TS 01001:1.0

CRN CS 300

Standard

Structures System

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Version 1.1	30 January 2022	TfNSW Template applied.
Version 2.0	30 January 2022	First full UGLRL issue

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1. Purpose, scope and application

This Standard is the "head" standard for bridges and structures. It establishes the high-level engineering standards for the design, construction and maintenance of bridges and structures on the Country Regional Network (CRN).

It also establishes the conventions adopted for describing types of bridges and structures and their individual members and contains definitions of standard terminology.

2. References

2.1. Australian and International Standards

AS 4292	“Railway Safety Management”
AS 5100	“Bridge design”

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

2.2. CRN documents

CRN CS 100	Civil Technical Maintenance Plan
CRN CS 215	Transit Space
CRN CS 310	Underbridges
CRN CS 320	Overbridges & footbridges
CRN CS 330	Miscellaneous structures
CRN CP 204	Product Approval
CRN CP 301	Structures Construction
CRN CM 001	Civil Technical Competencies and Engineering Authority
CRN CM 101	Civil Service Schedules
CRN CM 301 to CRN CM 311	Structures Engineering Manuals
CRN CM 302	Structures Examination

2.2.1. Other references

Rail Safety National Law (NSW) 2012 and Rail Safety National Law National Regulations 2012

NSW Work Health and Safety Act 2011

NSW Heritage Act 1977 and Heritage Regulation 2012

3. Engineering authority for bridges and structures

UGL Regional Linx Pty Ltd (UGLRL) CRN's Principal Track and Civil Engineer exercises Engineering Authority for all bridge and structures work undertaken on CRN infrastructure.

The Principal Track and Civil Engineer may delegate engineering authority for specified tasks

4. Bridge and structure categories

Bridges managed by UGLRL CRN fall into three (3) general categories:

Underbridges: These are bridges supporting the track and passing over waterways, roadways, pathways, flood plains, etc. Underbridges include viaduct, subway and culvert structures.

The term '**viaduct**' is used to refer to underbridges in excess of 100 metres in length.

The term '**subway**' is used to refer to an underbridge that passes over a pedestrian pathway.

The term '**culvert**' is used to refer to minor ballast-top openings comprising metal pipes, concrete pipes, concrete boxes, concrete arches, brick and masonry arches.

The term '**minor opening**' is also commonly used to refer to an underbridge less than 10 metres in length.

Overbridges: These are bridges carrying road vehicles or livestock over the track, and may include provision for pedestrians.

Footbridges: These are bridges over the track carrying pedestrian traffic only, and may be freestanding or combined with an overhead booking office and/or retail outlets.

In addition to bridges as defined above, there are specific categories of other *structures* on the CRN network crossing over, under or adjacent to the track:

Tunnels: These are structures constructed through high terrain that enables the rail track to continue at an acceptable grade. It may be constructed by boring or by cut and cover. It may be fully lined or unlined (depending on the stability of the natural ground) and may be constructed with drainage systems, ventilation shafts and safety refuges.

Overbridges built to accommodate wide or skewed roadways are not defined as tunnels.

Retaining Walls: Retaining walls are constructed to protect the rail track from subsidence or land slips and are typically provided in cuttings or on narrow embankments. They are also constructed in areas where natural ground batters and the necessary cess width are not possible owing to the limited width of the railway easement. They are typically constructed in timber, masonry, concrete, gabions, steel sheeting, reinforced earth or rails and sleepers.

Station Platforms: These are line-side structures built to provide public access to passenger trains.

Signal Gantries: Portal structures built to support signals over the tracks.

Buffer Stops: These are structures provided at the end of rail lines or sidings to prevent rolling stock from running off the end of the track and/or colliding with adjacent structures.

Service Crossings: These are structures carrying commercial product or utilities over or under the tracks and across the railway corridor.

Overhead Loading Structures: These are structures constructed over a rail track that permit the loading of bulk products into open-top freight wagons.

Unloading Bins: These are structures constructed beneath a rail track that permit the discharge of bulk products from the bottom of freight wagons.

Rockfall Shelters: Rockfall shelters are structures installed over and beside a rail track to prevent loose material from adjacent cuttings falling on to the rail line.

Lighting and Communication Towers: These are structures installed beside a rail line for the purpose of supporting overhead lighting and aerial communication lines.

Cranes, Storage Dams, Turntables, Water Columns, Water Tanks and Weighbridges: These structures are generally decommissioned and located in many cases on disused lines.

Cattle Grids: These are specially fabricated steel grids placed over the track at locations where boundary fences are intersected, to prevent livestock straying onto other properties.

5. Bridge and structure design

5.1. General

All bridges and structures on the CRN network shall be designed, constructed and maintained to meet the following general criteria:

- Provide a safe and reliable corridor for the passage of all rail, road and pedestrian traffic;
- Be capable of supporting the current / known future operation of rail traffic at the designated loads and speeds;
- Conform with transit space requirements
- Provide impact and derailment protection where applicable
- Meet the specified Availability, Reliability and Maintainability requirements.

The design of each bridge and structure shall be integrated taking into account all associated requirements such as service routes, signalling infrastructure, drainage, bonding and architectural treatments. Where appropriate, aesthetics shall be taken into account including proportions, details and finishes.

Approved construction materials for main structural elements are steel and concrete. Masonry and timber is approved for existing structures. With the exception of bridge transoms, timber materials shall not be used as structural elements in the design of new bridges and structures.

Fibre composite and engineered timber products may be used subject to the approval of the Principal Track and Civil Engineer.

All bridges and structures on the CRN network shall be managed in accordance with the requirements of the following CRN standards

- Underbridges CRN CS 310
- Overbridges & footbridges CRN CS 320
- Miscellaneous structures CRN CS 330

The Principal Track and Civil Engineer may approve permanent waivers to the requirements of the standards at specific locations. Where such waivers have been granted they shall be listed in the relevant standards.

5.2. Design life

All bridges and structures shall be generally designed for a design life of 100 years, in accordance with AS 5100 “Bridge Design”. Major assets in service such as steel truss bridges, long viaducts and tunnels shall, however, be maintained and preserved for an indefinite service life.

Bridges and structures configuration shall be selected to minimise the “Whole of Life” cost of the asset.

5.3. Transit space requirements

The design of the bridges and structures shall comply with the Transit Space requirements specified in CRN Engineering standard CRN CS 215 “Transit Space”.

The area extending one metre below design rail level of Normal Structure Gauge 1994 as detailed in CRN CS 215 shall be kept clear of structures and structure footings.

When modifying or replacing line-side or overhead structures, clearances, track centres and shoulder widths should be increased to the current standards to the maximum extent possible given practical restraints at the site. Where current standards cannot be achieved the approval of the Principal Track and Civil Engineer shall be obtained.

5.4. Safety

All works shall be designed to comply with the requirements of relevant safety, statutory and regulatory requirements and Australian Standards, in particular the Rail Safety National Law (NSW) 2012 and Rail Safety National Law National Regulations 2012, NSW Work Health and Safety Act 2011 and AS 4292 “Railway Safety Management”.

Designs for structures shall provide safe access for inspection and maintenance. This may include access steps, ladders, cages, walkways and fixing points.

Trackside structures shall not be painted in safeworking colours of red, orange or green.

5.5. Heritage assets

Heritage considerations and classifications shall be observed in all designs. This may have particular application in circumstances where:

- an existing structure is being refurbished or modified
- a new structure is being proposed in the vicinity of existing heritage items
- a redundant structure is to be demolished.

A heritage register shall be established and maintained for bridges and structures under UGLRL CRN control, in accordance with the provisions of the NSW Heritage Act 1977 and Heritage Regulation 2012.

The Heritage Branch of NSW Department of Planning maintains a State Heritage Inventory. The State Heritage Inventory is available on their website at www.heritage.nsw.gov.au.

These registers shall be referenced before planning any changes to structures assets to ensure changes comply with the requirements of the NSW Heritage Act.

5.6. Maintenance and maintainability

The existing bridges and structures assets on CRN are maintained in accordance with the Civil Technical Maintenance Plan (CRN Engineering standard CRN CS 100) and a suite of Service Schedules (CRN Engineering manual CRN CM 101). In addition, bridges and structures assets are installed, inspected and maintained using procedures documented in CRN Engineering Manuals CRN CM 301 to CRN CM 311. Installation, inspection and maintenance tasks are undertaken by people with the competencies documented in CRN Engineering Manual CRN CM 001.

When undertaking new bridge and structure designs, deterioration limits (to be referred to as Defect Limits) shall be set for relevant components that have failure modes with significant impact. A Mandatory Response shall also be set for each Defect Limit found, ranging from recording for future information and action to immediate closure of the track (or road). Limits and responses developed in the design shall be formulated to match the response regime documented in CRN Engineering Manual CRN CM 302 “Structures Examination”.

Technical Maintenance Plans (TMP) and Service Schedules (CSS) shall be prepared and implemented for all bridge and structure assets, specifying which items are to be maintained, what maintenance is to be carried out and when maintenance is required. Preventive Maintenance tasks already documented in CRN CS 100 and CRN CM 101 shall be utilized where possible. The TMP and Service Schedules shall be documented in a format that can be readily incorporated into CRN CS 100 and CRN CM 101. Installation, inspection and

maintenance procedures shall be documented in a format that can be readily incorporated in CRN CM 301 to CRN CM 311.

New designs shall consider and incorporate ease and cost of future maintenance. This includes consideration of site access, distance and time for staff to attend and staff knowledge and skills. Standard components should be used wherever possible to minimise costs, repair times and the risk of staff error.

When considering access to site for maintenance, designers shall consider the location and orientation of components that require regular maintenance with respect to the defined danger zone within the rail corridor. To maximise the safety of personnel whilst maintaining fixed equipment within the rail corridor, it is important that the manufacture and installation design of such equipment, wherever practicable, be such that personnel are able to work outside the danger zone and are not required to work with their backs to the danger zone.

5.7. Construction

Standard construction specifications shall be used for the manufacture, fabrication, erection and installation of bridge and structures components, and the construction of associated civil works.

UGLRL CRN has a suite of technical specifications for construction of bridges and structures. The specifications are detailed in CRN Engineering Specification CRN CP 301 “Structures Construction” and shall be incorporated in the design and construction documentation of structures. The specifications generally adopt the NSW Roads and Maritime Services (RMS) QA Specifications as posted on the RMS web site. The specifications include specific UGLRL CRN requirements where necessary.

5.8. Type Approval

Structure components, specialised repair processes and tools are subject to type approval, which is a process that assesses the fitness for purpose of any item from a specified manufacturer for use on the network. Products, manufacturers, and processes currently approved for use on CRN track infrastructure are detailed in appendices to CRN CS 310, CRN CS 320 and CRN CS 330.

If the design incorporates products (whether new or from a non-approved manufacturer) or processes that are not currently approved for use on CRN infrastructure, type approval shall be sought in accordance with the requirements of CRN Engineering Specification CRN CP 204 "Product Approval".

The type approval of an item from a specified manufacturer does not necessarily indicate that it is the preferred item for a specific site or operational requirement.

6. Description of bridges and structures

Terms used to describe individual members of bridges and structures are listed in Appendix 1. Sketches of typical bridge spans and members are shown in Appendix 2.

7. Bridge spans

7.1. Length

The length of bridge spans is measured and described as follows:

- Timber bridges: distance between centres of headstocks.
- Steel bridges: distance between centres of bearings.
- Concrete bridges: distance between centres of bearings.
- Brick and Stone bridges: distance between faces of piers.

For bridges with an integral deck, walls, and invert (e.g. box culverts, arch culverts, box drains and pipes), the span length is measured between faces of walls.

Skew spans are measured generally parallel to the supported track or road.

7.2. Types

There are three (3) types of bridge span:

- **Deck** - Has track on top with no parts of bridge above rail height.
- **Through** - Any type of bridge that has sides above the level of the track with no parts on top joining the sides.
- **Truss** - A bridge made up of a number of parts and forms a box type shape and trains pass through the centre.

8. Numbering of bridge members

Numbering of bridge members follows the same pattern for underbridges, overbridges, and footbridges.

8.1. Underbridges

For underbridges, the Sydney end abutment is the datum for numbering, being the No. 1 Abutment.

The numbering system for bridge components starts at the Sydney end of the bridge.

For members running across ways, e.g. abutments, spans, piers, cross girders, sway braces and transoms, the numbers start at number 1 at the Sydney end abutment and continue sequentially towards the country end of the bridge

Members are numbered as follows:

- Spans: No. 1 is the first span from the Sydney end abutment; and then numbered away from Sydney
- Girders, Stringers, Corbels: From the Down side of each span. For compound girders, add “top”, “intermediate”, or “bottom”.
- Other Longitudinal Members: as for Girders.
- Transverse Decking/ Cross Girders: from the Sydney end of each span.
- Abutments: No. 1 closer to Sydney, No. 2 other end of bridge.
- Piers: No. 1 closest to No. 1 Abutment, others in sequence.
- Trestles and Sills: As for Piers.
- Piles: From the Down side of each Abutment/Trestle/Pier.
- Wing Piles: From the track end of each Wing.
- Abutment Wings: No. 1 (Down) and No. 2 (Up) for No. 1 Abutment. No. 3 (Down) and No. 4 (Up) for No. 2 Abutment.
- Intermediate Supports: Numbered as for the span they support.
- Walings/Bracing: No. 1 on Sydney side of support.
- Bearings: No.1 on Down side of support

Refer to Appendix 2 Figure 1, Figure 2 and Figure 3 for examples of bridge numbering.

8.2. Overbridges and footbridges

For overbridges and footbridges, the Down side Abutment is the datum for numbering, i.e. the No. 1 Abutment.

The numbering system for bridge components starts at the Down side abutment. Bridge members then are numbered as for an underbridge i.e. from No. 1 abutment to No. 2 abutment, and from left to right when standing at No. 1 abutment facing the bridge.

9. Location of bridges and structures

All bridges and structures are to have a kilometrage (correct to 3 decimal places) stencilled in 75mm high black figures on a white background, or engraved on a plaque.

The kilometrage value is generally the value at the face of the structure on the Sydney end. For bridges and culverts, the kilometrage value is as follows:

- **Underbridges**: the km value at the face of the Sydney end abutment under the centreline of the furthest Down track.
- **Culverts**: the km value at the centreline of the culvert or the Sydney side centreline of a group of culverts.
- **Overbridges** and **Footbridges**: the km value where the Sydney side of the bridge crosses the track.

The stencilled kilometrage is to be located as shown:

- **Underbridges**: on the Up side of the No. 1 abutment and on the Down side of the No. 2 abutment.
- Underbridges less than 10 metres long are to be stencilled on the No. 1 abutment only. Bridges without defined abutments, e.g. single corrugated steel pipes, shall be stencilled on the face of the Down side headwall, or if this is not possible, star picket or old rail markers driven in adjacent to the Down side headwall, and the kilometrage printed on one face over a white background..
- **Overbridges** and **Footbridges**: on the abutment or pier adjacent to the furthest Down track and at the Sydney end.
- **Tunnels**: on the Down side of the No. 1 portal, and on the Up side of the No. 2 portal.
- **Platforms**: on the face of the coping at each end of No. 1 platform.
- **Signal Structures**: in accordance with conventions implemented by signalling discipline..
- **Other Structures**: on the Down side of the track and at the Sydney end.

A.1. Appendix 1 Definitions

Term	Description
A	
Abutment	The support at each end of a bridge.
Abutment sheeting	Timber planks used to retain the filling behind an abutment.
Approach slab	Slab (usually reinforced concrete) laid above the formation behind bridge abutments and designed to provide a transition zone for track stiffness onto the bridge.
B	
Ballast log	Timber, steel or concrete member sitting on top of the abutment wall to hold back track ballast.
Ballast top	Underbridge with continuous deck supporting metal ballast.

Term	Description
Ballast wall	Member laid longitudinally at the outer edge of a ballast top span to prevent ballast spilling over the side.
Barrier	The fence or walls along the sides of overbridges and footbridges, installed to protect road vehicles, cyclists and pedestrians from falling over the edge of the bridge.
Bearing	Seating area of a load-carrying member; may be a separate fabricated member attached to the girder ends.
Body bolt	Vertical bolt in timber girders and corbels causing pairs of members to deflect together.
Bracing	Horizontal or diagonal member attached to main members to stiffen those members, or to minimise sidesway.
Bridge	A structure spanning a river, road, railway, or the like, and carrying vehicles or persons.
Butt transom	Intermediate transom linking the ends of girders from adjacent spans.
Broad flange beam	A steel girder designed in the 1920's with thicker and wider flanges and reduced height of web for use in locations where greater vertical clearance was required.
Buffer stop	Structure provided at the end of a rail line or siding to prevent rolling stock from running off the end of the track and/or colliding with an adjacent structure.
C	
Caisson	A cylinder or rectangular ring-wall for keeping water or soft ground from flowing into an excavation. It may later form part of the foundation.
Capping	Impermeable layer of fill located immediately above the main formation and designed to shed water to the sides of the track.
Catchment	Area of land from which water flows into an underbridge.
Check	A separation that runs parallel to the timber grain and usually on the surface. It results from stresses that develop as the surface layers of wood loose moisture.
Compound girder	Timber girder made from two or more sections bolted firmly together on top of each other.
Compression flange	The face of a member that is in compression. For beams it is usually the upper face and in particular near mid-span. For a cantilever or a continuous member it is the lower face over the supports.
Coping	The longitudinal edge of a station platform.
Corbel	Short longitudinal member seated on a headstock providing a bearing for adjacent girders.
Corrosion	The gradual removal or weakening of metal from its surface by chemical attack. Generally, it requires the presence of water and oxygen, and is helped by carbon dioxide, sulphur dioxide and by other materials in small quantities in the air or water.
Crack	Open fissure on the surface of a member, but not necessarily right through the member.
Culvert	Arch, box-shaped or piped underbridge having integral walls, roof and floor.

Term	Description
D	
Damage	The sudden worsening of the condition of a structure, its elements and component materials due to the effect of a sudden event such as fire, flood, accident or vandalism.
Debris	Rubbish or other loose material lying near an underbridge and which impedes smooth water flow through the bridge opening.
Decay	Deterioration on or in a timber member causing loss of strength.
Deck	Part of bridge superstructure directly carrying the load.
Defect	Deterioration of a member of a structure from its original condition.
Deflection	Downwards displacement or sag of a girder when loaded by vehicles or persons.
Deflection wall	Structural wall installed to protect the supports of a structure adjacent to the track from collapse caused by a derailed train.
Deflectometer	Instrument for measuring deflection in girders - also referred to as “mousetrap”.
Deterioration	The gradual worsening of the condition of a structure, its elements and component materials due to the effects of traffic and other loadings, the action of the environment on the structure and/or the actions of the constituents of component materials over a period of time.
Driving mark	Mark cut into timber pile indicating in roman numerals the distance to the toe of the pile
E	
Engineered backfill	Compacted select earth fill behind abutments, reinforced with horizontal layers of geogrid or similar and used to stiffen the bridge approach”
F	
Flood level	Mark stencilled on No.1 Abutment of underbridges indicating height and date of maximum previous flood.
Footbridge	Bridge over the track carrying pedestrian traffic only. May be freestanding or combined with an overhead booking office.
Footway	Pedestrian access attached to, or included in, an overbridge.
Formation	Ground immediately beneath the capping and track.
G	
Gantry	An overhead structure consisting of side masts or columns joined at the top by a horizontal bridging member.
Girder	Main horizontal load-bearing member of a structure.
Guard rail	Rail placed in pairs and fixed to transoms or sleepers between the running rails, to guide the wheels of a derailed train.
H	
Handhold device	A system of handrails provided along a wall structure to provide support for personnel.

Term	Description
Headstock	Horizontal member(s) attached at or near the top of a trestle or pier, on which the superstructure bears.
I	
Intermediate transom	timber transverse member set between top and bottom girders in a ballast top span.
Invert	Earth or concrete floor of an underbridge.
J	
Jack arch	Form of bridge decking in which small concrete or masonry arches infill run between main longitudinal steel girders.
K,L	
M	
Maintenance	The actions necessary to preserve the serviceability, reliability and safety of a structure at or near its current level and to slow the rate of deterioration.
Minor opening	Underbridge less than 10 metres in length.
N	
O	
Obvert	Underside of bridge superstructure.
Overbridge	Bridge carrying road vehicles or livestock over a track.
P	
Packing	Piece of timber, steel, or other hard material, placed or driven between members to adjust their relative position.
Parapet	A type of barrier comprising a solid wall or post and rail fence along the sides of overbridges and footbridges, installed to protect road vehicles, cyclists and pedestrians from falling over the edge of the bridge.
Pier	Intermediate support of bridge spans between abutments, built of solid construction and usually in concrete or masonry.
Pile	A vertical or inclined member driven or cast in the ground to support a trestle, pier, sill, or abutment. Includes: • Batter pile: set at an angle to the vertical to resist sidesway; • Planted pile: set in excavated hole then backfilled and compacted; • Plumb pile: vertical pile; • Potted pile: set in concrete below ground level; • Pumping pile: a pile that is moving vertically in the ground under load; • Spliced pile: two or more pile sections joined end-to-end by plates; Stump pile: pile section left in the ground after top removed.
Pile cap	Concrete member located at the top of a nest of piles to link their supporting action together.
Pipe	Hollow longitudinal void near the centre of a timber member where the heartwood is usually situated.

Term	Description
Pitting	An extremely localised form of corrosive attack that results in holes or hollows in metal. Pits can be isolated or so close together that they may look like a rough surface.
Protection screen	Screen installed on overbridges and footbridges to prevent accessibility to a safety screen and to restrict objects from falling or being thrown onto the track below.
Q	
R	
Refuge	A 'safe area' provided along a bridge, retaining wall or in a tunnel.
Rockfall shelter	A structure installed over and beside a rail track to prevent loose material from adjacent cuttings falling on to the rail line.
Rot	Internal decay of a timber member caused by fungal attack.
Repair	The actions necessary to increase the current level of serviceability, reliability and/or safety of a structure.
Runner	Longitudinal member bolted to girders and transoms to hold transoms to correct spacing.
S	
Safe area	A place where people and equipment will not be hit by a passing train.
Safety walkway	An area along an underbridge where personnel can walk without falling through to the ground.
Scaling	The gradual and continuous loss of surface mortar and or aggregate over irregular areas of concrete. It most frequently affects horizontal surfaces exposed to the weather or traffic, but could also be an indication of frost or salt attack.
Screwing up	Maintenance process of tightening up body and other bolts to improve the load capacity of a timber bridge.
Service crossing	Structure carrying commercial product or utilities over or under a track and across the railway corridor.
Shakes (in timber)	Complete or partial separation, usually across the timber grain and due to causes other than shrinkage. Possible causes of shakes are due to felling of the tree, impact loading, stream forces or wind force.
Shear zone	That area of a member near to a support, where a force acts through the member.
Sheeting	Timber planks or steel panels, restraining the fill behind a wall type structure.
Sill	Concrete or masonry footing supporting a trestle.
Soffit	The underside of a bridge superstructure.
Spalling	Drummy or loose concrete, masonry or stone surfaces, which may have been initiated by corrosion of reinforcement or by heavy impact.
Span	(a) deck of a bridge between adjacent substructure supports (b) the distance between girder supports.
Spandrel wall	A wall carried on the extrados (upper convex surface) of an arch, filling the space below the deck.

Term	Description
Split	Fissure in a timber member running parallel to the grain, from one face right through to the opposite face.
Station platform	Line-side structure built to provide public access to passenger trains.
Stiffener	Vertical steel plate used to stabilise and strengthen the web of girders.
Strain	The lengthening or shortening of a member under load.
Substructure	The supports for a bridge deck including trestles, piers, abutments and foundations.
Subway	Underbridge passing over a pedestrian pathway.
Superstructure	The deck or “top part” of a bridge spanning between supports.
T	
Tension face	The face of a member that is in tension. For beams it is usually the lower face and in particular near mid-span. For a cantilever or a continuous member it is the upper face over the supports.
Teredo	Marine borer which destroys timber in tidal areas.
Termite	Insect (incorrectly called white ants) which attacks timber by eating the cells, causing strength loss.
Through span	Span type where the main girders rise above track level.
Tie bar and tie rod	long bars used to hold adjoining concrete girders or culvert units together across the track
Tie plate	steel plate used to hold adjoining concrete culvert units together across the track
Tip end sheeting	Sheeting behind extended timber girder ends of abutments.
Transom	Structural member (usually timber) laid across girders for attachment of rails on transom top spans.
Transom packer	small packers, usually steel, located between the underside of a transom and top of a girder, used to adjust the height and superelevation of the track and to remove loading from the girder flanges
Transom top	Underbridge where the track is directly fixed to the superstructure and metal ballast is not provided.
Trestle	Intermediate support for bridge spans between abutments, usually constructed as a timber or steel frame.
Troughing	Pipe in timber member starting at the top face.
Truss	Girder made from two horizontal members (top and bottom chords), joined by vertical and diagonal members.
U	
Underbridge	A bridge supporting a track and passing over waterways, roadways, pathways and flood plains etc.
V	
Viaduct	An underbridge consisting of multiple spans with total length over 100 metres.
W	

Term	Description
Waling	Headstock constructed from 2 pieces of timber bearing on pile
Walkway	An area along an underbridge where personnel can walk without falling through to the ground
Waterway	Clear area under a bridge for water to run through.
Wing	Piles and sheeting or concrete or masonry wall restraining embankment on each side of an abutment.
X, Y, Z	

A.2. Appendix 2 Typical bridge spans and members

The following figures are attached, illustrating a number of different types of bridge structures that exist in the CRN network, together with their major components:

Figure 1 - Transom top timber underbridge

Figure 2 - Ballast top timber underbridge

Figure 3 - Timber truss underbridge

Figure 4 - Transom top underbridge

Figure 5 - Ballast top underbridge

Figure 6 - Concrete box girder

Figure 7 - Masonry arch bridge

Figure 8 - Precast concrete box culvert

Figure 9 - Rolled Steel joist (RSJ) span

Figure 10 - Broad flange beam (BFB) span

Figure 11 - Plate web girder (PWG) welded deck span

Figure 12 - Plate web girder (PWG) rivetted deck span

Figure 13 - Plate Web Girder (PWG) rivetted through span

Figure 14 - Truss girder through span

Figure 15 - Steel overbridge jack arch span

Figure 16 - Footbridge and stepway

Figure 17 - Rolled steel sections

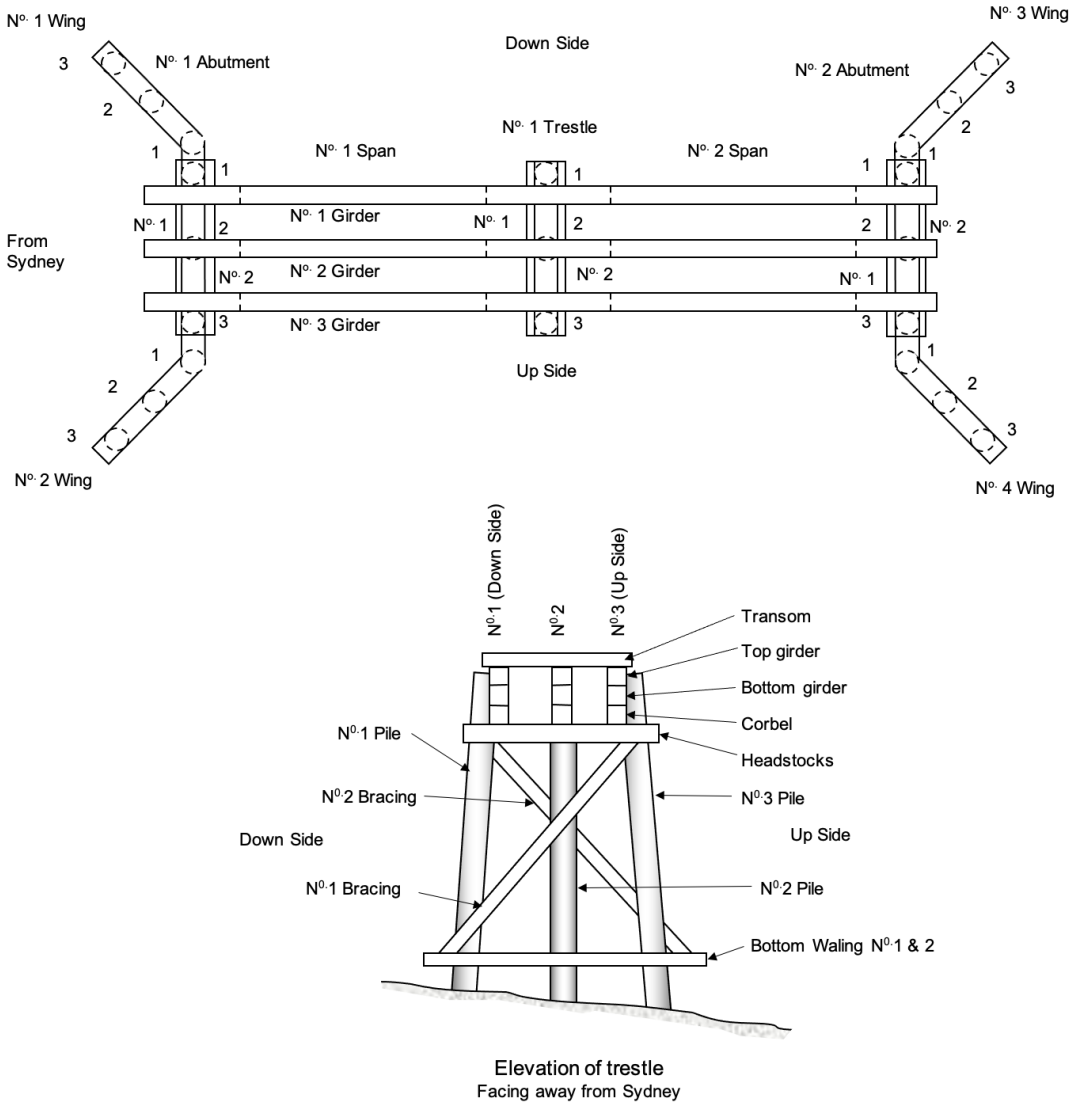
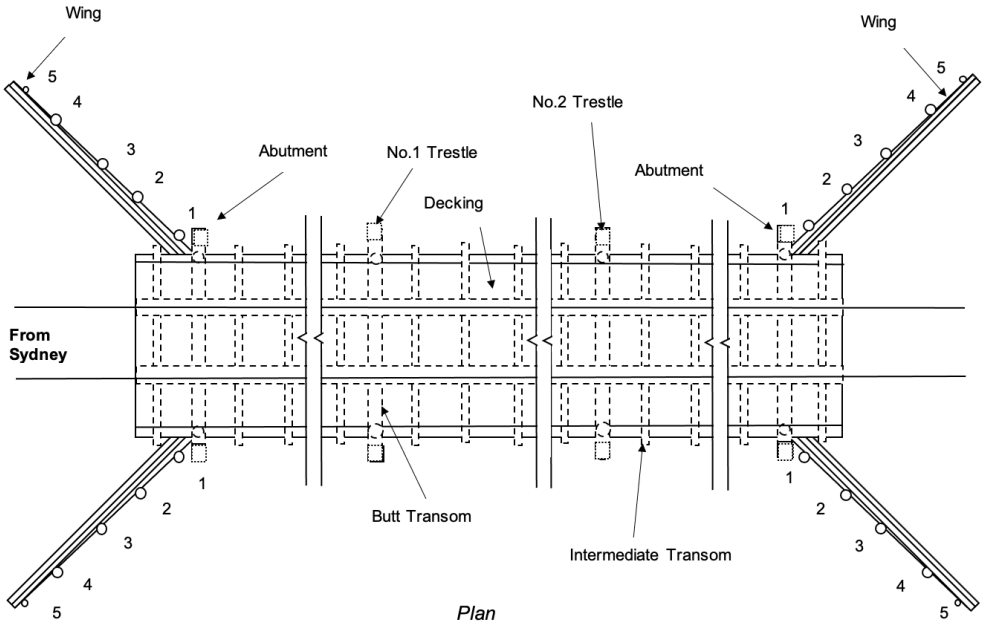


Figure 1 - Transom top timber underbridge



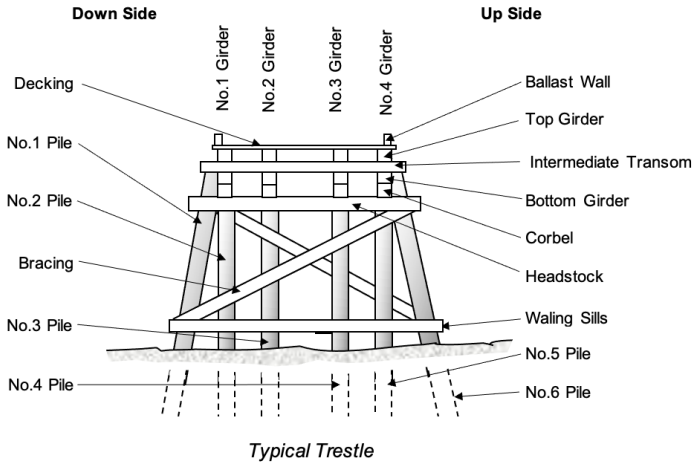


Figure 2 - Ballast top timber underbridge

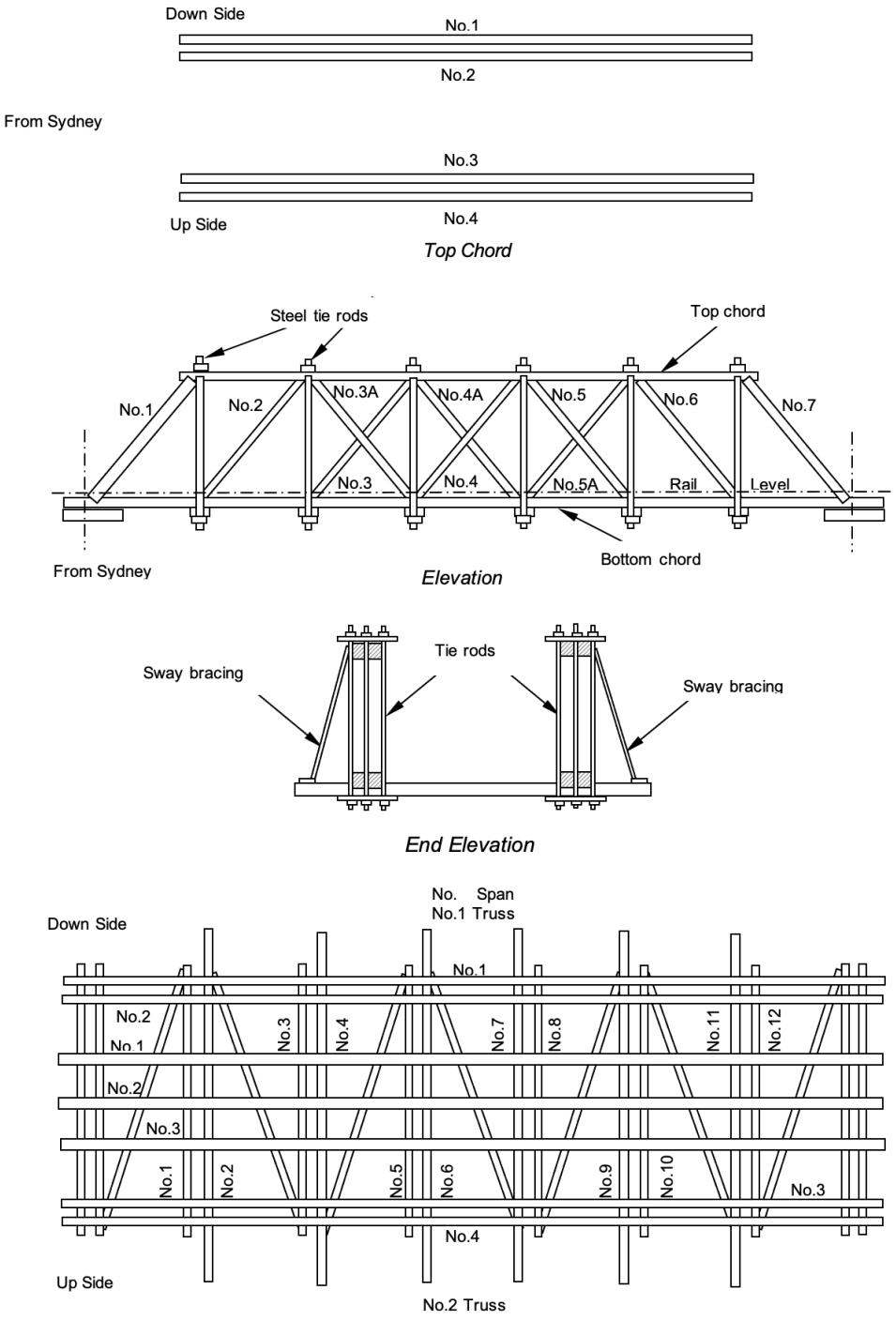


Figure 3 - Timber truss underbridge

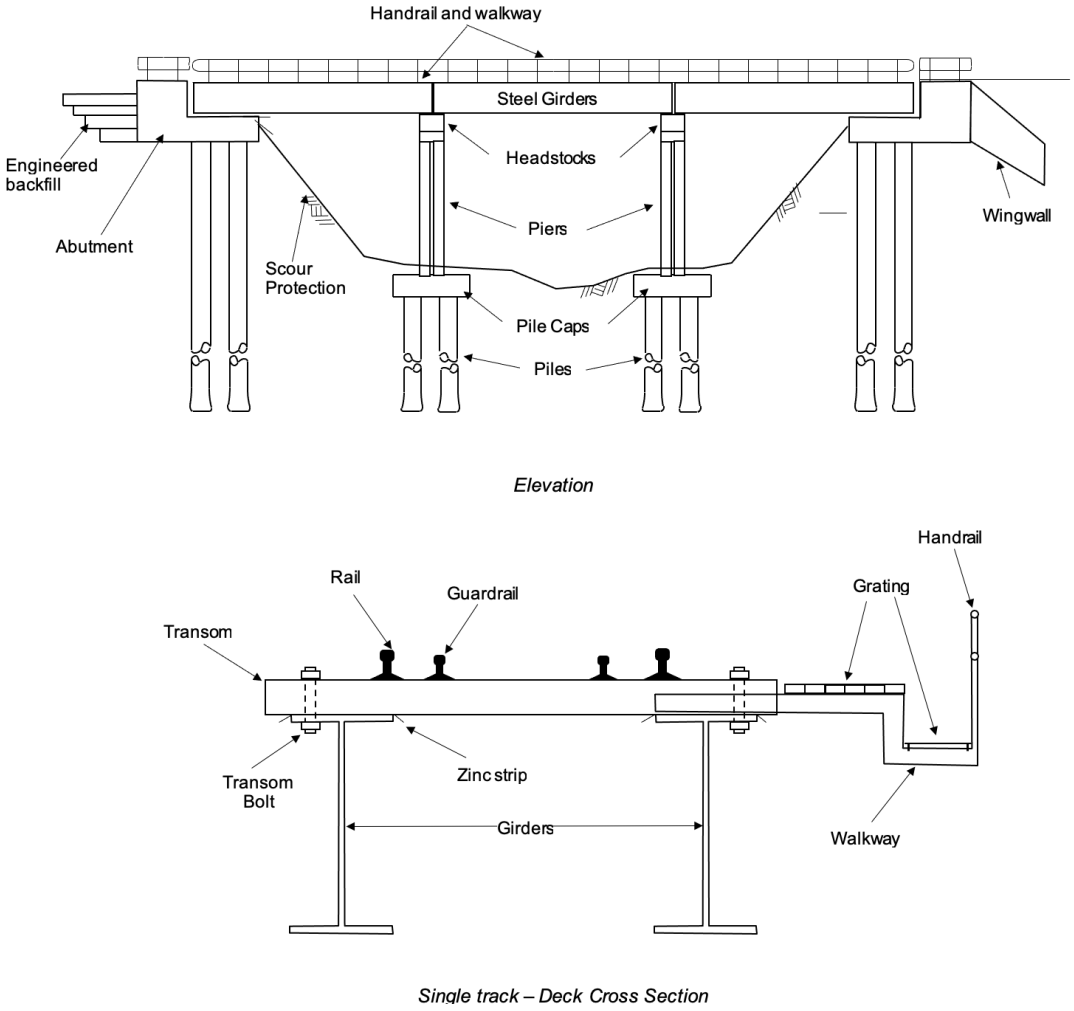


Figure 4 - Transom top underbridge

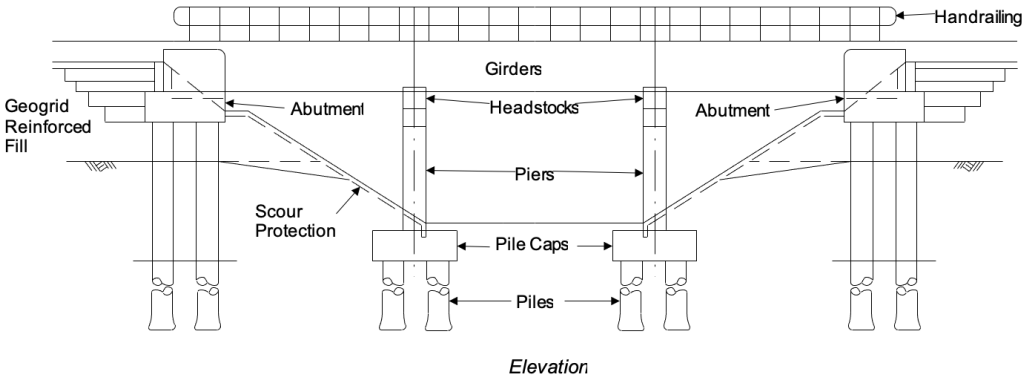


Figure 5 - Ballast top underbridge

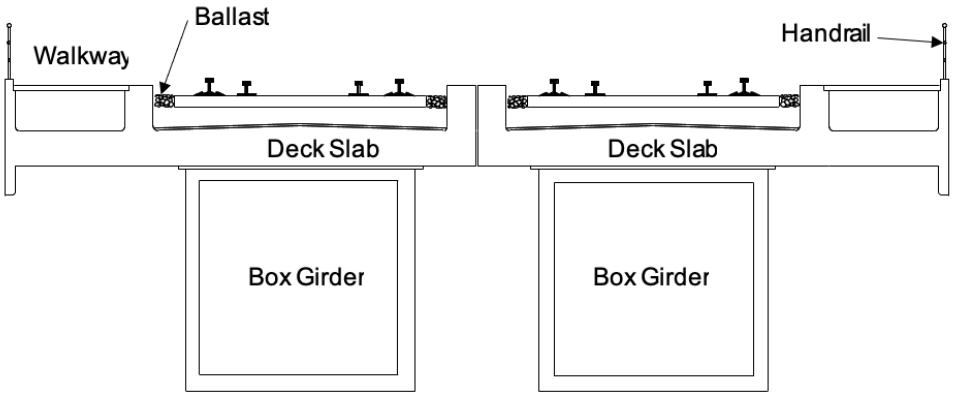


Figure 6 - Concrete box girder

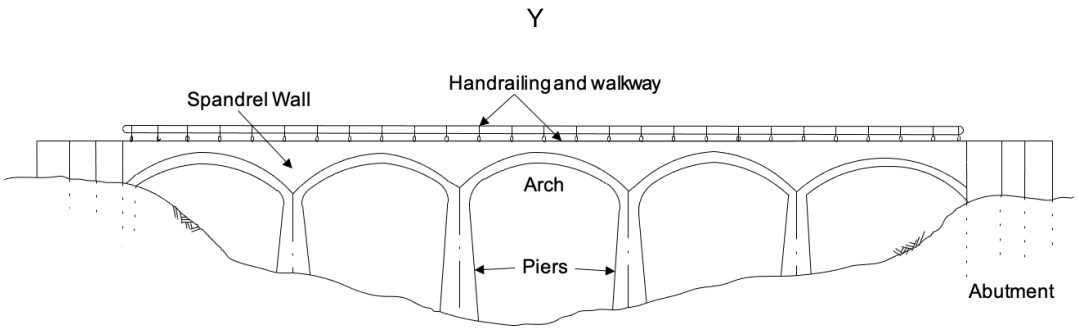


Figure 7 - Masonry arch bridge

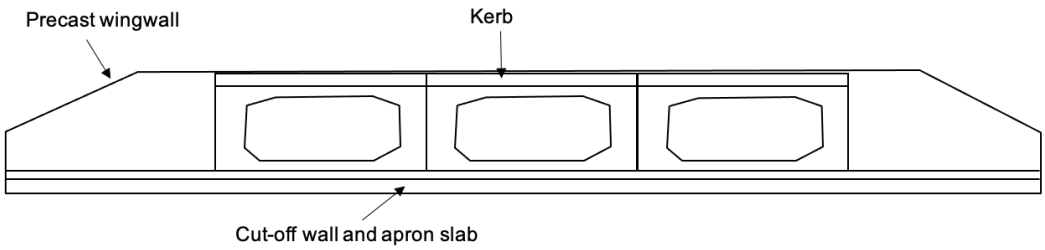


Figure 8 - Precast concrete box culvert

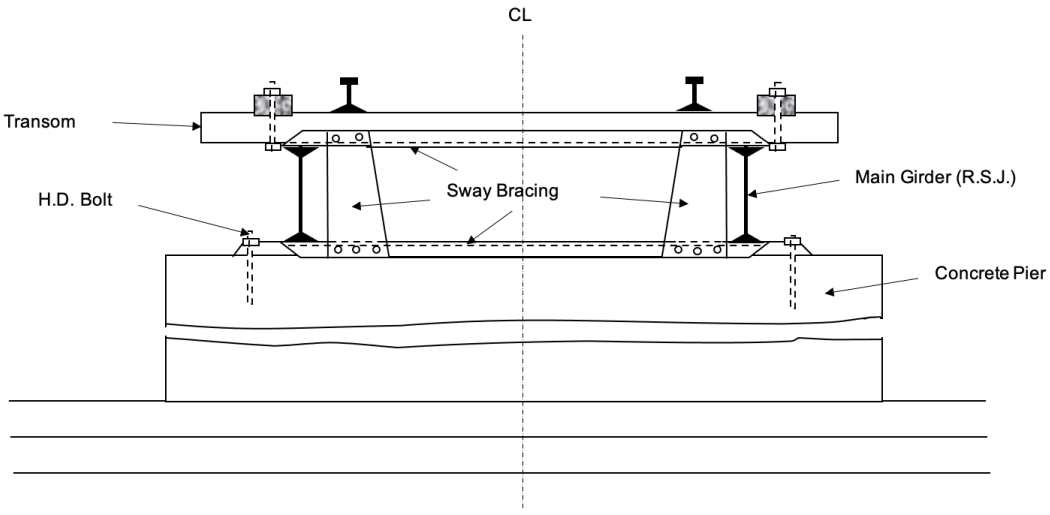


Figure 9 - Rolled Steel joist (RSJ) span

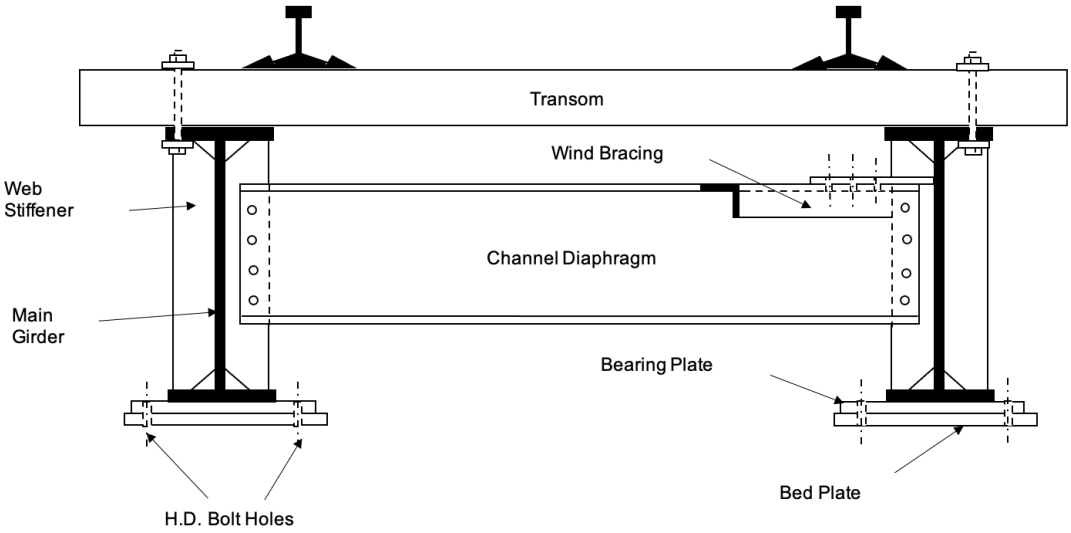
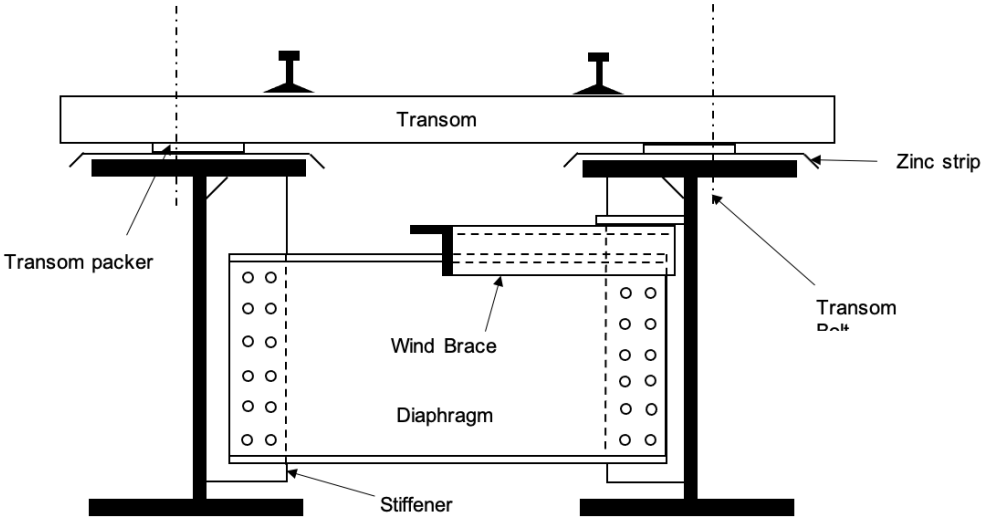
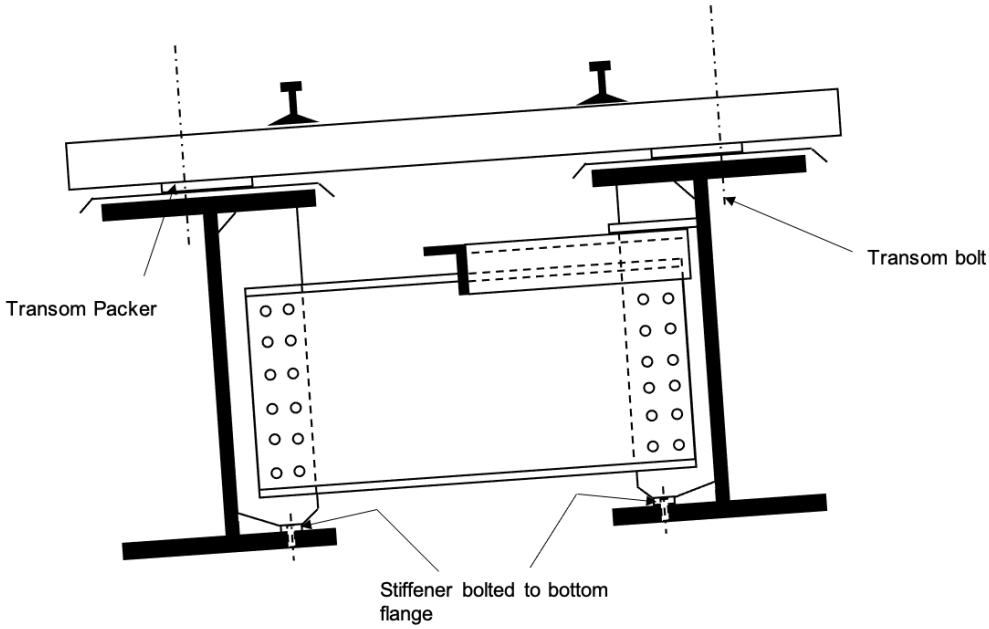


Figure 10 - Broad flange beam (BFB) span



Typical Section

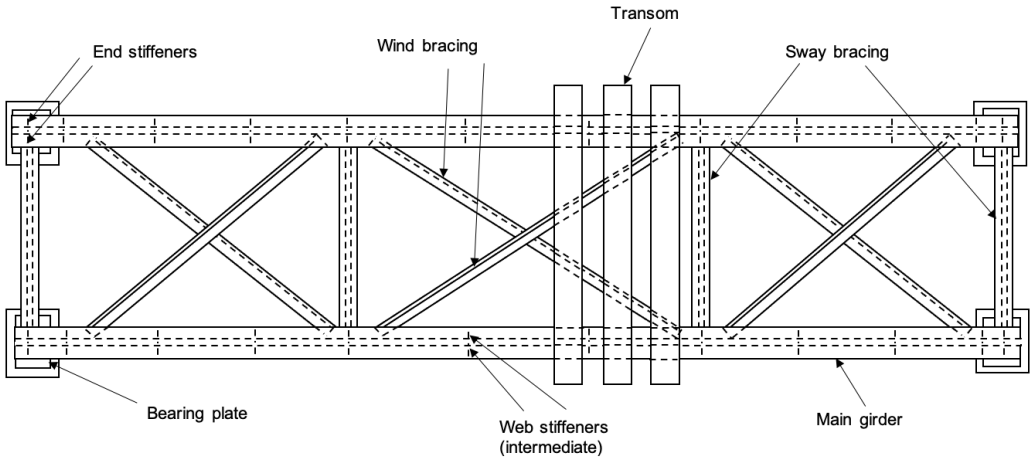
Original Design



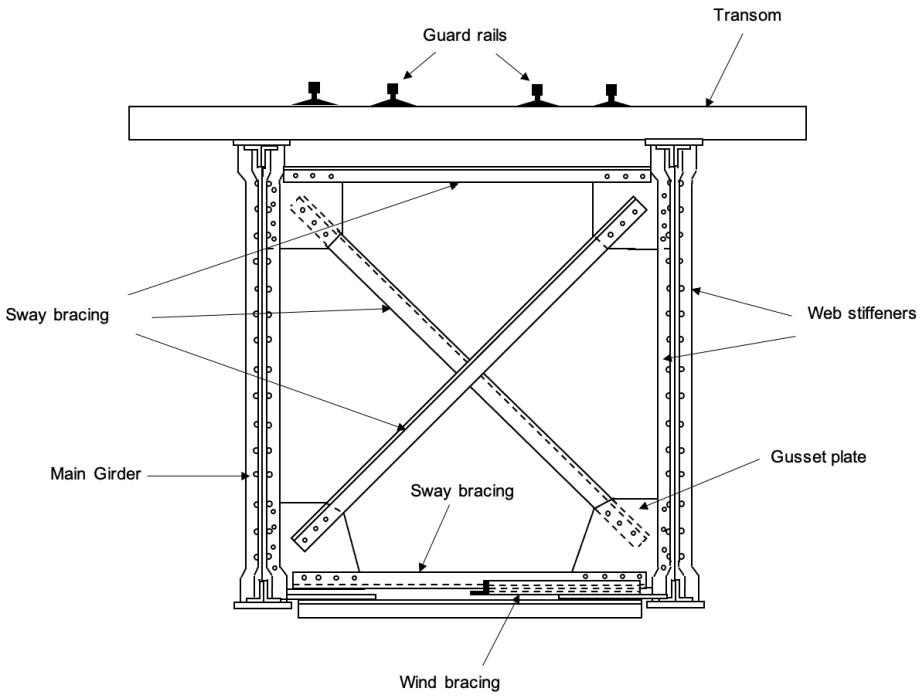
Typical Section

Modified Design

Figure 11 - Plate web girder (PWG) welded deck span



Plan



Typical Section

Figure 12 - Plate web girder (PWG) rivetted deck span

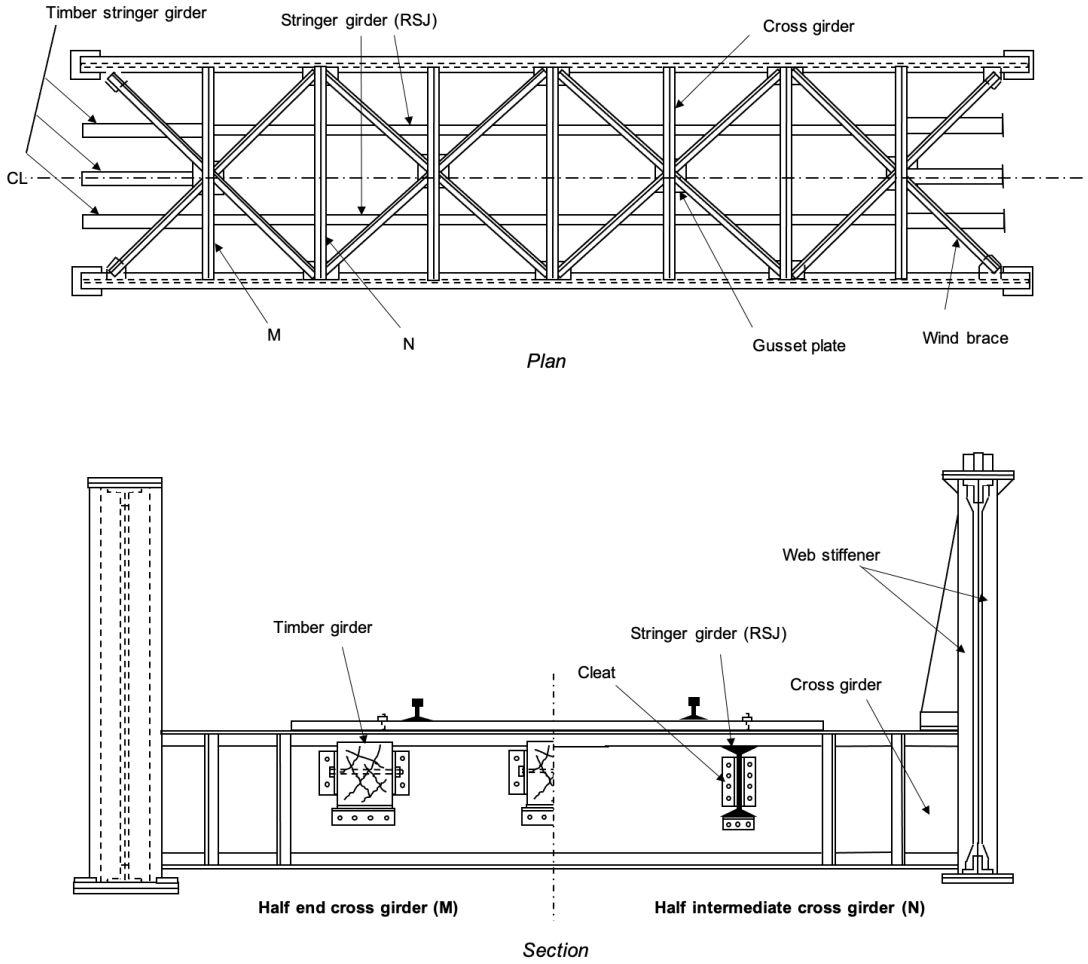


Figure 13 - Plate Web Girder (PWG) rivetted through span

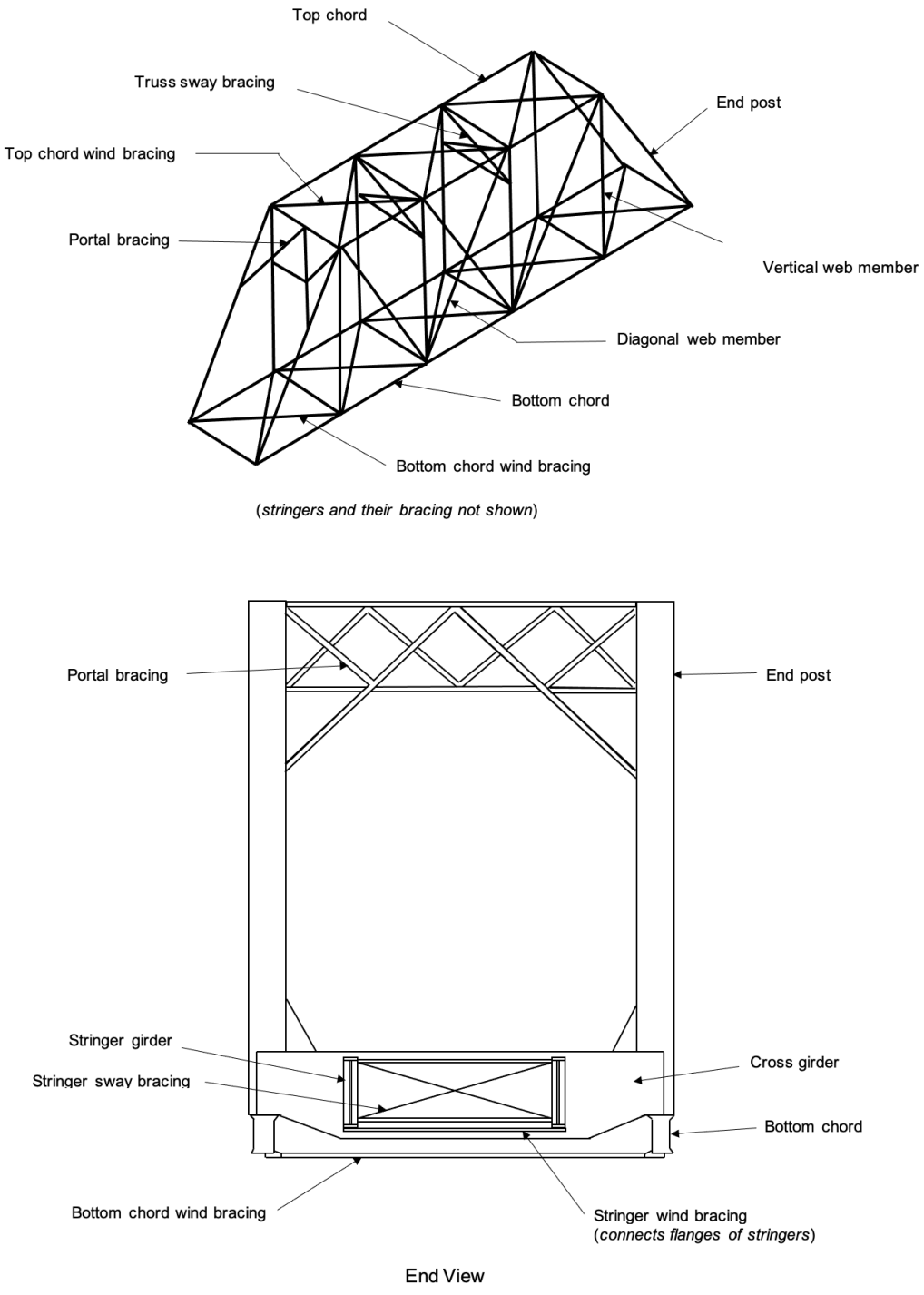


Figure 14 - Truss girder through span

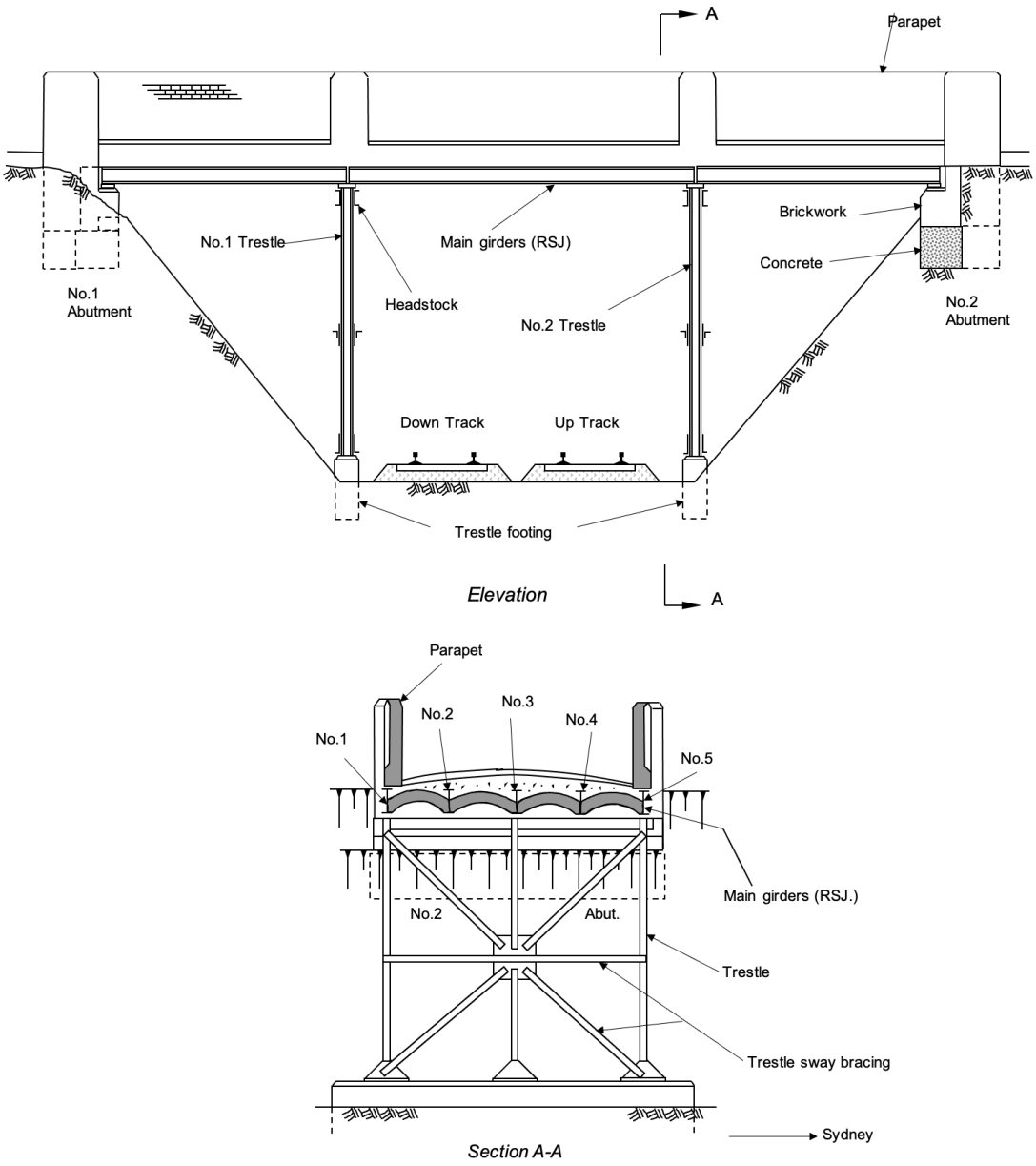


Figure 15 - Steel overbridge jack arch span

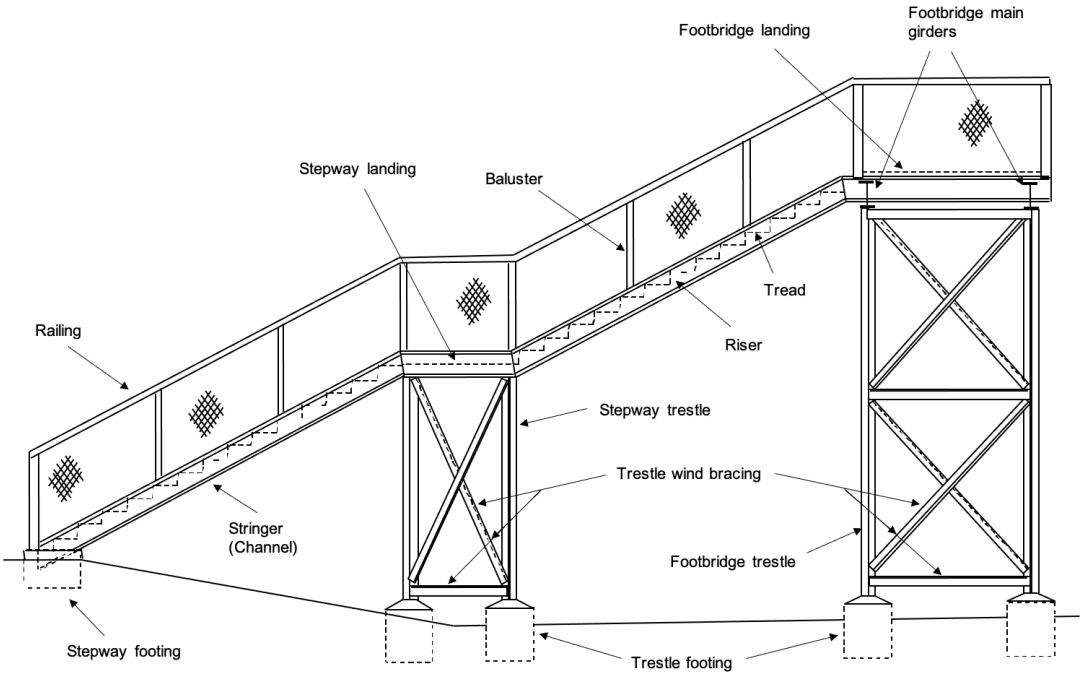


Figure 16 - Footbridge and stepway

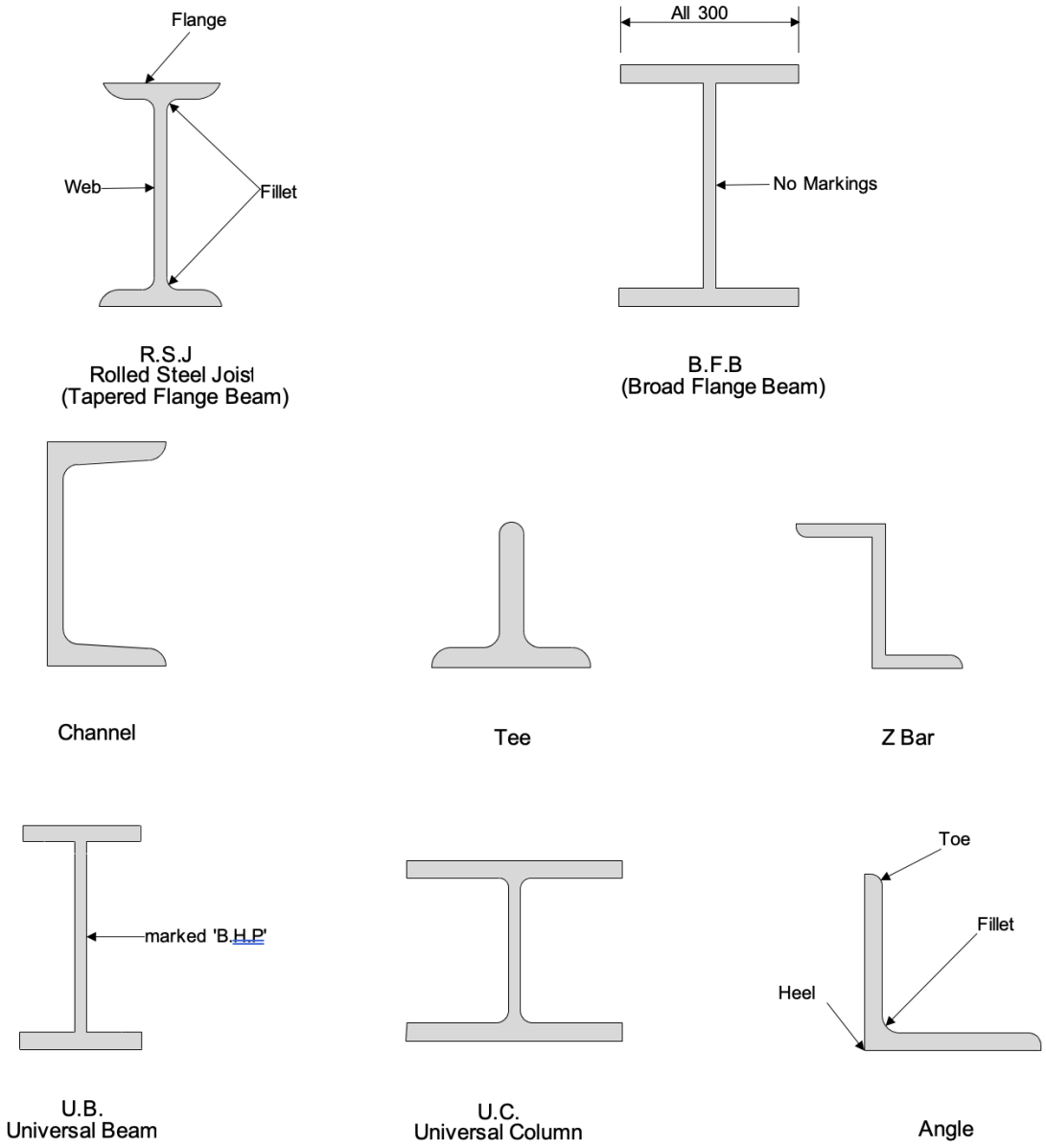


Figure 17 - Rolled steel sections