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Standard Design Details Underbridges – Z-Type

ELR: Site Specific Details to Be Provided

FORM A – APPROVAL IN PRINCIPLE:

12th December 2008



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Title of Scheme:		Standard Design Details Underbridges – Z-Type			
Location:		Site Specific Details to Be Provided			
ELR	TBC	Mileage	TBC	OS Grid Ref	TBC
				Structure No.	TBC

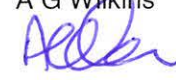
Mott MacDonald

Form A: APPROVAL IN PRINCIPLE

Standard Design Details Underbridges – Z-Type

ELR: *Site Specific Details to Be Provided*
CHAINAGE: *Site Specific Details to Be Provided*
BRIDGE NO: *Site Specific Details to Be Provided*
OS Map Ref: *Site Specific Details to Be Provided*

Issue and Revision Record:

Rev:	Date	Originator	Checker	Approver	Description
A	21/05/08	D M Edwards	I J Palmer	A G Wilkins	Draft for Network Rail Comment
B	12/12/08	I J Palmer	M J Kynoch	A G Wilkins	For Approval
					

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Network Rail

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Part 1: Scheme Details

- | | | |
|--------|---|---|
| 1.1 | Network Rail Sponsor | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.2 | External organisation(s) for whose benefit the scheme is required | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.3 | Proposed date for completion of construction | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.4 | Organisation responsible for Design to Approval in Principle stage | Network Rail |
| 1.5 | Existing Conditions | |
| 1.5.1 | <i>Brief general description</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.2 | <i>Structures affected</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.3 | <i>Local road name/road no./ river name</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.4 | <i>Existing headroom/lateral clearances/platform widths</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.5 | <i>Public or private rights of way affected</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.6 | <i>Number and layout of tracks/whether electrified/OHLE wire height, station layout</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.7 | <i>Adjacent earthworks to terrain</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.8 | <i>Details of defects to be remedied</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.9 | <i>Details of Design criteria for existing Structure</i> | <i>Structure Specific Scheme Details to Be Provided</i> |
| 1.5.10 | <i>Known hazards at the site</i> | <i>Structure Specific Scheme Details to Be Provided</i> |

1.6. Proposed works

- 1.6.1 *Brief general description giving details of the proposed Works*

This Form A covers the design of standard details for a Z type underbridge superstructure. The Z type design has developed over time and the standard details designed in accordance with this Form A are considered current best practice.

General arrangement drawings and site specific information shall be prepared by the scheme designer so that the design responsibility is retained by the scheme

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designer.

1.6.2 Details of assumptions made in developing the proposals regarding any Structures, earthworks or Permanent Way

The standard designs are not site specific. The scheme designer is responsible for preparing general arrangement and other site specific drawings and making reference to the relevant standard design details.

1.6.3 Number and layout of tracks

The standard details will consider a single track placed on the bridge and a maximum track offset (track centreline to deck centreline) of 226mm for straight track on a 3300mm wide deck (web centre to web centre) with 'shallow' girders reducing to 25mm for straight track on a 3165mm wide deck with 'deep' girders.

The deck width of 3300mm will accommodate track on a minimum radius of 250m for the longest span of 17m (no track eccentricity or tolerance) with 'shallow' girders and 340m with 'deep' girders. A maximum cant of 150mm and cant deficiency of 60% of the actual cant is considered.

The track gauge will be 1435mm.

1.6.4 Foundations and substructure

It is assumed that the scheme designer will confirm that the substructure can accommodate the standard cill beams detailed, these will be subject to separate Form As.

The scheme specific designer will confirm the requirement for either; the design of new foundations, or the assessment of the suitability of existing foundations for re-use.

1.6.5 Superstructure including Building layout if applicable

The Z type is built up of a single track half-though bridge comprising two Z-shaped steel main girders and a filler beam type or all steel Tee rib floor spanning transversely.

The decks support one track.

The main girders are assumed parallel.

A range of deck widths, measured between web centres, are to be considered between 2900mm (minimum) to 3300mm (maximum) are considered to accommodate a range of track alignments, cant and track eccentricity. Refer to Table 1 in Appendix B for details of the parameters assumed in deriving the deck widths.

For decks with skews less than 25°, the deck cross girders will be fanned whereas for skews above 25° and less than 50°, the deck cross girders will be trimmed square to the main girders. Where the span is insufficient for the fanned cross members to become perpendicular to the main girders, the cross members will remain fanned throughout the length of the span.

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1.6.6 *Span/bearing/articulation arrangements for bridges*

The standard designs will consider spans between 6m to 17m by designing for 6m, 9m, 10m, 11m, 12m, 14m and 17m decks.

Skews between 0° and 50° will be considered by designing square decks and decks with 25° and 50° skews. The skews are assumed to be equal at each end.

Bearings will be fabricated, high yield steel line rocker bearings with a nominal allowance for longitudinal movement at one end. The bearings shall allow rotation of the main girders about an axis perpendicular to the longitudinal girders. The bearings will provide resistance to uplift in the event of the superstructure being struck by highway vehicles. The design of bearings to prop abutments will be considered by the scheme specific designer. Refer to 1.23 for further details of assumed articulation of the main girder and the trimmer.

1.6.7 Headroom/Lateral clearances

The headroom is site specific and the scheme engineer shall ensure the suitability of using the standard design details and provide all relevant details concerning headroom to the appropriate authorities the scheme specific designer shall ensuring this information is included in site specific information provided to the contractor.

The lateral clearances provided by the standard Z type design comply with the lower sector structure gauge in GC/RT5212 for Class 373 (Eurostar) routes and where stock with yaw dampers travel.

Where 'deep' main girders are required, the girders will be located within the space reserved for platforms. The girder top flanges will be 350mm above the rail level and designed to act as robust kerbs. Where 'shallow' main girders are required, the girders top flange will be located not more than 110mm above the track. Note that shallow girders with the girder top flange above rail level shall not be used on the UK sections of the high speed Trans European Network (TEN) where the Railways (Interoperability) Regulations apply.

A deck may have one 'deep' and one 'shallow' girder where appropriate.

A maximum track offset (track centreline to deck centreline) of 226mm for straight track on a 3300mm wide deck (web centre to web centre) with 'shallow' girders reducing to 25mm for straight track on a 3165mm wide deck with 'deep' girders.

Curved track can be accommodated with a minimum

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radius of 250m for the longest span of 17m (no track eccentricity or tolerance) with 'shallow' girders and 340m with 'deep' girders. A maximum cant of 150mm and cant deficiency of 60% of the actual cant is considered. The maximum cant will be achieved through super elevating the deck noting the maximum difference in the distance between the deck and rail will be 50mm.

The main girders will be designed to allow for the passive provision of walkways accommodating line speeds up to 100mph / 160kph and up to 125mph / 200kph. 'Deep' main girders are also designed to act as robust kerbs.

1.6.8 Effects on sighting distance

To be confirmed by the scheme designer.

1.6.9 Unusual Features

To be confirmed by the scheme designer.

1.6.10 *Materials to be used*

Steel with the appropriate designation and through thickness properties will be specified: Ancillary and structural steel work shall be in accordance with EN 10025-2. Knuckle bearing plates will be fabricated from high yield steel, grade S460 in accordance with EN 10025-3.

Concrete used in the deck will in accordance with BS8500. The governing exposure condition will be XD3.

Reinforcing steel will be grade H500B to BS4449.

1.6.11 Special finishes/ Architectural involvement

None.

1.6.12 Special access/inspection/ maintenance arrangements

A minimum depth of 300mm $\pm$ 100mm ballast is provided below the sleepers; noting that the minimum ballast depth that will not affect permanent way maintenance operations is 225mm (subject to permanent way Form A at scheme design stage).

The scheme designer shall ensure that the web stiffeners to the six-foot girders are carefully positioned to facilitate the access for future inspection/painting.

The bearings will be positioned to ensure adequate space for inspection, maintenance and replacement. Jacking points will be provided and shown on construction drawings details of which will be included in the maintenance file.

1.6.13 Significant interface with Network Rail/other engineering disciplines or equipment

The standard designs will be prepared to meet the agreed requirements

1.6.14 Significant interface with external organisations

Not applicable as the standard designs are not site specific.

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- 1.6.15 Method of construction or erection envisaged, and any associated Temporary Works known to be required
- The standard Z type will be designed to be lifted by cranes (mobile road cranes and rail cranes, size to be determined by the scheme designer), or rolled in while supported at the bearings. Specific calculations will be required of the scheme designer if any other erection method is proposed.

Lifting points (where deck lifted with mobile road cranes or rail cranes) will be designed to allow the deck to be lifted with 300mm of ballast placed on the deck.

The superstructure with a maximum span of 17m is assumed to be delivered on site as a single element.

- 1.6.16 Disruption to rail/road/ pedestrian/ traffic caused by construction
- Where possible, the standard designs shall minimise the work required to be undertaken in possessions. The standard designs will be suitable for installation by methods that will enable possession times to be minimised, though the scheme designer may have to modify the standard design to suit the exact detail. The most appropriate installation method that limits disruption caused by construction shall be determined by the scheme designer. It is assumed that the bridge components arrive on site in a single unit as this will minimise the possession time for a replacement.

- 1.6.17 Environmental constraints
- Where possible, in the development of the standard designs, consideration will be given to specifying the appropriate materials and products with regard to the environment.

The standard designs are not site specific and the scheme designer will identify site specific environmental site constraints.

- 1.6.18 Any other relevant information
- None.

1.7 Alternative solutions to the Remit considered

- 1.7.1 Brief description
- Not applicable to standard designs.
- 1.7.2 Reasons for rejection
- Not applicable to standard designs.

1.8 Design Criteria (underline bridge)

- 1.8.1 Design railway loading
- RU Railway loading in accordance with draft NR/L2/CIV/020.

A factor α , applied where railway traffic could be heavier than normal traffic, is mandated in draft TSIs as 1.1 and shall apply.

The track and railway load model will be positioned in the

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most onerous position for the element considered.

The maximum centrifugal force to be considered will be $F_c = 0.20P$.

100% of the longitudinal loads resulting from traction and braking are to be sustained by the bridge: No transfer to the adjacent infrastructure shall be considered.

In addition to the standard railway design loading, the following nominal loading for a K1ROW KRC1200UK rail mounted crane shall be taken into account in the design:

Loads: 8 number point loads each of 250kN on each of 2 rails

Spacings: 1100 1200 1100 5600 1100 1200 1100 mm

The 16 No point loads (8 axles) shall be applied with a dynamic factor of 1.0 (i.e. there is no increase in the loads for dynamic effects) and the loading is not to be considered for fatigue checks.

The crane loading shall be applied as an alternative to RU loading on one track, with normal railway loading (RU, SW/o etc. as identified in 9.2) applied on the adjacent track(s). The crane loading shall be applied as part of Load Combination 1 in Table 1 of BS 5400-2: 2006 with the following factors applied:

$\gamma_{fL} = 1.25$ on the crane load

$\gamma_{fL} = 1.40$ on the coexistent railway load

$\alpha = 1.00$

impact factors on coexistent railway load = 1.00

1.8.2 Traffic type for fatigue (heavy/medium/light). The standard designs will consider light, medium and heavy traffic. See Drawing NR/CIV/SD/FORMA/1200/01

1.8.3 Actual annual traffic tonnage per track Not applicable as the standard designs are not site specific.

1.8.4 Design annual traffic tonnage per track for fatigue The standard designs will consider four cases; $>7 \times 10^6$ t/annum, $>12 \times 10^6$ t/annum, $>18 \times 10^6$ t/annum and $>27 \times 10^6$ t/annum.

The standard designs will therefore be suitable for locations where the predicted annual traffic tonnage is equal to but does not exceed 42×10^6 t/annum. Where shallow girder flange plate thicknesses would be unreasonable, longer span decks subject to heavy traffic will be designed for a reduced, span dependent annual traffic tonnage.

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1.8.5 Rail traffic Design speed The standard designs will be suitable for locations where the design speed does not exceed 200km/h.

1.8.6 Design footway/ walkway loading Walkways are subject to a separate Form A and will be designed in accordance with draft NR/L2/CIV/020. The main girders and U frame components will be designed to sustain the applied load from the walkways and parapet: Walkway: 1kN/m (services) + 5kN/m² + a point load of 2kN (live) + 1.8kN/m (wind) applied vertically (nominal); Parapet: 0.74kN/m (live) applied horizontally at 1.50m above the top of the top flange + 4.8kN/m (wind) applied horizontally at 0.75m above the top of the top flange (nominal).

It is assumed that the maximum parapet height will be 1500mm.

The parapets are assumed to be closed for the purpose of calculating load effects.

The reactions from the walkways on the main girder stiffeners are summarised in Appendix C.

1.8.7 Minimum ballast depth/sleeper type The standard designs will consider a minimum desired ballast depth of 200mm and a maximum desired ballast depth of 300mm below the lowest part of the sleeper and the deck. Standard F27 sleepers at 600mm centres and CEN60 rail will be assumed for the standard designs (368mm). Refer to section 1.8.9 for geometrical constraints.

The design will assume the maximum sleeper width that may be placed on the bridge without modification of the sleeper is the width of an EF28 sleeper: 2580mm. Ballast density assumed to be 21kN/m³. The minimum ballast depth of 200mm and maximum ballast depth of 400mm will be considered when calculating the applied loads.

Track weight assumed to be 2.5kN/m per track.

Direct fastening systems will not be considered in detail although the standard designs will be reviewed against likely performance requirements for such systems and the outcome reported in the Technical User Manual.

1.8.8 Track lift and/or realignment Not applicable as the standard designs are not site specific.

1.8.9 Construction depth (top of highest rail to soffit) and headroom to be provided The construction depth is calculated for each standard design with the following formula (assuming 200mm ballast and excluding future track lifts or construction