

Transport noise Barrier specification



Noise barrier on SH18 following the 'fluid landscape' and 'ribbon wall' urban design themes.

Hobsonville and Brigham Creek

As part of the Western Ring Route in Auckland, two new motorways were built between 2008 and 2011: the SH18 Hobsonville Deviation and the SH16 Brigham Creek Diversion, totalling 9km of 4-lane highway. The urban design concept for the noise walls was 'sinuous orange acoustic walls, undulating within the landforms alongside the highway, providing strong visual features'.

The proposed noise barrier design for the project was described in the winning contractor's tender documentation and urban design plan. Under the design and construct contract used on this project, the design was then developed by the contractor prior to construction. This case study examines the differences between the barrier envisaged in the urban design plan and the end product, and highlights issues with barrier construction details and programming. The case study also draws attention to contract documentation and the importance of robust noise barrier specifications for state highway projects.

Principal's Requirements

Noise mitigation was required at a number of locations along the new motorways to achieve the criteria set in designation conditions. This involved noise walls or bunds of heights between 2 and 4 metres.

Under the design and construct contract, the NZTA included general functional requirements for noise barriers in the Principal's Requirements (PRs) such as:

- a design life of at least 50 years
- minimal maintenance
- line and appearance to be retained over the life of the barrier
- integration with the urban design framework
- interruption to views to be minimised.

Design and construct projects can result in innovation from contractors to develop best-value solutions. However, in this instance, there were no objective measures or specifications for the barrier construction details in the PRs, and in practice the general functional requirements cannot be robustly verified during commissioning. While the PRs suggested that more durable materials than timber or sheet plywood may have been required, timber and sheet plywood were not specifically excluded and hence could be used by the contractor.

Urban design master plan

The winning contractor's Environmental and Urban Design Master Plan addressed the tender requirements for the noise mitigation by incorporating the following features:

- A 'fluid landscape' would be created by the use of spoil to form rolling landforms for noise attenuation and visual continuity, with noise bunds used in preference to noise walls.
- Noise barriers would be in the form of 'ribbon walls', following the motorway where required and interconnecting with rolling landforms and infrastructure elements.
- Where the footprint of a bund restricted the bund height to below that required for the noise attenuation, noise walls would be constructed on the top or sides of the bunds to achieve the additional height.
- Noise walls would be constructed from plywood panels on timber or steel supports.
- A distinctive orange colour would be used for the walls, with a satin or gloss finish – a reference to the ceramics industry that was previously based in the area.
- Where possible, both sides of noise walls would be panelled, providing the same visual amenity for motorway users and those outside the motorway environment.



A section of barrier with visible joints and artwork inspired by vehicle tyre-tracks.

As-built barriers

The as-built noise barriers differed in several respects to those presented in the Environmental and Urban Design Master Plan and a number of issues arose during the construction process:

- For the barriers adjacent to SH18 only the side of the barrier facing the road was panelled and painted.
- Timber supports with rigid connections were used exclusively. (Steel I-section supports can allow for natural movement of plywood panels, thus preventing distortion.)
- The barriers were unpainted for a period of time, potentially allowing moisture ingress. Some delamination of the plywood panels was observed soon after construction, requiring the contractor to replace these panels.
- Because the painting of the barriers was carried out at a late stage, they were not completed in time for the opening of the road and additional traffic management costs were incurred.
- Defects were evident at an early stage, such as gaps at the base of the barriers and warping of the panels.
- Using the panel-based construction technique, the joints are visible due to accumulation of dirt. Joints were not shown in the visualisation for the tender concept design.
- In the design and construction process, there was not sufficient integration of the noise wall design, earthworks and stormwater ponds. This compromised the ribbon wall concept, for example, resulting in hard angles in the walls.
- The barrier designers were not involved during the construction phase to provide quality control and prevent a number of these undesirable outcomes.
- Artworks applied to the barriers were not included in contractor's liability. Therefore, if future maintenance of the barriers requires replacement of the panels, the NZTA may bear the consequential costs of reinstating the artwork.
- In places, the paint surface has blistered near the panel joints. As at October 2012, this is still under investigation.

As the PRs did not specify an objective test or parameters for durability, it is not practical to verify whether the as-built barriers will achieve the required 50-year design life. The construction issues detailed above may reduce the life of the barriers or require more frequent replacement of panels than could otherwise be expected.

The as-built barriers cost approximately \$600 per linear metre for an average height of 3 metres.



Construction issues are evident on this barrier: the rear of the barrier is unpanelled and unpainted, and gaps show between the barrier and the ground.

Noise criteria

The designation conditions for these motorways required noise to be assessed using the Transit Guidelines. A weakness of those guidelines is that they often led to noise mitigation designed solely to achieve perfect compliance with a specified noise limit, and usually with reliance mainly on noise barriers. For this project the result is that substantial noise barriers have been constructed to achieve only modest reductions in noise levels at a small number of houses. For example, a 400m-long noise barrier has been constructed to achieve a reduction of 2 dB at one house.

Since 2010, the NZTA has adopted NZS 6806 for all new and altered state highway projects in place of the Transit Guidelines. NZS 6806 provides a method for holistic evaluation of noise mitigation, including urban design and value-for-money. It also explicitly allows for treatment of individual houses where this would be the best practicable option, rather than noise barriers.

If this project had been assessed under NZS 6806 it is likely that individual houses would have been treated and the noise barriers would probably not have been constructed.

Lessons learnt

- Key objective noise barrier design details should be included in design and construct specifications. These details should include: panel material, double-sided panelling where sheet materials on frames are used, painting or treatment, support connection details to allow for movement of wooden panels, and no gaps in the barriers or between the barriers and the ground.
- PRs should require a sample section of barrier to be installed early in construction for NZTA approval.
- Construction of noise barriers, including painting and artwork, should be scheduled before the road opens to avoid additional traffic management costs.
- The barrier designer should be involved throughout the process, including supervision of construction.
- Cooperation with the local council on artwork worked well and targeted easy-access areas where graffiti may be a problem.
- Where bright colours are to be used and a plain finish is required, the panels should not be butt-jointed, and materials should be selected to have a consistent appearance given the prominence created by the colour.
- Brightly coloured barriers can provoke public and media criticism (in this case, including complaints from road users over loss of sea views due to the barriers).
- Design and construct projects allow supplier innovation to develop best-value solutions. However, this must be underpinned by robust PRs as detailed above.

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