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Technical Direction – TD 00050:2024

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Title: Protection screens on bridges and elevated structures

Transport for NSW (TfNSW) recognises the risk of objects being dropped or thrown from bridges and elevated structures onto traffic passing underneath (motorists, rail or pedestrians). Generally, these incidents are infrequent and sporadic. However, severe injuries and fatalities have occurred due to these incidents, in the past.

This technical direction is issued by the Asset Management Branch (AMB) to provide guidance and requirements for protection screens on bridges and elevated structures along or over transport corridors, as a supplement to AS 5100.

This technical direction also provides a risk assessment procedure to evaluate the need for protection screens on existing and new bridges and elevated structures and to set guidelines for their design.

This technical direction supersedes BTD 2012/01.

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Document information

Owner:	Director Civil Engineering Infrastructure Asset Management Safety, Environment and Regulation
Mode:	Road
Discipline:	Civil

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1 Scope

The scope of this technical direction is to:

- Provide requirements and guidance for the design and detailing of protection screens on bridges and elevated structures along or over transport corridors that are accessible to public.
- Establish the criteria to determine the need to provide protection screens on new bridges and elevated structures and to retrofit protection screens on existing bridges and elevated structures in order to minimise risks from objects being dropped or thrown onto road, rail or pedestrian traffic passing underneath.
- Outline alternative and additional measures that can be taken to reduce risks of objects being dropped or thrown from bridges or elevated structures.

2 Application

This technical direction applies to TfNSW staff, consultants and contractors who are engaged in the development, delivery and maintenance of transport assets.

This technical direction applies to the protection screens that are part of transport assets and those that will be owned by TfNSW in the future. It also applies to protection screens on bridges and elevated structures that are not owned or maintained by TfNSW but are over or immediately adjacent to TfNSW roads or rail corridors.

This technical direction applies to the roads mode for TfNSW bridges and elevated structures and may also be used for the heavy and light rail corridor, where advised by the RIM.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International standards

ASTM A580 / A580M *Standard Specification for Stainless Steel Wire*

EN 10264-4 *Steel wire and wire products – Steel wire for ropes – Part 4: Stainless steel wire*

EN 12385 (all parts) *Steel Wire Ropes – Safety*

Australian standards

AS 1657:2013 *Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation*

AS 2423 *Coated steel wire fencing products for terrestrial, aquatic and general use*

AS 5100.1 *Bridge design Part 1: Scope and general principles*

AS 5100.2 *Bridge design Part 2: Design loads*

AS/NZS 4680 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

AS/NZS 5131 *Structural steelwork – Fabrication and erection*

Transport for NSW standards

TS 00033 *Supply of bolts, nuts and washers* (ATS 5420-20, Ed 1.0 MOD)

TS 01642 (T HR CI 12002 ST) *Durability Requirements for Civil Infrastructure*

TS 01715 (T HR CI 12030 ST) *Overbridges and Footbridges*

TS 01744 (IC-DC-B201 and IC-QA-B201) *Steelwork for Bridges*

TS 01746 (IC-DC-B220 and IC-QA-B220) *Protection of Steelwork by the Use of Paint Coatings*

TS 01753 (all parts) (IC-DC-B264 and IC-QA-B264) *Erection of Barrier Railings and Minor Components*

TS 02404 (T HR CI 12090 ST) *Airspace and External Developments*

TS 03247 (IC-DC-R271 and IC-QA-R271) *Design and Construction of Noise Walls*

TS 04981 (T MU MD 20001 ST) *System Safety Standard for New or Altered Assets*

TS 04982 (T MU MD 20002 ST) *Risk Criteria for Use by Organisations Providing Engineering Services*

Legislation

Work Health and Safety Act 2011 (NSW)

Other referenced documents

PBD 2016-03 *Construction Standards and Conformance*

Safe Work Australia, *Safe design of structures*, Code of Practice

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

ARI average recurrence interval

Asset Custodian the entity accountable for the end to end life cycle management and performance of assets (including asset condition, risk and reporting) on behalf of the asset owner to achieve agreed customer and community outcomes

Asset Steward – **delivery** the entity responsible for the development and delivery of assets (including asset condition, risk and reporting) on behalf of the Asset Custodian for the required life cycle stage and duration of the project (example, TfNSW project development or delivery team)

EAD European Assessment Document

elevated structures structures that have an accessible level difference over or adjacent to a transport corridor such as top of retaining walls, dive structures, tunnel portals, embankments, cuttings, parklands and the like

ETA European Technical Assessment

protection screen a physical barrier installed on bridges and elevated structures to restrict objects from falling or being thrown onto traffic (road, rail or pedestrians) passing underneath

rail corridor the land between the boundary fences over which a railway line passes or, where there are no fences, the extent of land owned, leased or otherwise utilised by the rail operator/state

RIM rail infrastructure manager; in relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person –

a) Owns the rail infrastructure; or

b) Has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it

SFAIRP so far as is reasonably practicable

underbridge a bridge structure that supports a railway track or tracks that can span over roadways, pathways, flood plains, waterways, other railway tracks and large openings

5 Safety requirements

5.1 Safety in design

The design of bridges and elevated structures shall incorporate safety design. *Work Health and Safety Act 2011* (NSW) provides requirements for safety design.

Guidance on the safe design of structures is provided in Safe Work Australia, *Safe design of structures*, Code of Practice. Refer to AS 5100.1 for additional information.

The design of protection screens, including the refurbishment of existing bridges and elevated structures, shall take into account the safety considerations for construction, operational maintenance and decommissioning works and the users of the structures.

The designer shall establish and implement a design process that manages safety across the full life cycle of the structure. The design process shall comply with TS 04981 (T MU MD 20001 ST) and *Safe Design of Structures* Code of Practice.

The design of protection screens shall facilitate safe access for inspection, maintenance and replacement.

5.2 Risk assessment

Risk assessments shall be site-specific.

Risk assessments shall include the following as a minimum:

- road and rail safety audit to identify hazards to all users
- road and rail type, usage, geometry and speed
- previous history of incidents and/or signs of graffiti in the vicinity of the bridge or elevated structure
- ease of pedestrian access
- proximity to the road corridor and traffic lanes
- proximity to the rail corridor and railway tracks
- proximity to pedestrian traffic generators such as schools, hotels, clubs, sporting venues, and so on
- security such as lighting and surveillance
- visibility of pedestrians on the bridge to traffic on the bridge and to traffic passing under the bridge or elevated structure
- amount of loose material nearby
- type of protection screen material, that is, the potential for collapse and damage
- working width of vehicles to protection screen and support elements
- previous barrier impact damage
- presence of hazards at the site, for example visual obstruction or glare
- bridge geometry, that is, straight or curved track, steep or flat gradient
- future usage and growth in patronage
- construction
- maintainability
- replaceability.

Risk assessments shall be submitted for acceptance by the Asset Custodian and Asset Steward – delivery for road projects and also by the RIM for rail corridor projects.

5.2.1 Protection screens over rail corridors

Protection screens on all new overbridges and footbridges over TfNSW rail corridors, and where nominated by the RIM on existing bridges, shall be in accordance with TS 01715 unless otherwise advised by the RIM.

Protection screens shall be provided on bridges and elevated structures with walkways including pedestrian, cycleway shared paths and vehicular bridges over light rail corridors. The

RIM shall be consulted for bridges and elevated structures without walkways and over light rail corridors.

Unless otherwise specified by the RIM, the need for protection screens can be assessed using the risk scoring matrix provided in Appendix A, assuming light rail corridor as a road corridor. Under the risk scoring matrix, segregated light rail alignment is considered as restricted access and based on light rail operational speed. Mixed and separated light rail alignments shall be based on the road classification and road speed environment. The risk assessment shall be subject to approval by the RIM. The design and detailing of protection screen over light rail corridor shall comply with this technical direction.

Protection screen shall be provided for TfNSW bridges over ARTC rail corridors in accordance with technical criteria specified by the RIM or this technical direction subject to approval by the RIM.

5.2.2 Protection screens for developments adjacent to the rail corridor

Protection screen on airspace and external developments shall be in accordance with TS 02404.

5.2.3 Protection screens on underbridges

The requirements for protection screens on underbridges shall be site-specific and subject to approval by the RIM.

5.2.4 Protection screens over road corridors

Protection screens shall be provided for pedestrian, cycleway, shared path bridges, bridges with walkway and elevated structures with walkway over motorways, freeways, highways, main roads and other major arterial routes. For all other bridges or elevated structures, not classified under these, (with or without walkway) over or adjacent to roads, the need for protection screens shall be assessed using the risk scoring matrix provided in Appendix A. The risk assessment shall be subject to approval by the Asset Steward – delivery.

The theoretical maximum score using the risk scoring matrix system in Appendix A is 68. A score greater than or equal to 30 requires installation of protection screen in accordance with AS 5100 and this technical direction.

When the need for the protection screen is confirmed on a bridge, protection screens shall be provided on both sides of the bridge regardless of whether pedestrian or cycle access is only provided on one side of the bridge.

For new bridges or elevated structures, a previous history of incidents in the local area may not be available. In these cases, experience at similar sites should be taken into account. To account for likely or known future developments, if a site-specific sensitivity analysis of the risk

assessment in Appendix A shows the score would require actions, then either of the following shall be complied with:

- protection screens shall be fitted when the bridge or the elevated structure is constructed
- provisions for future installation of protection screens shall be included in the design of the bridge or elevated structure, subject to approval by the Asset Custodian or Asset Steward – delivery.

The risk assessment in Appendix A does not cover situations such as to prevent unauthorised access to an area adjacent to a bridge, structure, attached advertising sign, access or for fall prevention between two adjacent bridges or extreme heights and the like. The need for protection screens in such cases shall be subject to a site-specific risk assessment in consultation with the Asset Custodian and Asset Steward – delivery conducted in accordance with TS 04982 and other applicable TfNSW Standards. Risk assessments shall be undertaken so that potential impacts are identified and mitigated to ensure safety SFAIRP.

5.2.5 Alternative and additional measures for existing bridges over road corridors

For existing bridges or elevated structures, the risk assessment score in Appendix A shall be reviewed if the conditions at the bridge or elevated structure site changes. Where the score requires action, protection screens shall be provided. Alternatively, a further risk assessment in accordance with TS 04982 may be conducted to establish the risk tolerance and determine an asset maintenance strategy for retrofitting protection screens.

Subject to the approval of Asset Custodian and Asset Steward – delivery, if the risk assessment score is between 30 and 32 and the risk rating is either ’C’ or ‘D’ in accordance with TS 04982, protection screens may not be required on existing bridges provided other risk reduction methods are implemented including but not limited to the following:

- removal of loose stones, litter and sundry foreign objects in the vicinity of the bridge or elevated structure 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 danger of dropping or throwing objects from overbridges with school and community groups and local authorities
- camera surveillance.

5.3 Security

Requirements for security and crime prevention strategies shall be determined in consultation with the Asset Custodian or Asset Steward – delivery or RIM.

Where required by the Asset Custodian or Asset Steward – delivery, anti-climb security mesh shall be used when the risk of persons attempting to climb up the protection screen is assessed as high.

6 Durability requirements

For metal elements requiring protective coatings, the type of coating shall be selected to ensure that the coating life to first maintenance is as close as possible to the element's design life.

Dissimilar metal elements in contact shall be electrically isolated to prevent corrosion caused by galvanic reactions.

6.1 Durability for protection screen over rail corridors

Durability requirements for protection screens on bridges and elevated structures along or over TfNSW rail corridors shall be in accordance with TS 01642 and TS 01715.

6.2 Durability for protection screen over road corridors

Protection screen shall comply with Clause 25.2 of AS 5100.2:2017. Protection screens for bridges and elevated structures along or over road corridors, including support elements and infill panels shall be designed to have a minimum design life of 50 years. Anchorages on new bridges or elevated structures shall have a minimum design life of 100 years.

Anchorages on existing bridges or structures shall have a minimum design life comparable with the expected remaining life of the bridge or structure but no less than 50 years.

For pedestrian, cyclist and shared path bridges, the material for the mesh infill shall be stainless steel with minimum grade 316.

7 Geometric requirements

Protection screens shall be in accordance with AS 5100.1. In addition, the following geometrical requirements apply:

a. A minimum height of 3 m above the roadway or footway surface or kerb or a ledge that people can stand on, or 2 m above the top rail of any adjacent pedestrian or traffic barrier, whichever is greater. Top surface of a concrete parapet of traffic barrier shall be classified as a ledge for the purpose of this document. See Figure 1.

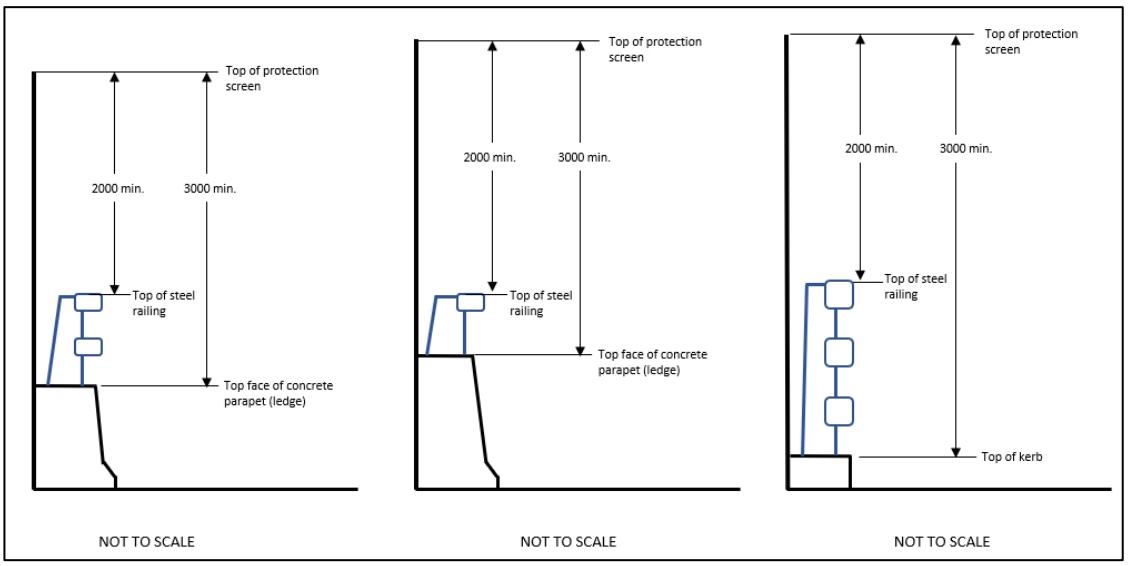

Figure 1 – Minimum height of protection screen from top of railing or concrete parapet or kerb

b. For bridges over road corridor, the protection screen conforming to minimum height requirement shall be extended not less than 6 m beyond the edge of the travelling lanes (including provision of future widening of carriageway) and may then taper down in height to meet aesthetics or urban design requirement.

c. For bridges over rail corridor, the protection screen conforming to minimum height requirement shall be extended not less than 9 m from the centreline of the outermost rail track (including provision of future track) and may then taper down in height to meet aesthetics or urban design requirement.

d. For skewed bridge crossings, the 6 m minimum extension shall be measured perpendicular to the edge lane line of the carriageway below bridge or the 9 m minimum extension is measured perpendicular to the centreline of the rail track, and not along the protection screen.

e. For bridges or elevated structures parallel and adjacent to transport corridor (road carriageway, rail corridor or footpath) which is located at lower level, protection screen conforming to minimum height requirements shall be installed and extended along the geometry of bridges or elevated structures. The protection screen can be terminated when the footway or road level of the bridge or elevated structure is equal to or less than 2 m above the adjacent transport corridor level.

f. Where protection screen is designed as an integral part of the pedestrian or cycleway barrier systems, vertical protection screen shall either be provided, or the lower part of protection screen be vertical without climbing footholds. Vertical protection screen portion shall be at least same height to the pedestrian or cycleway barrier systems in accordance with Clause 16.2.3 (a) of AS 5100.1:2017.

g. Pedestrian, shared path or cycleway bridges may have screens fully enclosed with minimum vertical clearance above the pedestrian, cyclist or shared paths in accordance

with AS 5100.1. In addition, for fully enclosed screens (curved inwards or levelled top), the minimum vertical clearance over the central 2 m of the cycleway or shared path shall be 3 m. See Figure 2.

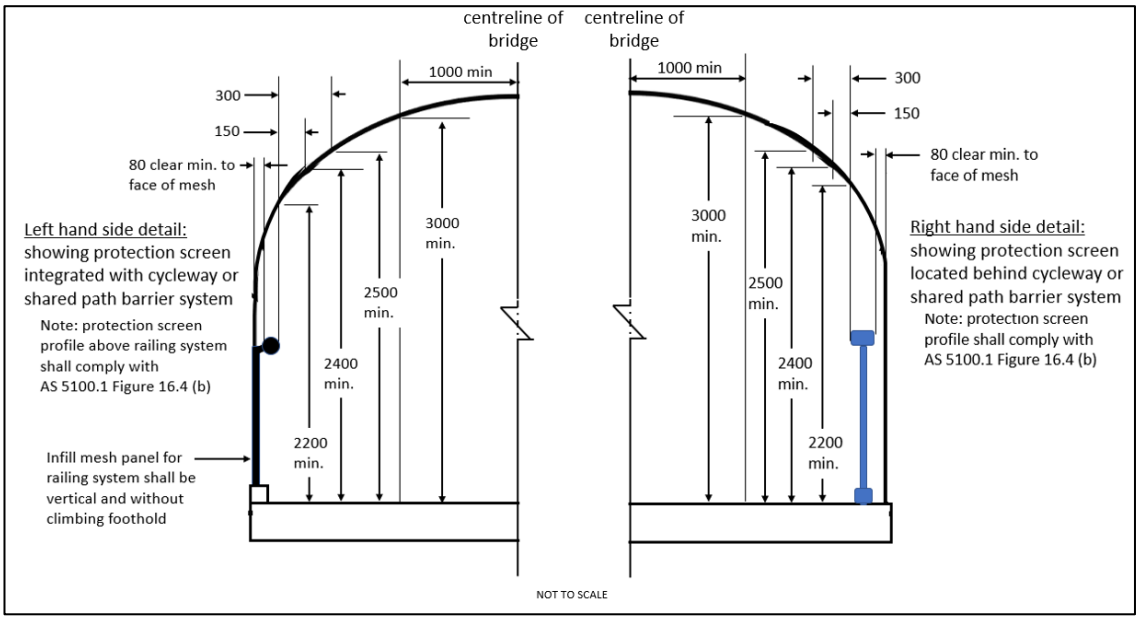

Figure 2 – Geometry requirement of enclosed protection screen for cycleway or share path bridge

h. For protection screens that are not fully enclosed, the maximum effective outward slope measured to a straight line drawn through the top of the protection screen infill panel and the bottom of the protection screen infill panel at the top of the concrete parapet or kerb shall not exceed 1 in 10. In addition, top of the posts shall be in line with top of the protection screen infill panel. See Figure 3. This outward slope protection screen configuration shall not be used for bridges or elevated structures over rail corridors.

i. For protection screens that are not fully enclosed and with kink arrangement at height, the maximum outward slope in any part of the protection screen shall not exceed 1 in 10 measured in the vertical direction. The overall 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 concrete parapet or kerb shall not exceed 1 in 10. See Figure 3. This outward slope protection screen with kink configuration shall not be used for bridges or elevated structures over rail corridors.

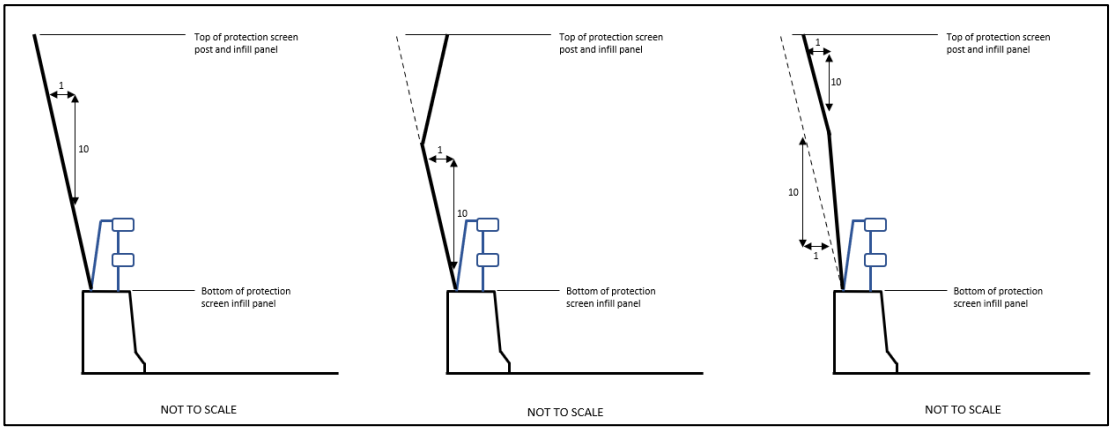

Figure 3 – Maximum outward slope of protection screen not exceeding 1 in 10

j. Posts for protection screens that are located on a bridge or elevated structure should normally be perpendicular to the top of the concrete parapet or footway surface. However, when the longitudinal grade of the bridge or elevated structure exceeds 6% at any point, posts shall be detailed to be truly vertical for the full extent of the screens.

k. Gap, if any, between the bottom edge of the screen and the bridge or elevated structure shall not be greater than 10 mm.

l. End termination of protection screen shall include risk assessment against unauthorised access to the outer face of protection screen or top of enclosed protection screen. Measures, configuration geometry and protection screen end termination detailing shall be provided to restrict unauthorised access.

8 Design and detailing requirements

Protection screens shall be designed and detailed in accordance with AS 5100.1 and AS 5100.2. In addition, the following requirements apply:

a. The ARI to be used for the calculations of the ULS and SLS wind forces shall be 1000 and 20 years, respectively.

b. The protection screen shall be installed on top of a concrete parapet of traffic barrier or a kerb to reduce the possibility of objects falling from the bridge.

c. For a new pedestrian walkway, cycleway, shared path either as a standalone bridge or on a road bridge, the screens can be designed as an integral part of the pedestrian or cycleway barrier systems. Where the protection screen also serves as a pedestrian or cyclist barrier systems, it shall be additionally designed for the loadings applicable to the pedestrian or cyclist barrier in accordance with AS 5100.2.

d. Post spacings for protection screens shall not exceed 3 m. For aesthetic considerations, post spacing for protection screen shall be as even as practical.

e. On new road bridges (and existing road bridges where applicable), the protection screen shall be designed with a post spacing and appearance complimentary to the traffic barrier:

Protection screens posts shall either be attached to the top or outside face of the bridge concrete parapets of traffic barriers or may be bolted to the posts or base plates of traffic barrier railings, provided the minimum working width clearance and setback requirements are met. Protection screen posts and infill panels shall not be attached to the railings of traffic barriers.

f. Where expansion joints are detailed on bridges or elevated structures, a joint in the protection screens shall be provided at each and every expansion joint location in the bridges or elevated structures. The joint in protection screens shall be detailed such that there is no break in the protection provided by the protection screen and no hazard to the users of the bridge.

g. Protection screens shall be designed to minimise future maintenance costs of all elements including maintenance of the protective coatings and the risk of damage due to vandalism and graffiti.

For existing bridges or elevated structures, protection screens shall be retrofitted as separate structural elements independent from the existing pedestrian or traffic barriers. The connection details shall not adversely affect the load carrying capacity of existing structural components.

8.1 Infill panels

In order to meet urban design, functional objectives and subject to satisfying all the requirements in AS 5100.1 and AS 5100.2 and this document, a range of infill panel types may be used including welded wire mesh, tensile cable mesh, perforated metal, profiled or punched metal sheeting and acrylic panels.

The infill panels shall be transparent to allow the ingress of light, allow the user to view the surroundings and to allow the road or rail user or pedestrians to the see the pedestrians or cyclists above. Solid opaque parapet walls or panels shall not be permitted for protection screens on bridges. They can be used only at specific locations with prior approval from the Asset Custodian and Asset Steward – delivery.

All infill panel types shall comply with the design and durability requirements in Section 6 of this document and AS 5100. The infill panel shall be fabricated in a way that the breakage of one wire or cable of the opening does not result in the failure of other wire beyond that opening.

The following wire mesh panel types may be used provided they comply with the design and durability requirements in Section 6 of this document, AS 5100.1 and AS 5100.2, and the acceptance criteria in Section 8.1.1 and Section 8.1.2:

- welded wire mesh panels with a maximum square grid of 50 mm x 50 mm with a minimum wire diameter of 4 mm
- anti-climb security mesh, such as 358 security mesh with a 75 mm x 13 mm grid and a minimum wire diameter of 4 mm

- welded wire mesh panels with a maximum square grid of 25 mm x 25 mm with minimum wire diameter of 3 mm
- stainless steel tensile cable mesh types with diamond-shaped openings with minimum wire diameter of 3 mm such that a 46 mm diameter sphere cannot pass through; area of the clear opening is not greater than 2120 mm^2 for bridges over road corridors or pedestrian paths; all components of the mesh system shall be stainless steel with minimum grade 316
- stainless steel tensile cable mesh types with diamond-shaped openings with minimum wire diameter of 3 mm such that a 22 mm diameter sphere cannot pass through; area of the clear opening is not greater than 490 mm^2 for bridges over rail corridors; all components of the mesh system shall be stainless steel with minimum grade 316.

Where a pattern is required to meet architectural objectives, a second decorative mesh panel (for example a 25 mm x 25 mm wire mesh) with the same material as the primary mesh may be tied to the primary mesh panel to produce a silhouette effect. The minimum wire diameter of any secondary mesh shall be 3 mm.

Perforated metal profiled or punched metal sheeting and tensile cable mesh shall comply with the geometric requirements in this document and AS 5100. These types of infill panel materials require specific operational and maintenance requirements and the whole-of-life cost shall be determined. The use of these infill panels shall be approved by the Asset Custodian and Asset Steward – delivery or RIM.

Noise walls fitted to road bridges or elevated structures, which comply with this document, may also function as protection screens. Noise walls shall comply with TS 03247.

The infill panels shall be securely fastened to reduce the risk of it being stolen or falling onto road / rail corridors underneath.

All vertical joints or overlaps in the infill mesh panels shall be located at the protection screen posts only.

8.1.1 Infill panels for pedestrian or cycleway barrier systems

Infill panels for independent pedestrian or cycleway barrier system or protection screen infill panels forming part of an integral pedestrian or cycleway barrier systems, together with members and connections that provide structural support, shall be designed to withstand the imposed actions in accordance with Clause 12.5 (b), (c) and (d) of AS 5100.2:2017.

The infill panels shall be designed and tested for strength and rigidity with following acceptance criteria:

a. For the imposed actions specified in Clause 12.5 (b) and (c) of AS 5100.2:2017, the horizontal deflection at the centre of an infill panel shall not exceed the limit of:

   [(height of infill panel / 60) + (length of infill panel between posts) / 240] or 30 mm, whichever is the smaller.

The infill panel or its connection to the pedestrian or cycleway barrier systems shall not have permanent deformation.

b. For the imposed actions specified in Clause (d) of AS 5100.2:2017, the infill panel or its connections to the pedestrian or cycleway barrier systems shall not have any structural failure.

For testing method, refer to Appendix C of AS 1657:2013, or approved equivalent.

8.1.2 Infill panels for protection screen

Infill panels of protection screens, together with members and connections that provide structural support, shall be designed to withstand the imposed actions in accordance with Clause 25 of AS 5100.2:2017.

The infill panels shall be either designed and tested with following acceptance criteria:

a. Under serviceability wind load, the horizontal deflection at the centre of an infill panel shall not exceed the limit of:

(length of infill panel between posts) / 60 or 50 mm, whichever is the smaller.

The infill panel or its connection to the posts shall not have permanent deformation.

b. For the imposed actions specified in Clause 25 of AS 5100.2, the infill panel or its connections to the posts shall not have any structural failure.

8.2 Records management

The installation of protection screens on a bridge, including drawings and reports, shall be recorded in the relevant bridge asset information system.

9 Construction requirements

Materials and fabrication of protection screen shall comply with NSW Government's Procurement Board Direction PBD 2016-03. Protection screens shall be fabricated by TfNSW prequalified or registered fabricators.

Protection screen steel structure designated construction category (CC) and associated traceability type in accordance with AS/NZS 5131, shall be minimum CC2.

The design documentation shall include all project specific requirements necessary for completeness of the technical specifications. Drawings shall include notes referencing to relevant TfNSW Standards and Australian Standards for materials, fabrication and installation requirements.

The technical specifications for steel protection screens fabrication and construction shall be in accordance with TfNSW Standards such as TS 00033, TS 01744, TS 01746 and TS 01753.

Unless otherwise specified on drawings:

- welded mesh shall comply with AS 2423 and be hot dip galvanised after fabrication in accordance with AS/NZS 4680
- stainless steel rigid mesh wire shall comply with ASTM A580 / A580M
- stainless steel tensile cable mesh shall comply with EN 10264-4 and EN 12385.

Stainless steel tensile cable mesh system shall comply with EAD or approved equivalent. ETA certification or approved equivalent shall be provided.

For protection screen materials not covered by TfNSW Standards, the project shall develop appropriate additional technical specifications from specialist technical literature to ensure that the designed works can be properly specified and constructed to adequate engineering performance levels and achieve its design life.

Appendix A Risk scoring matrix

Table 1 shows the weighting and scores for risk scoring matrix.

Table 1 – Weighting and scores for risk scoring matrix

Assessment factor No.	Weighting criteria	Weighting (W)	Scoring criteria	Score (S)
1	Type of road below • Motorway or Restricted Access • Major public road • Minor road or footway	10 6 2	Posted speed of road below • ≥ 80 kph • 70 kph • 60 kph or lower	 10 9 8
2	Type of bridge or elevated structure	10	• Pedestrian or shared path bridge • Road bridge / elevated structure with footways • Road bridge / elevated structure without footways	10 8 0
3	Distance from school	9	Up to 200 m 201 – 400 m 401 – 600 m 601 – 800 m 801 – 1000 m 1001 – 1200 m 1201 – 1400 m 1401 – 1600 m 1601 – 1800 m 1801 – 2000 m Beyond 2000 m	10 9 8 7 6 5 4 3 2 1 0
4	Distance from hotel or club	8	Up to 200 m 201 – 400 m 401 – 600 m 601 – 800 m 801 – 1000 m 1001 – 1200 m 1201 – 1400 m 1401 – 1600 m 1601 – 1800 m 1801 – 2000 m Beyond 2000 m	10 9 8 7 6 5 4 3 2 1 0

Assessment factor No.	Weighting criteria	Weighting (W)	Scoring criteria	Score (S)
5	Distance from youth attraction venue e.g. sporting venue, skateboard park	6	Up to 200 m 201 – 400 m 401 – 600 m 601 – 800 m 801 – 1000 m 1001 – 1200 m 1201 – 1400 m 1401 – 1600 m 1601 – 1800 m 1801 – 2000 m Beyond 2000 m	10 9 8 7 6 5 4 3 2 1 0
6	Other pedestrian generators e.g. shopping centres, bus / train stations, high density residential areas	1	Significant generators within 300m Minor generators within 300m None within 300 m	10 5 0
7	Lighting	3	Nil Adjacent Lighting Lighting on bridge / elevated structure	10 5 0
8	Exposure from adjacent buildings	7	Low Medium High	10 5 0
9	Exposure from passing traffic	7	Low Medium High	10 5 0
10	History of incidents and / or signs of graffiti	10	Large amounts of graffiti and record of past incidents Small amounts of graffiti No graffiti or past incidents	10 4 0
11	Any loose objects	4	Easily attainable large rocks or objects Few shrubs, rubbish & small rocks None	10 4 0

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 as shown in Equation 1.

$$\sum_{1}^{11} \frac{WxS}{11}$$

Equation 1 – Risk rating score

Figure 4 shows an example of risk rating score calculation where the score is greater than 30 and hence a protection screen is required.

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

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

Figure 4 – Example risk assessment

Authorisation:

Approved by	Director Civil Engineering Infrastructure Asset Management Safety, Environment and Regulation