Transport noise Transparency

NOISE BARRIER CASE STUDY 14

NZ TRANSPORT AGENCY WAKA KOTAHI

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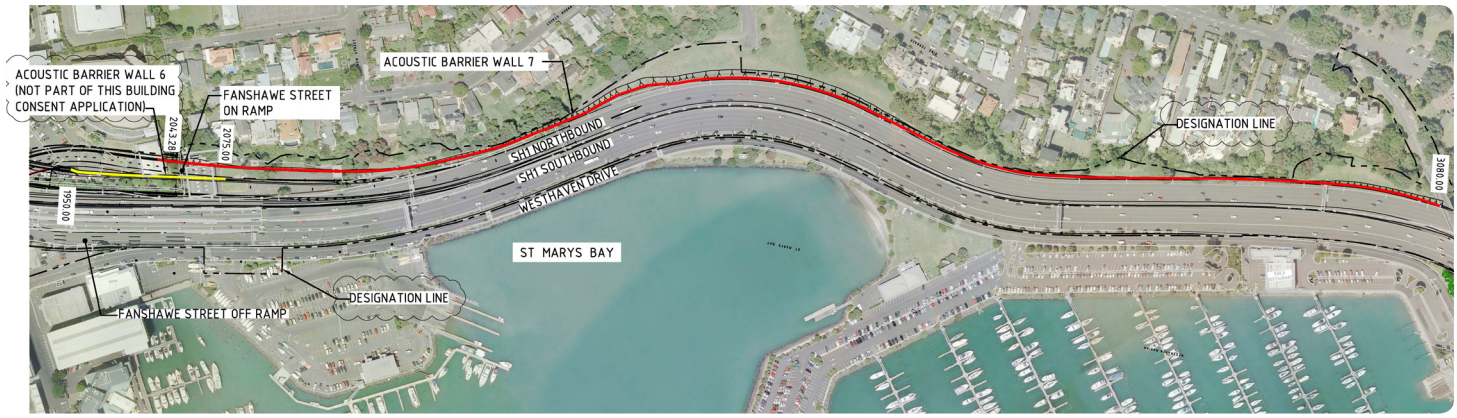


The unique location of the Victoria Park Tunnel noise barriers meant a number of design challenges needed to be overcome

Victoria Park Tunnel

The Victoria Park Tunnel (VPT) project involves the construction of a 450 metre cut and cover tunnel adjacent to the existing viaduct in Victoria Park and motorway widening for 2.2km through St Marys Bay in Auckland. It aims to address the traffic congestion on the central motorway network between the Auckland Harbour Bridge and Newmarket. Construction began in late 2009 and was completed in 2012.

In line with the designation conditions, noise modelling was carried out on the proposed motorway alteration to achieve compliance with the old *Transit guidelines*. Results indicated a continuous noise barrier was required with heights varying between 2 and 5 metres through the St Marys Bay section of the project. Designation conditions restricted the height of the barriers to 5 metres and specified that the noise barriers were to be transparent. In line with these requirements a transparent noise barrier was designed using acrylic panels and steel posts on top of a concrete safety barrier.

The location of the VPT noise barriers has presented significant design challenges along with a prescriptive set of designation conditions. This case study focuses on some of these issues.

Design challenges

The VPT noise barriers are in close proximity to the motorway and cliffs lined with pohutukawa trees. As well as being a significant species of tree requiring protection, the pohutukawa trees attract birds during the flowering season, with the potential hazard for birds striking the transparent noise barrier panels. Views were to be maintained for the cliff top residences overlooking the motorway to the Westhaven Marina and the Waitemata Harbour, as well as for users of the St Marys Bay Reserve, a popular community dog walking and recreation area between the noise barriers and cliffs.

Material selection

The project team undertook an analysis of transparent materials and concluded that just two materials, polycarbonate and acrylic, were suitable for use within the VPT project. Glass was not considered appropriate because local and offshore experience suggested that while it has excellent optical qualities, it is too easily damaged. A comparison between acrylic and polycarbonate was undertaken, and while neither is an ideal solution, on balance acrylic panels were recommended for this specific location. This was based primarily on the enhanced optical clarity of acrylic – a key requirement of the VPT noise barrier was to maintain views over its design life. The greater stiffness of acrylic also reduces the thickness of material required, leading to a small cost saving.

An analysis of transparent materials concluded that acrylic panels were best suited for this location, based upon the enhanced optical clarity of acrylic.

The close proximity of pedestrian access to the noise barriers meant anti-etch film has been used. A special film with black stripes has also been applied to panels to provide a visual cue to help prevent bird-strike.

Bird-strike

Transparent barriers constitute a potential hazard to birds in flight. Advice from an ecologist confirmed that resident bird populations could be impacted by the construction of the barrier in this location. The birds affected include both introduced (eg blackbird, starling, house sparrow and myna) and native species (eg tui, silver-eye, kereru).

Based on overseas studies the best option for avoiding bird-strike was considered to be the use of bold longitudinal striping visible on the transparent panels. Thus providing a sufficient visual cue to prevent bird-strike in the majority of instances, while at the same time maintaining the transparency of the panels. As such a special film with black longitudinal striping was applied to the acrylic panels (motorway facing side) by the manufacturer.

Graffiti and vandalism

Graffiti and vandalism are inevitable to a transparent wall of this magnitude. In regards to acrylic, the principal risk is etching of the panels, as it cannot be easily repaired. While spray-on solutions exist to mitigate the effects of tagging, replaceable adhesive films are the only viable solution to mitigate the effects of etching. Research found few products available that had been used with acrylic. Eventually, an adhesive film for glass, was found to be suitable for acrylic. The product is applied as a film to the panels (non-motorway side), and provides etching protection and a degree of shatter control. The ends of the noise barrier are situated some distance from easy pedestrian access, and as such etching protection has only been applied to the lower 2 metres of the noise barrier where there is pedestrian access.

In addition, landscaping is being undertaken adjacent to the noise barriers to discourage access for graffiti/vandalism. To ensure noise barrier transparency is maintained, low growing species have been selected.

Cost

The overall cost of the transparent barriers was approximately $\$1,200/m^2$ (eg in the order of $6,000 per linear metre at 5 metres high). A substantial proportion of the cost relates to the foundations to accommodate the wind and traffic impact loadings. The barrier is more expensive than conventional barriers using opaque materials such as timber or concrete. The ongoing maintenance cost for the transparent barriers is also expected to be much higher. This includes ongoing costs associated with regular cleaning to remove dirt and motorway grime from the panels, along with the replacement of anti-etch film (after vandalism has occurred).

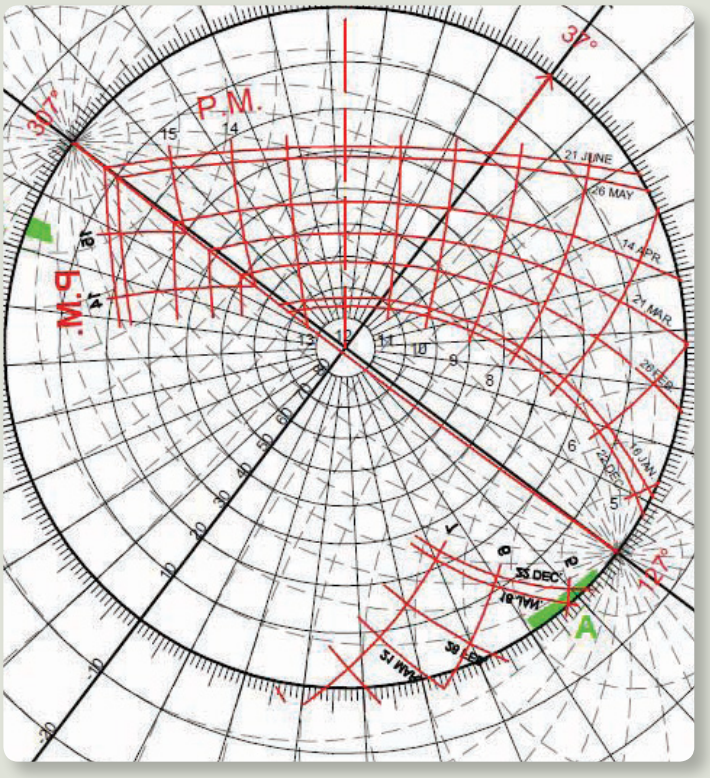
Ongoing maintenance costs will be higher for transparent panels and relates to cleaning and replacement of anti-etch film.

Sunstrike

The use of a reflective material such as acrylic in this particular location has the possibility of causing sunstrike for motorists, which in the worst-case could cause an accident. A specialist assessment determined that southbound drivers may experience sunstrike from some sections of the noise barrier in early morning during summer, and northbound drivers may experience sunstrike in the late afternoon during winter. Further analysis showed the likely timing of the sunstrike to be predominantly outside of peak traffic times, and for a short period of only 4 to 10 minutes.

A review of available products did not identify a suitable replacement for panels causing sunstrike. Suitable anti-reflective films could not be sourced.

A solution to rotate panels by 5 degrees away from the driver was not compatible with the aesthetics of the tapered steel tee support posts. However, this structure allowed a partial solution. The posts were originally conceived with the flanges facing the motorway. By reversing the flanges to face the St Marys Bay Reserve, the projecting tees interrupt reflected light by up to 10 degrees on the motorway side, which slightly reduces the extent of sunstrike. The re-positioning of the posts also allowed more straightforward installation of the acrylic panels, as these could be presented from the motorway side, thereby avoiding constraints of the pohutukawa trees. In the event that sunstrike presents a serious safety concern in the future, retrofitted mitigation is available through attaching deeper fins to posts at affected sites, or sandblasting acrylic panels.



Specialist assessments were undertaken to determine the effects of sunstrike from the acrylic noise barriers on motorists, during specific times of the year and day.

The projecting tees of the noise barrier support post were rotated to face the motorway side as a solution to help reduce the incidence of sunstrike.

Planning restrictions

The complex planning restrictions on the VPT project were an ongoing issue during the design phase. Designation conditions required compliance with the *Transit guidelines*, while at the same time restricting noise barrier heights to 5 metres. The height restriction meant that at some locations where noise barriers were installed only a minimal reduction in noise levels could be achieved.

Designation conditions specifying the use of transparent materials for noise barriers also added challenges as discussed above. Additionally, designation conditions stipulated multiple levels of approvals in regards to the urban design (including the noise barriers). In some cases decisions were changed during the approvals which led to the removal and heightening of trial noise barriers for example.

The application of the *Transit guidelines* along with prescriptive designation conditions about form (eg materials and height), significantly influenced design outcomes for the VPT noise barriers. The *Transit guidelines* have since been replaced by NZS 6806:2010 which sets performance targets and requires an integrated design process to achieve best practicable option in terms of noise. If the VPT project were reassessed under this new process it may have lead to a different design solution.

Noise barriers were designed to meet specific designation conditions and included the use of transparent materials to ensure views were maintained.

Lessons learnt

- There is not a perfect material available for transparent barriers. The strengths and weaknesses of glass, acrylic and polycarbonate should be considered for each specific location. See the NZ Transport Agency *State highway noise barrier design guide* (www.acoustics.nzta.govt.nz) for further guidance.
- When designing transparent barriers, specialist assessment of bird-strike and sunstrike in that specific location may be required.
- For an acrylic barrier a protective replaceable film should be applied in accessible areas to allow etching to be removed.
- When old designation conditions do not allow design of the best practicable option for noise mitigation, consideration should be given to updating conditions to reference NZS 6806.

  Note: Prior to seeking an update to designation conditions, advice should be sought from the NZ Transport Agency, Environment and Urban Design Team.
  Contact rob.hannaby@nzta.govt.nz.

There is no perfect material available for transparent barriers, and strengths and weaknesses should be considered for each specific location. For example glass is too easily damaged, especially where there is close pedestrian access.

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