REPORT

Technical Inspection Reporting

IJssel Bridge A12

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Content

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1 Reading Guide

This report discusses the results of the technical inspection of the IJsselbrug A12. Both inspection of the bridge (s) and the main bridge (s) are discussed.

Bridge Bridge Main bridge

Figure 1 - Side view of the IJssel bridge [A.46205A]

For the technical inspection, a drone with camera was used, with which both photos and video images are taken. A complete overview of the photos of the drone is available online to be fond of https://s3-eu-west-1.amazonaws.com/rhdhv.fotos-ijsselbrug-a12/viewer/index.html . The pictures are hereby indicated with selectable markers which correspond to the position of the genomes longitudinal photo of the bridge. The position of the markers in the width direction of the bridge is for the most pictures on the edge of the bridge, because the GPS signal under the bridge is disturbed by it bridge deck. The markers therefore only say something about the longitudinal position of the bridge.

The video images are made digitally available separately. In addition to the above images are also one number of measurements and photos taken from the jetties that were present under the IJssel Bridge during the inspection and from the top of the deck, during an overnight shutdown.

Figure 2 - Online environment with photos

In chapter 2, the dimensions of various parts have been randomly checked, for this parts have been measured and the dimensions have been checked on the basis of the photos. In chapter 3 the damage that has been identified is discussed and any material consumption is estimated. In Chapter 4 finally examines the asphalt thickness measurements that have been carried out.

2 Verification geometry

In this chapter, the geometry was randomly compared between photos taken during the inspection and the corresponding drawings. For this a comparison has been made of the geometry, for example, by comparing the shape, dimensions and / or number of rivets of various parts of the main supporting structure.

2.1 Main bridge

2.1.1 Main beams

For the main beams, various sizes were randomly checked. At pillar H, the center to center measurement of the vertical stiffeners of the K-bandages 5197 mm. This corresponds to the drawing (60-5 + 1665 + 120 + 1665 + 120 + 1665 + 60-280 / 2-14 = 5196 mm). Also the height between the top of the bottom flange bottom edge of console flange corresponds to 4768 mm (measured) according to drawing (5300-490-12-12-20 = 4766 mm).

5196

6
6
47

Figure 3 - Main beam geometry at pillar H [A.85365]

The head of the rivet in the bottom flange has a diameter of 35 mm, which corresponds to a rivet Ø23 mm, according to the drawing.

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The height between the bottom of the console and the top of the bottom flange is also checked at the middle of the main span. A height of 2268 mm has been measured, which corresponds well with the drawing (2800-490-12-12-20 = 2266 mm).

6
6
22

Figure 4 - Main girder geometry at center of river span [A.85367]

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For connection C1, the number of rivets in the connection plate in the bottom flange has been checked. This matches the drawing well

Figure 5 - Geometry connecting plate at section division C1 [Source: A7_T 50_DSC02589.JPG]

Figure 6 - Geometry connecting plate at section division C1 follow drawing [Source: A.85368]

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The length of the plate has been checked for connection C2. No deviations were found.
The thicknesses of the plates also correspond fairly well with the drawing. The slightly thicker measured total thickness (85 mm) compared to the drawing (80 mm) can be explained by the different layers coating on and between the plates.

1100

86
0

Figure 7 - Dimensions detail C2 according to drawing [Source: A.85368]

Figure 8 - Dimension detail C2 [Source: 3030.JPG]

Figure 9 - Dimension detail C2 [Source: 3032.JPG]

Figure 10 - Plate thickness detail C2 [Source: 3028.JPG]

Figure 11 - Plate thickness detail C2 according to drawing [Source: A.85368]

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The length of the plate has been checked at connection C5. This is slightly smaller at 2855 mm as shown on the drawing (2900 mm). The distance from the end of the plate to the first rivet is 50 mm equal to the drawing. Structurally, the difference in plate length will therefore not be significant have consequences for capacity.

2900

Figure 12 - Dimensions of section division C5 according to drawing [Source: A.85369]

Figure 13 - Measured dimensions of section division C5 [Source: 3057.JPG]

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The dimensions of the connecting plate are written on the bottom flange at connection C7.
The measured dimensions on one side (left in Figure 14) correspond well with the drawing. Well there are small deviations were found, but this is probably caused by the thickness of the paint layers.

100

400 130

54

Figure 14 - Dimensions according to drawing section C7 [Source: A.85312]

50 400
120
1

Figure 15 - Measured dimensions of section division C7 [Source: 3063.JPG]

100 25
120 54
400

Figure 16 - Dimensions according to drawing at section division C7 [Source: A.85312]

50
120 400
30

100

Figure 17 - Measured dimensions at section division C7 [Source: 3049.JPG]

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On the other side, there appears to be a deviation in the beveling of the flange extenders. These are shorter than shown in the drawing. This deviation is also reflected in the report [R10290B] of TNO. However, it is unclear where exactly the 300 mm distance in the TNO report starts.

200

55

55

200

Figure 18 - Main bridge detail [Source: 3052.JPG]

Figure 19 - Detail main bridge [Source: 3061.JPG]

Figure 20 - Dimensions according to drawing [A.85370]

Figure 21 - Dimensions according to TNO report [R10290B]

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In addition to the bottom flange, the width of the web plate has also been checked. This comes with a total width of 350 + 150 = 500 mm corresponds well to the drawing.

500

350

150

Figure 22 - Measured size of connecting plate body at section division C7 [Source: 3051.JPG]

The number of rivets in both horizontal and vertical directions in Figure 23 also corresponds to the drawing, see Figure 24.

Figure 23 - Section division C7 in the body [Source: A8_T 32_DSC02633.JPG]

Figure 24 - Section division C7 according to drawing [Source: A.85366 & A.85367]

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On the inside you can see that the horizontal stiffeners correspond to the drawing in Figure 26 .
The number of rivets also corresponds to the drawing.

Figure 25 - Main girder interior
[Source: B2_T 11_DSC02384.JPG]

Figure 26 - Inside of main beam according to drawing
[Source: A.85366 & A.85367]

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2.1.2 Crossbars

The height, width and thickness of the cross beam has been checked at a number of locations. The body has one measured height of 500 mm, the bottom flange 13x250 mm. According to drawing is the thickness of the bottom flange 12 mm. The deviation probably lies in the thickness of the paint layers.

Figure 27 - Cross beam according to drawing [Source: A.85378]

Figure 28 - Bottom flange as per drawing [Source: A.85378]

250

Figure 29 - Crossbars under the deck [Source: B7_T 24_DSC02585.JPG]

Figure 30 - Dimensions of bottom flange for cross beam [Source: DSCN3039.JPG]

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2.1.3 K-dressings

The geometry and profiles of the K-bandages correspond to the drawings.

Figure 31 - Underside of K-band diagonals [Source: DSCN3035.JPG]

Figure 32 - Diagonals and bottom edge of K-bandage [Source: DSCN3037.JPG]

Figure 33 - Connection lower edge K-bandage to main beam [Source: DSCN3085.JPG]

Figure 34 - Geometry K-relations

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2.1.4 Deck construction

The height, width and center-to-center distance of the bulbs has been checked at a number of locations. The bulbs have a measured height of 160 mm and a width at the bottom of 40 mm. The spacing between the bulbs varies between 287 mm and 293 mm, which corresponds pretty well with the drawing (300-8 = 292 mm).

40

160

Figure 35 - Bulbs main beam [Source: 3038.JPG]

Figure 36 - Bulb size [Source: A.85378]

Figure 37 - Bulbs main beam [Source: B3_T_14_DSC02412.JPG]

Figure 38 - Connection of deck parts [Source: DSCN3005.JPG]

Figure 39 - Connection of deck parts according to drawing [Source: A.85324]

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2.1.5 Imposition

At the location of the river pillars (pillar H and J), a scaffold plate is present above the support. The number of rivets in the horizontal and vertical directions correspond to the drawing in Figure 42. In Figure 41 see that this sheet extends to the second horizontal stiffener, according to the drawing.
The bulkheads perpendicular to the plate also match. It can be seen that there is a dual role in pillar J, corresponding to the drawings.

Figure 40 - Exterior of main beam at pillar J [Source: B5_T 3_DSC02456.JPG]

Figure 41 - Inside of main beam at pillar J [Source: A14_T 22_DSC02726.JPG]

Figure 42 - Plate on main beam body according to drawing [Source: A.85365]

The geometry of the screed plate also corresponds to pillar G. The number of rivets in both horizontal the vertical direction corresponds to the drawing in Figure 44. This pillar has a single roller.

Figure 43 - Exterior of main beam at pillar G.
[Source: A6_T 63_DSC02539.JPG

Figure 44 - Main girder at pillar G according to drawing
[Source: A.85363]

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At the location of pillar F, the geometry of the top plate and the support is also good.

Figure 45 - Main girder (outside) at pillar F bearing
[Source: A6_T27_DSC02503.JPG]

Figure 46 Main girder (inside) at pillar F bearing according to drawing [Source: A.85362]

2.2 Bridge

2.2.1 Main beams

The dimensions of the bottom flange are checked at the end of the cover plate. The width and thickness of the bottom flange (400x28 mm) and thickness plate (380x28 mm) correspond to the drawing. The geometry of the end of the plate also corresponds to the drawing.

Figure 47 - Bottom of main beam
[Source: A20_T 4_DSC02895.JPG]

Figure 48 - Underside of main beam according to drawing
[Source: A.39074]

A number of checks have been carried out on the dimensions of the main beams. The geometry of the section divisions correspond to the drawings. In Figure 49 it is seen that there is in the vertical direction 20 rivets are present and in horizontal direction 4. This corresponds to the drawing in Figure 50 . Also the number of bolts in the connection between the top flange and the body, as well as in the cross beam connection corresponds to the drawing.

Figure 49 - Main beam side view
[Source: A5_T 33_DSC02437.JPG]

Figure 50 - Side view of main beam according to drawing
[Source: A.39074]

Figure 51 - Interior view of top flange - body connection
[Source: DSCN3122.JPG]

The photo of the rivet cartridge in the bottom flange [(Figure 52)] shows that 36 rivets are present to be. This is consistent with the drawing in [Figure 53] . The geometry of the plate also seems to match well come.

Figure 52 - Main beam view
[Source: A4_T 38_DSC02390.JPG]

Figure 53 - Top view of connection of main beam according to drawing [Source: A.39074]

2.2.2 Crossbars

The geometry of the cross bars corresponds well to the drawing. The measured dimensions of the bulkhead (150x13 mm) and the bottom flange of the cross beam (298x23 mm) almost correspond to the dimensions according to drawing. The deviation in the thickness can be explained by the coating.

Figure 54 - Crossbar with K-bandage
[Source: DSCN3105.JPG]

Figure 55 - Connection crossbeam without k-bandage
[Source: DSCN3100.JPG]

Figure 56 - Crossbar with K-bandage according to drawing
[Source: A.22650]

Figure 57 - Cross beam - main beam connection
[Source: A.22649]

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2.2.3 K-dressings

The geometry of the K-bandages is in good agreement with the drawings.

Figure 58 - Connection diagonal Bottom
[Source: DSCN3106.JPG]

Figure 59 - Diagonal connection Bottom according to drawing
[Source: A.22650]

Figure 60 - Connection diagonal Bottom
[Source: DSCN3107.JPG]

Figure 61 - Diagonal connection Bottom according to drawing
[Source: A.22650]

Figure 62 - Diagonal top connection
[Source: DSCN3108.JPG]

Figure 63 - Connection diagonal top side according to drawing
[Source: A.22650]

2.2.4 Imposition

There is a plate on the body at the location of the intermediate supports. From Figure 64 to Figure 67 is too conclude that the number of rivets corresponds to the number indicated in Figure 67. It is also too see that the sheet continues to the first horizontal stiffener. This corresponds to the drawing.

Figure 64 - Detail of main beam
[Source: A4_T 15_DSC02367.JPG]

Figure 65 - Main beam detail
[Source: A20_T 33_DSC02924.JPG]

Figure 66 - Main beam detail [Source: A20_T 3_DSC02894.JPG]

Figure 67 - Detail of main beam according to drawing [Source: A.39074]

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2.2.5 Concrete deck

Inspection of the concrete deck is only performed on the underside of the bridge. There is no in the concrete deck significant cracking has been observed. In particular, at the location of the transition from the reinforced concrete deck looked at the prestressed concrete deck, as the most critical location with regard to cracking.

Figure 68 - Concrete deck at cantilever [Source: A20_T 3_DSC02894.JPG]

Figure 69 - Reinforced concrete deck [Source: A16_T 6_DSC02758.JPG]

Figure 70 - Pre-stressed concrete deck transition - reinforced concrete deck [Source: A18_T 27_DSC02843.JPG]

Figure 71 - Pre-stressed concrete deck transition - reinforced concrete deck [Source: A20_T 3_DSC02894.JPG]

2.3 Conclusion

A random check was carried out to determine whether the geometry of the construction corresponds to the drawings. With the exception of one of the connections in the bottom flange of the main beam in the main bridge (connection C7) no deviations were found.

3 Damages

This chapter provides an overview of the damages incurred during the technical inspection
have been identified. It should be noted that the purpose of this inspection is to correct any damages incurred by
impact on the structural carrying capacity. There is no hand-held inspection
executed. This report therefore does not provide a complete overview of all damages.

3.1 Consoles main bridge

The consoles of the main bridge show superficial corrosion in various places. That is estimated
the corrosion has caused less than a 5% decrease in the cross-sectional area of the bottom flange, and thus
has negligible effects on strength and stiffness. It is recommended to do this prior to or
during the renovation work. The cause of the corrosion probably lies in the
openings in the edge strip of the deck (see next section).

Figure 72 - Rust spot bottom console flange [Source: 3073.JPG]

Figure 73 - Rust spot bottom console flange [Source: 3069.JPG]

3.2 Steel strip edge strip

The edge strip of the steel deck shows at the location of the connections of the brackets of the inspection path significant corrosion. Although this does not affect the strength and stiffness of the main supporting structure, this may have consequences for the strength of the inspection path. The corrosion also occurs at the location of the old holes in the edge strip that are currently no longer used used. It is recommended to connect the consoles to the console before the renovation
edge strip (to have it assessed) whether it is still possible to radiate and preserve it, or to share it here should be replaced.

Figure 74 - Rust spot edge strip steel deck [Source: 3074.JPG]

Figure 75 - Rust spot edge strip steel deck [Source: 3075.JPG]

Figure 76 - Rust spot edge strip steel deck at console inspection path [Source: 3044.JPG]

Figure 77 - Rust spot edge strip steel deck at console inspection path [Source: DSCN2684.JPG]

3.3 Joint transitions and road furniture

Although inspection of the joint transitions and road furniture was not part of the technical inspection, it is pointed out then the joint transitions and the underside of the vehicle barrier corrosion show that in some locations the rubbers are locally torn and that there is a serious degree of it contamination is present in the joint transitions. An indicative overview is given in Appendix A.

Figure 78 - Corrosion joint transition [Source: DSCN2675.JPG]

Figure 79 - Corrosion joint transition [Source: DSCN2652.JPG]

Figure 80 - Corrosion joint transition [Source: DSCN2659.JPG]

Figure 81 - Corrosion joint transition [Source: DSCN2674.JPG]

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Figure 82 - Rust spot edge strip steel deck at console inspection path and corrosion underneath vehicle barrier [Source: DSCN2675.JPG]

Figure 83 - Corrosion of edge strip on steel deck at console inspection path [Source: DSCN2689.JPG]

3.4 Diagonal K-bandage

The first diagonal of the river span is locally bent on one side. It is unclear what
this happened exactly, possibly during a previous inspection of the bridge due to a collision with an aerial platform on a boat or platform. It is recommended that the bend out of the profile. However, this has not been included for modeling.

Figure 84 - Distortion of the diagonal of one of the diagonals in the river span.

3.5 Conclusions

The damages found do not affect the calculation model for the recalculation. It will be it is recommended to fully visualize the damage found prior to the renovation and especially for the edge strip / connection consoles inspection path make an assessment to what extent here repair by blasting and preservation is still possible, or parts need to be replaced.

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4 Pavement height measurements

The design thickness of the pavement for both bridges is 50 mm [BR 2571], [BR 3126], [A.50973]. In 1996 this was replaced on the steel bridges for ZOAB (30-35 mm) on DAB (25 mm) with two Parafor membrane layers (2x5 mm) [VI Asphalt 1998]. This brings the total thickness to approx. 70 mm. For the bridging it was not possible to find out what the thickness of the asphalt pavement applied during the replacement has been applied, although it is likely that the thickness here is the same as on the main bridge as the decks are in line and they are the same from the design
design thickness of the asphalt. The joints were also replaced at the time.

It was therefore decided to determine the asphalt thickness during an inspection of the western bridge (see Annex A). The height difference between the top of the asphalt and the top of the cut edge (bridging) is and edge strip (main bridge) measured and the thickness of the asphalt pavement was derived from this. The designation west and east in the table below refer to the flank side on the west side and east side, in both fallen from the western bridge.

Bridge			Main bridge		
Location	west	east	Location	west	east
LH north	85		Pillar F		80
Pillar A	105		Pillar G	75	60
Pillar B	105		Pillar H	75	95
Pillar C	115		Pillar J	100	90
Pillar D	85	75	Pillar K.	90	80
Pillar E	85	85	LH south	85	70
Pillar F	65				

Table 1 - Asphalt thickness based on height measurements bk scrap edge - bk pavement

As can be seen, the thicknesses are greater than conforming cutlery. It has been agreed in consultation with Rijkswaterstaat to start from the average asphalt thickness per bridge.

The table below gives an overview of the applied asphalt thicknesses. The current is calculated asphalt thickness.

	Asphalt thickness design	Source	Current asphalt thickness	tax	Source
Main bridge east	50 mm	BR 2571, A.50937	82 mm	1.89 kN / m²	Measurement based on the height of the bk edge
Main bridge west	50 mm	BR 3126, A.50937	82 mm	1.89 kN / m²	Measurement based on the height of the bk edge
1 e aanbrug	50 mm	A.50937	102.5 mm	2.36 kN / m²	Measurement based on the height of the bk edge
2 e aanbrug	50 mm	A.50937	85 mm	1.96 kN / m²	Measurement based on the height of the bk edge

Table 2 - Overview of asphalt thickness in accordance with design and current asphalt thickness

Appendix

Appendix A - Pavement thickness measurements

IJssel Bridge

measuring location	measurement numbering measuring point	KM / re	Object ID	part	joint drummer	Photos	Information	height * A in mm. (= bk asphalt to bk schamkant / steel head plate
		134,790	40B-003-02			2633	overview photo	
STP01	**1**	134,790	40B-003-02	bridge		2634	measurement taken from the western side, inside, measuring point 0.70m1 from the inside taken shameless	140
STP01		134,790	40B-003-02	bridge	**V_1**	2635-2637	STP01: single joint construction with rubber seal: steel profile is laminated, rubbers are heavily contaminated with sand / fine gravel which can lead to a reduction deformation of the joint construction	
STP02	**2**	134,830	40B-003-02	bridge		2638-2640	measurement taken from the western side, inside, measuring point 0.70m1 from the inside taken shameless	120
STP03	**3**	134,870	40B-003-02	bridge		2641	measurement taken from the western side, inside, measuring point 0.70m1 from the inside taken shameless	120
STP04	**4**	134,910	40B-003-02	bridge		2642	measurement taken from the western side, inside, measuring point 0.70m1 from the inside taken shameless	110
STP04		134,910	40B-003-02	bridge	**V_2**	2643-2648	STP04: single joint construction with rubber seal: steel profile is laminated, rubbers are heavily contaminated with sand / fine gravel which can lead to a reduction deformation of the joint construction	
STP05	**5_west**	134,950	40B-003-02	bridge		2649	measurement taken from the western side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	140
STP05	**5_oost**	134,950	40B-003-02	bridge		2650	measurement taken from the eastern side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	150
STP06	**6_west**	134,990	40B-003-02	bridge		2651	measurement taken from the western side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	140
STP06	**6_oost**	134,990	40B-003-02	bridge			measurement taken from the eastern side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	140
STP07	**7_west**	135,030	40B-003-02	HDC		2653	measurement taken from the western side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	160
STP07		135,030	40B-003-02	transition bridge / HDC	**V_3**	2655-2659	STP07: multiple (slat joint) joint construction with rubber seal: steel profile is laminated, rubbers are locally cracked and heavily contaminated with sand / fine gravel can lead to reduced deformation of the joint construction	
STP07	**7_oost**	135,030	40B-003-02	HDC		2654	measurement taken from the eastern side, inside, measuring point 0.25m1 from the inside taken as a sham edge, gutter width = 0.2m1	140
STP08	**8_west**	135,075	40B-003-02	HDC		2660-2661	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	130
STP08	**8_oost**	135,075	40B-003-02	HDC		2662	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	160
STP09	**9_west**	135,125	40B-003-02	HDC		2663	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	130
STP09	**9_oost**	135,125	40B-003-02	HDC		2664	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	125
STP010	**10_west**	135,230	40B-003-02	HDC		2665	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	105
STP010	**10_east**	135,230	40B-003-02	HDC		2666	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	130
STP011	**11_west**	135,280	40B-003-02	HDC		2667	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	115
STP011	**11_oost**	135,280	40B-003-02	HDC		2668	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	140
STP012	**12_west**	135,325	40B-003-02	HDC		2669	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	120
STP12		135,325	40B-003-02	HDC	**V_4**	2671-2774	STP12: multiple (slat joint) joint construction with rubber seal: steel profile is laminated, rubbers are locally cracked and heavily contaminated with sand / fine gravel can lead to reduced deformation of the joint construction	
STP012	**12_east**	135,325	40B-003-02	HDC		2670	measurement of asphalt 1m1 taken from steel edge plate, gutter width = 0.75m1	150