Corporate Circular

CC: BTD2012/01

Transport Roads & Maritime Services

BRIDGE TECHNICAL DIRECTION BTD2012/01

PROVISION OF SAFETY SCREENS ON BRIDGES

Background

Roads and Maritime Services recognises that there is a risk to motorists from objects being dropped or thrown from overbridges onto traffic passing underneath. Generally these incidents are infrequent and sporadic. However, severe injuries and fatalities have occurred in the past.

Technical Direction TD2002/RS02 was issued in October 2002 to provide a risk assessment procedure for the evaluation of the need for screens on existing and new bridges and to set guidelines for the design of the safety (protection) screens.

This Bridge Technical Direction updates and replaces TD2002/RS02.

Objectives

The objectives of this Technical Direction are to:

1. Establish the criteria to determine the need to provide safety screens on new bridges and to retrofit safety screens on existing bridges
2. Provide guidance and standards for the design of safety screens that satisfy structural design, road safety, traffic operation and urban design objectives.
3. Outline alternative and additional measures that can be taken to reduce risk of objects being dropped or thrown from bridges.

This Technical Direction does not cover methods for the prevention of objects being thrown from the side of the road, a cutting or an embankment.

Risk Parameters

The risk of serious injury associated with these incidents is mainly dependent on the height of the bridge above the road beneath and the speed of the vehicle that may be hit by the object.

For passenger cars, an increase in speed from 80 km/h to 100 km/h will have a greater influence on the outcome than doubling the bridge height from 6 to 12 metres. For trucks, with a windscreen angle generally much closer to the vertical, the influence of bridge height is negligible compared with travel speed. It should be noted that this analysis only approximates the injury risk, as there are many other factors that will influence the outcome, including the size and strength of the windscreen, the size, shape and composition of the object being dropped.

Object dropped from high bridges have the potential to cause severe impacts. However, it is more difficult for perpetrators to target individual vehicles accurately.

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Accordingly, the speed of traffic on the road beneath the bridge is the most important factor in determining priorities. It is anticipated that bridges over rural roads where the posted speed limit is less than 80 km/h and for urban roads where the posted speed limit is less than 60 km/h would only be screened in exceptional circumstances.

Assessment Criteria

Assessment for the need for safety screens on bridges over roads shall be carried out using the formal risk assessment process set out in Appendix 2.

The risk assessment factors to be considered and scored are as follows:

- Previous history of incidents and/or signs of graffiti in the vicinity of the bridge
- Ease of pedestrian access
- Type of road underneath
- Posted speed of the road underneath
- Proximity to pedestrian traffic generators such as schools, hotels, clubs, sporting venues etc
- Lighting
- Visibility of pedestrians on the bridge to traffic on the bridge and to traffic passing under the bridge
- Amount of loose material nearby

The theoretical maximum score using the matrix rating system is 68. A score greater than or equal to 30 warrants action.

For new bridges a previous history of incidents in the local area may not be available. In these cases, the experience at similar sites should be taken into account. Where it is anticipated that during the life of the structure a future risk assessment would require their installation, safety screens should be fitted when the bridge is constructed. The installation of safety screens should not be delayed until a serious incident definitely establishes the need.

For existing bridges the risk assessment score should be reviewed if the conditions at the bridge site change.

Safety screens shall be provided on all pedestrian, shared path, cycleway and road bridges with footways over railway lines. For road bridges without footways the Railway Authority shall be consulted to determine the need for safety screens. The design and extent of these safety screens shall be as required by the relevant Railway Authority.

Design Standards

Safety screens shall be designed to have a minimum design life of 50 years. They shall be designed to comply with the requirements set out in Appendix 1.

On existing bridges, screens would normally be retrofitted as separate structural elements independent from the existing pedestrian or traffic barriers.

On new pedestrian, cycleway, shared path or road bridges with footways the screens should be designed as an integrated part of the pedestrian or cycleway barrier systems. On new road bridges the safety screen should be designed with a post spacing and appearance complimentary to the traffic barrier.

Noise walls and privacy screens fitted to bridges, provided they comply with the height requirements of Appendix 1 may also function as safety screens.

Safety screens shall be designed to minimise future maintenance costs and to minimise the risk of damage due to vandalism and graffiti.

Alternative and Additional Measures

If the risk assessment score is marginal and the decision is made not to install safety screens other risk reduction methods should be considered including:

- Removal of loose stones, litter and sundry foreign objects in the vicinity of the bridge that could potentially be used as missiles
- Replacement of timber and metal delineator posts in the immediate vicinity of the structures with lightweight plastic alternatives
- Modification or removal of other road furniture that could be used as projectiles
- Installation of lighting or enhanced lighting
- Raising awareness of the danger of dropping or throwing objects from overbridges with school and community groups and local authorities
- Camera surveillance

Records Management

The installation of safety screen on a bridge shall be recorded in the Bridge Information System (BIS).

Attachments to this Technical Direction

1. Appendix 1 - Design of safety screens on bridges
2. Appendix 2 - Risk assessment matrix

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Approved: Wije Ariyaratne
Principal Bridge and Structures Engineer

DISTRIBUTION:
Publication on RMS' Intranet and the Internet
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Appendix 1 - Design of Safety Screens on Bridges

Geometric Requirements

Safety screens shall have the following geometrical properties:

(a) A minimum height of 3.0 m above the roadway or footway surface or 2.0 m above the top rail or top surface of any adjacent pedestrian or traffic barrier, whichever is the greater.

(b) The safety screen shall extend at least 6 m beyond the edge lane line of the roadway below or, if this is not possible, to within 1 m of the end of the Abutment wing walls or on pedestrian and shared path bridges to the landings at the end of the main bridge spans.
The safety screen shall be at or above the minimum height for a distance of at least 2 m past the outer edge lane line of the roadway below, and may then taper down in height.

(c) Where the safety screen is adjacent to the traffic carriageway, the screen shall have a minimum setback from the inside face of the traffic barrier of 350 mm.

(d) For pedestrian footways on road bridges and on pedestrian bridges the safety screens shall have a minimum head clearance of 2.20 m at the inside face of the railing and 2.40 m at 150 mm from the inside face of the railing or handrail.

(e) On shared path bridges and cycleways the safety screens shall have a minimum head clearance of 2.5 m at 300 mm from the inside face of the adjacent railing or handrail.

(f) A minimum clear width of 80 mm shall be provided between the safety screen and the railing or handrail.

(g) Post spacing shall not exceed 3 m. However, as the standard size of a mesh panel is 2.4 x 3.0 m, post spacing based on an infill panel width of 2.4 m will eliminate the need for a 2 mesh panels vertically.

(h) Pedestrian and shared path bridges with a clear width between railings or handrails of up to 3.0 m may be fully enclosed, but measures shall be taken to restrict unauthorised access onto the top of the screen. On shared path bridges the minimum head clearance over the central 2.0 m of the bridge carriageway shall be 3.0 m.

(i) For safety screens that are not fully enclosed, the maximum effective outward slope measured to a straight line drawn through the top of the infill panel and the bottom of the infill panel at the top of the parapet or kerb shall not exceed 1 in 10.

(j) Posts for safety screens that are located on a bridge where the longitudinal grade of the bridge exceeds 6% at any point, shall be detailed to be truly vertical for the full extent of the screens. Where the longitudinal grade does not exceed 6% at any point, the posts should normally be perpendicular to the top of the concrete parapet or footway surface.

Construction Details

The following construction details shall be adopted for the design of the safety screens:

(a) The design of the safety screen should be modular, so that individual components can be easily replaced if damaged by an over-width or errant vehicle.

(b) It is preferred that safety screens are attached to the top or outside face of the bridge parapets. However, safety screen posts may be bolted to the posts or base plates of traffic barrier railings, provided the minimum lateral clearance requirements are met.

(c) Safety screens shall not be attached to the railings of traffic barriers.

Infill Panels

For normal road bridges the safety screens should use wire mesh panels. However, in special circumstances such as heritage bridges, where the safety screens also have a noise mitigation function,

bridges fitted with advertising signs or bridges that require special architectural treatment the use of alternative panel types may be approved by the Principal Bridge and Structures Engineer.

On pedestrian and shared path bridges, to meet urban design and functional objectives, a range of infill panel types is permitted including wire mesh, perforated metal, profiled or punched metal sheeting and acrylic panels. The safety screen should be reasonably transparent to allow the ingress of light, allow the user to view the surroundings and to allow the motorist to see the pedestrian or cyclist.

Wire mesh panels shall have a maximum square grid of 50 x 50 mm with a minimum wire diameter of 4 mm diameter wire or 358 security mesh with a 75 x 13 grid and a minimum wire diameter of 4 mm. Security mesh should be used where there is an assessed high risk that persons may attempt to climb up the screen.

Where a pattern is required to meet architectural objectives a second decorative mesh panel (typically a 25 x 25 wire mesh) can be tied to the primary mesh panel to produce a silhouette effect. The minimum wire diameter of any secondary mesh shall be 3 mm.

Apart from where security mesh is used the maximum aperture of any gap or opening in the safety screen shall be 50 mm in any direction.

The infill panel shall be securely fastened to reduce the risk of it being stolen.

Design Loadings

Safety screens shall be designed in accordance with AS 5100.

The safety screen shall be designed for the most critical combination of the ultimate dead loads plus one of the following transient load effects:

Wind loading

The ultimate limit state wind speed and wind loading shall be as specified in AS/NZS 1170.2 for a 500 year return period.

Pedestrian Live Loading

Where the safety screen will also function as a pedestrian barrier an ultimate horizontal live load of 2.25 kPa shall be applied onto the screen from the footway level to 1.1 m above footway level.

General Live Load

An ultimate transverse load of 2 kN applied over an area of 0.2 m by 0.2 m anywhere on the screen.

Appendix 2 - Risk Assessment Matrix

Weightings and scores for risk assessment

Assessment Factor Number	Weighting Criteria	Weighting (W)	Scoring Criteria	Score (S)
1	Type of road below		Posted speed of road below	
	Motorway or Restricted Access	10	>80 kph	10
	Major Public Road	6	>60 – 80 kph	9
	Minor road or footway	2	60 kph or lower	8
2	Type of bridge	10	Pedestrian or shared path	10
			Road bridge with footway	8
			Road bridge without footways	0
3	Distance from school	9	Up to 200m	10
			201m - 400m	9
			401m - 600m	8
			601m - 800m	7
4	Distance from hotel or club	8	801m - 1000m	6
			1001m - 1200m	5
			1201m - 1400m	4
			1401m - 1600m	3
5	Distance from youth attraction venue eg sporting venue, skateboard park	6	1601m - 1800m	2
			1801m - 2000m	1
			beyond 2000m	0
6	Other pedestrian generators eg Shopping centres, bus & train stations, high density residential areas	1	Significant generators within 300m	10
			Minor generators within 300m	5
			None within 300m	0
7	Lighting	3	Nil	10
			Adjacent lighting	5
			Lighting on bridge	0
8	Exposure from adjacent buildings	7	Low	10
			Med	5
			High	0
9	Exposure from passing traffic	7	Low	10
			Med	5
			High	0
10	History of incidents and/or signs of graffiti	10	Large amounts of graffiti and record of past incidents.	10
			Small amounts of graffiti	4
			No graffiti or past incidents	0
11	Any loose objects	4	Easily attainable large rocks or objects	10
			Few shrubs, rubbish & small rocks	4
			None	0

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The risk rating score is calculated as the sum of the multiplication of the Weighting W and the Score S divided by number of risk assessment factors:

$$\text{Risk Rating Score} = \sum_{1}^{11} \frac{W \times S}{11}$$

Example Risk Assessment

Assessment Factor No	Description	W	S	W × S
1	A bridge over a major public road that has a posted speed limit of 70 kph	6	9	54
2	Pedestrian bridge	10	10	100
3	500 m from the nearest school	9	8	72
4	More than 2000 m from a hotel, club	8	0	0
5	More than 2000 m from a youth attraction venue	6	0	0
6	Within 300 m of a shopping centre	1	5	5
7	Some light from street lights	3	5	15
8	Medium exposure from surrounding buildings	7	5	35
9	Medium exposure from passing traffic	7	5	35
10	In an area where past incidents of vandalism have occurred	10	10	100
11	Loose rocks in an adjacent garden bed	4	10	40
Sum of WS				456

$$\text{Risk Rating Score} = \frac{456}{11} = 41.5$$

Risk Rating Score ≥ 30, so a safety screen is required.

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