time measurements taken during the survey, based on a 5 minute measurement sample. Adoption of the above dB L_{AFmax} design limits would not provide absolute control of transient noise sources such as police sirens, inappropriately silenced motorbikes, etc., which may occasionally occur however, the final building design should nevertheless minimise resultant disturbance due to external noise.

The suggested design targets apply when windows are closed and background ventilation is provided. When windows are opened, an increase in internal noise levels is inevitable and it is not reasonable ^[1] to expect the target levels above to be achieved. As noted in the previous section, the targets are based on annual average data and do not have to be achieved in all circumstances.

^[1] Proposals for amending Part E (resistance to the passage of sound): consultation, Clause C1.5

4.0 Baseline Conditions

4.1 Site Description

The site under consideration is a plot of land in Twickenham bordered to the east by Water Lane and the south by The Embankment, within the London Borough of Richmond upon Thames. Existing buildings of the site include offices and commercial with their frontage on King Street and a number of derelict (building windows Boarded up) buildings that lie in the southern part of the plot under consideration.

To the north west of the site lies King Street, being a two way trafficked highway. To the north of King Street lie 3 / 4 storey properties, generally comprising retail outlets at ground floor level with commercial / residential above. To the north of the site lies the road junction of King Street, Water Lane / Church Street. Church Street includes residential accommodation in properties such as Numbers 31 and 28, both to the north of the site.

To the east of the site lies Water Lane. Properties lie on the east side of Water Lane with their frontage facing Water Lane, most of which contain residential use accommodation. Most of these properties are two storeys in height. To the south of the site lies The Embankment, beyond which lies the River Thames. To the south of the River Thames lies Eel Pie Island on which lie numerous residential properties. Diamond Jubilee Gardens lie to the south west of the site. Generally to the west of the site lie the properties with their frontage on the south side of King Street.

The site location is illustrated by plan in Appendix A.

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4.2 Existing Noise Climate

Noise emanating from vehicular road traffic was deemed to provide a significant contribution to the ambient noise climate proximal to the nearest affected residential premises. The overall noise comprises both individual “event” type emissions from vehicles passing along local roads, and also continuous low frequency “rumble” due to middle distance traffic flows. Rail traffic was not noted. Aircraft over flights were observed at the site. Due to the relatively close proximity of Heathrow airport, estimated at 7km, aircraft are still at a low altitude and hence noise levels associated with the aircraft can be significant in terms of the ambient noise climate.

Numerous items of mechanical plant items were observed that were associated with third party properties. At the rear of properties with their frontage on King Street a greater amount of mechanical plant was noted. In addition, a low frequency “hum” associated with a transformer located in the vicinity was observed. It is taken that all mechanical plant associated with third party premises is operating within legal noise limits and has planning permission.

Noise associated with the speech of pedestrians is evident during the day time. Birds, including geese, pigeons, and rooks etc., all produce noise that is very noticeable during the day in the proximity of the southern end of Water Lane / Embankment, as people were observed feeding the birds on numerous occasions. During the daytime noise survey speech noise associated with the general public using the amenity areas along the embankment was audible.

5.0 Noise Control Requirements

A suitable degree of protection will be required to control noise to appropriate levels within any potentially affected dwellings.

5.1 Sound Insulation Terminology

Due to the numerous methods used to quantify sound insulation performance, it is necessary to define the various acoustic parameters that are encountered.

Table 4: Sound Insulation Parameters

Quantity	Definition	Description
R	Sound Reduction Index	The sound reduction index R is a property of the building element, independent of its surface area and absorption within the receiving room. R is obtained from the results of Laboratory tests, thus eliminating flanking transmission, such that the sound insulation performance of the test sample only is established.
R_w	Weighted Sound Reduction Index	Single figure sound insulation value derived from the measured sound reduction index R .
C ; C_{tr}	Spectrum adaptation terms 1 & 2. Used with single figure ratings as defined by ISO717-1:1996	C - calculated with spectrum No. 1 (A-weighted pink noise); C_{tr} - calculated with spectrum No. 2 (A-weighted urban traffic noise). The spectra of most commonly encountered indoor and outdoor noise sources lie in the range of spectra Nos. 1 and 2; the spectrum adaptation terms C and C_{tr} may therefore be used to characterize sound insulation with respect to many types of noise.

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6.0 External Building Fabric

The building envelope shall be designed so as to maintain the target internal noise levels given in Table 2. The assessment shall consider all features of the building envelope to all proposed internal residential apartments, to include, but not limited to:

- All external walls that will include features such as masonry constructions / cladding, glazed areas, etc.
- All roof areas
- All proposed ventilation arrangements shall be designed such that they reduce external noise ingress such that the overall target internal levels are maintained
- All floors where the floor is exposed to transportation noise sources.

The assessments shall include the combined noise transmission of external noise to internal areas of the residential accommodation via all building envelope elements to residential apartments.

It is advised that the northern facades of the development facing King Street shall require a greater degree of sound insulation than the rear of the site to the south.

Subject to future assessment the ventilation to residential apartments on the noisier facades of the site are likely to require the use of a continuous mechanical supply and extract with heat recovery (MVHR). Any MVHR systems shall be designed so as to ensure that self-generated noise from the mechanical ventilation system meets the guidance given at paragraphs 4.3.5 & 4.3.6 of Approved Document F 2010 and that attenuators are incorporated to reduce external noise sources to appropriate internal levels. In addition, any MVHR system shall also be designed such that its overall noise level contribution in any living room is no more than 25dB(A), and in any bedroom no more than 20dB(A). This includes the combined, total noise levels due to self-generated noise from powered elements, aerodynamic noise, external noise ingress via the system itself and break-out noise levels.

Provisional estimates of north façade noise levels. The north façade is potentially subject to the highest transportation noise levels due to its close proximity to the Kings Road. A preliminary assessment has been undertaken to establish if, in principle the external noise levels may be reduced to the target internal noise criteria.

Table 5: Provisional Estimated Building Envelope Sound Insulation Requirement of north façade

Façade	Space	Design Intent dB re: 20µPa		Noise Exposure dB re: 20µPa – estimated** at facade		Provisional Façade requirements $R_w + C_{tr}$ dB
		$L_{pAeq,T}$	L_{pAFmax}	$L_{pAeq,T}$	L_{pAFmax}	
North	Living	35 dB	n/a	71 dB	-	36 dB
	Bed	30 dB	45	62 dB	91 dB	46 dB

Notes:

1. Day time reference time interval T = 16 hours (07:00 to 23:00)
2. Night time reference time interval T = 8 hours (23:00 to 07:00)

** In terms whether noise mitigation measures can be introduced to reduce external transportation noise to reasonable internal noise levels within apartments, this practice has undertaken a very provisional first pass assessment of the likely noise at the north of the site. It is stressed that the noise data acquired during the survey did not sample sufficiently short term levels to enable an accurate distribution of the quantity L_{Amax} to be established. In addition, the meter was positioned in a location that was not necessarily representative of road traffic on the north façade, and full spectral noise data have not been acquired. As a result,

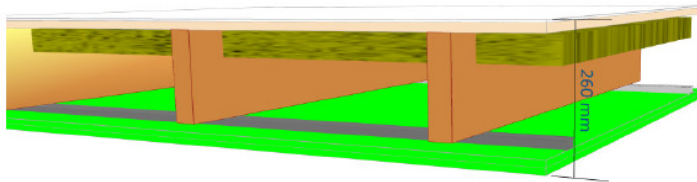
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these figures are best estimates and may not be fully representative of the transportation noise sources impinging on the north façade of the site. The client shall undertake full surveys to establish the noise levels impinging on the façades of the building and shall undertake a detailed assessment of building envelop acoustic requirements prior to RIBA stage 3 / 4 and subsequent procurement.

Very preliminary estimates indicate that the following example constructions would be sufficient in principle to achieve the provisional Façade requirements $dB R_w + C_{tr}$ dB, although it is stressed that these are estimates and prior to full scheme design a full acoustic assessment shall be required of the façades.

Roof

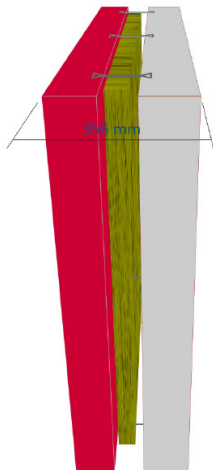
- 4mm rubber roof treatment on
- 17.5mm plywood on
- 200mm deep joists with 600mm stud spacing with 60mm fiberglass (10kg/m^3) infill between joists with
- BG resilient bars to underside of joists ,
- 2 layers of 13mm plasterboard



Predicted $R_w + C_{tr}$ of roof as above: 49 dB

Walls

Cavity Masonry wall comprising brick outer, butterfly ties,
 94mm deep cavity
 Inner layer of 140mm blockwork
 Overall surface mass of 459 Kg/m^2



Predicted $R_w + C_{tr}$ of walls as above: 55 dB

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Glazing:

Living areas: Provisionally 12.8 (16) 8.8 [Glazing (airgap) glazing] to give **Rw + Ctr 36 dB**

Bedrooms: Provisionally 14.8A (24) 12.8A [Glazing (airgap) glazing] to give **Rw + Ctr 46 dB**

Above configurations are based on acoustic data by Saint Gobain

An 'A' after the laminate denotes the use of SGG STADIP SILENCE acoustic laminate glass

Ventilation

Ventilation to residential apartments on the north façade to be by use of a continuous mechanical supply and extract with heat recovery (MVHR). Any MVHR systems shall be designed so as to ensure that self-generated noise from the mechanical ventilation system meets the guidance given at paragraphs 4.3.5 & 4.3.6 of Approved Document F 2010 and that attenuators are incorporated to reduce external noise sources to appropriate internal levels. In addition, any MVHR system shall also be designed such that its overall noise level contribution in any living room is no more than 25dB(A), and in any bedroom no more than 20dB(A). This includes the combined, total noise levels due to self-generated noise from powered elements, aerodynamic noise, external noise ingress via the system itself and break-out noise levels.

General

It is stressed that all of the above structures are for guidance purposes and the accompanying acoustic performance has been derived from predictions. The noise data acquired to date only allows an initial estimate of the building envelope construction to be undertaken and consequently the client shall re-assess all noise levels impinging on the proposed site and undertake a full assessment of the building envelope acoustic requirements prior to full design and procurement.

7.0 Conclusions

Appropriate internal noise limits have been discussed based on various sources of guidance and internal noise criteria have been proposed.

The future assessment of external noise transmission to internal residential areas the building shall consider the combined noise transmission of external noise to internal areas of the residential accommodation via all building envelope elements.

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Appendix A: Site Location

