Railway noise mitigation factsheet 03: Low-height noise barriers

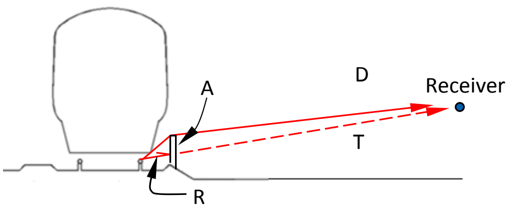
1.1 Overview

Low-height noise barriers are defined in this factsheet as being less than 1.0m high). When used on railways, these barriers are located at or in very close proximity to the ends of the sleepers (typically ~1.7m from the centreline of the track) and provide an alternative to conventional full-height barriers at the trackside, screening noise in close proximity to the source.

Although research dates back as far as 1996 (when application in combination with rolling stock bogie shrouds (wheel covers) was investigated; Jones et al., 1996), their use is not widespread at the current time.

Authors: P A Morgan & J Peeling

1.2 Mitigation modes



Noise barriers reduce noise levels at a receiver behind the barrier by obstructing the direct transmission of airborne sound emanating from the source in front of the barrier (in this case, noise generated at the wheel/rail interface). Sound waves are either reflected back from the barrier, absorbed by the barrier, transmitted through it, or are diffracted[1] over the top of the barrier (see Figure 2).

Provided the density of the materials used for the noise barrier are sufficient to prevent sound transmission, the level of mitigation offered will be primarily dependent upon the height of the barrier, its position relative to the track and the local topography.

For trains travelling at high speeds (in excess of 340 km/h), aerodynamic noise sources will be the primary source of noise disturbance, and these can be distributed over the full height of the train (see Factsheet 01, 'Overview of railway noise'). Low-height barriers are

[1] Diffraction is the bending of sound waves around an obstacle and is dependent upon the frequency of the sound and the size of the barrier or obstacle.

therefore of limited benefit as a sole noise mitigation measure on high-speed rail lines since they will only screen aerodynamic sources in the vicinity of the wheels; alternative methods will be required for the mitigation of aerodynamic noise from sources such as pantographs.

It may be feasible to use these barriers in combination with full-height barriers; whilst the presence of the two diffracting edges may potentially offer a small increase in overall noise reduction, no examples to quantify this have been identified in the literature.

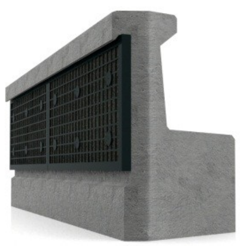
1.3 Noise barrier design

Barrier materials: The materials used for constructing low-height noise barriers are not significantly different to those for conventional noise barriers, e.g. aluminium box sections/panels, concrete, porous concrete, wood cement (where the wood fibres are coated with cement to form a porous matrix of bound fibres. or stone (usually as gabion constructions). However, the close proximity of the barriers to the track means increased sound reflection between the body of the rolling stock and the noise barrier, so sound absorptive barriers are more effective.

Barrier shape/profile: The low height of the barriers restricts their shape/profile to vertical designs. However, one such low barrier tested in Germany incorporated foldable climb-over aids to assist access over the barriers and passages for small animals were also integrated every 20 m along the wall (Figure 3). Depending upon the design of the barrier, they can either be ground mounted or potentially secured to the rail/sleeper.

Examples of three distinctly different low-height barriers have been found, as follows, although no evidence has been identified of these types of barrier being used on high-speed rail lines:

- A reinforced concrete design incorporating sound absorptive elements in the form of a thin mat of finely granulated rubber combined with air pockets (Figure 4a). These have been used on projects in Sweden in two locations (in Umeå (3.5km and 1.5km lengths) and a short 140m section in Örnsköldsvik) and also in trials in Germany (300m in Celle and 300m in Bingen). The barriers require only very basic foundations;



(a) Reinforced concerete absorptive barriers (Photo: Zbloc International)

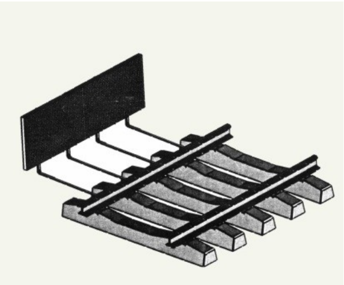
(b) Stone gabion barriers, Germany (Photo: Hering International)

(c) Sound absorptive aluminium panel barriers, Finland (Photo: Soundim)

Figure 4: Examples of low-height barriers used in Europe

- Stone gabions have been trialled on several projects in Germany (Figure 4b), at locations near Ludwigshafen (1.2km) and Bad Godesberg (540m). In addition to conventional gabions filled completely with rocks, designs have been found using a cylindrical profile with three 'chambers'; the outer chambers are filled with rocks and the centre chamber consists of a concrete core and a sound absorptive mat;

- Prefabricated aluminium sections have been used in pilot projects in Ristinummi, Finland (Figure 4b). These are installed on the top of aluminium cable trays. The external appearance and the colours of the barriers can be changed to suit the environment in which the barrier is installed. A study into the functionality of low-height noise barriers has also been ordered by the Finnish Transport Agency;



A further example of a low-height barrier is one where the barrier is fastened to the rail (Figure 5; it is unclear whether this is the actual rail or the sleepers) and, it is assumed, does therefore not require conventional foundations. No examples of this design in practical use have been identified and it is unclear whether the design has progressed beyond the concept stage.

1.4 Indicative performance levels

Figure 2: Noise barrier mitigation modes Absorption (A), Transmission (T), Reflection (R) and Diffraction (D)

Based on a summary of pass-by noise levels recorded over the last 10 years for high speed trains, noise levels for trains travelling at 300 km/h are likely to be of the order of 90 dB(A) at 25 m from the track (Gautier, Poisson and Létourneaux, 2007; see separate factsheet for further details).

For comparative purposes, the pass-by noise levels at 25 m from a motorway due to vehicles travelling at or close to the speed limit will be of the order of 75 dB(A) in the absence of any noise mitigation.

Noise barriers provide screening at a local level only, e.g. in the vicinity of where they are installed and not across the network. A 2012 European Commission report (Clausen et al, 2012) suggests typical levels of noise reduction are, on average over a range of different receptor positions, of the order of 8-10 dB(A) for low height barriers in combination with bogie shrouds. No noise levels are quoted specifically for the use of low-height barriers alone. Practical trials of low railway noise barriers in Finland have indicated reductions of 10 dB (Poikolainen, 2011) although no indication is given as the locations of the receiver positions relative to the track. These reductions will be solely associated with the mitigation of wheel/rail noise.

1.5 Illustrative costs

No cost information on the use of low-height barriers has been identified. The costs will depend upon the design, materials and height of the barrier as well as the ground conditions at the point of installation. However, the size of the barriers means that the costs are likely to be less than for conventional height barriers both in terms of the barriers themselves and the associated foundations that are required.

1.6 Benefits and disbenefits

The **benefits** of low noise barriers can be summarised as follows:

- In common with conventional height barriers, they have a smaller physical footprint compared to other mitigation measures such as earth embankments. However, their position relative to the track means space is less of an issue than may be the case for conventional height barriers;

- The size of the barriers means that the costs are likely to be less than for conventional height barriers both in terms of the barriers themselves and the associated foundations that are required. They will also be less prone to vandalism than conventional height noise barriers;

- The elements of the barrier can potentially be easily removed where work is required on the railway line;

- When equipped with wire mesh, textured surfaces or climb over aids, the barriers can serve to assist passenger exit from carriages in an emergency;

- They can be integrated more easily into the natural environment than other measures.

The **disadvantages** of noise barriers can be summarised as follows:

- Low barriers will not provide screening for all of the most important noise sources for trains travelling at speeds in excess of 340 km/h and will therefore be of limited benefit unless used in combination with other measures;

- The scale of use of low barriers is considerably less than that of conventional height barriers. Although there is some real-world use, many of the reported applications are restricted to test sections;

- The performance of low noise barriers over time has not been sufficiently analysed.

1.7 Suitability for use on HS2

The use of low-height noise barriers on HS2 is perceived to be limited due to their inability to provide screening for the full range of aerodynamic sources. They may potentially be used in combination with other measures such as full-height noise barriers or earth berms where the presence of an additional diffracting edge might provide some additional screening, but this benefit will be small compared to the screening offered by the other measure alone. No examples have been found in the literature quantifying any such effects.

1.8 References

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