

WHEN BARRIERS FALL DOWN IDENTIFYING COMMON ERRORS IN NOISE BARRIER DESIGNS FOR ENVIRONMENTAL APPLICATIONS

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1 INTRODUCTION

Some noise barriers do fall down, because of structural failure, some noise barriers lose their performance through lack of durability and some noise barriers fail from the outset due to basic avoidable design faults. However noise barriers correctly designed and specified should work, should last, should stay up and look good.

With 25 years' experience specialising in noise barrier design, we have highlighted below a few of the common errors that may occur at the design or specification stage of a noise barrier scheme for local environmental applications such as to mitigate industrial noise or for housing or commercial developments.

This may be particularly relevant to noise consultants who include barriers in their noise mitigation designs and to environmental health and pollution control officers tasked with vetting noise impact assessments and mitigation design schemes whether to control existing environmental noise or as part of future planning applications.

2 OVER-RELIANCE ON SURFACE DENSITIES

Noise barriers are specified to ensure that sound transmitted through the material surface is negligible compared to the sound diffracted over the top of the barrier. To achieve this, many consultants purely rely on quoting inadequately low values of surface densities such as 10 or 12 kg/m² as a "minimum specification".

Single-leaf Timber barrier panels of 10-12 kg/m² may only be 15-18 mm thick (based on timber density of 650 kg/m³) making for a very thin structure. Tested single-leaf timber barriers typically lose up to 7dB in insulation performance within the first 5 years due to gaps forming and deterioration. This evidence is covered in the TRL report PPR490 (2010)¹ demonstrating that relying purely on a basic figure for surface density is wholly insufficient for noise barrier specification which results in timber-based noise barriers under-performing and deteriorating rapidly.

3 NOT SPECIFYING ROAD TRAFFIC NOISE BARRIERS

All noise barriers for road traffic noise fall under the CPR (The Construction Products Regulation)². This is a legal requirement and is just as relevant for housing and commercial development schemes where road traffic is the primary noise source requiring mitigation.

The legal requirement is that the road traffic noise barriers must be specified in accordance with the harmonised standard BSEN 14388:2005³. Installing a road traffic noise barrier that does not meet this standard is against the law. BSEN 14388:2005 covers all the test standards that relate to the acoustic, non-acoustic and durability performance characteristics of the noise barrier product.

As mentioned above, many consultants merely state low surface densities based on an ancient Department of Transport technical memorandum H14/76 even though it is 50 years old, has twice been superseded and would certainly not be accepted by National Highways for their barrier specifications. It is also worth noting that surface density is not to be found as a required characteristic in the BSEN 14388:2005 declaration of performance.

4 “WE DON’T SPECIFY WE JUST DESIGN”

In their assessments, noise consultants determine if a noise barrier is required, they might calculate the position, length and height of the barrier, and might even state whether it should be absorptive or reflective. If that is all they’ve been instructed to provide then that’s fine. However they would often see it as beyond their remit or skillset to provide a product/performance specification for the required barrier system.

This presents the client with a problem: They assume the consultant’s report has given them enough of a noise barrier specification to proceed, but they find they’re left not knowing what to ask for. This creates a ‘gap’. When they go out to tender for the noise barrier they cannot provide any specification requirements for suppliers/installers to meet. As a result they often end up with inadequate products that haven’t been correctly specified acoustically, structurally or for durability. The only comparable metric they are left with is cost, which is a recipe for disaster!

As an analogy, let’s imagine a housing development scheme. The developer-client would rightly expect at the very least, the windows to have a detailed lab-tested sound insulation specification to meet the internal design criteria. What if the consultant ignored that and merely proposed the windows should be made of “X” mm thick glass? The client would rightly send them back to try again. Consultants, at the very least, should be asking what the client’s expectations are.

5 TALL, THIN BARRIER PROBLEMS

Having once been asked to review a 9 metre high noise barrier design for a waste transfer site, to be constructed from 1.2 mm steel sheets, I pondered on its aerodynamic properties and remarked, that’s not a barrier, it’s a kite! Tall thin noise barriers pose both considerable acoustic and structural problems.

For any noise barrier less than 2 metres high, most of the noise is passing over the top and the transmission loss through the barrier surface is less significant. As the barrier height rises the transmission loss become more significant, especially at lower frequencies. For taller barriers 3 metres and above, it becomes increasingly important to take into account the transmitted component of noise through the barrier surface. All industry standard modelling software (eg - ISO9613-2:2024)⁴ only determine the diffraction loss of a noise barrier and assume transmitted noise is negligible. In addition to the modelled results, it is therefore important to calculate the transmitted noise component across the frequency range based on the certificated performance of the barrier.

6 LOW FREQUENCY PERFORMANCE ISSUES

For industrial noise applications, especially where the source of noise has a dominant low frequency component (<200Hz), it is essential that the noise barrier design is not based on a simple broadband analysis. The ISO9613-2:2024 methodology allows the designer to calculate the barrier diffraction performance down to 63Hz. Most modelling software extrapolate the calculation method to even lower frequency bands. As a rule of thumb, the noise barrier height should be at least of the same order as the wavelength of the noise source. For example if attenuating an idling diesel train which typically

generates high levels in the 40Hz band, a 4 metre high barrier just won't work when the wavelength is close to 9 metres.

Industrial applications tend to have more reflective surfaces – walls, buildings, high-sided lorries, hence absorptive noise barrier designs tend to be the optimum choice. It is very important in designing the barrier scheme to characterise the absorptive performance across the frequency range, especially at low frequencies. Most absorptive barrier products significantly reduce in their absorptive performance below 100Hz. So, for an electrical substation transformer, where the 100Hz component is dominant, it is vital to set the absorptive performance of the noise barrier correctly and realistically so that the right specification values can be determined.

7 INSERTION LOSS / SOUND INSULATION MIX-UP

The airborne sound insulation of a noise barrier product is the reduction in transmitted noise through the barrier surface. This is an intrinsic property of the noise barrier product itself that can be tested in a laboratory with a typical value of 25-30 dB DL_R .

The true benefit of any noise barrier system is the reduction in noise it provides at the noise sensitive receptor which could be a house say 50 metres behind the barrier. This difference in noise at the house, with and without the barrier is the Insertion Loss of the whole scheme. The Insertion loss is an extrinsic property of the barrier. In other words it depends on outside factors; how it is used in that particular scenario, thus it is very site-specific. One would expect this to be of the order of 5-10 dB assuming the mitigation design has been done correctly.

A common error is where these two values are mixed up in the barrier specification. We are increasingly seeing suppliers being asked to provide a noise barrier to give say - an insertion loss of 20 dB (which would be breaking the laws of physics in most practical scenarios). It is important to remember that noise barriers can only be specified on the basis of their intrinsic performance, rather than the extrinsic performance of the scheme which is entirely dependent on its surroundings.

8 TIMBER ABSORPTIVE – GEOTEXTILE PROBLEMS

Geotextile / woven polypropylene membranes are commonly used in the construction of absorptive timber noise barriers. The geotextile membrane acts as a structural support / protection for the absorptive mineral wool core of the barrier. However the intended use of the geotextile product is underground (it's in the name!). Above ground they are prone to rapid deterioration due to UV light. This results in brittling and tearing forming gaps leaving the mineral wool exposed to rapid damage. Even with high concentrations of Carbon-Black treatment, their life expectancy can only be increased to 5-10 years (according to geotextile manufacturers).

Noise barriers specifiers and those vetting designs and specifications should view Timber Absorptive barriers with great caution where a durable barrier system is required (eg for a housing or commercial development). Other more durable products should be considered. However for some industrial applications, where site use and layout can adapt and change every 5-10 years, timber absorptive barrier remain a viable option as a semi-permanent solution.

9 CHECK THE MAINTENANCE REQUIREMENTS!

The structural and acoustic durability of a noise barrier is directly linked to its maintenance requirements. Noise barriers should be specified for a long (~ 40yr) life. The need to go back, other than for routine inspection should be unnecessary. From past experience we would strongly recommend that the manufacturers maintenance regime is therefore taken into consideration in

specifying noise barrier systems. For example, barrier systems that require regular cleaning as part of their maintenance so as to not invalidate the warranty should be treated with caution. This may otherwise go un-noticed and add significant cost to maintain the system to the manufacturers recommendations. If someone declares "Maintenance Free" get them to provide the evidence.

Similarly timber barriers that declare a long operational life - assuming the all timber members are replaced on a regular basis - should obviously be refused. Any 'Only Fools and Horses' fans reading this will recognise the Trigger's Broom⁵ approach being taken here to product maintenance! :

10 REFERENCES

1. Transport Research Laboratory : Published Project Report PPR490 : "The acoustic durability of timber noise barriers on England's strategic road network" (Published May 2010) – All barriers tested were installed after 2001, some much more recently. No Test report evidence has been published since that counters the conclusions of this study with regard to the deterioration of UK timber noise barriers.
2. The Construction Products Regulations 2013, also known as the Construction Products Regulation (CPR), implement Regulation (EU) No 305/2011. This regulation establishes harmonized conditions for marketing construction products.
3. BSEN 14388:2005, Road Traffic Noise Reducing Devices : Specifications. This is the only harmonised standard for road traffic noise barriers and therefore the only one that can be legally used for specifications. It provides the characteristics and means of producing the declaration of performance DoP for the product. A more recent version (2015) was published and is currently listed on the BSI website however it was never harmonised and therefore cannot be used to specify UK road traffic noise barriers.
4. ISO9613-2:2024 : Acoustics – Attenuation of sound during propagation outdoors. Part 2: Engineering method for the prediction of sound pressure levels outdoors.
5. Only Fools and Horses "Trigger's Broom" clip : <https://www.youtube.com/watch?v=LAh8HryVaeY>