Successful Noise Barrier Case Studies for Transport and Industrial Sources

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ABSTRACT

There is a general lack of confidence in the noise barrier industry in the design and specification of effective noise barriers. There is also a need for clear guidance in the application of appropriate standards. The aim of this paper is to give practical case studies of real-life noise barrier projects for roads and industry to show how barrier design theory and specifications can be applied effectively.

NOISE BARRIER DESIGN FOR THE M50 BROMSBERROW HEATH, UK

Introduction

Bromsberrow Heath Village was located on the north western side of the M50 motorway between Gloucester and Ledbury in the UK. The aim of this study was first, to carry out a detailed noise impact assessment for the village due to the noise of the M50 motorway. Secondly, to determine the optimum form of noise mitigation based on a combination of road resurfacing and noise barrier installation, providing a detailed design, product and performance specification for the complete noise barrier system.

The noise impact assessment was quantified in terms of the Severity of noise nuisance (using the assessment methodology in the UK Highways Agency memorandum, 'Noise Problems on Existing Roads – Detailed studies' Annex B). The objective of the noise mitigation was to attempt to eradicate the severity of noise nuisance and thus to substantially reduce the likelihood of future complaints due to the noise of the M50.

The work was carried out on behalf of Amey Mouchel, the Agents for the Highways Agency in UK Area 9.

The first step was to carry out a noise survey to quantify the potential noise nuisance due to the motorway. The study would take into account the variation in traffic noise during the day. Much of the traffic noise was due to fast moving traffic however any barrier design would need to insulate against low frequency noise such as that from heavy goods vehicles. The frequency content of the noise was therefore also taken into account to effectively "tune" the barrier design to the traffic noise.

The measurements were used in the production of a three-dimensional computer model that was constructed to examine how the noise spread from the road to the village. The computer model was then used to design the extent of effective resurfacing and the optimum noise barrier construction. This was specified in terms of its position, height, material and acoustic performance. Using the computer model the barrier performance was defined in terms of the predicted "before and after" noise levels at each individual house in the village.

This paper was a practical examination of the emergence of new standards for noise barrier design and specification both in the UK and in the continent of Europe as a whole. Whilst a few of these standards were specific to the originating countries most were general and of direct relevance to the Australasian market also.

Background

A previous "Noise Mitigation Study" study carried out had predicted the need for noise mitigation for Bromsberrow Heath recommending a combination of noise barrier installation and road resurfacing. Though the approach taken in carrying out this study to CRTN was correct, no noise measurements had been taken, no topographical variation had been taken into account, building types, floor levels and habitation were not determined and the final barrier had not been specified in terms of its position, line, length or even performance. It was therefore necessary to carry out a rigorous investigation to determine the best practical means of providing adequate protection for the village.

There was also a growing public awareness to the noise "problem" in Bromsberrow due to the M50. Where public awareness was high, it was unwise to base conclusions merely on past traffic flow figures. It was important to undergird the work with detailed noise measurements at sensitive locations in the village.

Previously, the approach to model the effect of replacing road surfaces has been to simply subtract a fixed value – eg 2.5 dB for every property considered. In reality the benefit of a new road surface depends on the location of the property and the existing ground conditions. In practice some properties may have seen a benefit of 2 – 3 dB other properties may have seen no benefit at all. This had to be correctly analysed as part of the detailed study.

Noise Measurement Survey

Three sensitive locations were chosen for noise monitoring:

26 Sandfields – (To the North of the Scheme – set above the carriageway)

Wallfields Cottage – (Central in the Scheme – close to the carriageway)

Robinswood – (To the South of the Scheme – set back from the carriageway)

Wallfields Cottage was close to the edge of the M50 and was currently receiving continuously high noise levels. The owner had already constructed a low bund along his boundary though this gave negligible protection. Noise measurements were taken in the garden near to the motorway.

26 Sandfields was a bungalow built approximately 3 metres above the M50. It received very high noise levels at the rear garden boundary which looked down on the nearside carriageway of the M50. The owner had constructed a high mound in his back garden which did provide a high level of protection for his bungalow. The measurements were taken on the top of the mound where noise levels remained high.

Robinswood was a bungalow at a distance from the motorway toward the centre of the village. Whilst the line of sight was clear to the motorway and traffic was clearly visible, the noise levels were noticeably lower. Measurements were taken at the garden boundary.

At each location measurements were taken in “free field” conditions away from any building facade and only at ground floor level, 1.5 metres above the ground. (*Predicted noise levels given later in this paper were higher in some cases. This was because they are taken at the highest floor level and at the property façade*).

Noise measurements at each location were taken over a 24-hour period between 18th and 20th August 2003. For this survey weather conditions were dry and still with daytime temperatures averaging at about 25 °C. Hourly LA10 and LAeq noise levels were recorded to determine the overall 18 Hr LA10, and the 16 and 8 Hr LAeq noise levels. At Wallfields Cottage the average 1/3 octave frequency spectrum of the noise was also analysed. This highlighted the high level of low frequency noise in the signal. A basic timber fence construction would be incapable of providing adequate protection against this.

Two 01-dB type SIP95 noise analysers were used to take the measurements. The analysers were secured in weather-proof cases and battery powered for continuous monitoring. The microphones were also weather protected with rainguard, dehumidifier, windscreen and bird-spike.

Topographical Assessment

The occasion of the noise monitoring also served as an optimum time to carry out a basic building and topographical assessment adjacent to the carriageway and toward the village itself. Of particular importance was to identify the situation and height of the most affected properties and the topographical outline close to the edge of the carriageway. It was necessary to determine an appropriate location for potential barrier installation.

Time was also taken to assess each home in the village and to determine the number of actually habitable addresses, (including newly built homes), to also note the height of the property (bungalow, two storey or three storey) and to estimate the ground height of each property based on the local topography. All this information would be necessary to produce an accurate model of the village.

Measurement Results

Table 1 gave the basic summary of the noise measurements. From first glance it was apparent that 26 Sandfields and Wallfields Cottage well exceeded the 68 dB(A) limit for LA10(18 hour) and demonstrated why this location had been considered under the UK Hansard list. Robinswood identified a property that was border-line. The LAeq levels were not directly relevant for this study but were indicative of the intrusive level of noise experienced in an otherwise semi-rural setting.

Table 1 Summary of Noise Measurements, 18th-20th August 2003

Location	LA10 18hr dB(A)	LAeq 16hr dB(A)	LAeq 8hr dB(A)
Sandfields	79	75	70
Wallfields Cottage	72	69	64
Robinswood	67	64	61

METHOD OF ANALYSIS

Computer Modelling using Mithra

In order to assess the impact of the noise and to design the barrier system, a computer model was used. The software package *Mithra*, a three dimensional computational system allowed for acoustic modelling of particular noise sources: road, rail traffic or industrial sources of noise. It showed how the noise interacted with adjacent buildings, taking into account different ground conditions and it examined the effects at different noise frequencies.

Mithra could also model the effect of different road surfaces and the inclusion of different noise barrier designs. It allowed for variation in the insulating and absorbing properties of noise barriers and therefore could be used as a noise barrier design tool.

The basic model was produced showing locations of buildings and houses together with all obtained topographical details including the line and surrounding profile of the carriageway itself. This model was then verified using the measurements taken to ensure it was giving the correct noise levels at the specified receiver positions.

Severity Analysis

Once verified, the noise model was used to determine the predicted 18Hr LA10 noise level at the highest floor façade for each property in the village (110 properties). Of these, 23 properties experienced a level exceeding 68 dB(A). These were the properties considered in determining the Severity of this “hotspot”. The highest noise levels, not surprisingly, were predicted at those properties closest to the motorway: Sandpits, The Meadows and Wallfields Cottage. Here the predicted first floor noise levels were close to 80dB(A) over an 18hr period.

Table 2 calculated the current Severity at over 12, based on an approximate frontage length of 700 metres. Different mitigation measures were then introduced to the model and the noise benefit for all the village properties was noted and the change to the severity determined.

Severity was defined as the frequency of complaints expected per kilometre of road and was detailed in the UK Highways Agency memorandum, ‘Noise Problems on Existing Roads – Detailed studies’ Annex B.

NOISE MITIGATION

Road Resurfacing

The use of a thin noise reducing road surface was introduced into the model. The length and location of resurfacing was varied to determine the benefit to the whole village. The optimum length was approximately 790 metres extending 140 metres past the Heath Farm bridge in a southerly direction and as far as the Sandpit to the north. Should the resurfacing be extended further, it would have negligible benefit for the village. One property Heath house, south of the Heath farm bridge, was in the Severity list. It has therefore been considered for protection through resurfacing. There was however an existing fence along the Heath House boundary with the motorway and it was considered unwise to replace this to benefit just one property. It would be better to improve conditions by considering extending the resurfacing by 140 metres.

Choosing an Optimum Barrier Design

Using the model, various barrier designs, lengths and sizes were considered to determine the optimum system for this application. In general the assumption was made that the required barriers were impervious to noise. Mithra however allowed for various levels of sound insulation to be considered. This served to demonstrate that thin or poorly constructed barriers would not give satisfactory acoustic results. This would not be picked up by a typical CRTN based modelling technique.

Since the village was predominantly on the north-western side of the motorway and there were few properties to the south-east, the majority of the barrier system need only be Reflective in design. At the southern end, an Absorptive section was recommended opposite *Freedom farm* to ensure that its installation did not result in an increase in the noise level for this property. Of the nearly 750 metres of barrier proposed, approximately 100 metres would be absorptive in construction and performance.

The height of the optimum noise barrier ranged from 2 to 3 metres in height. Although originally a 4 metre high section was proposed in front of the closest properties, this was revised down to 3 metres after understandable concerns over visibility were raised by the nearest residents.

The UK Highways boundary generally followed the crest of the batter next to the motorway. This was clearly the most effective location for building the barrier. Where there was a ditch at the edge of the motorway, the highways boundary tended to be lower than the road level. In these locations, the barrier line was brought as close to the motorway as allowable to ensure that as little height was lost as possible.

PREDICTED NOISE REDUCTION

Resurfacing Only

The road resurfacing was predicted to reduce the noise level for the 23 severest properties by an average of under 2 dB. It also reduced the severity index to over 7. This would provide an almost imperceptible change to the general noise levels in the village and leave a significant number of properties (14) still receiving unreasonably high noise levels.

Noise Barrier Only

This did provide a significant reduction. The noise barrier design was predicted to reduce the noise level for the 23 severest properties by an average of nearly 7 dB. It also reduced the noise for all the properties in the village by an average of nearly 4 dB. This was a noticeable change for the whole community. It also resulted in the Severity Index being reduced to under 2 leaving only three properties over 68 dB(A).

Resurfacing and Noise Barrier Combined

The combined effect would be to provide an average reduction for the whole village of over 5 dB and **over 8 dB** for the 23 severest properties. The Severity index was also virtually wiped out to a level below 1 with only 1 property still over **68 dB(A).**

The property predicted to remain over 68 dB(A) was *Sandpits* at first floor level. Visually its position virtually overhung the motorway. It was therefore deemed impractical to try to reduce the noise at this position any further.

Table 2 Summary of Severity Calculations, M50 Bromsberrow

	Number of Properties			
LA10 18hr dB(A)	Current	Resurface only	Barrier only	Resurface & Barrier
68	6	3	0	0
69	4	4	1	0
70	2	2	1	0
71	3	1	0	1
72	2	1	0	0
73	2	0	0	0
74	0	0	1	0
75	1	1	0	0
76	0	1	0	0
77	1	1	0	0
78	1	0	0	0
79	1	0	0	0
80	0	0	0	0
Total	23	14	3	1
Severity	12.2	7.2	1.6	0.5

NOISE BARRIER SPECIFICATION

Timber Reflective Noise Barrier

The installed noise barrier was timber in construction with the reflective element based on a double skinned design to provide sufficient insulation to reduce the traffic noise from the motorway. The barrier panels would be supported by UC galvanised steel posts as designed by the contractor.

Timber Absorptive Noise Barrier

The timber absorptive barrier section also incorporated a high density mineral wool mattress in its construction to absorb the noise. The mineral wool was wrapped in an air breathing glass fibre fine mesh with vertical support timbers for further structural protection. The barrier panels were supported by UC galvanised steel posts to the contractor’s design.

Material Quality

The barrier was designed to fully conform with UK Highways Guidance documents HA65/94 and HA66/65 for highways barrier design. The timber used also conformed to Highway works requirements and timber requirements in BS5589:1989 with regard to timber preservation and panel fabrication and BS8417:2003 Preservation of Timber - Recommendations.

Contractor Training and Competence

The Contractor was required to ensure minimum training and competency requirements for all their installers and team members ensuring that they were registered and working towards relevant qualifications mentioned in the FISS/CSCS Scheme.

Identification and Traceability

It was also necessary to demonstrate that the Contractor was using timber from a sustainable source. This was currently considered a priority by the Highways Agency to insist upon and monitor.

Acoustic Performance

The absorptive and reflective timber noise barriers were required to be laboratory tested and certified for insulation and absorption to give high acoustic performance at low frequency. The minimum requirements for acoustic performance were given in Table 3 below. All barriers were specified as B3 in accordance with EN 1793 Part 2 and the Absorptive barrier section were also specified as A3 in accordance with EN 1793 Part 1.

Table 3 Minimum Coefficients

1/3 Octave Frequency band	Sound Absorption Coefficient *(Absorptive Barrier Section Only)*	Sound Insulation Coefficient
100	0.6	17
125	0.6	18
160	0.6	19
200	0.8	21
250	0.8	23
315	0.8	25
400	0.8	27
500	0.8	31
630	0.8	33
800 to 5000	0.8	35

POST INSTALLATION MEASUREMENTS

A further noise measurement survey was carried out in March 2005 6 months after installation had been completed and the M50 was fully operational. Measurements were carried out at specifically sensitive properties and the resultant noise reduction compared with predicted values. These comparisons were given in Table 4.

Care was taken to ensure that measurements were taken on days comparable with those taken previously both in terms of road loading and weather conditions. Whilst it was not possible to completely match conditions, the results obtained were generally consistent and served to verify the predicted performance of the noise barrier design.

It was worth noting that it was not general policy to carry out a noise survey after installation of a barrier scheme was completed, it was considered a worthwhile exercise and of value both to the agents and to the local community.

Table 4 Comparison Between Measured and Predicted Results

Location	PREDICTED	MEASURED	Difference
	Top Floor Facade	Top Floor Facade	
Robinswood	62	60	-2
26 Sandfields	64	64	0
Wallfields	71	70	-1
14 Sandfields	64	62	-2
Meadows	67	68	+1
Highbanks	67	67	0

NOISE BARRIER DESIGN FOR THE QUATTRO (UK) DEPOT

Introduction

Quattro (UK) waste transfer depot was located close to the Park Royal industrial estate in Acton, London. Noise complaints from the nearby Wells House road had necessitated the design and installation of a suitable noise barrier system. The presence of an operating rail line between the depot and Wells House Road would add a further complication to the solution. In this particular case, the design work was carried out on behalf of the London Borough of Ealing.

In the depot, lorry movements and machinery operation were spread over a large area. The existence of high waste piles also ensured that the noise was not just emanating from ground level. Any suitable barrier height would therefore need to be particularly high to act as a realistic barrier to the noise. The original objective had been to provide a noise reduction of over 20 dB.

A previous design study carried out by a UK consultancy and submitted to the London Borough of Ealing was examined to determine the acoustic suitability of the proposals. Specific attention was also given to the effect on rail noise reflection due to the inclusion of a noise barrier at the boundary of the site.

The requirements of the study were based upon BS4142: The UK method for rating industrial noise affecting mixed residential and industrial areas.

Background

The previous study carried out had employed an in-house software package based on the calculation for road traffic noise (CRTN). This was a reliable and accurate calculation method for general environmental noise from highways. It was however greatly limited in its use for industrial noise sources. It also did not take into account the transmission of noise through surfaces, nor did it adequately model the effects of surface reflection of noise. When low noise barriers (< 3metres) were being considered, this did not pose a great problem. It was however incapable of modelling the behaviour of a 9 metre high barrier accurately, where noise transmission through the surface became a significant component.

Another limitation was that it could not distinguish between the performances of barriers of different thickness. It assumed all surfaces are impervious to noise; a factor that was not borne out in practice. For Quattro (UK), the nature of the activities on site, with considerable lorry movement, excavation work and shovelling would produce considerable low frequency noise. This would be largely transmitted through a thin single skinned barrier.

Description of the Basic Design

The previous study did however provide an excellent starting point for a final design. Structurally it was ambitious and rigorously designed. In dimensions it was 9 metres high with a 4 metre overhang into the depot yard. In a rough C-shape it partially enclosed the yard, completely blocking the view of site activities from the residents of Wells House road. The inclusion of a 4 metre overhang would certainly improve the basic performance of the barrier by giving the effect of moving the barrier line closer to the sources of noise whilst increasing the "path difference" over the barrier itself. The support structure for such a barrier including posts, fixings and foundations would clearly be very costly.

Thin Skin Problems

The main weakness of the previous design was the lack of specification detail for the barrier skin itself. The only detail was a requirement to provide a 1.2 mm single steel sheet surface that would certainly not be sufficient. Theoretically, according to the Mass Law, this would only give a maximum transmission loss of 17 dB(A) overall. Furthermore, the overall effectiveness would be greatly reduced by the transmission of low frequency noise and the likelihood of considerable noise leakage at the posts: Acoustic tightness for such a scheme would be paramount.

Site Reflection Problems

The assumption had also been made that a high reflective barrier will be sufficient for the project. It was however of particular concern that no consideration has been given to the use of absorptive surfaces. The Quattro (UK) depot already consisted entirely of hard reflective concrete walls and compound. Adding a further 9 metre high reflective wall with a 4 metre reflective overhang in such close proximity would undoubtedly set up multiple reflections across the site thus increasing the noise levels at source on site.

Railway Reflection Problems

Furthermore, no reference has been made to the fact that a 9 metre high barrier would reflect the noise from the adjacent railway line back towards the properties on Wells House Road. Past measurements by Ealing Council did demonstrate that the rail traffic already contributes significantly to the general background noise levels. Further increases in the noise from the rail track by reflection could not be considered acceptable.

The Need of Appropriate Barrier Specification

In any barrier specification it was fundamental that the acoustic performance was clearly detailed in terms of its absorptive and sound reduction properties, and also that clear reference was made to the need for designed acoustic tightness of the whole system. The preferable way would be to specify the laboratory tested performance of the barrier system *including the post* for absorption and insulation.

METHOD OF ANALYSIS

Computer Modelling using Mithra

The site was also modelled using Mithra since it allowed for variation in the insulating and absorbing properties of noise walls. The model produced analysed the noise at selected observation points and identified the performance of proposed treatments and their benefit to the observer.

Initially the site was modelled in the same format as that previously undertaken. This incorporated all the moving and stationary noise sources on site together with the site lorries in twelve identified positions. The model also included for the typical daytime background noise level of 50 dB(A), taking into account the noise from passing rail traffic. The noise sources were positioned to reflect their realistic operating heights, for example, the noise emanating from the lorries was modelled at an average height of 1.5metres. *(In some instances the vehicular noise height would have been higher than this).*

Noise levels were assessed at the first and second floor levels of 101 Wells House Road. In all, the objective was to be as consistent as possible with the work previously carried out.

Comparing Noise Barrier Options

For comparison two barrier designs were compared for predicted noise reduction performance using the computer model. Both were of identical dimensions in terms of position height and length; 9 metres high with a 4 metre overhang.

The first was based upon a single skin steel cladding 1.2 mm in thickness as described in the previous noise study. In the model, transmission characteristics were incorporated that were consistent with this design. Performance at low frequency would be poor and leakages at the fixings would occur.

The second was based upon a *"back to back"* metal absorptive barrier that had been designed to give high performance for absorption and insulation down to 100 Hz. By fixing the panels back to back, the barrier would absorb the noise on site as well as from the rail track. The body of both panels would be 1.5 mm in thickness. The combined thickness of 3mm will give a theoretical noise reduction of over 22dB(A) through the surface (Mass Law). This was a minimum where the aim was to provide an overall barrier noise reduction of up to 20dB.

PREDICTED NOISE BARRIER PERFORMANCE

Basic Steel Cladding (Ref Table 5)

As expected, the predicted performance of the single skinned design would be poor compared to the theoretical "Maekawa" result, primarily due to the transmission of noise through the barrier surface. A thin reflective barrier, 9 metres in height would only achieve an attenuation of less than 12 dB (at 2nd floor level). A contributing factor to this would be the rise in the rail noise due to reflections off the back of the barrier. Refer to Table 5.

As stated above, the use of a reflective barrier would have "amplified" the noise in the compound which would further reduce its overall performance. It was very clear from the study that a "cheap" cladding offers no benefits. It would also appear to be a poor investment since the actual barrier support structure would take up the vast majority of the overall cost.

Table 5 Predicted LAeq Levels and Barrier Attenuations Using the Basic Steel Cladding Design

Floor Level	Unprotected	Basic Steel Cladding Design	Basic Steel Cladding Attenuation
1st Floor	68 dB(A)	59 dB(A)	9 dB
2nd Floor	70 dB(A)	59 dB(A)	11 dB

Double Skinned Metal Absorptive Barrier

The double absorptive barrier provided results closer to the required reductions. This was primarily because noise transmission was kept to low levels and surface reflections were also minimised. Even so, the 9 metre high barrier with a 4 metre overhang still only offered a noise attenuation of 18 dB at 2nd Floor level. It thus remained to be seen whether this would be sufficient to meet the requirements of BS4142. Refer to Table 6.

Table 6 Predicted LAeq Levels and Barrier Attenuations Using the SBS Barrier Design

Floor Level	Unprotected	SBS Barrier Design	SBS Predicted Attenuation
1st Floor	68 dB(A)	51 dB(A)	17 dB
2nd Floor	70 dB(A)	52 dB(A)	18 dB

Compliance with BS4142

In order to comply with BS4142, the resulting LAeq should not exceed the L90 by more than **5dB** where the primary sources of noise were impulsive, intermittent or tonal. This exceedance was however considered to represent a borderline case and should not be considered acceptable for planning condition of new activity. Based on the assumed daytime background levels of 50dB(A), the SBS double skinned barrier design was predicted to bring the LAeq down to less than **3dB** over the background. A difference of 3 dB would build in a reasonable element of safety.

Operational Changes on Site

Although a noise reduction of 20 dB would not be achieved with the current barrier dimensions, this study was based on 10 lorries active on site 100 % of the time. Since the lorries contributed the most to the overall noise levels on site, any proposed reduction of lorry frequency on site would have a reducing effect on the overall site noise levels.

FURTHER MODIFICATIONS

Inclusion of Concrete "Push Wall"

The barrier design had assumed a full 9 metres height of barrier. In reality, Quattro required a 5 metre high concrete "push-wall" for the base of the barrier. The barrier design was therefore altered to take account of this. (*Waste material is generally piled up against the push wall*). The inner face of the concrete was therefore left bare without an absorbing layer.

To incorporate the push wall, the final barrier design now comprised a main 9 metre high barrier wall of which the lower 5 metres comprised of single skinned metal absorptive panels and the top 4 metres of double skinned metal absorptive panels. The top 4 metre wide hood also comprised of a single skin of absorptive panels. The whole 9 metre wall slanted inwards on all 3 sides towards the depot site.

Any incorporated modifications were included in the noise model to ensure that they were not detrimental to the overall performance of the barrier system.

NOISE BARRIER SPECIFICATION

Need for Laboratory Certification

Because of the height of the structure and the nature of the noise produced on site, it was vital that the barrier design has been laboratory tested and certificated to justify its acoustic performance. The acoustic testing for sound reduction had to be carried out for the designed barrier system and not just of the panel skin. This was important both for the barrier and the hood section. Experientially, leakage at the posts results in a high deterioration in barrier performance. This therefore had to be taken into account.

Testing for absorption was carried out according to ISO354 and to ISO 140 for sound reduction/ airborne sound insulation. Reference was also made to the installation requirements of the UK Highways Agency standards BSEN 1793 Parts 1 & 2 since they refined the ISO tests to include post and fixing details.

Material Limitations

Especially from the resident side, it was important to maintain a visual consistency in the barrier appearance. For example, the cladding should match the hood and barrier in appearance or at least compliment them visually.

Absorptive barrier designs were either porous or fibrous in nature.

The location of the push wall would ensure that most of the dust was confined at lower level, however even for absorptive panels above a 5 metre height, a porous absorptive barrier design would be unsuitable since it would be prone to clogging and difficult to clean. Fibrous barrier designs were typically timber based or metal based. Metal based panels were protected by a perforated metal front. Compared to porous surfaces, this was easier to clean for surface dirt. Timber-based panels were protected by a glass-fibre mesh cover. This would also be prone to clogging. It would also be more difficult to clean.

Whilst the specification should not be prescriptive, the metal absorptive based design appeared the best practical choice and the most readily available.

DETAILED BARRIER SPECIFICATION:

A *The metal absorptive barrier panel will consist of a minimum 1.5 mm galvanized steel body for extra rigidity, a perforated non-corrosive aluminium grid, and a rock wool/mineral wool absorptive core.*

B *The barrier panels will be fixed back to back to provide a double absorptive surface and slid together in fabrication fixed within the web of the posts. It is preferable that metal to metal contacts are left unbolted and unscrewed to ensure long life for the galvanized steel finish and to ensure that the barrier is easily dismantled.*

C *The fixing of the panels within the web of the posts should be designed to ensure acoustic tightness. This should also be maintained between the panels. Acoustic tightness of the design will be demonstrated by laboratory certification (see below).*

The posts will be fabricated from galvanized steel and the structural design of the foundation will be determined and justified by the contractor.

D *All external metal surfaces shall be powder-coated to the required RAL colour to blend in with the environment and enhance the life of the barrier.*

The overall design must be free to drain of water to prevent the mineral wool core from becoming saturated.

E ***Acoustic Performance***

Laboratory Certification must be supplied with the individual barrier panels within the posts, giving the following test results. Results must be supplied in terms of 1/3 octave frequency bands.

1) The minimum requirement for the Absorption Coefficients tested to ISO 354 shall be 0.5 at 100 Hz and 0.8 at 200 Hz.

2) The minimum requirement for the Sound Reduction Coefficients tested to ISO 140 shall be 17 at 100 Hz and 22 at 200 Hz.

F *The barrier design will demonstrate acoustic tightness especially at the post locations and ensure that there is no path for noise leakage. This could be achieved within* *the web of the post using a locking bolt to compress the panels to the flange of the post*

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