

HIGHWAYS DEPARTMENT

PRACTICE NOTES NO. BSTR/PN/003 - Revision G

Noise Barriers with Transparent Panels

Bridges and Structures Division

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Contents

	Page No.
1. Introduction	1
2. Suppliers of Transparent Panels	1
3. Competition Policy	1
4. Design Considerations	2
5. Particular Specification Clauses	5
6. Future Improvement	5
Annex I Sample Particular Specification for Noise Barriers with Transparent Panels	6
Annex II Sample Additional Conditions of Contract for Noise Barriers with Transparent Panels	29

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Noise Barriers with Transparent Panels

1. Introduction

Transparent noise barrier panels¹ have the advantages of transmitting light to nearby residents and allowing road users to orientate themselves by providing views of the surrounding area. This Practice Notes No. BSTR/PN/003 is intended to give guidance to designers on the selection and design of the materials to be used in noise barriers with transparent panels. Sample particular specification clauses and additional conditions of contract clauses are provided in the annexes.

2. Suppliers of Transparent Panels

The transparent panels for noise barriers on highways shall be supplied by either:

- (i) Suppliers on the List of Approved Suppliers of Materials and Specialist Contractors for Public Works in the "Transparent Panels for Noise Barriers on Highways" category; or
- (ii) Suppliers for the approved products with a valid certificate under the corresponding category for transparent noise barrier panel of the Construction Product Accreditation Scheme (hereinafter "CPAS")².

3. Competition Policy

The designer shall identify as far as practicable more than one suitable material for the transparent noise barrier panels and have all suitable materials specified on the Drawings³ for the *Contractor* to propose to the *Supervisor* for acceptance. Only in very special circumstances when there is no more than one suitable material should a single material be specified.

Notwithstanding the above, the designer shall seek comments from the relevant maintenance offices for the use of special transparent panel products with proper justifications.

¹ For the avoidance of doubt, the design considerations and requirements specified in this practice notes apply to any noise barrier panel made of Polymethyl Methacrylate (PMMA), polycarbonate or glass, regardless of its opacity.

² CPAS is launched by the Building Technology Research Institute (BTRi) to provide accreditation for construction products and establish a central database to promote local application of high-quality and cost-effective construction products from the Mainland and overseas. The list and the status of CPAS-approved products are accessible at the CPAS online portal (<https://cpas.btri.hk/>)

³ All capitalised terms and italicized terms shall have the meaning assigned to them in the Contract and the Contract Data, respectively.

4. Design Considerations

Apart from the noise mitigation requirement for the noise barrier, the designer shall also consider, *inter alia*,:-

- (iii) Cost effectiveness
- (iv) Safety and fire resistance
- (v) Aesthetics
- (vi) Glare
- (vii) Durability
- (viii) Vandalism
- (ix) Warranty
- (x) Application history
- (xi) Bird collision
- (xii) Maintenance

4.1 Cost effectiveness

The designer must ensure best cost effectiveness for the choice of material(s). This shall include capital cost, life cycle cost (life time maintenance and replacement) and associated costs such as loading on supporting frames and bridge or foundation structures. Whenever practicable, more than one material shall be specified.

4.2 Safety and fire resistance

Where noise barrier elements may fall off onto public traffic areas in the event of vehicular impact, the designer should consider specifying holding devices and catching contrivances on the Drawings.

Normally, holding devices should be provided to prevent panels from falling off the noise barrier. Such devices should hold the four corners of each panel by wire ropes. If holes can be drilled on the panels (e.g. plastic panels), the wire should be fixed to panels via holes near the corners. On the other hand, if drilling on the panels is considered not appropriate (e.g. glass panels), the wire should hold the sub-frames instead. In that case, the panels should be properly glued to the sub-frames by sealant.

Catching contrivances should be provided to prevent spread of panel fragments that could cause hazard to road users. Some materials would be supplied together with catching contrivances facilities but some may not. The designer shall carefully consider his own case and decide in his design whether such requirement could be waived through the incorporation of other protection measures in his design in order to allow for a wider competition of supplies. Such measures could be in the form of mounting the noise barrier on concrete profile barrier or by providing external guard nets. However, external guard nets would seriously affect the appearance of the noise barrier and hence should only be used in very special circumstances.

In case of glass panels, the risks and consequences of fracture and broken glass falling should be duly considered and appropriate mitigation measures should be incorporated into the design. In spite of any mitigation measures proposed, only laminated tempered glass should be used. Fixings should be carefully detailed to avoid direct contact between

the glass and other hard materials, and undue differential thermal stresses or acutely punching impacts. The use of glass for overhead or overhanging installations should be avoided as far as possible, particularly at blackspots and locations prone to fallen objects.

Various materials behave differently under fire. Polymethyl Methacrylate (PMMA) emits less noxious fumes than polycarbonate but it is less resistant to fire spread. Glass is not combustible but it may shatter under fire. The designer shall circulate his proposal to the Fire Services Department for comments.

In general, the following fire safety measures shall be adopted:

- (i) to include 4 m wide transverse firebreak for every 100 m long noise barrier/enclosure;
- (ii) to include longitudinal firebreak for semi-enclosures and full enclosures to reduce the risk of fire spread from the vertical section to the roof section;
- (iii) to incorporate emergency exit points along the noise barriers/enclosures to assist evacuation;
- (iv) to incorporate air vents and pressure release valves for semi-enclosures and full enclosures;
- (v) to minimize the use of transparent panels on the roofs of noise semi-enclosures and full noise enclosures as far as possible while maintaining adequate daylight levels; and
- (vi) to have the transparent panels in compliance with the minimum requirements of reaction to fire as specified in the Annex I of this Practice Notes.

4.3 Aesthetics

In most cases, it is a common practice for the designer to design the supporting posts and the *Contractor* to design the sub-frame in between these posts. The layout of the sub-frame is most important for both the overall aesthetics of the noise barrier and the costs to the project. PMMA normally has a nominal minimum thickness and its cost is less sensitive to sub-frame design. However, cost of polycarbonate panels generally could be reduced if secondary members are added to the sub-frame to reduce the span lengths of the polycarbonate sheets. Therefore, the designer shall clearly state his requirement to ensure fair competition. In particular, the designer shall specify whether the *Contractor* is allowed to add sub-frame members to reduce the size of the panels. The sample Particular Specification in Annex I has been prepared on the basis that the sub-framing arrangement shown on the Drawing has been designed by the designer. The *Contractor* shall design the sub-frames but cannot change the sub-framing arrangement. The designer may change the sample Particular Specification to suit his projects.

4.4 Glare

Unless otherwise treated, all transparent materials reflect light. Under some situations, the reflection of sunlight from slanting or horizontal panels would cause nuisance to nearby

residents. For East-West running noise barriers, the reflection of sunlight at sunset or dawn may also cause nuisance to road users and possibly some residents. The designer should address possible glaring problems and pay attention to the sample PS Clause 27.13(8) that noise barriers shall not reflect light in such a way as to prejudice road safety and top surface of roof panels shall be non-glaring.

4.5 Durability

PMMA, polycarbonate and glass are commonly used as noise barrier panels and are generally acceptable. In special case where high long term resistance to weather and abrasion is required, PMMA and glass perform slightly better and may be considered.

4.6 Vandalism

PMMA and polycarbonate could be damaged by fire, and glass could be damaged by strong impact. The designer shall consider the likely vandalism and decide accordingly.

4.7 Additional Conditions of Contract Clauses and Warranty

It has been a common practice for suppliers to provide a 10-year warranty for PMMA, polycarbonate and glass. Thus, a warranty period of 10 years should normally be specified. The sample warranty form is given in Appendix of Sample Additional Conditions of Contract in Annex II for reference.

4.8 Application history

For quality assurance, transparent noise barrier panels are generally required to possess minimum five years of application history in weathering conditions similar to Hong Kong climate, and shall satisfy the *Supervisor* by at least one successful project for noise barriers on highways or similar works in the past 3 years.

In assessing the manufacturer or his agent's job references, project engineer may have his own set of considerations to suit individual case. As a general rule, a project involving at least \$0.8 million worth of noise barriers with transparent panels works can be regarded as an acceptable job reference.

4.9 Bird collision

There are reported cases where birds collide onto the transparent noise barrier panels causing bird mortality. As the panels are either transparent which appears invisible to birds or reflective that mirrors the facing landscape, birds are unable to recognize them as physical barriers. Having considered the bird collision problem, the Agriculture, Fisheries and Conservation Department (AFCD) recommended that transparent materials should be avoided as far as possible in the design of noise barrier in areas with high bird density or for roads that cut across rural areas.

To address the bird collision problem, the designer should consider bird collision

prevention measures during the design stage. In this regard, transparent noise barrier panels shall be provided with either embedded/superimposed opaque stripes or embedded/superimposed opaque dots/visual markers. The stripe pattern should have a maximum spacing of 2 inches (50mm) for horizontal stripes or a maximum spacing of 4 inches (100mm) for vertical stripes (2" x 4" rules) on transparent panel to prevent bird collision. The colour of visual markers/stripes shall provide as much contrast as possible. The transparent panel may be angled at 20 to 40 degree from the vertical for reducing reflection from the sky and surrounding environment to prevent bird collision. The designer shall seek advice from AFCD on the proposed bird collision prevention measures.

4.10 Maintenance

The design considerations should include maintenance considerations such as the provision of a safe access/means for future maintenance and inspection, maintenance requirements, etc. The selection of the material should take into account its market availability. It would be preferable to have the material readily available on market for immediate purchasing for replacement. Besides, the panel sizes should be standardized as far as possible for ease of future replacement works.

Panel surfaces may be stained by contaminants such as airborne grime, bird droppings, oil droplets from vehicle's exhaust emission and water-splash from the road surface with the passage of time. Frequent cleaning of panel surfaces may be required.

To facilitate the cleaning process and reduce the cleaning frequency of panels, self-cleaning coating may be adopted on the panel surfaces. The designer shall consider the location for application of self-cleaning coating as the cleaning mechanism relies on rainwater. In addition, trial tests shall be carried out to prove the performance of self-cleaning panels.

Safety is a major concern in maintenance. Provision of fall protection measures on noise enclosures shall be considered to facilitate the maintenance operation, such as inspection or replacement of panels on noise enclosures. There are various types of fall protection measures such as guardrail system and fall arrest systems including lifeline system and anchor point system. The designer shall refer to the relevant design standards/guidelines for the approach to determine the appropriate fall protection measures.

5. Particular Specification

Sample Particular Specification Clauses are in Annex I. Designers may use it as a reference in drafting the Particular Specification for their projects.

6. Future Improvement

Comments on this Practice Notes are most welcome so that improvements can be made in future editions. All comments or enquires shall be directed to the Chief Highway Engineer/Bridges & Structures for the attention of Senior Engineer/Projects 1 via email at sep1.bstr@hyd.gov.hk or by phone at 3903 6503.

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