Project related

Type	vrw's long distance	As-distance [m]	Axle type	Axle load a low [kN] 50%	agent [kN] 35%	high [kN] 15%	Truck tax a low [kN] 50%	agent [kN] 35%	high [kN] 15%
1 V11	10%	5.2	a	35	55	70	75	125	170
			B	40	70	100			
2 V12	10%	3.8	a	55	75	90	145	215	315
		1.3	B	50	80	125			
			B	40	60	100			
3 T11O2	25%	3.8	a	55	60	70	180	245	350
		6.6	B	55	75	110			
		1.3	B	35	55	85			
			B	35	55	85			
4 T11O3	50%	3.8	a	60	70	80	185	345	475
		5.6	B	50	95	125			
		1.3	B	25	60	90			
		1.3	B	25	60	90			
			B	25	60	90			
5 T12O3	5%	2.8	a	60	70	80	295	460	600
		1.3	B	40	60	90			
		5.6	B	60	90	115			
		1.3	B	45	80	105			
		1.3	B	45	80	105			

B	45	80	105

Table 46 - Truck composition period 1964 - 1990

Type	vrw's long distance	As-Distance [m]	As-type	Axle load a low [kN] 50%	agent [kN] 35%	high [kN] 15%	Truck tax a low [kN] 50%	agent [kN] 35%	high [kN] 15%
1 V11	10%	5.2	a	35	55	70	75	125	170
			B	40	70	100			
2 V12	10%	3.8	a	55	75	90	145	215	315
		1.3	B	50	80	125			
			B	40	60	100			
3 T11O2	25%	3.8	a	55	60	70	180	245	350
		6.6	B	55	75	110			
		1.3	C	35	55	85			
			C	35	55	85			
4 T11O3	50%	3.8	a	60	70	80	185	345	475
		5.6	B	50	95	125			
		1.3	C	25	60	90			
		1.3	C	25	60	90			
			C	25	60	90			

		2.8	a	60	70	80			
		1.3	B	40	60	90			
5 T12O3	5%	5.6	B	60	90	115	295	460	600
		1.3	B	45	80	105			
		1.3	B	45	80	105			
			B	45	80	105			

Table 47 - Truck composition for the period 1991-2010

Type	vrw's long distance	As-Distance [m]	As-type	Axle load a			Truck tax a		
				low [kN] 50%	agent [kN] 35%	high [kN] 15%	low [kN] 50%	agent [kN] 35%	high [kN] 15%
1 V11	10%	5.2	a	35	55	70	75	125	170
			B	40	70	100			
2 V12	10%	3.8	a	55	75	90	145	215	315
		1.3	B	50	80	125			
			C	40	60	100			
3 T11O2	20%	3.8	a	55	60	70	180	245	350
		6.6	B	55	75	110			
		1.3	C	35	55	85			
			C	35	55	85			

		3.8	a	60	70	80			
		5.6	B	50	95	125			
4 T11O3	50%	1.3	C	25	60	90	185	345	475
		1.3	C	25	60	90			
			C	25	60	90			
		4.2	a	60	75	90			
		1.3	B	70	95	125			
		4.2	C	45	70	95			
5 V12A12	5%						300	450	580
		3.8	C	45	80	100			
		1.3	C	40	65	85			
			C	40	65	85			
		2.8	a	60	70	80			
		1.3	B	40	60	90			
		5.6	B	60	90	115			
		1.3	C	45	80	105			
6 T12O3A2	5%						365	580	770
		1.3	C	45	80	105			
		4.2	C	45	80	105			
		1.3	C	35	60	85			
			C	35	60	85			

Table 48 - Truck composition for the period 2011-2050

The tables include the axle and truck loads for the situation associated with the reference year 2000, excluding dynamic effects and excluding development over time. The correction factors for this tax are discussed in sections 6.10.5 and 6.10.6.

6.10.3 Combination of trucks on adjacent lanes and convoys

In accordance with NEN-EN 1991-2 and the call for tenders, combinations of truck on adjacent lanes. In addition, in accordance with NEN-EN 1991-2 also serves to take into account convoys if the influence line length is greater than 60m. Below figure gives an overview of the considered truck configurations.

Figure 82 - Configurations to consider

For the main girders of the main bridge, all tests are performed with and without convoys, where the standard of the two applies. This is done because it is not too advance say is where the line lies between where the situation with or without convoys is decisive. This will depend, among other things, on the detail category.

Traffic in adjacent lane (NEN-EN 1991-2 art 4.6.1 (3))
When driving in the same direction, there must be a load in addition to the load on the heavy traffic lane in the adjacent lane for other traffic. This tax occurs simultaneously in one in ten lorry passages in the heavy traffic lane (10%).

For the number of trucks in the heavy traffic lane 100% * $N_{\text{obs is used}}$, see Appendix K. For the number of trucks in the adjacent lane, 10% * $N_{\text{obs is used}}$. In in total 110% * $N_{\text{obs will be}}$ crossed. For the lorries on the left lane may be accepted these are of the type “low axle load” according to NEN 8701. Because the distribution between trucks with “high, medium and low axle load” should be 15%, 35% and 50%, the distribution is on the right lane adjusted, so that proportionally more trucks with heavy and medium axle load pass. The total of trucks passing the bridge has the correct ratio.

Traffic in adjacent lane with influence length greater than 60 meters (NEN-EN 1991-2 art 4.6.5.3)
For (parts of) bridges with (a) continuous positive or negative influence line length (s) greater than 60 m (all support moments and field moments field 2 and 3 of the main bridge) next one:

a) The heavy traffic lane must include one in five (20%) of passages ($N_{\text{obs in}}$ accordance with Appendix K) driving two trucks in a row. These trucks are expected to follow each other with a center-to-center distance (center-to-center configuration) of 50 m the same vehicles occur simultaneously.

b) When driving in the same direction, there must be a load next to the load on the heavy traffic lane in the adjacent lane for other traffic. The load on this lane 5% of the number of trucks (= 0.05 N_{obs}) must be combined with a single truck on the lane for heavy traffic and 5% of the number of trucks (= 0.05 N_{obs}) with two trucks who drive one after the other.

(c) In accordance with the call for tenders, the passing lorries in the left-hand lane are based on the the same type of truck, with “low axle load” according to NEN 8701 appendix A. The numbers lorries of the “low axle load” type driving on the left-hand lane may enter the numbers subtract the right lane (total number of N_{obs} remains the same).

The above conditions are met with the distribution given in Figure 82 . The total of the number of vehicles in the right lane is 100%, in the left lane 10%.

6.10.4 Development over time

The axle and truck loads in the tables above apply to the reference year 2000 application in other years must be corrected for the influence of development of traffic taxes. A tax increase of 20% in 100 years (0.2% per year) has been assumed the future and a tax reduction of 20% in 100 years (0.2% per year) to the past.

The development over time of the numbers of trucks has already been incorporated into the numbers such as specified in the call for tenders, see appendix K. Therefore, no correction needs to be made.

Project related

6.10.5 Dynamic effects due to unevenness

The correction factor for dynamic effects resulting from road irregularities and dynamic effects of construction parts is □ $_{s1}$ = 1.1 according to NEN 8701.

NB In TNO's report [R310631-R11499] this factor has been reduced to 1.05. This is based on the fact that the assessment concerns the main beam, for which the total mass of the bridge is important. The ratio between the mass of the bridge and the mass of one or two trucks is so large that the bridge can hardly be brought into vertical vibration. This is supported by strain gauge measurements on the Merwedebrug, where a dynamic factor of $\varphi = 1.05$ resulted in a almost perfect match between measurement and model. For the time being, it is in consultation with Rijkswaterstaat decided not to take this lower factor into account.

6.10.6 Enlargement factor at joint transitions

The effects of joints or joint transitions must be taken into account in addition to the above brought in accordance with NEN-EN 1991-2 and NEN-EN 1993-2. It is assumed that one good road quality. For the fatigue calculation, close to the joint transitions based on:

□□ $_{fat}$ = 1.15

This magnification factor must be applied to all axles of a vehicle in fatigue calculation if at least one axle of the vehicle is within a distance $D \leq 6$ m from the relevant transition located. □□ $_{fat}$ must be assumed continuously over the entire distance $D \leq 6$ m from the transition. This surcharge is automatically charged by the python tool if one of the axes is located within 6 m of the joint transition.

6.10.7 Geometry and contact surfaces of the wheels

The wheel and axle types are shown in the figure below, in accordance with Appendix A.2 of NEN 8701.

Figure 83 - Wheels and axle types to consider

The calculation is always based on wheel type A, because there are no local tests of the deck executed.

6.10.8 Detail category of connections

The detail categories have been determined according to various reports from TNO and NEN-EN 1993-1-9.

- TNO report "Various fatigue recommendations for the bridge near Rheden" [TNO 2017 R11499]
- TNO report "Fatigue IJssel Bridge Rheden - non-absorbing rivet connections"
- TNO report "Detail categories for fatigue of rivet joints and orthotope driving decks with open stiffeners "[TNO 2017 R10405]
- TNO memo "Fatigue classification of fillet welds in cross and T-joints" [100315818 / ALL]
- RBK sample [TNO report TNO-2017-R10480]
- NEN-EN 1993-1-9

An overview of the various detail categories is given in Appendix K. It should be noted that for a number of details deviating slopes (m_1) and break points in the SN curve are applied compared to the usual values in NEN-EN 1993-1-9.

For the assessment of fillet welds for fatigue (including the connections of the cross beam and bulkhead under the crossbeam) the initial calculation is damage category 36 * according to the standard. If this is not sufficient, the damage category 40 determined by TNO will be taken into account, whereby the normal compressive stress present in the weld is taken into account [ref 100315818 / ALL]. In accordance with this report, the fatigue damage from the normal stress in the weld will be determined twice once for the situation with contact between the plates and once for the situation without contact between the plates. It is then assumed the maximum of the two damage numbers, because in practice it cannot be determined with certainty whether there is contact pressure between the plates. The damage should be added to the damage due to the shear stress parallel to the longitudinal direction of the weld.

7 Main bridge

7.1 Construction description

The main bridges (east and west) each have a length of 295 meters and consist of 5 spans of 45 m, 50 m, 105 m, 50 m and 45 m respectively.

Figure 84 - Side view from the west on the main bridges [A.22646]

7.1.1 Main beams

The main supporting structure consists of two steel beams with a variable height (2.4 m - 5.3 m) with ter instead of the top flange a steel driving deck with bulbs.

Figure 85 - Cross section of one of the main bridges [A.22646]

The main beams are constructed from a DIN 30 profile, which is cut in two. On the up side the top flange with 50 mm body is used and at the bottom the bottom flange with 230 mm body. In between is a 12 mm thick web plate welded with variable height. The bottom flange has a full length 500 mm wide plate, which alternately has a thickness of 20 or 30 mm.

At the location of the first and last field there is an extra plate on the bottom flange of 350 * 30 mm. At the location of the second, third and fourth field and at the location of Pillar H and J an extra plate is 550 x 30 applied. The plate in the middle field has a section of about 6 m at the ends with a size of 530x10 mm

350x30 550x30 550x30 550x30 350x30
v

Figure 86 - Stripping on the bottom flange [A.22646]

The main beam is stiffened by means of horizontal pleat stiffeners (L-profiles) and vertical ones pleat stiffeners (half INP profiles). Depending on the height, there are one or more horizontal ones pleat stiffeners applied to the inside of the main beams. The vertical pleat stiffeners on site of the K-bandages are with a few exceptions both on the inside and the outside applied. At the location of the intermediate cross bars, the vertical pleat stiffeners are only on the applied inside.

Figure 87 - Cross-section and side view of main beam with horizontal and vertical pleat stiffeners [A.85304]

7.1.2 Crossbars

The cross bars are composed of a 500x10 mm web plate with a welded bottom flange of 250 * 12 mm. Outside the main girders, the crossbars continue into a console and drop to 200 in height mm at the end of the console. A distinction is made in the “normal” cross bars with including a K-bandage and the intermediate cross members without a K-bandage. The normal cross bars are alternated with 1 or 2 intermediate intermediate crossbars. The center-to-center size is approx. 1.75 to 1.80 m.

Figure 88 - “Normal” cross beam [A.85320]

Figure 89 - Intermediate cross member [A.85319]

7.1.3 Consoles

Around 1975 the consoles on both were extended to make room for an inspection path behind the vehicle barrier.

Figure 90 - Widening bridge deck with consoles [A.50937]

The bridge has been widened with two types of consoles, normal consoles (IPE 120), which only have the inspection path and carry the handrail, and “reinforced” brackets (sleeve 260x260x11), which also carry a light tower.

Figure 91 - Normal console (left) [A.50928-C] and “reinforced” console (right) [A.50939]

7.1.4 Deck construction

The deck construction consists of a steel plate (t = 10 mm or t = 12 mm) with bulbs (160 * 8 mm). To the At the end of the (original) console, a strip of 445x10 mm is applied. The next longitudinal rib is different from the other bulbs and has a rectangular cross section 100x8 mm. The bulbs and strip span from cross beam to cross beam with a span of approximately 1.80 m the bottom of the bulbs has a round hole in the crossbeam.

Continuous end strip 445x10 mm

Strip 100x8 mm

Bulb 160x8 mm

Figure 92 - Cross section of the bulbs and outer longitudinal rib (left) [A.85319] and end strip on the console (right) [A.85323]

7.1.5 K-dressings

The K-bandages are made up of the following profiles:

- Diagonals: composite bar of two angle profiles (L80x80x8 or L90x90x9) (blue);
- Bottom edge: Half DIN 20 profile (red);
- Verticals: Two half INP profiles (INP24 or INP30) (purple).

Figure 93 - K-bandage “normal” crossbeam [A.85320]

Crossdrive	Outside	Inside	Diagonal	Bottom Edge	Crossdrive	Outside	Inside	Diagonal	Bottom Edge
1	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	15	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
2	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	16	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
3	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	17	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
4	-	1/2 INP24	80 * 80 * 8	1/2 DIN20	18	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
5	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	19	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
6	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	20	1/2 INP30	1/2 INP30	90 * 90 * 9	1/2 DIN20
7	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20	21	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20
8	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	22	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20
9	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	23	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20
10	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	24	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20
11	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	25	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20
12	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	26	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20
13	-	1/2 INP30	80 * 80 * 8	1/2 DIN20	27	1/2 INP24	1/2 INP24	80 * 80 * 8	1/2 DIN20
14	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20	14	1/2 INP24	1/2 INP30	80 * 80 * 8	1/2 DIN20

Table 49 - Profiles K-bandages per axle

7.1.6 Portals

At the location of the supports, heavier K-bandages are applied, which become a portal indicated. The portal at the location of the final bearings (portal A) is comparable to the other K-bandages, but has an additional horizontal top edge. In addition, it is located on the south abutment also mounted vertically in the center. This is not present at the transition to the to bridge.

Figure 94 - Portal A [A.85373]

Portal	Exterior	Inside	Middle	Diagonal	Bottom edge	Top edge
a	1/2 INP30	1/2 INP30	L90 * 90 * 9	2 * L100 * 100 * 10	1/2 DIN20	Cross beam + ½ DIN20
a	1/2 INP30	1/2 INP30		2 * L100 * 100 * 10	1/2 DIN20	Cross beam + ½ DIN20

Table 50 - Profiles K-bandages portal A

The K-braces at the location of the outer intermediate supports (portal B) have for the verticals on the outside and for the bottom edge a T-profile composed of plates. In addition to the imposition of pressure here there is also a tensile support that is connected to the lower edge of the K-bandage.

Figure 95 - Portal B [A.85374]

Portal	Exterior	Inside	Diagonal	Bottom edge	Top edge
B	126x12 (body) 150x12 (flange)	1/2 INP30	2 * L 100 * 100 * 10	390x12 (body) 30x300 (flanges)	Cross beam

Table 51 - Profiles K-bandages portal B

The K-bandages at the location of the supports in addition to the river span (portal C) also have front
the vertical sections are composed of profiles, the other profiles are double and heavier.
In addition, a double top edge has been applied.

Figure 96 - Portal C [A.85375]

Portal	Exterior	Inside	Diagonal	Bottom edge	Top edge
C	126x12 (body) 150x12 (flange)	1/2 INP30	2xUNP260	2xUNP260	Cross beam + 2 * UNP260

Table 52 - Profiles K-bandages portal B

7.2 Bearings

The fixed supports are located at pillar H and are designed as a cast steel chair. The other supports are roller bearings (longitudinal) in the form of single or double cast steel pendulum. The capacity of the bearings is, according to the drawing, 158 tons (final bearings), 203 tons (2nd and 5th support) and 592 tons (support at river piers).

Figure 97 - Fixed supports at pillar H (left) and roller supports at pillar J (right) [A.21582]

Figure 98 - Roller bearings at pillar F and abutment (left) and roller bearings at pillar G and K (right) [A.21583]

The pendants are equipped with cams, so that the bridge cannot move in the transverse direction. There is no capacity of the support in horizontal direction given on drawing. However, there is in the NET calculation [BBV0010-01] made a recalculation, from which a capacity can be derived. This is continued discussed in the calculation report.

Project related

In addition to the (pressure) support, portal B also has a tension anchor.

Figure 99 - Towing support at pillar G and K (right) [A.22862]

The anchoring from the original substructure is coupled, so that it is shifted in the deposit later.

The laying conditions for the eastern main bridge will be at Pillar J in the near future change. The pendulums are replaced by spherical segment bearings that are free in the horizontal flat and a horizontal fixation in the middle of the bottom rail of the portal. To this end, under the The bottom flange of the cross beam is fitted with a steel saddle, which is mounted by means of a rubber block is fixed between two steel pressure plates. The effects on the calculation will be minimal. An exception is the bottom edge of the portal, which has an extra moment due to the eccentric connection gets. This moment can affect the verticals and the diagonals of the portal. Eccentricity will are included in the finite element model.

Figure 100 - Horizontal support [17245-ONT-003] and convex support [17245-ONT-004] at pillar J.

7.3 Material overview

The table below lists the materials used in the bridge, with a reference to the source.

Part	West bridge source	East bridge source	Material
Main beams			
Main beams	A.85362 to A.85367	A.85304 to A.85309	LQMc 52
Vertical stiffeners	A.85376	A.85317	QMc 37
Horizontal stiffeners	A.85376	A.85317	QMc 37
Rivets	A.85362 to A.85367	A.85304 to A.85309	LQMC 34 and LQMC 42
Cross bars / consoles			
Cross bars / consoles	A.85378 to A.85381	A.85319 to A.85322	LQMc 52
Corner piece between cross bars	A.85378	A.85319	QMc 37
Rivets	A.85378 to A.85381	A.85319 to A.85322	LQMc 34 and LQMc 42
Extended consoles	A.50928-C and A.50939	A.50928-C and A.50939	Fe 360
Deck construction			
Cover plate	A.85382 to A.85392	A.85323 to A.85332	LQMc 52
Bulbs / Bead plate	A.85382 to A.85392	A.85323 to A.85332	LQMc 52
Edge strip 430 / 445x10 mm	A.85382 to A.85392	A.85323 to A.85332	St 37 (QMc 37)
Strip 100x8 mm	A.85382 to A.85392	A.85323 to A.85332	St 37 (QMc 37)
K-bandage normal cross bars			
Verticals	A.85379 to A.85381	A.85320 to A.85322	QMc 37
Bottom edge	A.85379 to A.85381	A.85320 to A.85322	QMc 37
Diagonals	A.85379 to A.85381	A.85320 to A.85322	QMc 37
Connecting plates	A.85379 to A.85381	A.85320 to A.85322	QMc 37

Rivets	A.85379 to A.85381	A.85320 to A.85322	LQMc 34
Portal A			
Vertical on body main beam	A.85373	A.85314	QMC 37
Vertical center	A.85373	A.85314	QMC 37
Bottom edge	A.85373	A.85314	QMc 37
Top edge	A.85373	A.85314	QMC 37
Diagonals	A.85373	A.85314	QMc 37
Connecting plates bottom edge	A.85373	A.85314	QMc 37
Rivets	A.85373	A.85314	LQMc 34 and QMc 42
Bolts	A.85373	A.85314	QMC 37

Part	West bridge source	East bridge source	Material
Fitting bolts	A.85373	A.85314	QMC 42
Portal B			
Vertical on body main beam	A.85363	A.85305	St 37 (QMc 37)
Bottom edge	A.85374	A.85315	LQMc 52
Diagonals	A.85374	A.85315	QMc 37
Connecting plates	A.85374	A.85315	QMc 37
Stiffening plate support	A.85363	A.85305	St 37 (QMc 37)
Rivets	A.85374	A.85315	LQMc 34 and LQMc 42
Fitting bolts	A.85374	A.85315	LQMc 52
Portal C			
Vertical on body main beam	A.85375	A.85316	QMc 37
Bottom edge	A.85375	A.85316	QMc 37
Top edge	A.85375	A.85316	QMc 37
Diagonals	A.85375	A.85316	QMc 37
Connecting plates	A.85375	A.85316	QMc 37
Stiffening plate support	A.85365	A.85307	St 37 (QMc 37)
Rivets	A.85375	A.85316	LQMc 34 and LQMc 42

Impositions			
Roller bearings	A.21582 and A.21583	A.92198 and A.92199	Forged steel stilts QMc 60
Fixed imposition	A.21582	A.92199	Cast steel QM 45 and Forged steel QMc 60
Toothpieces	A.21582 and A.21583	A.92198 and A.92199	St QMc 37
Pull anchor	A.22862	A.22862	QMc 37
Spherical segment bearings		KA8.5-NLD-CH12676-A	1.4404 / S355J2 + N

Table 53 - Overview of materials in the construction

7.4 Modeling of the main bridge

Several finite element models have been set up for the main bridge. Initially, one is global model for testing the main supporting structure and one local model for testing the deck (deck plate, bulbs, cross bars, brackets and K-bandages) and for the determination of the transverse bending effects in the lower flange of the main beams for the fatigue calculations. In front of both models use SCIA Engineer (version 17.01 or 18.1)

Following the results of the fatigue calculation, it was later decided to add an additional four hybrid beam / plate models to be drawn up for testing the connection between the crossbars and the main beam. SCIA Engineer 18.1 was used for this.

7.4.1 Global model

The global model consists of a combination of scale and beam elements, whereby the beam members directly below the deck are eccentrically connected to the deck. Because of axis symmetry in the loads, the entire bridge is modeled. The modeling method will be specified for each part explained. The input of the finite element model is given in Appendix O.

7.4.1.1 Construction phasing

Two construction phases have been applied in the model, as explained in section 7.4.1.1. In the first phase it is part of the spans across the floodplains modeled with a cantilever at the river span (shown in gray). In the second construction phase, the remaining part is above the river added (shown in green).

Figure 101 - 3D representation of the construction phases SCIA Engineer

7.4.1.2 Main beams

The main beams are introduced as eccentric beams that are connected at the top to the cover plate. The main beams have a variable height, which in the model is linear from the cross beam to crossbeam. The cross sections of the main beam are not standard profiles and are therefore modeled with the "general cross-section" module of SCIA Engineer.

Figure 102 - Side view of main beam course in first 2 fields (top) and midfield (bottom)

The colors correspond to the differences in bottom flange:

- Green: ½ DIN 30 + plate 500x30
- Yellow: ½ DIN 30 + sheet 500x30 + 350x30
- Red: ½ DIN 30 + plate 500x20
- Blue: ½ DIN 30 + sheet 500x30 + 550x30
- Pink: ½ DIN 30 + plate 500x30 + 530x10

The web plate consists of a plate of 12 mm thickness, with the top flange ½ DIN 30 profile.
The figure below shows a cross-section over the main beams.

Figure 103 - Section across the main beams

The various connectors and stiffeners are charged by a surcharge on it specific weight, as determined in Appendix M.

Project related

7.4.1.3 Deck construction

The deck construction is modeled with scale elements (Mindlin) with two different thicknesses, t = 10 mm (shown in yellow) and t = 12 mm (shown in pink).

Figure 104 - Cover plate with different thicknesses (1st and 2nd span)

Figure 105 - Cover plate with different thicknesses (river span)

The bulbs are modeled as eccentric beam elements. To make the calculation model somewhat workable We chose to model only one in three bulbs between the main beams. For the modeled bulb, the stiffness properties and weight are multiplied by a factor of 3 get the same (global) properties. For the bulbs outside the main girders is one of the two bulbs modeled, with the bulb in the model held exactly between the two actual bulbs. For this bulb, the stiffness properties and weight have been multiplied by a factor of 2. This is possible because the orthotropic deck itself is tested with a local model.

Project related

Figure 106 - Cross-section of the deck construction with center-to-center size of fictitious bulbs

The outer edge strip and the first rectangular stiffener are modeled according to the actual position and stiffness.

The figure below shows a 3D representation of the deck construction, with the bulbs with in pink stiffness properties x2, in red with stiffness properties x3. The green strips have the normal stiffness.

Figure 107 - 3D view of deck construction (deck plate not shown).

7.4.1.4 Cross bars and consoles

The cross beams and brackets are modeled as beams with an inverted T section which is eccentrically connected to the deck. The cross beams have a constant cross section, the console a variable cross-section that decreases from h = 500 mm to h = 200 mm.

Figure 108 - 3D view of crossbars / consoles (cover plate not shown).

Figure 109 - Side view of crossbars / consoles (cover plate not shown).

The crossbars and brackets are momentarily connected to the main beam.

7.4.1.5 K-dressings

The normal K-connections are modeled with beam elements for the vertical, diagonal and bottom edge. Because the diagonals at the bottom edge of the cross beam connect to the heart of the main beam's body, a rigid bond is modeled between the top of the main beam (crossbar / main beam system line) and the end of the diagonals (shown in red in the bottom figure). The vertical stiffeners on the body of the main beam are part of the K-bandage and are therefore also modeled. The stiffness of the vertical is in the plane of the web of the main beam held infinitely stiff. The diagonals are momentarily connected in the plane of the K-connection the bottom edge and with the main beam. The diagonals are hinged from the plane, since the flanges are not connected to the main beam and the bottom edge. The other connections are momentarily connected.

Figure 110 - Side view of K dressing

Rigid binding

Figure 111 - K-system system lines

The K-relationships will be tested with the global model. The wind load from the bottom flange of the main beam will be placed as a point load on the K-bandage, with a size of 1/2 (main) beam height times the center to center distance of the K-bandages. The global effects (eg torsion of the bridge due to eccentric traffic loads) is also included in the global model, because the vertical bar at the location of the main beam web has the mechanical properties of the vertical stiffeners. This bar shape together with the K-bandage form a whole and are therefore loaded due to both wind load and global effects.

7.4.1.6 Portal A

The portals are in principle modeled in the same way as the K-bandages. The portals are on the top has an extra horizontal bar (1/2 DIN 20). This is just like the diagonals in the plane of the portal is momentarily fixed, hinged out of the plane to the main beam.

Figure 112 - Side view of portal A on the north side

Portal A at the abutment south also has a vertical beam element (L90x90x9) in it
the middle. The vertical is moment-fixed in the plane and hinged out of the plane to the top
and bottom edge of the k-bandage.

Figure 113 - Side view of portal A on the south side

Here too, the rigid bonds run to the bottom of the cross beam. Below that are in between
bottom crossbeam and the connection with the diagonals / horizontal top rail the stiffeners on it
body modeled.

7.4.1.7 Portal B

Portal B has a rigid connection at the bottom between the top and the bottom flange, for distance
bridge between the system line and the top flange (connection diagonals). The system line of the
bottom edge is laid at the bottom, at the level of the supports.

Figure 114 - Side view of portal B

Figure 115 - Portal system lines B

7.4.1.8 Portal C

Portal C is basically the same in construction as portal A, however at portal C heavier, composite profiles (2xUNP 260) applied for the bottom edge, top edge and the diagonals.

Figure 116 - Side view of portal C

The bars are modeled as one bar with a cross section of both UNP profiles. The connections of the diagonals and horizontals bars are torque-resistant in both directions because moments from the plane can become like pull and pressure in the individual UNP profiles transferred. The fixed supports (portal H) and the horizontal supports (portal J) are eccentric modeled with respect to the bottom edge, because they cause a moment in the bottom edge.

7.4.1.9 Impositions

The supports are modeled as follows. The supports are at the bottom edge of each portal secured in z direction. The bridge is secured in the longitudinal and transverse directions at pillar H (x- and y-direction) with a hinged support. An eccentricity of 440 mm relative to the center bottom edge of the portal. With the roller bearings (pillar F, G, K and abutment south), the longitudinal translations and rotations are left free, both translation and rotation are transverse secured. This is a correct assumption as long as the support under the vertical support reaction is in combination with the associated horizontal support reaction and the corresponding moment remains largely under pressure. This has been checked in section 7.5.

At the river pier J, the laying of the western bridge will soon be replaced and the laying is in rolling and hinged in both directions. The horizontal support in the transverse direction is halfway the bottom edge secured. The model takes into account the eccentricity of this connection (220 mm under bottom bottom flange) [17245-ONT-003], built from the clearance height to the top edge of the concrete, varying between 35 mm and 40 mm, conservatively maintained as 40 mm + half the height of the printing surface with concrete, approx. 50 mm + the distance to the center bottom edge of the portal (130 mm).

Figure 117 - Northern part bearings (phases 1 and 2)

Project related

For the southern part, two additional longitudinal supports were installed in the first construction phase at pillar J, because in phase 1 the two parts of the bridge are not connected, and it otherwise the model is not stable.

Figure 118 - Southern part bearings (phase 1)

In the second phase, these supports are removed and only the vertical supports remain about.

Figure 119 - Bearings southern part (phase 2)

At the location of portal B (pillar G and K), a separate pulling support is actually made at 250 mm distance from the pressure bearing. For the global model, this is modeled as a single pull / push bearing location of the printing. When testing the lower edge of portal B, the tensile force in the imposition translated into a moment and transverse force on the first part of the bottom edge of the portal.

7.4.2 Local model

As described, a local model has been created with two purposes

- Testing of the deck construction (cross bars, consoles, cover plate, bulbs, K-bandages);
- Determination of the transverse bending effects in the lower flange of the main girders for the fatigue calculations.

In accordance with the tender, the first model must be 7 cross bars long, the second model must be 4 K-connections to be long. In consultation with Rijkswaterstaat, a single model of 4 K- was chosen. long bandages (bandages 11 to 14), which corresponds to 8 cross bars. This model will work for both targets are used. It has been chosen to model the part circled in [Figure 120](#) because here the indicative locations of the fatigue details are located.

Figure 120 - Modeled part for the local model (cross beam 11 to 14)

The model consists entirely of scale elements and contains, in addition to the parts as described under the global model also includes the horizontal and vertical stiffeners and the connecting plates between the main beam and cross beam / diagonals / bottom edge K-bandage and between bottom edge K-bandage and diagonals.

Figure 121 - Plate model between cross beam 11-14

7.4.2.1 Main beam

The top flange of the main beam is modeled as a thickened cover plate. The bottom flange consists of two or three parts with different thicknesses, depending on the amount of plates. This has been taken into account with the eccentricity of the different plates.

Figure 122 - Main beam in the local model

The different horizontal and vertical stiffeners on the body are modeled with plates, or thickenings of the web plate. (NB some horizontal stiffeners are still missing in the figure to be added).

Figure 123 - Main beam in the local model

7.4.2.2 Crossbars / Consoles

The crossbars are modeled with a plate for the body and a plate for the bottom flange. Be hereby also the connecting plates under the bottom flange, connecting to the main beam web and the diagonals, modeled with it. A round recess has been made in the body at the bottom edge of the bulbs.

Figure 124 - Modeling Crossbeam in the local model

7.4.2.3 K bandage

The different parts of the K-bandage are also modeled with plates. Here is also the connecting plates at the bottom edge of the K-bandage at the connection to the body and to the diagonals taken away. The coupling plates between the 2 L-connections of the diagonals are also included.

Figure 125 - Modeling K-relationship in the local model

7.4.2.4 Deck construction

The deck is modeled as a plate with bulbs underneath. The bulbs are also modeled as plates with an equivalent rectangular bulge (13x40) at the rounded head.

Figure 126 - Modeling top side of deck construction in the local model

Figure 127 - Modeling bottom of deck construction in the local model

7.4.3 Hybrid models

During the calculations it appeared that local models are also necessary for additional considerations of the stresses in the portals at the supports and in the connection between the crossbars and the main beam. For this purpose, four hybrid models have been drawn up, consisting of one combination of a local plate model of part of the bridge and a beam model for the rest of the bridge. It was decided to make four separate models, each with a different part that plate elements have been modeled in order to keep the size of the model manageable. It combining multiple parts with plate elements in one model would result in a calculation model that is not workable (too long computing time, too large file size).

The location and dimensions of the part with plate elements have been determined in consultation with Rijkswaterstaat, such that the three portals are taken along with the supports, as well as the cross beams halfway one of the fields. The models have the following lengths:
Model A: A length of 2 K-bandages from portal A (Portal A to cross beam 2)
Model B: A length of 2 K-bandages on either side of portal B, of cross beam 7 to 10
Model C: A length of 1 K bandage on both sides of portal C, from crossbars 17 to 18
Model D: A length of 4 K-bandages, from cross beam 11 to 14 (equal to the local model from section 7.4.2) .

In Figure 128 , the location of the different areas which are displayed with plate elements modeled in the different models. The rest of the bridge applies to all models is modeled with beam elements.

Plate part Model A

Plate part Model B

Plate part Model D

Plate part Model C.

Figure 128 The location of the hybrid model.

The models were used for the calculations of the following parts:
Model A: Cross beam connection at portal A and cross beam with K-bandage with 1/2 INP24 stiffener
Model B: Cross beam connection at portal B and intermediate cross beam without k-bandage
Model C: Cross beam connection at portal C.
Model D: Cross beam connection cross beam with K-bandage with 1/2 INP30 stiffener

The modeling of model B is described in the rest of this section. For the other three the same principle applies, this is not repeated.

To model the boundary conditions of the plate model properly, the local plate model (red shown) and the global bar model (shown in pink) merged into a hybrid model see Figure 129 .

Plate model Beam model

Figure 129 Hybrid model consisting of a combined plate and scale model.

The plate model is sho re 131, the pink main beam is one bar element (shown in 3D).

Figure 130 3D view oblique-top view of hybrid model

Figure 131 3D view oblique bottom view of hybrid model

At the junction between the two models, the bars of the global model are rigid

bonds connected to all sheet edges in the cutting plane; see Figure 132 . The 2D members are therefore both on
the body when the flanges and the longitudinal stiffeners are rigidly connected.

Figure 132 Rigid connection between bar and plate edges.

At the location of the local plate model, the support is modeled by the plate edges of the
to connect the support with rigid bindings (shown in pink) to the support, see Figure 133.

Figure 133 Imposition of the plate model at Pillar G site.

7.5 Validation

7.5.1 Global model

The global model of main bridge has been validated with a comparison of the reaction forces and the deflection due to self weight with original design calculation and later recalculations. In addition, the behavior is under an evenly distributed load and asymmetrical taxes assessed.

Resultant support reactions due to the weight of the steel construction

The self-weight of the steel construction has been compared to the weights in accordance with the running conditions [1903 folder 4B].

Figure 134 - Weight of the steel construction in accordance with running condition [1903 map 4B]

In accordance with the claim conditions, the weight of the steel construction is 1143 tons. Of this, 16 tons is for the supports (not on the construction) and 14 tons for the railings (will be charged separately brought). In the running condition, the center piece weight (156 tons) is in the total addition mistakenly counted double, as this corresponds to part H + K. This brings the weight of the steel structure, excluding inspection paths, at 958 tons (9,398 kN). In the SCIA calculation, a resultant of 9268 kN found. The 1% deviation is considered acceptable.

It is noted that the recalculation from 1991 (NET calculation [BBV-0010-01]) assumes of 1050 tons (10300 kN). The calculation states that this is an estimated weight. However, there is unsubstantiated how this was determined. This is expected to include inspection paths under and next to the bridge is (approx. 850 kN), making the load almost equal (9268 + 850 = 10118 kN).

In the calculation of the NUON heat pipe [912-257.R01] a resultant of 9844 kN is used
found it. Again, it is not substantiated how this tax was determined. It is believed that this
including inspection paths under / next to the bridge.

Figure 135 Resultant reaction from Scia under its own weight of steel.

The resultant of horizontal forces and moments are very small. The small values become caused by the slightly different length of the fields outside the end crossbars between the north and south side. It is concluded that the results of the load due to the self weight modeled sufficiently accurately.

Support reactions due to self-weight steel construction

The distribution of support reactions among the support points has been compared with the NET calculation [BBV-0010-01] and the calculation of the NUON heat pipe [912-257.R01].

Figure 136 - Support reactions per support point [BBV-0010-01]

Project related

Figure 137 - Support reactions per support point [912-257.R01]

The following distribution is found in the SCIA calculation

Figure 138 - Support reactions per support point according to SCIA

The reaction forces are summarized again in the table below.

Pillar	SCIA [kN]	BBV-0010-01 [kN]	Ratio	[912-257.R01]	Ratio
F	303	361	1.20	287	0.95
G	435	566	1.30	663	1.52
H	1578	1645	1.04	1513	0.96
J	1580	1645	1.04	1510	0.96
K	435	566	1.30	662	1.52
L	302	361	1.20	287	0.95
Total	4633	5145	1.11	4922	1.06

Table 54 - Reaction forces according to SCIA, [BBV-0010-01] and [912-257.R01]

It can be seen that the distribution with compared to the NUON calculation there is relatively less load on it second point of support is coming. This can partly be explained by the construction phasing that is in the SCIA calculation taken away. If this is not done, a slightly higher load (457 kN) is placed on the second found a fulcrum. In addition, the overall load is somewhat higher, because it probably includes the inspection paths under / next to the bridge. In addition, in the calculation of heat conduction is a very rough approximation of the cross-section properties of the main beam used.

Check compressive stress in support

The calculation assumes a rotationally fixed support in the plane of the portal for the supports F, G, K and abutment south. The table below verifies the vertical support reaction due to the permanent loads in combination with the clamping moment and the horizontal support reaction is under pressure. The horizontal support reaction has been translated into a moment at the bottom of the roll support (R_y x height support) and added to the clamping moment. The tensile force (per unit length) that arises as a result of this moment is added to the compressive force per unit of length. It can be seen that the entire imposition remains under pressure.

Pillar	R_z	R_y	M_x	Height	Width	q_{Fz}	q_{Fy}	q_{Mx}	q_{to}

	[kN]	[kN]	[kNm]	solution [mm]	[mm]	[kN / m]	[kN / m]	[kN / m]	[kN / m]
F / LH south	-535	1.75	-19.63	485	420	-1274	29	668	-577
G / K	-801	7.05	4.20	485	550	-1457	-68	83	-1441

Table 55 - Validation of assumption of rotation clamping main bridge

In principle, due to the UDL load, a similar ratio of moment and vertical response will occur occur and the bearing therefore remains under pressure across the entire width of the roll. In the UGT it would that with a high wind load and little vertical load, the support is partly retracted. However, even if the imposition is partly on the rise by the moment, there will still be one for some time to come clamped support, because the center of gravity of the support will shift, without large rotation can occur. The assumption of a clamping for the modeling in the plane of the portal will so are closest to actual behavior.

Deflection due to own weight

The deflection has been compared to the original calculation. Here are the following deflections found.

Figure 139 - Deflection design calculation 1 st and 2 nd span

Figure 140 - Deflection design calculation 3rd span

Figure 141 - Deflection SCIA at the end of phase 1 (top) and phase 2 (bottom)

In the first field, a deflection of 22.6 mm is found, against 21.5 in the original calculation, which is a good match. In the second field a bend of 17.1 mm is found, against 9.2 mm in the original calculation. This differs slightly more. The deflection of the second field is however sensitive to the angular rotation at the river piers due to the deflection of the river span, so that a small deviation gives large deviations in percentage. The slightly larger deflection in the third field (see below) will result in a slightly greater angular displacement at the river pier, and thus a slightly larger deflection of field 2.

In the third field (river span), the deflection from the first phase must be added because SCIA shows the deflection from hanging for the middle section. The total deflection this comes to 15.4 mm + 100.8 mm = 116.2 mm, against 109.9 mm in the design calculation. The deflection of the third, largest field in the SCIA calculation corresponds well to the original design calculation.

Support reactions under evenly distributed load:
In addition to a verification of the own weight, a comparison has also been made with an even weight distributed tax. This is based on the permanent load as calculated in the NET calculation [BBV-0010-01], namely 7.2 kN / m, per main beam. Assuming half a bridge width of 9.29 m / 2 this equates to 1.55 kN / m².

Figure 142 - Support reactions per support point [BBV-0010-01]

The figure below shows the reaction forces from SCIA.

Figure 143 Reaction forces Scia calculation for evenly distributed load (1.55 kN / m²)

The results are listed side by side in the table below. The results almost come together match.

Pillar	SCIA [kN]	BBV-0010-01 [kN]	Ratio
F	149	149	100%

G	239	233	97%
H	676	678	100%
J	676	678	100%
K	239	233	97%
L	149	149	100%
Total	2129	2120	100%

Table 56 - Reaction forces according to SCIA, [BBV-0010-01] and [912-257.R01]

Deformation of the bridge:

For five taxes, it was checked whether the deflection behaves as expected.

UDL on entire bridge:

Figure 144 - Deflection at UDL load on entire bridge

UDL 1 E field bridge:

Figure 145 - Deflection with UDL load on 1 st field

UDL 2 e field bridge:

Figure 146 - Deflection at UDL load on the second E field

Project related

UDL 3 e field bridge:

Figure 147 - Deflection at UDL load at 3 E field

UDL on half of the bridge:

Figure 148 - Deflection at UDL load on half of the bridge (in transverse direction)

Figure 149 - View of the front side when deflected at UDL load on half of the bridge (in transverse direction)

In all cases, the distortion behaves as expected. It is concluded that the model is correct works.

7.5.2 Local model

The deformations and the results of the support reactions of the local plate model have been checked in the reporting the verification calculation. The distortion is as expected.

Figure 150 - 3D deformation local model at unit load on 5 th cross beam (3D overview)

7.5.3 Hybrid models

The cooperation between the plate and bar model has been validated on the basis of the deformations by permanent loads, based on the voltage pattern and by comparing the support reactions.

The deformations of the hybrid models have been compared with the deformations from the global bar model.

28.0 Global model

180.8

26.6 Hybrid model A.

194.7

27.3 Hybrid model B.

195.4

28.5

Hybrid model C.

191.0

26.5

Hybrid model D.

194.5

Figure 151 Deformation of hybrid and global model under permanent loads.

Figure 151 shows the deformation behavior of the hybrid models and the global model with each other agree. As mentioned earlier, the global model shows a jump in the middle part of field 3, because this part is only added in phase 2. When the deflection is corrected for this a total deflection of 180.8 + 15.4 = 196.2 mm is found, which corresponds to the hybrid models. It is concluded that the deformation behavior of the hybrid models corresponds to that of the global model.

It was also examined whether the voltage image looks somewhat logical under an evenly distributed (asphalt) load. When the local disturbance in the voltages are ignored, the voltage in the bottom flange of the main beam in the part modeled with beam elements approx. 10 N / mm² at the left side and approx. 14 N / mm² on the right side of the connection with the plate model.

Figure 152 Tensions in the bottom flange of the main beam in the beam members on either side of the panel part (model D).

In the plate model, similar stresses are found at the bottom of the main beam, approx. 8-10 N / mm² on the left and approx. 12-14 N / mm² on the right.

Figure 153 Tensions in the main beam in the plate elements (model D).

Only very locally when connecting to the beam model, some disturbances in the plate model are visible, but this is soon no longer visible in the tensions. However, there is one halfway through the model visible disturbance in the body, this is caused by the transition in the lower flange, one of which the thickness plates finish. It is concluded that the magnitude of the stresses is correct in the plate part and that the disturbance of the transition beam element - plate elements only occurs very locally and all has disappeared from the first transverse stiffener.

In addition to a comparison of the tensions, a comparison was also made between the support reactions from the different models, see table below.

Pillar	SCIA [kN]	SCIA without construction phase [kN]	Model A [kN]	Model B [kN]	Model C. [kN]	Model D [kN]

F	303	300	303	298	301	301
G	435	452	449	433	444	450
H	1578	1564	1564	1560	1595	1563
J	1580	1566	1566	1567	1559	1565
K	435	452	452	451	455	452
L	302	300	300	300	300	300
Total	4633	4634	4634	4610	4654	4631

Table 57 - Reaction forces according to SCIA in the different models.

The support reactions correspond well. It is concluded that the hybrid models work well.

8 Bridge

8.1 Description of construction

The bridges consist of two bridges each (east / west bridge) of length
120 m. Each bridge consists of 3 spans of approximately 40 m. The two bridges are symmetrical relative to each other.

Figure 154 - Side view from the west on the bridges [A.22646]

8.1.1 Main beams

The main supporting structure consists of two steel beams with a height of 2.1 m. The top flange of the main beams are connected to the concrete driving deck by means of dowels, so that there is one composite steel concrete beam.

Figure 155 - Cross sections of one of the bridges.

The main beams are constructed of steel plates that are joined together by welding and rivets
be connected. The top flange is made of a steel plate with a thickness of 20 mm and a width of
350 mm. Wider (400 mm) and thicker (28 mm) steel plate is used for the bottom flange. The
the bottom flange is thickened between Pillar C and D, between Pillar E and F and at Pillar D and E at the extra steel plate of 380x20 mm. The main beam body has a thickness of 12 mm and a constant height of 2060 mm. The main beam is stiffened by means of horizontal pleat stiffeners (bulbs) and vertical pleat stiffeners (half INP profiles).

Figure 156 - Cross-section and side view of main beam with horizontal and vertical pleat stiffeners [A.22650, A.38818]

8.1.2 Crossbars

The cross beams are DIE 45 profiles, which are again square 50 mm by means of welded rods connected to the concrete deck with a hairpin Ø16 welded to it. The top flange of the crossbeam extends to the end of the slant, in the section below the top flange of the main beam is missing the top flange of the cross beam.

Like the main beams, the cross beams are composite steel-concrete beams. There is on drawing distinction was made in the “normal” cross bars without K-bandage, “end cross bars” with underneath a K-bandage, “intermediate crossbars” with underneath a K-bandage and “crossbars with bandage above pillars ”with a K bandage below. It should be noted that this name differs from the main bridge, where the terms normal cross beam and intermediate cross beam are used reversed.

Figure 157 Normal cross beams [A.22649]

The end crossbars at the joint transitions continue as consoles outside the main beams and the top flange of these end crossbars is provided with a 300x20 mm steel plate. At the end consoles decrease the height of profile from approximately 500 mm to 250 mm at the end.

Figure 158 - End cross members [A.22649]

Figure 159 - Intermediate cross members [A.22650]

Figure 160 - Crossbars with bandages above pillars [A.22650]

The center-to-center distance of cross beams is 2.5 m. The end cross beams are torque-resistant in both directions connected to the main beam. The other cross beams are momentary in the plane and hinged out of the plane because the top flange is missing in the last piece and the bottom flange connects to the body, without bulkheads to transmit moments around the weak axis.

8.1.3 K-dressings

The K-bandages are made up of the following profiles:

- Diagonals: composite bar from two corner profiles (L80x80x10) (blue);
- Bottom edge: Half DIN 30 or DIE26 profile (red);
- Verticals: Two or one half INP32 profile (purple).

Figure 161 - Crossbars with bandages above pillars [A.22650]

The K-bandages are for “end crossbars”, “intermediate crossbars” and “crossbars with bandage above pillars ”. The table below shows the profiles for the various K-

bandages. The different bars are connected to each other momentarily, with the exception of the diagonals, which are hinged around the weak axis, connected to the main beam and the bottom edge.

Crossdr	Outside	Inside	Diagonal	Bottom edge
End cross thread	1/2 INP32	1/2 INP32	80 * 80 * 10	1/2 DIN30
Intermediate dr	-	1/2 INP32	80 * 80 * 10	1/2 DIE26
Above pillars	1/2 INP32	1/2 INP32	80 * 80 * 10	1/2 DIN30

Table 58 - Overview of profiles K-bandages per cross beam

8.1.4 Concrete deck

The concrete deck consists of two prestressed parts at the intermediate supports, each with one width of 12 m. The remaining part of the concrete deck is reinforced concrete.

Figure 162 - Top view bridging deck with prestressed section in red [A.27268]

The concrete deck has a thickness of 200 mm, with a thickening up to 300 mm at the location of the main beams. The concrete deck is connected to the main beams and cross beams by means of dowels. The concrete had to have a minimum concrete compressive strength of 45 N / mm² in accordance with the specifications.

Figure 163 - Bridge deck cross-section with pretension position [C.9366]

Dowels

The concrete deck is by means of strips welded to the top flange square 50 mm with welded to it "Hairpins" Ø16 mm connected to the main beams and the cross bars (see Figure 163) .

In addition, on the end of the reinforced concrete part, two times four angled bars are square 30 mm (QMc37) welded to the top flange of the main steel girders, via a 150x12 steel plate, see V-shaped bars in Figure 162. At the location of the prestressed part, there are two at the end three and then an equal distance to the center two more times three oblique bars applied square 30 mm (QMc 37). In transverse direction at the ends of the cross carrier are the same once rod welded to the sloping part of the top flange.

Prestressed concrete

The prestressed part has been poured and tensioned before jacking. At the time of prestressing the top flange of the main beam (T-piece) is not yet connected to the body of the main beam. because of this the prestress remains mainly in the concrete and is not absorbed by the steel construction of the main beams (except the top flange). The top flange becomes through after prestressing by means of bolts connected to the body.

Figure 164 - Connection top flange with web at prestressed concrete [A.39074]

The prestressed concrete is prestressed with straight Dywidag rods 44Ø26 mm running at 100 mm from underside of the concrete deck. The applied pretension is further explained in section 6.1.3.

Reinforced concrete

The reinforced concrete part was poured after the steel construction had been jacked at the site of the intermediate supports with 400 mm. After the reinforced concrete part has hardened, the bridge construction is finished released again, so that a compressive stress is created in the concrete.

Reinforcement

The (mild steel) reinforcement (QR42) in both the reinforced concrete and the prestressed concrete is the same executed. In the longitudinal direction 39Ø16-250 has been applied to the top reinforcement and 69Ø16-125 as bottom reinforcement. In the transverse direction, Ø14-250 above and below is used plus Ø14-250 which is used in the field the bottom of the deck lies and is bent in front of the supports (main girders).

In the area of the ribs, 4Ø16 is additionally applied in the longitudinal direction, and in the transverse direction below Ø14-250 and above Ø16-250.

Figure 165 - Concrete deck reinforcement [A.23359]

8.1.5 Extended consoles

Around 1975 the consoles were extended on both sides to make room for a rear inspection path
the vehicle barrier.

Figure 166 - Sections of one of the bridges with consoles for inspection path [A.50937]

The bridge has been widened with two types of consoles, normal consoles (IPE 120), which only have the inspection path and carry the handrail, and “reinforced” brackets (sleeve 260x260x11), which also carry a light tower. The inspection paths are connected to the concrete edges of the barge by means of wedge bolts.

Figure 167 - Normal console (left) [A.50928-C] and reinforced console (right) [A.50939]

8.2 Bearings

The supports of the bridges are comparable to the main bridge. The fixed supports of the the first bridge is located at pillar B, of the second bridge at pillar D. De other supports are longitudinal roll supports (pendulums) [A.22656]. According to drawing a distinction is made between “small roller bearings” at the location of the final bearings and “large ones roller bearings ”at the location of the intermediate bearings. The small supports have a capacity of 146 tons, the large roller bearings have a capacity of 285 tons. The fixed supports are designed for the capacity of 285 tons.

Figure 168 - Small roller bearings for the end bearings, large roller bearings for the intermediate bearings [A. 22656]

Figure 169 - Fixed supports at pillar B and D [A.22656]

The pendants are equipped with cams, so that the bridge cannot move in the transverse direction. There is no capacity of the support in horizontal direction given on drawing. However, there is in the NET calculation [BBV0010-01] made a recalculation, from which a capacity can be derived. This is continued discussed in the calculation report.

8.3 Material overview

The table below shows the materials used in the bridges, with a reference to the source.

Part	West bridge source	East bridge source	Material
Main beams			
Main beams	A.39071 to A.39076	A.38818 to A.38823	LQMc 52
Vertical stiffeners	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Horizontal stiffeners	A.39071 to A.39076	A.38818 to A.38823	LQMc 52
Rivets	A.39071 to A.39076	A.38818 to A.38823	LQMC 34 and LQMC 42
Cross bars / consoles			
Cross bars / consoles	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Extended consoles	A.50928-C and A.50939	A.50928-C and A.50939	Fe 360
Rivets	A.39077 and A.39078	A.22649 and A.22650	QMc 34
Fitting bolts	A.39077 and A.39078	A.22649 and A.22650	QMc 50
K-bandages			
Verticals	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Bottom edge	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Diagonals	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Connecting plates	A.39077 and A.39078	A.22649 and A.22650	QMc 37
Rivets	A.39077 and A.39078	A.22649 and A.22650	QMc 34

Fitting bolts	A.39077 and A.39078	A.22649 and A.22650	QMc 50
Impositions			
Roller bearings	A.39084	A.22656	Forged steel stilts QMc 60
Fixed imposition	A.39084	A.22656	Cast steel QM 45 and Forged steel QMc 60
Toothpieces	A.39084	A.22656	St QMc 37

Table 59 - Overview of materials in the construction

8.4 Modeling bridges

8.4.1 Modeled bridge

The two bridges are almost identical. The main differences are the position of the regular support points and the length of the first and last field. When the bridges are mirror symmetrical are considered in relation to the joint transition between the two bridges, then the bridges however, almost the same. There is a (very) small difference in length of one of the fields, the second bridge is 6 mm longer than the first bridge. Therefore, one model has been made for both ramps, starting from the geometry of the second e aanbrug. For the fatigue calculations distinguished between the western and the eastern bridge in terms of numbers of trucks per lane. The same finite element model is used for this.

8.4.2 Construction phasing

11 construction phases have been applied in the model, as explained in section 5.1. In phases 1 and 2, only the steel structure present, whereby in phase 1 the own weight of the steel structure is taken into account and in phase 2 the bulk density of the prestressed concrete. At this stage, the top flange of the main beam not present at the intermediate supports. The weight of this tee, as well as the connectors and plates that are not included in the model are charged as one surcharge on the specific mass (per section). This supplement is determined in Appendix M.

Figure 170 - Construction phase 1 and 2 - steel construction + bulk density of prestressed concrete

Stage 3, the prestressing of the concrete deck is calculated in a separate model, because it is not it was possible to combine this in one model. For this, a model of only the prestressed concrete deck with top flange of the main beam and the crossbars made. With this model, the tension in the top flange (T-piece) and in the concrete deck determined. The results are reported in the assessment combined with the results of the global model. The properties of the concrete are explained in Table 60 .

Figure 171 - Construction phase 3 - prestressed concrete deck

In stage 4 (jacking) and stage 5 (bulk density reinforced concrete deck) the prestressed concrete is added to the model (shown in green), but the reinforced concrete is not yet present. Also at this stage, the top flange of the main beam is added to the cross-section, including the two connecting plates on both sides of the body.

Figure 172 - Construction phase 4 and 5 - jacking and bulk density reinforced concrete deck

In phase 6, the reinforced concrete deck is then added to the model. Be with this model jacking the load cases, asphalt pavement, other permanent loads, shrinkage and creep and prestressing losses charged.

Figure 173 - Construction phase 6 and further - jacking, asphalt pavement, other permanent loads, shrinkage and creep and pretension losses

In addition to the aforementioned structural changes, there is a different stiffness of it at each stage concrete deck applied, in connection with taking into account the effects of creep, in accordance with NEN-EN 1994-2. This will be further discussed in the description of the modeling of the concrete deck (section 8.4.7) .

8.4.3 Main beams

The main beam is schematized as an eccentric beam under the concrete bridge deck. Hereby is distinction made in the parts with or without additional plate on the bottom flange and between the parts ter at the location of the prestressed concrete deck and at the location of the reinforced concrete deck.

Blue: without additional flange plate, at the reinforced concrete deck
Yellow: with extra flange plate, at the reinforced concrete deck
Pink: without additional flange plate, at the prestressed concrete deck
Green: with extra flange plate, at the prestressed concrete deck

Figure 174 - Bridge the steel construction

For the main beam at the prestressed concrete deck, the
construction phases, where in construction phases 1 and 2 the T-piece of the top flange is not present. In construction phase 4 it is added only in the cross section, as well as the two strips connecting the joint
top flange and body.

The main beam body is longitudinally stiffened with horizontal bulbs at the pre-stressed position concrete deck and with vertical stiffeners (1/2 DIN 32) on each cross beam. These stiffeners serve as pleat stiffeners for the body. For the model, these stiffeners have been neglected and are left alone included in the assessment of the fold stability of the body.

Figure 175 Cross sections of main beams.

8.4.4 Crossbars

Sleepers are modeled as eccentric beam members (I DIE 45) connected to it
concrete deck. The cross section of the normal sleepers has a sloping location at the concrete rib height. At the location of the part below the top flange of the main beam, the top flange of the cross beam (shown in purple).

Figure 176 - Normal cross bars

At the end crossbeam, the crossbars have been extended with a console with a variable intersection. Here the concrete deck has a constant thickness and the height of the cross beam (between the main beams) constantly.

Figure 177 - End cross member

8.4.5 K-dressings

According to the drawings [A.22649] and [A.22650] the lines of gravity of the diagonals of the K-bandage the body of the main beams at the lower edge of the crossbeam. Similar as with The main bridge is fitted with rigid connections for this purpose between the system line of the main beam and the diagonals of the K-relation. The vertical stiffeners on the body of the main beam are part of the K-bandage and are therefore modeled with it. The stiffness of the verticals are in the plane of it body of the main beam held infinitely stiff.

Figure 178 - View of K dressing

Rigid binding

Figure 179 - Rigid bindings K-bandages

8.4.6 Concrete deck

The concrete deck consists of two parts, prestressed concrete decks and reinforced concrete decks. The prestressed concrete blanket have a length of 12 m at the location of the intermediate supports (gray displayed). The reinforced concrete decks are shown in green.

Figure 180 - Reinforced concrete deck (green) and prestressed concrete deck (gray)

The concrete deck system line is laid in the center of the slab (t = 200 mm). At the location of the main girders, the concrete deck has a thickening to 300 mm. The main beams and crossbars are connected eccentrically to the concrete deck.

Figure 181 - Section across the concrete deck (global model)

During prestressing, the top flange of the main beam is not yet connected to the body. Such as described in the construction phases, a separate model was made for this, in which only the T-pieces of the top flange are present. The crossbars are also present, but these are not (yet) connected to the (top flange) of the side member. To this end, all degrees of freedom are at the end of the cross beam released between main girder and crossbeam.

Figure 182 - Section across the concrete deck (Model Construction phase 3)

8.4.7 Concrete stiffness

In accordance with article 5.4.2.3 of NEN-EN 1994-2, a calculation of the construction will first be made made with non-cracked concrete under the characteristic load combination. If the tensile stress under this combination in the extreme fibers greater than twice the strength f_{ctm}, the stiffness will be reduced for cracked concrete. For the time being, it is expected that the concrete will remain non-cracked.

The uncracked stiffness of the concrete deck is determined in accordance with NEN-EN 1994-2, art. 5.4.2.2. Hereby should a different stiffness must be maintained for the different permanent loads, whereby the influence of creep has been taken into account. This stiffness depends on the time of loading (t_0) and the age of the concrete at the time considered (t). In addition, the stiffness also depends on the type load (□$_L$ = 1.1 for permanent loads, □$_L$ = 0.55 for primary and secondary effects due to shrinkage and □$_L$ = 1.5 for prestressing due to imposed deformations).

The time of loading has been adhered to in accordance with [BBV-0010-00]. This is based on jacking after 28 days, jacking after 3 months, paving and edges 1 to 2 months after screw. The reinforced concrete deck is approximately 28 days old at the time of jacking.

The stiffnesses are determined in Appendix N, assuming t = 100 years. For the determination of the pretension (phase 3), it is assumed that the pretension is after 21 days and that the top flange 3 days later is attached to the body (assumption). Variable taxes are assumed of the short-term stiffness of concrete. The table below summarizes the stiffnesses for both prestressed as the reinforced concrete.

		Prestressed concrete			Reinforced concrete		
Phase Tax Case	□ L	t_0	n_L	E_{fic}	t_0	n_L	E_{fic}
Phase 1 Sample weight	-	-	-	-	-	-	-
Phase 2 Bulk density pre-stressed concrete deck	-	-	-	-	-	-	-
Phase 3 Preload	1.1	21	9	23700	-	-	-
Phase 4 Jacking	1.5	28	23	9300	-	-	-
Phase 5 Bulk density of reinforced concrete deck 1.1		60	16	12800	-	-	-
Stage 6 Indulgences	1.5	90	19	11000	28	23	9300
Phase 7 Asphalt pavement	1.1	120	15	13900	60	16	12800
Phase 8 Other permanent taxes 1.1		120	15	13900	60	16	12800
Stage 9 Shrink and creep	0.55	1	20	10400	1	20	10400
Phase 10 Preload loss	1.1	21	19	11000	21	19	11000
Stage 11 Variable taxes				33000			33000

Table 60 - Concrete stiffnesses maintained in the various construction phases

In the transverse direction, cracking can occur, especially with the cantilever, and should therefore be reckoned with lower transverse stiffness. For the time being, this has not been charged, because this if the disadvantage is that it is not possible to calculate with variable height of the concrete deck. In addition, the the power transfer hardly change, because the load on the cantilever is only in one direction is transferred to the main beam. There are no consoles under the cantilever (with exception of the end cross member).

8.4.8 Preload

The pretension is applied in the local model (33 tons per cable). This is entered as one line load across the width of the deck (shown in green) plus a line moment at the location of the rib (pink shown), due to the eccentricity of the pretension. In the rib, this eccentricity is 100 mm. In the inclined part slopes linearly down to 0 mm at the thinnest part.

Figure 183 - Preload (Model Construction phase 3)

The losses (10%) are charged to the global model, due to an opposite line charge and line moment.

8.4.9 Jacking and draining

The construction is jacked at the location of the intermediate supports and later released. For this is an imposed deformation of 400 mm applied at the intermediate supports.

Figure 184 - Deformation of jacked construction

8.4.10 Shrink and creep

The shrinkage and creep of the concrete deck is taken into account in construction phase 9 and is modeled by apply an imposed rack to the concrete deck.

8.4.11 Impositions

The main beams of the bridges are each supported with 4 supports. According to drawing [A.22656] there are three longitudinal roller bearings and one hinged fixed bearing used for each main beam. In the transverse direction, the bridge is held by the fixed support and by friction of the other supports. The hinged fixed supports are modeled to accommodate the displacements X, Y and Z directions are prevented and the rotations are released. The roller bearings are such schematized to prevent displacement in transverse (Y) and vertical (Z) directions. Also is the rotation in the plane of the portal is prevented. This is a correct assumption as long as the imposition is below the vertical support reaction in combination with the corresponding horizontal support reaction and the corresponding moment remains largely under pressure. This has been checked in section 8. 5. The supports are on the underside of the K-bandages.

Figure 185 - Bridging bearings

The local model is supported during the prestressing by the body of the main beam. The imposition of the local model is therefore a linear support along the length of the main beam. Prior to has been checked with a separate model that the deflection due to prestressing is minimal and considerable smaller than the deflection by its own weight, when the beam only supports in the middle would be.

Figure 186 - Impositions local model

8.5 Validation

The bridge model has been validated with a comparison of the deflections and the reaction forces due to the self-weight of the steel structure. In addition, the deformation assessed under an evenly distributed load and asymmetrical loads.

Results of support reactions due to own weight of steel
The result of the support reactions due to the self-weight of the steel construction is compared to the weights according to the renvoo states. According to the Renovation States [1903 Folder 4B], the steel construction weighing 1729 kN (excluding supports and inspection paths, inclusive joint transitions). In the SCIA calculation a result of 1795 kN is found. The difference (4%) is considered to be sufficiently accurate.

Figure 187 - Resultant reaction forces due to self-weight steel construction

Support reactions due to own weight of steel
The support reactions were checked using a handsom and the design calculation. For the handsom is based on a beam on 4 supports with an equal span of 40 m. The beam is loaded by 1795 kN / (2x120m) = 7.48 kN / m.

Support reactions can be determined using forget-me-nots.

$R_{end} = 0.4qL = 0.4\ 7.4840 = 120$ kN
$R_{between} = 1.1qL = 1.17.4840 = 329$ kN

In addition, the support reaction has also been compared with the design calculations [Map BBV-0010-00]. In here the following support reactions are determined for phase 1 (mounting steel construction).

Figure 188 - Self-weighting reactions of steel in accordance with design calculations [BBV-0010-00]

The support reactions are calculated in the SCIA model as;

R_{end} = 127 kN

$R_{between}$ = 323 kN

Figure 189 Support reactions from Scia under its own weight of steel.

	Scia calculation [kN]	Hand calculation [kN]	Design calculation [kN]
R_A	126	120	113
R_B	321	329	290
R_C	323	329	290
R_D	127	120	113
Total	897	898	806

Table 61 - Support reactions from Scia, manual calculation and original calculation.

The hand calculation and the SCIA calculation correspond well. The design calculation takes about 11% lower forces, because this is based on a total weight of the bridge of 1600 kN instead of 1795 kN in accordance with the SCIA calculation. It is unclear why in the design calculation of such low weight has gone out. This also deviates from the renvoo states. The distribution of support reactions between the different support points is in the design calculation in proportion to the found distribution in the SCIA calculation. The slight difference in the SCIA calculation between the first two bearings and the last two bearings is caused by a small deviation in the length of the first field relative to the third field.

Check compressive stress in support

The calculation assumes a rotationally fixed support in the plane of the portal for the supports with roller bearings. The table below has checked whether the vertical support reaction continues the permanent loads in combination with the clamping moment and the horizontal support reaction is under pressure. For this, the horizontal support reaction has been translated to a moment at the bottom of the roll support (R_y x height support) and added to the clamping moment. The tensile force (per unit of length) that arises as a result of this moment is added to the compression force per unit of length. It can be seen that the entire imposition remains under pressure.

Pillar	F_z	F_y [kN]	M_x [kNm]	Height sol. [mm]	Width [mm]	q_{Fz} [kN / m]	q_{Fy} [kN / m]	q_{Mx} [kN / m]	q_{to} [kN / m]
End support	-812	-32.6	13.1	600	600	-1353	326	218	-809
Intermediate support	-2155	-60.1	26.1	600	600	-3592	601	435	-2556

Table 62 - Validation of assumption of rotation clamping bridge

In principle, due to the UDL load, a similar ratio of moment and vertical response will occur occur and the bearing therefore remains under pressure across the entire width of the roll. In the UGT it would that with a high wind load and little vertical load, the support is partly retracted. However, even if the imposition is partly on the rise by the moment, there will still be one for some time to come clamped support, because the center of gravity of the support will shift, without large rotation can occur. The assumption of a clamping for the modeling in the plane of the portal will so are closest to actual behavior.

Deflection under own weight of steel:

The deflection of the main beam by the weight of the steel structure is determined using forget-me-nots. This is based on an EI based on a beam with an extra flange plate in it first field and without additional flange plate in the second field.

$$= 0.007 \quad \cdot ^{4} \quad = 0.007 \frac{7.48 \cdot 40^{4}}{210 \cdot 10^{6} \cdot 3.41 \cdot 10^{-2}} = 18.7$$

$$= 0.0005 \quad \cdot ^{4} \quad = 0.0005 \frac{7.48 \cdot 40^{4}}{210 \cdot 10^{6} \cdot 2.81 \cdot 10^{-2}} = 1.6$$

In addition, a comparison has also been made with the design calculations [BBV-0010-00].

Figure 190 - Deflection according to the design calculations [BBV-0010-00], above field 1, below field 2

The following deflections are found in SCIA.

Figure 191 Deflection from Scia for self weight of steel.

The deflections are summarized again in the table below.

Span	Scia calculation [mm]	Hand calculation [mm]	Design calculation [mm]
End	20.6	18.7	19
Middle	6.9	1.6	5

Table 63 Deflection from Scia, hand and calculation at the time.

The difference between the hand calculation and the Scia calculation can be explained by the fact that in the manual calculation the stiffnesses are simplified. The deflections in the design calculations are similar to the SCIA calculations. The values found in the design calculation are slightly lower, which can be explained by the lower weight that has been charged (approx. 11% lower).
It is concluded that the deflections match well.

Support reactions under evenly distributed q-load:

The load in the phase of the pouring of the asphalt pavement (after finishing concrete decks) is also compared to the design calculation and a manual calculation. This is based on a distributed q load of 2.36 kN / m $_2$, over a width of 8.25 m. This corresponds to a load of 2.36 kN / m² x 8.25 m / 2 = 9.74 kN / m per beam.

The total resultant must correspond to a load of 8.25 m · 120 m · 2.36 kN / m² = 2336 kN Scia calculates resultant response as 2334 kN, which is a good match. A little moment arises due to the different length of the first field in relation to the third field.

Figure 192 Resulting reaction forces due to asphalt pavement

Support reactions can be determined with forget-me-nots.

R_{end} = 0.4qL = 0.4 9.74 kN / m40 m = 156 kN

$R_{between}$ = 1.1qL = 1.19,74 kN / m40 m = 429 kN

Figure 193 - Support reactions from Scia calculation for asphalt pavement

The support reactions correspond well with the values found in the manual calculation.

The deflection has been compared to the design calculation, where a calculation is also made under one evenly distributed load of 3.9 kN / m in the phase towards the curing of the concrete. Among these load, a deflection of 3 mm is found in the first field and 0 mm in the midfield.

Figure 194 - Deflection design calculation due to line load 3.9 kN / m

When this is scaled to 9.74 kN / m, a deflection of 9.74 / 3.9x3mm is found ≈ 8 mm.

Figure 195 - Deflection SCIA calculation (corresponding to a line load 9.74 kN / m)

A slightly higher deflection is found in SCIA, but is comparable in order of magnitude. The differences will mainly be in the rounding. It is concluded that the model is also in the phase with concrete deck is sufficiently accurate.

Deformation of the bridge:
For four loads, it was checked whether the deflection behaves as expected.

UDL on entire bridge:

Figure 196 - Deflection at UDL load on entire bridge

UDL 1^{E} field bridge:

Figure 197 - Deflection with UDL load on 1^{st} field

UDL 2^{e} field bridge:

Figure 198 - Deflection at UDL load on the second ^{E} field

UDL on half of the bridge:

Figure 199 - Deflection at UDL load on half of the bridge (in transverse direction)

Figure 200 - View of end face when deflected at UDL load on half of the bridge (in transverse direction)

In all cases, the deformation behaves as expected. It is concluded that the model is correct works.

9 Plan of Action for reinforcement measures

9.1 General

The recalculation will try as much as possible to prevent reinforcement measures. Therefore, before proceeding with the reinforcement, first attempt will be made to the construction anyway to comply. Any conservative assumptions will, where possible and promising, emerge from the calculation. A decision will also be made whether to use advanced methods calculation models (e.g. non-linear models, plate models of connections, etc.) can be demonstrated that the construction still complies. If, in consultation with Rijkswaterstaat, this is considered promising, we will perform the advanced recalculations.

If it turns out that the construction subsequently does not meet the requirements, we will consult with Rijkswaterstaat proceed to design the reinforcement measures. Because it is not yet known whether and if so which, parts do not comply, can only be discussed in general in the design of the reinforcement measures. However, it is expected that especially the connections in the bottom flange and the body of the main beams and at the location of the pleat stiffeners will not satisfy fatigue. For this specific bridge we are currently thinking of (a combination of) the following measures:

- Thickening of the bottom flange by reinforcing plates or an extra profile;
- Adding pleat stiffeners;
- Replacement / thickening of the weld between body and flange;
- Replacing rivets with pretension injection bolts;
- Adjusting welding details so that it falls into a higher detail category;
- Installing (external) pre-tension (cables);
- Establish an inspection regime (for the next 30 years).

9.2 Preliminary Design

In the Preliminary Design (VO), the reinforcement measures will initially be designed on based on the results of the recalculation without the gains being included in the calculation model. The reinforcements (including the reinforced parts) will be designed at the level renovation, the existing parts will be tested at the level of use. For the reinforcements Assumes actual use with a reference period of 30 years (AII) (from 1 January 2021).

The construction phases will be taken into account in the calculation, since later added parts may not bear all loads.

When designing the reinforcement measures, we will take it into account as much as possible limiting traffic nuisance (shipping, road traffic) during implementation. We do this by one to develop an implementation solution that can be (partly) prepared in the factory and / or is quick and easy to implement. For the Preliminary Design of the reinforcements, an estimate will be on based on the SSK-2010 system, as well as an estimate of the nuisance caused by the performance.

9.3 Final Design

In the Final Design (DO) of the reinforcements, the reinforcements will be included in the finite element model of the bridge and the amplification will be tested again. If necessary the reinforcement measures will be adapted to this or, if possible, optimized. It including the reinforcements in the finite element model is necessary if the reinforcements provide for a changed power transfer, for example due to a change in stiffness, and to take into account with the construction phasing.

In the DO design, the points of attention, possibilities and impossibilities for the implementation phases are appointed. Also, the DO design will propose an optimal one implementation phases are drawn up, with the starting point being to minimize the number of lanes at the same time, but do what is necessary to ensure high-quality reinforcement to realize. Any changes at this stage will be reflected in the SSK estimate.

The DO calculations will be made in such a way that the contractor without additional can perform an Execution Design (UO), including factory drawings, and then perform the reinforcements. A complete digital delivery file will be made of the reinforcements supplied, including drawings, calculations and specifications.

Appendix

Appendix A - Overview of drawings

IJssel Bridge

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Drawing / document name	Type	Part	East West	Construction part Current	Document number	RWS archive folder	Year	Institution
ladders to pillars and abutment downstream	Drawing	Substructure	east (40B-100)	Other	A.8385-I	1265 folder -		
ladders to pillars and abutment upstream (bridge Drawing		Substructure	east (40B-100)	Other	A.8385-II	1265 folder -		
transverse soundings 1961 km. 881-883	Drawing	Other	both	Other	61,109	1265 folder -		
transverse soundings 1961 km. 883-885	Drawing	Other	both	Other	61,110	1265 folder -		
tension anchoring	Drawing	Main bridge	east (40B-100)	Imposition	A.22862	1265 folder 2		
drain vortex	Drawing	Other	east (40B-100)	Other	A.22142-A	1265 folder 3		
change lid with closure	Drawing	Other	east (40B-100)	Other	A.23409	1265 folder 3		
polls	Drawing	Other	east (40B-100)	Other	58,229	1265 folder 4		
Overview	Drawing	Main bridge	east (40B-100)	Steel construction	A.21146-A	1265 folder 4A		
layout fittings	Drawing	Main bridge	east (40B-100)	Steel construction	A.21581	1265 folder 4A		
sheer chart and main beam dimensions	Drawing	Main bridge	east (40B-100)	Main spar	A.21584-B	1265 folder 4A		
situation side view	Drawing	Main bridge	east (40B-100)	Main spar	A.22646	1265 folder 4A		
size drawing driving floor	Drawing	Bridge	east (40B-100)	Concrete deck	A.23315	1265 folder 4A		
reinforcement driving deck	Drawing	Bridge	east (40B-100)	Concrete deck	A.23359	1265 folder 4A		
sea charts at div. periods during assembly	Drawing	Bridge	east (40B-100)	Main spar	A.23791	1265 folder 4A		
Renovation States	Drawing	Entire bridge	east (40B-100)	Other	Renovation States	1265 folder 4A		
construction sheer of the main beam	Drawing	Main bridge	east (40B-100)	Main spar	A.85302	1592 folder 4B		
pre-processing of the main beam	Drawing	Main bridge	east (40B-100)	Main spar	A.85303	1592 folder 4B		
main beam 0- 4 and 30-34	Drawing	Main bridge	east (40B-100)	Main spar	A.85304	1592 folder 4B		
main beam 4-7 and 27-30	Drawing	Main bridge	east (40B-100)	Main spar	A.85305	1592 folder 4B		
main beam 7-9 and 25-27	Drawing	Main bridge	east (40B-100)	Main spar	A.85306	1592 folder 4B		

main beam 9-12 and 22-25	Drawing	Main bridge	east (40B-100)	Main spar	A.85307	1592 folder 4B		
main beam 12-14 and 20-22	Drawing	Main bridge	east (40B-100)	Main spar	A.85308	1592 folder 4B		
main beam 14-20	Drawing	Main bridge	east (40B-100)	Main spar	A.85309	1592 folder 4B		
riveting classes in main girders 2-32-4-30 and 5-29	Drawing	Main bridge	east (40B-100)	Main spar	A.85310	1592 folder 4B		
riveting classes in main beams 7-27 and 9-25	Drawing	Main bridge	east (40B-100)	Main spar	A.85311	1592 folder 4B		
riveting classes in main beams 12-22 and 14-20	Drawing	Main bridge	east (40B-100)	Main spar	A.85312	1592 folder 4B		
latch class in main beam point 16-18	Drawing	Main bridge	east (40B-100)	Main spar	A.85313	1592 folder 4B		
portal A	Drawing	Main bridge	east (40B-100)	Main spar	A.85314	1592 folder 4B		
portal B	Drawing	Main bridge	east (40B-100)	Main spar	A.85315	1592 folder 4B		
portal C	Drawing	Main bridge	east (40B-100)	Main spar	A.85316	1592 folder 4B		
intermediate stiffeners in the main beams	Drawing	Main bridge	east (40B-100)	Main spar	A.85317	1592 folder 4B		
details connection dw.verb. to main beam	Drawing	Main bridge	east (40B-100)	Main spar	A.85318	1592 folder 4B		
intermediate crossbars	Drawing	Main bridge	east (40B-100)	Crossbar / bandage	A.85319	1592 folder 4B		
cross bars no. 1 to 15	Drawing	Main bridge	east (40B-100)	Crossbar / bandage	A.85320	1592 folder 4B		
cross bars no. 16 to 21	Drawing	Main bridge	east (40B-100)	Crossbar / bandage	A.85321	1592 folder 4B		
cross bars no. 22 to 27	Drawing	Main bridge	east (40B-100)	Crossbar / bandage	A.85322	1592 folder 4B		
section floor 0-2	Drawing	Main bridge	east (40B-100)	Steel deck	A.85323	1592 folder 4B		
part of the floor 2-4 and 30-32	Drawing	Main bridge	east (40B-100)	Steel deck	A.85324	1592 folder 4B		
section of driving floor 4-5 and 29-30	Drawing	Main bridge	east (40B-100)	Steel deck	A.85325	1592 folder 4B		
section floor 5-7 and 27-29	Drawing	Main bridge	east (40B-100)	Steel deck	A.85326	1592 folder 4B		
section floor 7-9 and 25-27	Drawing	Main bridge	east (40B-100)	Steel deck	A.85327	1592 folder 4B		
part of the floor 9-12 and 22-25	Drawing	Main bridge	east (40B-100)	Steel deck	A.85328	1592 folder 4B		
section floor 12-14 and 20-22	Drawing	Main bridge	east (40B-100)	Steel deck	A.85329	1592 folder 4B		
section floor 14-16 and 18-20	Drawing	Main bridge	east (40B-100)	Steel deck	A.85330	1592 folder 4B		
section floor 16-18	Drawing	Main bridge	east (40B-100)	Steel deck	A.85331	1592 folder 4B		
section floor 32-34	Drawing	Main bridge	east (40B-100)	Steel deck	A.85332	1592 folder 4B		
sidewalk at river span east side	Drawing	Main bridge	east (40B-100)	Steel deck	A.85333	1592 folder 4B		
sidewalk at river span west side	Drawing	Main bridge	east (40B-100)	Steel deck	A.85334	1592 folder 4B		
sidewalk at southern abutment east side	Drawing	Main bridge	east (40B-100)	Steel deck	A.85335	1592 folder 4B		
sidewalk at southern abutment west side	Drawing	Main bridge	east (40B-100)	Steel deck	A.85336	1592 folder 4B		
railings on the bridge	Drawing	Main bridge	east (40B-100)	Other	A.85337	1592 folder 4B		
Sketch (data for mounting weld)	Drawing	Main bridge	east (40B-100)	Other	Sketch (data for assembly	1592 folder 4B		
bearings 36,158, 203 tons	Drawing	Main bridge	east (40B-100)	Imposition	A.92198	1900 folder 4BB		
trailers 592 tons	Drawing	Main bridge	east (40B-100)	Imposition	A.92199	1900 folder 4BB		
plan for the placement of the bridge section 9-12	Drawing	Main bridge	east (40B-100)	Edit	A.85342	1900 folder 4C		
polls for mounting	Drawing	Main bridge	east (40B-100)	Edit	H105-50	1900 folder 4C		
mounting plan for the bridges	Drawing	Bridge	east (40B-100)	Edit	H105-51	1900 folder 4C		
assembly plan for the river span	Drawing	Main bridge	east (40B-100)	Edit	H105-52-A	1900 folder 4C		
plan for the placement of the bridge section 9-12	Drawing	Main bridge	east (40B-100)	Edit	H105-53	1900 folder 4C		
heights for western and eastern roller track	Drawing	Entire bridge	east (40B-100)	Edit	H105-54	1900 folder 4C		
anchor templates for pillars F; G; H; J; K and southern abutment Drawing		Main bridge	east (40B-100)	Edit	H105-55-A	1900 folder 4C		
anchors for the roller tracks	Drawing	Entire bridge	east (40B-100)	Edit	H105-56	1900 folder 4C		
the L-trestle beams 1 to 7 and the associated roller beams Drawing		Main bridge	east (40B-100)	Edit	H105-57-A	1900 folder 4C		
roll bars on pillars A to F	Drawing	Bridge	east (40B-100)	Edit	H105-58-A	1900 folder 4C		
the L and T trestle beams 8 to 14	Drawing	Main bridge	east (40B-100)	Edit	H105-59-A	1900 folder 4C		
details roller track	Drawing	Entire bridge	east (40B-100)	Edit	H105-60	1900 folder 4C		
details yokes no. 9-10-12-14 and pillar H	Drawing	Main bridge	east (40B-100)	Edit	H105-61	1900 folder 4C		
bev. strip of the rollers along the bridges	Drawing	Bridge	east (40B-100)	Edit	H105-62-B	1900 folder 4C		
lifting points for bridging	Drawing	Bridge	east (40B-100)	Edit	H105-63	1900 folder 4C		
mounting the part 0-7	Drawing	Main bridge	east (40B-100)	Edit	H105-64-A	1900 folder 4C		
mounting the section 7-14	Drawing	Main bridge	east (40B-100)	Edit	H105-65-A	1900 folder 4C		
lifting points for mounting part 0-14	Drawing	Main bridge	east (40B-100)	Edit	H105-66-B	1900 folder 4C		
mounting section 27-34	Drawing	Main bridge	east (40B-100)	Edit	H105-67	1900 folder 4C		
mounting section 20-27	Drawing	Main bridge	east (40B-100)	Edit	H105-68	1900 folder 4C		
mounting the keep 14-20	Drawing	Main bridge	east (40B-100)	Edit	H105-69	1900 folder 4C		
arrangement of bridge on assembly site P&B	Drawing	Other	east (40B-100)	Edit	H105-70-A	1900 folder 4C		
roller rack for part 7-9	Drawing	Main bridge	east (40B-100)	Edit	H105-72-A	1900 folder 4C		
placing bridge section 0 to 14 on the bins	Drawing	Main bridge	east (40B-100)	Edit	H105-73	1900 folder 4C		
bandage in braces and spacers	Drawing	Other	east (40B-100)	Edit	H105-74	1900 folder 4C		
sailing plan for the side spans	Drawing	Bridge	east (40B-100)	Edit	H105-75	1900 folder 4C		
sailing plan bridge part 0 to 7	Drawing	Main bridge	east (40B-100)	Edit	H105-78	1900 folder 4C		
details sailing plan bridge part 0-7	Drawing	Main bridge	east (40B-100)	Edit	H105-79	1900 folder 4C		
sailing plan bridge section 7-14	Drawing	Main bridge	east (40B-100)	Edit	H105-80	1900 folder 4C		
overview L and T-trestle beams 15 to 22	Drawing	Main bridge	east (40B-100)	Edit	H105-81	1900 folder 4C		
change. bandages of the yokes 15-17-19 and 20	Drawing	Main bridge	east (40B-100)	Edit	H105-82	1900 folder 4C		
lifting points for end piece section 14-20	Drawing	Main bridge	east (40B-100)	Edit	H105-85	1900 folder 4C		
sailing plan of the bridge section 14-20	Drawing	Main bridge	east (40B-100)	Edit	H105-86	1900 folder 4C		
construction sheer of the main beam	Drawing	Main bridge	east (40B-100)	Main spar	H105-01	1900 folder 4D		
parts for the inspection path	Drawing	Main bridge	east (40B-100)	Inspection path under the bridge	A.85343	1901 folder 4E		
overview and details of the inspection path	Drawing	Entire bridge	east (40B-100)	Inspection path under the bridge	A.85344	1901 folder 4E		
railing of the inspection path	Drawing	Entire bridge	east (40B-100)	Inspection path under the bridge	A.85345	1901 folder 4E		
change. v. inspection path at port. B	Drawing	Entire bridge	east (40B-100)	Inspection path under the bridge	A.85346	1901 folder 4E		
change. hangers for inspection path in bridge section 20-25	Drawing	Main bridge	east (40B-100)	Inspection path under the bridge	A.85358	1901 folder 4E		
cabinets I-east. and west above pillar H	Drawing	Main bridge	east (40B-100)	Other	A.85347	1901 folder 4F		
doors of cabinets I to IV east and west	Drawing	Main bridge	east (40B-100)	Other	A.85348	1901 folder 4F		
cabinets II-III and IV, above pillar H- and H	Drawing	Main bridge	east (40B-100)	Other	A.85349	1901 folder 4F		
cabinets I east and west above pillar J	Drawing	Main bridge	east (40B-100)	Other	A.85350	1901 folder 4F		
holes for cupboards in main beam 9-12 and 22-25	Drawing	Main bridge	east (40B-100)	Other	A.85351	1901 folder 4F		
side landing at pillar H and J	Drawing	Main bridge	east (40B-100)	Other	A.85352	1901 folder 4F		
cross platforms for cross beam 16	Drawing	Main bridge	east (40B-100)	Other	A.85353	1901 folder 4F		
Sketch cross platforms	Drawing	Main bridge	east (40B-100)	Other	A.85354	1901 folder 4F		
longitudinal path from pillar H to cross beam no.16	Drawing	Main bridge	east (40B-100)	Other	A.85356	1901 folder 4F		
longitudinal path from pillar H to cross beam no.19	Drawing	Main bridge	east (40B-100)	Other	A.85357	1901 folder 4F		
cross platforms at cross beam 19	Drawing	Main bridge	east (40B-100)	Other	A.85359	1901 folder 4F		
BOMs	Drawing	Main bridge	east (40B-100)	Other	Parts lists H105	1901 folder 4F		
PLAN for placement of the bridge section 9-12	Drawing	Main bridge	east (40B-100)	Edit	H105-55	1901 folder 4H		
end and normal crossbars side span	Drawing	Bridge	east (40B-100)	Crossbar / bandage	A.22649	1901 folder 4J		
intermediate crossbars and crossbars above pillars ABD Drawing		Bridge	east (40B-100)	Crossbar / bandage	A.22650	1901 folder 4J		
riding irons on northern abutment	Drawing	Bridge	east (40B-100)	Joint transition	A.22651	1901 folder 4J		
driving irons above pillar C.	Drawing	Bridge	east (40B-100)	Joint transition	A.22652	1901 folder 4J		
side spans	Drawing	Bridge	east (40B-100)	Imposition	A.22656	1901 folder 4J		
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38818	1901 folder 4J		
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38819	1901 folder 4J		
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38820	1901 folder 4J		
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38821	1901 folder 4J		
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38822	1901 folder 4J		

Drawing / document name	Type	Part	East West	Construction part Current	Document number	RWS archive folder	Year	Institution
main beams side spans	Drawing	Bridge	east (40B-100)	Main spar	A.38823	1901 folder 4J		
assembly drawing	Drawing	Bridge	east (40B-100)	Steel construction	A.38824	1901 folder 4J		

anchor templates for pillars A to F and northern abutment	Drawing	Bridge	east (40B-100)	Pillars / Abutment		A.38825	1901 folder 4J	
mounting bandage	Drawing	Bridge	east (40B-100)	Edit		A.38826	1901 folder 4J	
inspection paths	Drawing	Bridge	east (40B-100)	Inspection path under the bridge		A.38827	1901 folder 4J	
division section headl.	Drawing	Bridge	east (40B-100)	Main spar		A.38828	1901 folder 4J	
machining bodypl. main beams	Drawing	Bridge	east (40B-100)	Main spar		A.38829	1901 folder 4J	
anchor jig irons	Drawing	Bridge	east (40B-100)	Joint transition		A.38830	1901 folder 4J	
ORDER Cw5184	Drawing	Bridge	east (40B-100)	Steel construction		CW.5184	1901 folder 4J	
ultrasonic examination top edge strips bridge parts A6-A1Drawing		Bridge	east (40B-100)	Main spar		CW.5184-PLS	1901 folder 4J	
handrail side span + drain b. + Renv.	Drawing	Bridge	east (40B-100)	Other		A.22655-B	1902 folder 11	1961
Overview	Drawing	Entire bridge	east (40B-100)	Steel construction		A.21146-A	1902 folder 13	
end cross member A with connection for northern transition Drawing		Main bridge	east (40B-100)	Crossbar / bandage		A.21577-A	1902 folder 13	
bark side	Drawing	Main bridge	east (40B-100)	Other		A.21580-D	1902 folder 13	
wt. concrete guide bands	Drawing	Main bridge	east (40B-100)	Other		A.25314-B	1902 folder 13	
wt. concrete guide bands	Drawing	Main bridge	east (40B-100)	Other		A.25314-C	1902 folder 13	
scratch side (concrete) at drainage gully	Drawing	Main bridge	east (40B-100)	Other		A.25709-A	1902 folder 13	
scratch side (concrete) at drainage gully	Drawing	Main bridge	east (40B-100)	Other		A.25709-B	1902 folder 13	
Reinforcement of driving floor SW side	Drawing	Bridge	east (40B-100)	Concrete deck		A.27268	1902 folder 13	
brackets handrail lighting	Drawing	Other	east (40B-100)	Other		B3-82	1902 folder 15	
overview bridge 1 and 2 (new condition) A	Drawing	Main bridge	both	Steel construction		A.50937	3674 folder 26	
riding irons (recovery 1973) southern abutment	Drawing	Main bridge	east (40B-100)	Joint transition		A.57963	3674 folder 26	
driving irons (recovery 1973) second bridge	Drawing	Main bridge	west (40B-111)	Joint transition		A.57967	3674 folder 26	
joint transition at southern abutment	Drawing	Main bridge	both	Joint transition		A.103915	3674 folder 29A	
joint transition at pillar F	Drawing	Main bridge	both	Joint transition		A.103916	3674 folder 29A	
Maurer - Dehnfuge D180 southern abutment	Drawing	Main bridge	both	Joint transition		A.103915	3674 folder 29B	
Maurer - Dehnfuge D180 pillar F	Drawing	Main bridge	both	Joint transition		A.103916	3674 folder 29B	
Querschnitte D180 southern abutment	Drawing	Main bridge	both	Joint transition		A.105057	3674 folder 29B	
Querschnitte D180 pillar F	Drawing	Main bridge	both	Joint transition		A.105058	3674 folder 29B	
injection preload bolt connection	Drawing	Main bridge	both	Joint transition		830915C	471 folder 30A	
MAURER - Dehnfuge D180 southern abutment	Drawing	Main bridge	both	Joint transition		A.103915	471 folder 30A	1990
MAURER - Dehnfuge D180 pillar F	Drawing	Main bridge	both	Joint transition		A.103916	471 folder 30A	1990
Querschnitte D180 southern abutment	Drawing	Main bridge	both	Joint transition		A.105057	471 folder 30A	1990
Querschnitte D180 pillar F	Drawing	Main bridge	both	Joint transition		A.105058	471 folder 30A	1990
overview bridge 1 and 2 (new condition)	Drawing	Main bridge	both	Steel construction		A.50937	471 folder 30A	1970
section floor 0-2 bridge 1	Drawing	Main bridge	east (40B-100)	Steel deck		A.85323	471 folder 30A	1958
section floor 32-34	Drawing	Main bridge	east (40B-100)	Steel deck		A.85332	471 folder 30A	1958
sidewalk at river span east side	Drawing	Main bridge	east (40B-100)	Steel deck		A.85333	471 folder 30A	1958
sidewalk at river span west side	Drawing	Main bridge	east (40B-100)	Steel deck		A.85334	471 folder 30A	1958
sidewalk at southern abutment east side	Drawing	Main bridge	east (40B-100)	Steel deck		A.85335	471 folder 30A	1958
sidewalk at southern abutment west side	Drawing	Main bridge	east (40B-100)	Steel deck		A.85336	471 folder 30A	1958
driving irons above pillar F	Drawing	Main bridge	east (40B-100)	Joint transition	No	A.85339	471 folder 30A	1959
riding irons on southern abutment	Drawing	Main bridge	east (40B-100)	Joint transition	No	A.85340	471 folder 30A	1959
section floor 0-2 bridge 2	Drawing	Main bridge	west (40B-111)	Steel deck		A.85382	471 folder 30A	1958
section floor 32-34	Drawing	Main bridge	west (40B-111)	Steel deck		A.85392	471 folder 30A	1958
sidewalk at river span west side north	Drawing	Main bridge	west (40B-111)	Steel deck		A.85393	471 folder 30A	1960
sidewalk at river span east side north	Drawing	Main bridge	west (40B-111)	Steel deck		A.85394	471 folder 30A	1960
sidewalk at southern abutment west side	Drawing	Main bridge	west (40B-111)	Steel deck		A.85395	471 folder 30A	1960
sidewalk at southern abutment east side	Drawing	Main bridge	west (40B-111)	Steel deck		A.85396	471 folder 30A	1960
driving irons above pillar F	Drawing	Main bridge	west (40B-111)	Joint transition	No	A.85399	471 folder 30A	
riding irons on southern abutment	Drawing	Main bridge	west (40B-111)	Joint transition	No	A.85400	471 folder 30A	1961
front plate Maurer joint transition	Drawing	Main bridge	both	Joint transition		8	471 folder 30B	1991
brackets and stiffeners on the end crossbeam at the south drawing		Main bridge	both	Crossbar / bandage		A.103917	471 folder 30B	1990
brackets and stiffeners on the end cross member at the arrow Drawing		Main bridge	both	Crossbar / bandage		A.103918	471 folder 30B	1990
composition (southern abutment)	Drawing	Main bridge	both	Crossbar / bandage		A.103919	471 folder 30B	1990
composition (pillar F)	Drawing	Main bridge	both	Crossbar / bandage		A.103920	471 folder 30B	1990
removing irons and sidewalk crossings at the south side Drawing		Main bridge	both	Crossbar / bandage		A.103921	471 folder 30B	1990
driving irons and curbs to be removed at the pillar F drawing		Main bridge	both	Crossbar / bandage		A.103922	471 folder 30B	1990
adaptations southern abutment and pillar F	Drawing	Substructure	both	Pillars / Abutment		B.61073	471 folder 30B	1990
forged steel	Drawing	Substructure	west (40B-111)	Imposition		A.21828	1903 folder 2	1958
forged steel order drawing	Drawing	Substructure	west (40B-111)	Imposition		A.22657	1903 folder 2	
cast steel	Drawing	Substructure	west (40B-111)	Imposition		A.21827	1903 folder 3	1958
cast iron order drawing	Drawing	Substructure	west (40B-111)	Imposition		A.22658	1903 folder 3	
cabinets I-east and west above pillar H	Drawing	Main bridge	west (40B-111)	Main spar		A.85405	1903 folder 4A	
doors of cabinets I to IV east and west	Drawing	Main bridge	west (40B-111)	Main spar		A.85406	1903 folder 4A	
cabinets II, III and IV above pillar H and J	Drawing	Main bridge	west (40B-111)	Main spar		A.85407	1903 folder 4A	
cabinets I east and west above pillar J	Drawing	Main bridge	west (40B-111)	Main spar		A.85408	1903 folder 4A	
holes for cabinets in main beams 9-12 and 22-25	Drawing	Main bridge	west (40B-111)	Main spar		A.85409	1903 folder 4A	
side landing at pillar H and J	Drawing	Main bridge	west (40B-111)	Steel construction		A.85410	1903 folder 4A	
cross platforms for cross bar nr. 16	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85411	1903 folder 4A	
longitudinal path from pillar H to cross beam no.16	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85412	1903 folder 4A	
longitudinal path from pillar J to cross beam no.19	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85413	1903 folder 4A	
parts for drawing. 101 and 105 and situation	Drawing	Main bridge	west (40B-111)	Steel construction		A.85414	1903 folder 4A	
cross platforms for cross bar no.19	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85415	1903 folder 4A	
ladder ladders	Drawing	Main bridge	west (40B-111)	Other		A.85416	1903 folder 4A	1960
Renovation States	Drawing	Entire bridge	west (40B-111)	Other		Renovation States	1903 folder 4B	
construction sheer of the main beam	Drawing	Main bridge	west (40B-111)	Main spar		A.85360	1904 folder 4C	1958
pre-processing of the main beam	Drawing	Main bridge	west (40B-111)	Main spar		A.85361	1904 folder 4C	1958
main beams 0- 4 and 30-34	Drawing	Main bridge	west (40B-111)	Main spar		A.85362	1904 folder 4C	1958
main beams 4-7 and 27-30	Drawing	Main bridge	west (40B-111)	Main spar		A.85363	1904 folder 4C	1958
main girders 7-9 and 25-27	Drawing	Main bridge	west (40B-111)	Main spar		A.85364	1904 folder 4C	1958
main beams 9-12 and 22-25	Drawing	Main bridge	west (40B-111)	Main spar		A.85365	1904 folder 4C	1958
main girders 12-14 and 20-22	Drawing	Main bridge	west (40B-111)	Main spar		A.85366	1904 folder 4C	1958
main girders 14-20	Drawing	Main bridge	west (40B-111)	Main spar		A.85367	1904 folder 4C	
riveting classes in main girders 2-32 and 4-30 and 5-29	Drawing	Main bridge	west (40B-111)	Main spar		A.85368	1904 folder 4C	1958
riveting classes in main beams 7-27 and 9-25	Drawing	Main bridge	west (40B-111)	Main spar		A.85369	1904 folder 4C	1958
riveting classes in main beams 12-22 and 14-20	Drawing	Main bridge	west (40B-111)	Main spar		A.85370	1904 folder 4C	1958
sketch sequence of procedure b / h hinge mounting (drawing		Main bridge	west (40B-111)	Main spar		A.85371	1904 folder 4C	1962
vowels in main beam point 16-18	Drawing	Main bridge	west (40B-111)	Main spar		A.85372	1904 folder 4C	1958
portal A	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85373	1904 folder 4C	1958
portal B	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85374	1904 folder 4C	
portal C	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85375	1904 folder 4C	
intermediate stiffeners in the main beams	Drawing	Main bridge	west (40B-111)	Main spar		A.85376	1904 folder 4C	
details connection dw.verb. to main beams	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85377	1904 folder 4C	
intermediate crossbars	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85378	1904 folder 4C	1958
cross bars no. 1 to 15	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85379	1904 folder 4C	
cross bars no. 16 to 21	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85380	1904 folder 4C	
cross bars no. 22 to 27	Drawing	Main bridge	west (40B-111)	Crossbar / bandage		A.85381	1904 folder 4C	
section floor 0-2	Drawing	Main bridge	west (40B-111)	Steel deck		A.85382	1904 folder 4C	
part of the floor 2-4 and 30-32	Drawing	Main bridge	west (40B-111)	Steel deck		A.85383	1904 folder 4C	
section of driving floor 4-5 and 29-30	Drawing	Main bridge	west (40B-111)	Steel deck		A.85384	1904 folder 4C	
section floor 5-7 and 27-29	Drawing	Main bridge	west (40B-111)	Steel deck		A.85385	1904 folder 4C	
section floor 7-9 and 25-27	Drawing	Main bridge	west (40B-111)	Steel deck		A.85386	1904 folder 4C	
part of the floor 9-12 and 22-25	Drawing	Main bridge	west (40B-111)	Steel deck		A.85387	1904 folder 4C	
sketch of facilities welded to the driving floor (see drawing 29) Drawing		Main bridge	west (40B-111)	Steel deck		A.85388	1904 folder 4C	
section floor 12-14 and 20-22	Drawing	Main bridge	west (40B-111)	Steel deck		A.85389	1904 folder 4C	
section floor 14-16 and 18-20	Drawing	Main bridge	west (40B-111)	Steel deck		A.85390	1904 folder 4C	
section floor 16-18	Drawing	Main bridge	west (40B-111)	Steel deck		A.85391	1904 folder 4C	1959
section floor 32-34	Drawing	Main bridge	west (40B-111)	Steel deck		A.85392	1904 folder 4C	1958
sidewalk at river span west side (north)	Drawing	Main bridge	west (40B-111)	Steel deck		A.85393	1904 folder 4C	1960
sidewalk at river span east side (north)	Drawing	Main bridge	west (40B-111)	Steel deck		A.85394	1904 folder 4C	1960
sidewalk at southern abutment west side	Drawing	Main bridge	west (40B-111)	Steel deck		A.85395	1904 folder 4C	1960
sidewalk at southern abutment east side	Drawing	Main bridge	west (40B-111)	Steel deck		A.85396	1904 folder 4C	1960
railings on the bridge	Drawing	Main bridge	west (40B-111)	Other		A.85397	1904 folder 4C	1958
hinge movement of the driving irons	Drawing	Main bridge	west (40B-111)	Joint transition		A.85398	1904 folder 4C	1959
driving irons above pillar F	Drawing	Main bridge	west (40B-111)	Joint transition		A.85399	1904 folder 4C	1958
riding irons on southern abutment	Drawing	Main bridge	west (40B-111)	Joint transition		A.85400	1904 folder 4C	1958

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Drawing / document name	Type	Part	East West	Construction part Current	Document number	RWS archive folder	Year	Institution
overview and details of the inspection path	Drawing	Main bridge	west (40B-111)	Other	A.85401	1904 folder 4C	1958	
parts of the inspection path	Drawing	Main bridge	west (40B-111)	Other	A.85402	1904 folder 4C	1958	
handrail of the inspection path	Drawing	Main bridge	west (40B-111)	Other	A.85403	1904 folder 4C	1958	
situation inspection path at portal B	Drawing	Main bridge	west (40B-111)	Crossbar / bandage	A.85404	1904 folder 4C	1958	
trailers 592 tons	Drawing	Main bridge	west (40B-111)	Imposition	A.21582	1905 folder 4D		
trailers 36,158,203 tons	Drawing	Main bridge	west (40B-111)	Imposition	A.21583	1905 folder 4D		
tension anchoring	Drawing	Main bridge	west (40B-111)	Imposition	A.22862	1905 folder 4D		
main beams side spans	Drawing	Bridge	west (40B-111)	Main spar	A.39071	1905 folder 4E		
main beams side spans	Drawing	Bridge	west (40B-111)	Main spar	A.39072	1905 folder 4E		
Main beams side spans Main beams side spans Drawing		Bridge	west (40B-111)	Main spar	A.39073	1905 folder 4E		
main beams side spans	Drawing	Bridge	west (40B-111)	Main spar	A.39074	1905 folder 4E		
main beams side spans	Drawing	Bridge	west (40B-111)	Main spar	A.39075	1905 folder 4E		
main beams side spans	Drawing	Bridge	west (40B-111)	Main spar	A.39076	1905 folder 4E		
end and normal cross beam side spans	Drawing	Bridge	west (40B-111)	Crossbar / bandage	A.39077	1905 folder 4E		
intermediate crossbars and crossbars above pillars ABD Drawing		Bridge	west (40B-111)	Crossbar / bandage	A.39078	1905 folder 4E		
assembly drawing	Drawing	Bridge	west (40B-111)	Joint transition	A.39079	1905 folder 4E		
driving irons above pillar C.	Drawing	Bridge	west (40B-111)	Joint transition	A.39080	1905 folder 4E		
riding irons on northern abutment	Drawing	Bridge	west (40B-111)	Joint transition	A.39081	1905 folder 4E		
anchor templates for pillars A to F and northern abutment	Drawing	Bridge	west (40B-111)	Imposition	A.39082	1905 folder 4E		
mounting bandage	Drawing	Bridge	west (40B-111)	Other	A.39083	1905 folder 4E	1959	
side spans	Drawing	Bridge	west (40B-111)	Imposition	A.39084	1905 folder 4E		
inspection paths	Drawing	Bridge	west (40B-111)	Inspection path under the bridge	A.39085	1905 folder 4E		
layout sections body. main beams	Drawing	Bridge	west (40B-111)	Main spar	A.39086	1905 folder 4E		
machining bodypl. main beam	Drawing	Bridge	west (40B-111)	Main spar	A.39087 (2)	1905 folder 4E		
machining bodypl. main beam	Drawing	Bridge	west (40B-111)	Main spar	A.39087	1905 folder 4E		
sidewalk transitions at spans F and noor Drawing		Bridge	west (40B-111)	Joint transition	A.39088	1905 folder 4E	1962	
drain vortex	Drawing	Other	west (40B-111)	Other	A.28712	1905 folder 9		
Overview	Drawing	Main bridge	east (40B-100)	Steel construction	A.21146-A	1905 folder 11		
end cross member A with connection for northern transition Drawing		Main bridge	west (40B-111)	Crossbar / bandage	A.21577-A	1905 folder 11	1958	
bark side	Drawing	Main bridge	west (40B-111)	Steel deck	A.21580	1905 folder 11		
scratch side (concrete) at drainage gully	Drawing	Main bridge	west (40B-111)	Other	A.25709	1905 folder 11		
wt. concrete guide bands	Drawing	Main bridge	west (40B-111)	Other	A.29748	1905 folder 11		
change. sidewalk crossing at the river crossing to side entrance		Main bridge	west (40B-111)	Other	A.29780	1905 folder 11		
light poles	Drawing	Entire bridge	both	Other	A.49875	1906 folder 19	1974	
connection box for light pole Ø 219 mm.	Drawing	Entire bridge	both	Other	A.49876	1906 folder 19		
double junction box for light pole Ø 219 mm.	Drawing	Entire bridge	both	Other	A.49877	1906 folder 19		
base plate for a 12 m mast.	Drawing	Entire bridge	both	Other	A.49878	1906 folder 19		
mast for mounting box for wall sockets	Drawing	Entire bridge	both	Other	A.55077	1906 folder 19		
cable run bridge lighting	Drawing	Entire bridge	both	Other	A.54522 (2)	1906 folder 21		
cable run bridge lighting	Drawing	Entire bridge	both	Other	A.54522	1906 folder 21		
overview lighting	Drawing	Entire bridge	both	Other	A.54535	1906 folder 21		
road lighting schedule	Drawing	Entire bridge	both	Other	A.54585	1906 folder 21		
socket box and mounting plates in light poles	Drawing	Entire bridge	both	Other	G.14452	1906 folder 21		
drain vortex	Drawing	Entire bridge	both	Other	A.22142-B	1906 folder 22		
wt. concrete guide bands	Drawing	Entire bridge	both	Other	A.25314-C	1906 folder 22	1962	
scratch side (concrete) at drainage gully	Drawing	Entire bridge	both	Other	A.25709-A	1906 folder 22		
lighting plan	Drawing	Entire bridge	both	Other	A.49852-B	1906 folder 22		
light poles	Drawing	Entire bridge	both	Other	A.49875	1906 folder 22		
detail console (additional work)	Drawing	Entire bridge	both	Console	A.50928-C	1906 folder 22		
overview bridge I and II (old condition)	Drawing	Entire bridge	both	Console	A.46205A	1906 folder 22A	1974	
overview bridge I and II (new condition)	Drawing	Entire bridge	both	Console	A.50937	1906 folder 22A	1974	
reinforced console detail	Drawing	Entire bridge	both	Console	A.50939	1906 folder 22A		
console for abutments	Drawing	Entire bridge	both	Console	A.50940	1906 folder 22A		
handrail concrete bridge deck	Drawing	Bridge	both	Other	A.50941	1906 folder 22A		
composition handrail steel bridge deck 1 and 2	Drawing	Main bridge	both	Other	A.50942	1906 folder 22A		
railings steel bridge deck	Drawing	Main bridge	both	Other	A.50943	1906 folder 22A		
grids concrete bridge deck and at north and south. abutment Drawing		Entire bridge	both	Other	A.50944	1906 folder 22A	1974	
grids at pillar C and F	Drawing	Bridge	both	Inspection pad consoles	A.50945	1906 folder 22A		
gratings steel bridge deck	Drawing	Main bridge	both	Inspection pad consoles	A.50946	1906 folder 22A		
guardrail concrete bridge deck	Drawing	Bridge	both	Other	A.50947	1906 folder 22A		
guardrail steel bridge deck	Drawing	Entire bridge	both	Other	A.50948	1906 folder 22A		
walkway between bridge 1 and 2 at point LMN and P drain drawing		Main bridge	both	Inspection pad consoles	A.52793B	1906 folder 22A		
cable duct at the northern abutment of Renvooistaten.	Drawing	Bridge	both	Other	A.61301	1906 folder 22A		
walkway between bridge 1 and 2 at point LMN and P drain drawing		Main bridge	both	Inspection pad consoles	A.61429	1906 folder 22A		
Renovation States	Drawing	Entire bridge	both	Other	Renovation States	1906 folder 22A		
hanging jetty	Drawing	Other	west (40B-111)	Other	09 74 2	1907 folder 33	1989	
hanging jetty	Drawing	Other	west (40B-111)	Other	09 74 3	1907 folder 33	1989	
hang mobile scaffold principle sketch	Drawing	Other	west (40B-111)	Other	09 74 9C	1907 folder 33	1990	
Overview	Drawing	Entire bridge	east (40B-100)	Other	A.22646	1907 folder 33	1958	
overview bridge 1 and 2 (new condition)	Drawing	Entire bridge	both	Other	A.50937	1907 folder 33	1970	
Bending states	Drawing	Substructure	both	Pillars / Abutment	B.5472-Bend	B.0292		
Northern abutment - Fund.plate and construction up to 14.65+ Drawing		Substructure	both	Pillars / Abutment	B.5472	B.0292		
Bending states	Drawing	Substructure	both	Pillars / Abutment	B.5473-Bend	B.0292		
Northern abutment - Connecting plate and front wall	Drawing	Substructure	both	Pillars / Abutment	B.5473	B.0292		
Bending states	Drawing	Substructure	both	Pillars / Abutment	B.5474-Bend	B.0292		
Southern abutment - base plate and construction until 1878	Drawing	Substructure	both	Pillars / Abutment	B.5474	B.0292		
Bending states	Drawing	Substructure	both	Pillars / Abutment	B.5475-Bend	B.0292		
Southern abutment - Connecting plate and front wall	Drawing	Substructure	both	Pillars / Abutment	B.5475	B.0292		
Bending states	Drawing	Substructure	both	Pillars / Abutment	B.5537-Bend	B.0292		
Northern and Southern abutment - side walls above head Drawing		Substructure	both	Pillars / Abutment	B.5537	B.0292		
Bank supply pillar H	Drawing	Substructure	both	Pillars / Abutment	C.10715	B.0292		
Overview scheme	Drawing	Substructure	both	Pillars / Abutment	C.144	B.0292		
Situation	Drawing	Substructure	both	Pillars / Abutment	C.4193	B.0292		
Situation and situation with the location of the deep probes	Drawing	Substructure	both	Pillars / Abutment	C.4194	B.0292		
Measured length profile in the axis of the bridge	Drawing	Substructure	both	Pillars / Abutment	C.4233	B.0292		
Perspective drawing (Holtkamp)	Drawing	Entire bridge	both	Other	C.4237	B.0292		
Polls in the IJssel and the position of the polls	Drawing	Substructure	both	Other	C.4240	B.0292		
Southern Bandijk section	Drawing	Other	both	Other	C.4273	B.0292		
North bank section (situation)	Drawing	Other	both	Other	C.4274	B.0292		
Measured length profile in the axis of the bridge	Drawing	Other	both	Other	C.4285	B.0292		
River profile in the axis of the bridge (recorded April 1941) Drawing		Other	both	Other	C.4286	B.0292		
Northern abutment - piling plan	Drawing	Substructure	both	Pillars / Abutment	C.4338	B.0292		
Southern abutment - piling plan	Drawing	Substructure	both	Pillars / Abutment	C.4339	B.0292		
Pillar A - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4340	B.0292		
Pillar B - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4341	B.0292		
Pillar C - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4342	B.0292		
Pillar D - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4343	B.0292		
Pillar E - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4344	B.0292		
Pillar F - driving plan	Drawing	Substructure	both	Pillars / Abutment	C.4345	B.0292		

Pillar G - driving plan	Drawing	Substructure	both	Pillars / Abutment		C.4346	B.0292		
Pillar K - driving plan	Drawing	Substructure	both	Pillars / Abutment		C.4347	B.0292		
Northern abutment - overview	Drawing	Substructure	both	Pillars / Abutment		C.4348	B.0292		
Southern abutment - overview	Drawing	Substructure	both	Pillars / Abutment		C.4349	B.0292		
Perspective drawing (vd Steur)	Drawing	Other	both	Other		C.4453	B.0292		
Tender drawing - length profile, situation and ground bores Drawing		Substructure	both	Pillars / Abutment		C.4460	B.0292		
Tender drawing - Pillars A to K	Drawing	Substructure	both	Pillars / Abutment		C.4461	B.0292		
Specifications drawing - Northern and southern abutment	Drawing	Substructure	both	Pillars / Abutment		C.4462	B.0292		
Top part no o rdelij k on southern la n Dhoo f d	Drawing	Substructure	both	Pillars / Abutment		C.4475	B.0292		
South bank section (situation)	Drawing	Substructure	both	Pillars / Abutment		C.4492	B.0292		
Perspective drawing (vd Steur)	Drawing	Other	both	Other		C.4493	B.0292		
Side view and sections	Drawing	Other	both	Other	Yes	C.8717	B.0292		
Tender drawing - Change of substructure 1st bridge - Overview drawing		Substructure	east (40B-100)	Pillars / Abutment		C.8907	B.0292	1958	
Tender drawing - modification of substructure 1st bridge - support block		Substructure	east (40B-100)	Pillars / Abutment		C.8923	B.0292		
Tender drawing - modification of substructure 1st bridge - support block		Substructure	east (40B-100)	Pillars / Abutment		C.8924	B.0292		
Gutter edges on abutments	Drawing	Substructure	both	Pillars / Abutment		C.9130	B.0292	1958	
Tender drawing - modification of substructure 2nd bridge - overview Drawing		Substructure	west (40B-111)	Pillars / Abutment		C.9847	B.0292	1960	
Schampkant (river span)	Drawing	Main bridge	east (40B-100)	Other		A.21580	B.0293	1960	

Drawing / document name	Type	Part	East West	Construction part	Current	Document number	RWS archive folder	Year	Institution
Floor drawing size drawing	Drawing	Bridge	east (40B-100)	Concrete deck		A.23315 I	B.0293		
Tender drawing - Concrete deck (1st bridge)	Drawing	Bridge	east (40B-100)	Concrete deck		A.23315 II	B.0293		
Rebar driving deck	Drawing	Bridge	east (40B-100)	Concrete deck		A.23359	B.0293		
Reinforced concrete guide bands	Drawing	Main bridge	east (40B-100)	Other		A.25314	B.0293	1960	
Sham edge (concrete) at drainage gully	Drawing	Main bridge	east (40B-100)	Other		A.25709	B.0293		
Tender drawing - Concrete deck (2nd bridge)	Drawing	Bridge	west (40B-111)	Concrete deck		A.27267	B.0293		
Floor reinforcement	Drawing	Bridge	west (40B-111)	Concrete deck		A.27268	B.0293	1962	
Concrete guide bands	Drawing	Main bridge	west (40B-111)	Other		A.29748	B.0293		
Substructure repairs - Abutment south and pillars F to Drawing		Substructure	both	Pillars / Abutment		B.46620	B.0293	1985	
Substructure repairs - North abutment and pillars A tDrawing		Substructure	both	Pillars / Abutment		B.46621	B.0293		
Bending States Bank Piers A, B, C, D, E, F, G, K - Foundation P Drawing		Substructure	both	Pillars / Abutment		B.5468-Bend	B.0293		
Bank piers A, B, C, D, E, F, G, K - Foundation plate	Drawing	Substructure	both	Pillars / Abutment		B.5468	B.0293		
Bending states Bank pillars A, B, C, D, E, F, G, K - Structure	Drawing	Substructure	both	Pillars / Abutment		B.5469-Bend	B.0293		
Bank pillars A, B, C, D, E, F, G, K - Construction	Drawing	Substructure	both	Pillars / Abutment		B.5469	B.0293		
Bending states River pillars H and J - Foundation plate	Drawing	Substructure	both	Pillars / Abutment		B.5470-Bend	B.0293		
River pillars H and J - Foundation slab	Drawing	Substructure	both	Pillars / Abutment		B.5470	B.0293		
Bending states River pillars H and J - Structure (page 1)	Drawing	Substructure	both	Pillars / Abutment		B.5471-Bend	B.0293		
River pillars H and J - Structure (page 1)	Drawing	Substructure	both	Pillars / Abutment		B.5471	B.0293		
River pillars H and J - Structure (page 2)	Drawing	Substructure	both	Pillars / Abutment		B.5511	B.0293		
Overview (BR 2411/1991)	Drawing	Entire bridge	both	Other		B.61072	B.0293	1990	
Southern abutment and pillar "F" adjustments	Drawing	Entire bridge	both	Joint transition		B.61073	B.0293	1990	
Southern abutment and pillar "F" adjustments	Drawing	Entire bridge	both	Joint transition		B.61073A	B.0293	1990	
Northern abutment and pillar "C" adjustments	Drawing	Entire bridge	both	Joint transition		B.61074	B.0293	1990	
Binding tests: Portland cement with Lentan and with Cerino Drawing		Entire bridge	both	Other		C.10773	B.0293	1959	
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 1	B.0293	1941	
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 10	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 11	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 12	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 13	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 14	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 15	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 16	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 2	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 3	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 4	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 5	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 6	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 7	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 8	B.0293		
Articon concrete blocks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4259 - sheet 9	B.0293		
Concrete bricks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4260 - sheet 1	B.0293		
Concrete bricks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4260 - sheet 2	B.0293		
Concrete bricks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4260 - sheet 3	B.0293		
Concrete bricks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4260 - sheet 4	B.0293		
Concrete bricks for pillars and abutments	Drawing	Substructure	both	Pillars / Abutment		C.4260 - sheet 5	B.0293		
Pillars A, B, C, D, E, G and K - Overview	Drawing	Substructure	both	Pillars / Abutment		C.4350	B.0293		
Pillar F - Overview	Drawing	Substructure	both	Pillars / Abutment		C.4351	B.0293		
Pillars H and J - Overview	Drawing	Substructure	both	Pillars / Abutment		C.4352	B.0293		
Anchors and dives for the concrete blocks	Drawing	Substructure	both	Pillars / Abutment		C.4353	B.0293		
River pier H - Cutouts	Drawing	Substructure	both	Pillars / Abutment		C.4552	B.0293		
Pillar H - Liège and climbing irons	Drawing	Substructure	both	Pillars / Abutment		C.4553	B.0293		
Bending states	Drawing	Substructure	both	Pillars / Abutment		C.8969-Bend	B.0293		
Support blocks for the pillars ABCDEFGHJ and K and v Drawing		Substructure	east (40B-100)	Imposition		C.8969	B.0293		
Change of position of prestressing cables	Drawing	Bridge	both	Concrete deck		C.9366	B.0293		
Support blocks for the pillars ABCDEFG and K (2nd bridge) Drawing		Substructure	east (40B-100)	Imposition		C.9904	B.0293		
Support blocks for pillars H and J and Northern and Southern Drawing		Substructure	east (40B-100)	Imposition		C.9905	B.0293		
Überganskonstruktion DT160 Maurer Söhne	Drawing	Entire bridge	east (40B-100)	Joint transition		559751-110	BDX-8485 folder 27	2007	
Überganskonstruktion D240 Maurer Söhne	Drawing	Main bridge	east (40B-100)	Joint transition		559751-120	BDX-8485 folder 27	2007	
Bearings 36, 158, 203 tons	Drawing	Entire bridge	both	Imposition		A.21583	BDX-8485 folder 27		
main beam 14-20	Drawing	Main bridge	both	Main spar		H-105-08	BBV-0010-00		

Appendix

Appendix B - Overview calculations

IJssel Bridge

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Drawing / document name	Type	Part	East West	Construction part Current	Document number	RWS archive folder	Year	Institution
Calculation of the yokes	Calculation	Substructure	east (40B-100)	Edit	Calculations	1592 folder 4B	1959	
Stability calculations for transporting bridge pieces	Calculation	Substructure	east (40B-100)	Edit	Stability calculations	1592 folder 4B	1959	
Calculation of edge beam with suspended platform	Calculation	Main bridge	west (40B-111)	Other	BR 1651 calculation edge beam m1907 folder 33		1989	
Calculation consoles with hanging scaffold	Calculation	Main bridge	west (40B-111)	Other	BR 1651 calculations consoles 1907 folder 33		1989	
Calculation suspended platform	Calculation	Main bridge	west (40B-111)	Other	BR 1651 calculations hanging platform 1907 folder 33		1990	
Calculation Special transports SAAB - Side span Calculation		Bridge	both	Steel construction	BAL-0065-30	BAL-0065-30	2003	
Calculation Special transports SAAB - Main span Calculation		Main bridge	both	Steel construction	BAL-0065-31	BAL-0065-31	2003	
Profile data and mechanics schedules	Calculation	Entire bridge	both	Steel construction	BAN-0011-00	BAN-0011-00	1982	
Calculation Connection profiles	Calculation	Bridge	both	Steel construction	Connection profiles	BBV-0010-00		
Calculation Determination of construction screen	Calculation	Bridge	both	Main spar	Determination of construction sheer	BBV-0010-00		
Calculation Determination of transverse forces	Calculation	Bridge	both	Main spar	Determination of shear forces	BBV-0010-00		
Calculation Top flange mounting	Calculation	Bridge	both	Main spar	Top flange mounting	BBV-0010-00		
Calculation Various calculations	Calculation	Entire bridge	both	Main spar	Various calculations	BBV-0010-00		
Deflection Calculation	Calculation	Bridge	both	Main spar	Deflection	BBV-0010-00		
Transverse forces calculation	Calculation	Bridge	both	Main spar	Transverse forces	BBV-0010-00		
Main beam calculation	Calculation	Bridge	both	Main spar	Main spar	BBV-0010-00		
Calculation Assembly butt	Calculation	Bridge	both	Main spar	Assembly butt	BBV-0010-00		
Calculation Specified construction sheer	Calculation	Bridge	both	Main spar	Specified construction sheer	BBV-0010-00		
Calculation reaction	Calculation	Bridge	both	Imposition	Support reaction	BBV-0010-00		
Span calculation	Calculation	Bridge	both	Main spar	Span	BBV-0010-00		
Calculation Phase 1	Calculation	Bridge	both	Main spar	Phase 1	BBV-0010-00		
Calculation Phase 2	Calculation	Bridge	both	Main spar	Phase 2	BBV-0010-00		
Calculation Phase 3	Calculation	Bridge	both	Main spar	Phase 3	BBV-0010-00		
Calculation Phase 4	Calculation	Bridge	both	Main spar	Phase 4	BBV-0010-00		
Calculation Phase 5	Calculation	Bridge	both	Main spar	Phase 5	BBV-0010-00		
Calculation Phase 6	Calculation	Bridge	both	Main spar	Phase 6	BBV-0010-00		
Calculation Phase 7	Calculation	Bridge	both	Main spar	Phase 7	BBV-0010-00		
Fold safety calculation	Calculation	Bridge	both	Main spar	Fold safety	BBV-0010-00		
Calculation of the driving floor construction	Calculation	Bridge	both	Concrete deck	Driving floor construction	BBV-0010-00		
Calculation Hinge support	Calculation	Bridge	both	Imposition	Hinge support	BBV-0010-00		
Calculation Voltage due to dehydration	Calculation	Bridge	both	Concrete deck	Stress due to dehydration	BBV-0010-00		
Calculation Voltage relative to own weight	Calculation	Bridge	both	Main spar	Tension relative to own weight	BBV-0010-00		
Midfield Deposit Calculation	Calculation	Bridge	both	Concrete deck	Deposit midfield	BBV-0010-00		
Calculation Reinforced console concrete bridge	Calculation	Bridge	both	Console	Reinforced console concrete bridgeBBV-0010-00			
Calculation Reinforced steel bridge console	Calculation	Main bridge	both	Console	Reinforced console steel bridge BBV-0010-00			
Preload Calculation	Calculation	Bridge	both	Concrete deck	Preload	BBV-0010-00		
Wind load calculation	Calculation	Bridge	both	Concrete deck	Wind load	BBV-0010-00		
Calculation of bearings	Calculation	Main bridge	both	Imposition	Calculation of bearings	BBV-0010-01	1991	
Expulsion calculation	Calculation	Entire bridge	both	Joint transition	Expulsion calculation	BBV-0010-01	1991	
Jacking calculation	Calculation	Main bridge	both	Imposition	Jacking calculation	BBV-0010-01	1991	

Calculation change due to console grid voltages mob Calculation		Main bridge	both	console	Calculation change due to consoleBBV-0010-01		1987	
ZOAB calculation on bridge	Calculation	Main bridge	both	Main spar	ZOAB calculation on bridge	BBV-0010-01		
NET main span calculation	Calculation	Main bridge	both	Steel construction	NET calculation main span BBV-0010-01			
NET side span calculation	Calculation	Bridge	both	Steel construction	NET side span calculationBBV-0010-01			
Investigate cracking of steel bridges	Calculation	Entire bridge	both	Steel construction	BBV-0102-00 (Examination Tear BBV-0102-00			
Fatigue calculation	Calculation	Main bridge	both	Steel construction	BBV-0116-00	BBV-0116-00		
Report 6-79-6 - Measurements and interpretation of dyna Calculation		Main bridge	west (40B-111)	Steel construction	DRA-0559-07	DRA-0559-07	1979	Stevin Laborator
Report 6-79-6 - Measurements and interpretation of dyna Calculation		Main bridge	west (40B-111)	Steel construction	DRA-0559-08	DRA-0559-08	1979	Stevin Laborator
Calculation Foundation	Calculation	Substructure	both	Pillars / Abutment	Archive Calculation Foundation			
Bridge control work plan	Calculation	Main bridge	west (40B-111)	Other	20140219 1713021-WerkPl-001 Bridge pipe rev 2 inc 2014			A. Chop
Bridge calculation for NUON water supply	Calculation	Main bridge	west (40B-111)	Other	912-275.R01 bridge calculation St Water pipe NUON 2012			Strackee
Design note convex segment supports STP10.pdf	Calculation	Main bridge	east (40B-100)	Imposition	17245-ONT-001	Change imposed 2018		Edilon Sedra
Design note fixation STP10 2.0.pdf	Calculation	Main bridge	east (40B-100)	Imposition	17245-ONT-003	Change imposed 2018		Edilon Sedra
Design note concrete work bolsegmentopening.pdf	Calculation	Main bridge	east (40B-100)	Imposition	17245-ONT-004	Change imposed 2018		Edilon Sedra
Design note concrete work fixation STP10 2.0.pdf	Calculation	Main bridge	east (40B-100)	Imposition	17245-ONT-005	Change imposed 2018		Edilon Sedra

Appendix

Appendix C - Specifications overview

IJssel Bridge

Drawing / document name	Type	Part	East West	Construction part Current	Document number	RWS archive folder	Year	Institution
OVK BR / 2183. Changing the existing substructure Specifications		Substructure	east (40B-100)	Imposition	BR 2183	1265 folder 2	1957	

ASSIGNMENT 1523. The cont. and supply of cast iron drain cutlery		Other	east (40B-100)	Other	BR 1523-I	1265 folder 3	1958
OVK. It rep. of the steel superstructure.	Cutlery	Entire bridge	east (40B-100)	Steel construction	BR 2370	1265 folder 4	1959
Guidance for work on the steel structure	Cutlery	Entire bridge	east (40B-100)	Steel construction	H105 order H105	1901 folder 4E	1959
OVK / St. of extra work. Assembling the steel top Cutlery		Entire bridge	east (40B-100)	Steel construction	BR 2251	1902 folder 8	1959
OVK / Assignment. It rep. and supply railings for dBekek		Entire bridge	east (40B-100)	Other	BR 2381	1902 folder 11	1960
OVK / Assignment / St. of extra work. Applying eeBekek		Main bridge	east (40B-100)	Hardening	BR 2571	1902 folder 13	1960
Order. It rep. and supply of handrail lighting cutlery brackets		Other	east (40B-100)	Other	Task 2512-I	1902 folder 15	1961
OVK / Assignments / St. of extra work / Letter sol. Work. The cutlery		Entire bridge	east (40B-100)	Steel construction	BR 7968	1902 folder 21	1977
OVK / Assignment. Repairing the asphalt structures. Cutlery		Entire bridge	both	Hardening	BR 9846	1902 folder 22	1983
OVK / Telex assignment. Replacing the asphalt construction Cutlery		Main bridge	east (40B-100)	Hardening	BR 304	1902 folder 23	1983
OVK / Assignment / Power of Attorney. Repairing the road plates Cutlery		Main bridge	both	Other	BR 903	3674 folder 26	1986
OVK / Assignment / Power of Attorney / Preservation Product Sheet / ProdBestek		Main bridge	both	Joint transition	OVK-Assignment-Proxy-Conse 3674 folder 29		1990
OVK / Assignment / Power of Attorney / Preservation Product Sheet / ProdBestek		Main bridge	both	Joint transition	BR 2305	3674 folder 29	1990
SPECIFICATIONS + appendix / Inspection reports / Assembly program / ConBestek		Main bridge	both	Joint transition	BR 2364	471 folder 30	1991
It rep. and supply of forged steel parts.	Cutlery	Substructure	west (40B-111)	Imposition	Task 11466-I	1903 folder 2	1961
It rep. and supplying cast steel parts (raw cutlery		Substructure	west (40B-111)	Imposition	Task 11468-I	1903 folder 3	1961
It rep. of the steel superstructure of the bridge.	Cutlery	Entire bridge	west (40B-111)	Steel construction	BR 2755	1903 folder 4	1960
Supplying 3 pieces of drainage gullies.	Cutlery	Other	west (40B-111)	Other	Order form 23	1905 folder 9	1962
Assembling the steel superstructure.	Cutlery	Entire bridge	west (40B-111)	Steel construction	BR 2987	1905 folder 10	1962
The application of a bituminous coating construction Cutlery		Main bridge	west (40B-111)	Hardening	BR 3126	1905 folder 11	1963
It rep. and supply 45 light poles and 8 poles for AA cutlery		Entire bridge	both	Other	BR 6548 additional work	1906 folder 19	1975
It rep. and supply 45 light poles and 8 poles for AA cutlery		Entire bridge	both	Other	BR 6548	1906 folder 19	1975
The production, delivery and professional drafting of Specifications		Entire bridge	both	Other	BR 6559	1906 folder 21	1975
The production, delivery and professional drafting of Specifications		Entire bridge	both	Other	BR 6559a	1906 folder 21	1974
with additional work.	Cutlery	Entire bridge	both	Other	BR 6558 additional work	1906 folder 22	1975
The replacement, delivery and operational installation or installation cutlery		Entire bridge	both	Other	BR 6558	1906 folder 22	1975
Preservation of the bridge. - tender	Cutlery	Entire bridge	west (40B-111)	Steel construction	BR 1651 tender	1907 folder 33	1989
Preservation of the bridge. - cutlery	Cutlery	Entire bridge	west (40B-111)	Steel construction	BR 1651 cutlery	1907 folder 33	1989
Preservation of the bridge. - preservation product sheet Cutlery		Entire bridge	west (40B-111)	Steel construction	BR 1651 preservation product B1907 folder 33		1989
Preservation of the bridge. - agreement and state of Cutlery		Entire bridge	west (40B-111)	Steel construction	BR 1651 agreement and state 1907 map 33		1989
Make substructure	Cutlery	Substructure	both	Pillars / Abutment	BR 73	B.0292	1941
Change existing substructure (1st bridge)	Cutlery	Substructure	east (40B-100)	Pillars / Abutment	BR 2183	B.0292	1959
Change existing substructure (2nd bridge)	Cutlery	Substructure	west (40B-111)	Pillars / Abutment	BR 2536	B.0292	1960
Concrete deck (1st bridge)	Cutlery	Bridge	east (40B-100)	Concrete deck	BR 205	B.0292	1959
Concrete deck (2nd bridge)	Cutlery	Bridge	west (40B-111)	Concrete deck	BR 104	B.0292	1962
Renovate concrete and masonry	Cutlery	Substructure	both	Pillars / Abutment	BR 716	B.0292	1985
Renovation of concrete and masonry (modification)	Cutlery	Substructure	both	Pillars / Abutment	BR 716a	B.0292	1985

Appendix

Appendix D - Overview Other documents

IJssel Bridge

Drawing / document name	Type	Part	East West	Construction part	Current	Document number	RWS archive folder	Year	Institution
Design note UP14 - Eastern bridge od Ijssel REV 00	Recovery advice	Entire bridge	east (40B-100)	Other		40B-003-02 Design Note UP14	BDX-8485 Folder 27	2007	
Draft note UP14 - Eastern bridge od Ijssel REV 01	Recovery advice	Entire bridge	east (40B-100)	Other		40B-003-02 Design Note UP14	BDX-8485 Folder 27	2007	
Draft note UP14 - West bridge od Ijssel REV 01	Recovery advice	Entire bridge	west (40B-111)	Other		40B-003-03 Design Note UP14	BDX-8485 Folder 27	2007	
Design note UP14 - West bridge od Ijssel REV 00	Recovery advice	Entire bridge	west (40B-111)	Other		40B-003-03 Design Note UP14	BDX-8485 Folder 27	2007	
Design note UP14 - RW12 IJssel bridge REV 00	Recovery advice				N / A (concrete	40B-003-06 Design note UP14	BDX-8485 folder 27	2007	
Management and maintenance plan 40B-003-01 - Bridges over the	Repair Advice	Entire bridge	east (40B-100)	Other		Management and maintenance plan 40B	BDX-8454 folder 72	2008	
Management and maintenance plan 40B-003-02 - Westelijke IJssel	Recovery advice	Entire bridge	west (40B-111)	Other		Management and maintenance plan 40B	BDX-8454 folder 72	2008	
Management and maintenance plan 40B-003-03 - IJsselbrug	Recovery advice				N / A (concrete	Management and maintenance plan 40B	BDX-8454 folder 72	2008	
recovery measures report	Recovery advice	Entire bridge	both	Concrete deck		recovery measures report	Concrete construction	1991	
joint transition advisory report	Inspection report				N / A (A73)	40B-003 advisory report joint 40B-100			
blank report BC01 1995	Inspection report	Whole bridge	east (40B-100)	Other		40B-003 blank report BC01 1940B-100		1995	RWS
Inspection report BC01 1995	Inspection report	Whole bridge	east (40B-100)	Other		40B-003 Inspection Report BC01 40B-100		1995	RWS
inspection report SV01 + 02 1990	Inspection report	Whole bridge	east (40B-100)	Steel construction		40B-003 inspection report SV01 + 40B-100		1990	RWS
passport 2013-01-08	Inspection report	Whole bridge	east (40B-100)	Other		40B-003 passport 2013-01-08 40B-100		2013	RWS
blank report BC01 1995	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01 blank report BC0 40B-100		1995	RWS
Zero Inspection-2008	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01 Null Inspection-2008 40B-100		2008	Nebest
Eastern IJssel Bridge	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01 East IJssel Bridge 40B-100		2011	A-Quin
PI report 2008 Movares	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01 PI Report 2008 Mo40B-100		2008	Movares
walkway inspection report 2008	Inspection report	Whole bridge	east (40B-100)	Inspection pad consoles		40B-003-01 + 02 inspection report 40B-100		2008	Applus
inspection report SV01 + 02 1980	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01 + 02 inspection report 40B-100		1980	RWS
VI Asphalt 1997	Inspection report	Main bridge	both	Hardening		40B-003-01 + 02 VI Asphalt 1997 40B-100		1997	Aveco
VI Asphalt 1998	Inspection report	Main bridge	both	Hardening		40B-003-01 + 02 VI Asphalt 1998 40B-100		1998	Aveco
asphalt research 2001 AvB	Inspection report	Whole bridge	east (40B-100)	Hardening		40B-003-01-02 asphalt survey 40B-100		2001	Aveco
evaluation of asphalt research 2001	Inspection report	Whole bridge	east (40B-100)	Hardening		40B-003-01-02 evaluation asphalto40B-100		2001	Aveco
B_O plan Nebest 2008	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-B_O-plan Nebest 2040B-100		2008	Nebest
Research report asbestos	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-Investigation report 40B-100		2010	NOTE
TI inspection facilities 2012	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-TI inspection facility 40B-100		2012	Nebest
TI Joint Transitions 2012	Inspection report	Whole bridge	east (40B-100)	Joint transition		40B-003-01-TI joint transitions 40B-100		2012	Maurer Söhne
Asbestos inventory list management objects	Inspection report	Whole bridge	east (40B-100)	Other		Asbestos inventory list management 40B-100		2009	RWS
blank report BC02 1995	Inspection report	Whole bridge	west (40B-111)	Other		40B-003 blank report BC02 1940B-111		1995	RWS
inspection report SV01 + 02 1990	Inspection report	Whole bridge	west (40B-111)	Steel construction		40B-003 inspection report SV01 + 40B-111		1990	RWS
passport 2013-01-08	Inspection report	Whole bridge	west (40B-111)	Other		40B-003 passport 2013-01-08 40B-111		2013	RWS
walkway inspection report 2008	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-01 + 02 inspection report 40B-111		2008	Applus
inspection report SV01 + 02 1980	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-01 + 02 inspection report 40B-111		1980	RWS
VI Asphalt 1997	Inspection report	Whole bridge	west (40B-111)	Hardening		40B-003-01 + 02 VI Asphalt 1997 40B-111		1997	Aveco
VI Asphalt 1998	Inspection report	Whole bridge	west (40B-111)	Hardening		40B-003-01 + 02 VI Asphalt 1998 40B-111		1998	Aveco
asphalt research 2001 AvB	Inspection report	Whole bridge	west (40B-111)	Hardening		40B-003-01-02 asphalt survey 40B-111		2001	Aveco
evaluation of asphalt research 2001	Inspection report	Whole bridge	west (40B-111)	Hardening		40B-003-01-02 evaluation asphalto40B-111		2001	Aveco
Inspection report 1995	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02 Inspection Report 19 40B-111		1995	RWS
PI 2008 Movares	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02 PI 2008 Movares	40B-111	2008	Movares
Western IJssel Bridge	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02 West IJsselbru 40B-111		2011	A-Quin
B_O plan Nebest 2008	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-B_O-plan Nebest 2040B-111		2008	Nebest
NI 2008 Nebest	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-NI 2008 Nebest	40B-111	2008	Nebest
Research report-Asbestos	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-Investigation report 40B-111		2010	NOTE
TI inspection facilities (same as 01)	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-TI inspection provide 40B-111		2012	Nebest
Add TI (ditto 01)	Inspection report	Whole bridge	west (40B-111)	Joint transition		Add 40B-003-02-TI (ditto 40B-111		2012	Maurer Söhne
Asbestos inventory list management objects	Inspection report	Whole bridge	west (40B-111)	Other		Asbestos inventory list management 40B-111		2009	RWS
TI Joint Transitions 2012	Inspection report	Whole bridge	west (40B-111)	Joint transition		40B-003-01-TI joint transitions 40B-111		2012	Maurer Söhne
Asbestos inventory list management objects	Inspection report	Whole bridge	west (40B-111)	Other		Asbestos inventory list management 40B-111		2009	RWS
Inspection drawing set 2015 Oostbrug	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-Inspection drawing E02 Inspection report 2015			RWS
Object Risk Analysis 2016 Oostbrug.	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-Object Risk Analysis02 Inspection Report 2016			IV infrastructure
Programming inspection 2016 Oostbrug	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-Programming Ins 02 Inspection Report 2016			IV infrastructure
State inspection Inspection facilities 2012 Oostbrug	Inspection report	Whole bridge	east (40B-100)	Other		40B-003-01-Condition inspection I 02 Inspection report 2012			Nebest
Condition Inspection Joint Transitions 2012 Oostbrug	Inspection report	Whole bridge	east (40B-100)	Joint transition		40B-003-01-Condition inspection V02 Inspection report 2012			Maurer Söhne
Inspection drawing set 2015 Westbrug	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-Inspection drawing E02 Inspection report 2015			RWS
Object Risk Analysis 2016 Westbrug.	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-Object Risk Analysis02 Inspection Report 2016			IV infrastructure
Programming inspection 2016 Westbrug	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-Programming Ins 02 Inspection Report 2016			IV infrastructure
State inspection Inspection facilities 2012 Westbrug	Inspection report	Whole bridge	west (40B-111)	Other		40B-003-02-Condition inspection I 02 Inspection report 2012			Nebest
Condition inspection of joint transitions in 2012 Westbrug	Inspection report	Whole bridge	west (40B-111)	Joint transition		40B-003-02-Condition inspection V02 Inspection report 2012			Maurer Söhne
GTI Laying on the IJssel Bridge 2017	Inspection report	Whole bridge	both	Imposition		GTI Impositions IJsselbrug 201702 Inspection report 2017			DMV consulting
Inspection report Fatigue details	Inspection report	Whole bridge	both	Steel construction		Inspection report Fatigue02 Inspection report 2017			InfraInspection
Inspections Fatigue details IJssel bridge April-June 2017	Inspection report	Whole bridge	both	Steel construction		Inspections Fatigue Details IJ 02 Inspection Report 2017			InfraInspection
Inspections Fatigue details IJssel bridge November-December	Inspection report	Whole bridge	both	Steel construction		Inspections Fatigue Details IJ 02 Inspection Report 2017			InfraInspection
Memo - Follow-up process Assurance of Structural Safety IJ	Research	entire bridge	both	Steel construction		Memo - Follow-up procedure CTNO assurance		2017	RWS
Memo Detail category	Whole bridge		both	Steel construction		0100313038-A / VSS	TNO	2018	TNO
TNO report 2017 R11499 Various fatigue recommendations			both	Steel construction		TNO report 2017 R11499 DiveTNO		2017	TNO
TNO report fatigue rivet joints and orhto	Research report	Whole bridge	both	Steel construction		TNO report fatigue rivetNO		2017	TNO
Inspections Fatigue details IJssel bridge November-Decem	Inspection report	Whole bridge	both	Steel construction		2017_070_RWS_Rep1_Rev 0	InfraInspection	2017	InfraInspection

Appendix

Appendix E - Continuing taxes

IJssel Bridge

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Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Permanent loads (G) - 1 to 9

Tax case **1: Own weight of steel**

The own weight of the steel construction is generated by Scia itself based on the specific weight entered. Below are the specific types held called weights:

Density of steel $\gamma_{st} =$ 78.5 kN / m^3 ***BG 1***

For the main span, a distinction is made between two construction phases, BG1a corresponds to the dead weight of part 0-14 and part 20-34, BG1b corresponds to the dead weight of part 14-20

Surcharge percentages

In the SCIA models, a surcharge on the own weight has been made per part for additional parts and connecting means, in connection with the import of net cross-sections in Scia Engineer. These supplement percentages are shown in Appendix M.

Tax case **2 and 5: Own weight of concrete**

A distinction is made in the calculation between prestressed concrete and reinforced concrete. In BG2, only the weight of the prestressed concrete charged. In BG5, the weight of the reinforced concrete deck is taken into account. The following volume is taken into account weight:

prestressed concrete	γ_b =	25.0 kN / m 3	***BG 2***
Density wt. concrete	γ_b =	25.0 kN / m 3	***BG 5***

The load is translated to line loads on the main beams, console and cross beams based on a load transfer envelope at 45 °. The load from the rib is transferred directly to the main beam.

Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **3 and 10: Preload and preload loss**

In the bridges, from 6 m up to 6 m after each intermediate support, prestress is applied in the longitudinal direction of the bridge. In the deck, per intermediate support point, are 44 Dywidag rods Ø26 mm applied [A.27268], [C.9366], [BR 205], [BR 104].

Tension bar diameter	$Ø_p$	=	26 mm
Surface pretension	A_p	=	531 mm² / cable
Number of bars	n_p	=	44 cables

Initial preload	$\sigma_{pm,0}$ =	622 N / mm²	
Initial prestressing force	$F_{pm,0}$ =	330 kN / cable	
Work preload	$\sigma_{pm,\infty}$ =	565 N / mm²	
Preload force	$F_{pm,\infty}$ =	300 kN / cable	

To enter the prestressing force in the model, the prestressing force is split into two construction phases, to take into account the construction phasing. BG3 becomes entered in a separate model, because at the time of prestressing the concrete deck + top flange are not yet connected to the rest of the construction.

1. Initial prestressing force at t = 0 after curing concrete (BG3)
2. Prestressing loss at t = ∞ (BG 8)

The prestressing force is entered as a line load across the width of the deck and a moment relative to the system line (top of main beam)

Deck width	b_{deck} =	9.44 m	
Eccentricity rib 300 mm	$e_{p,a}$ =	100 mm	
Eccentricity deck 200 mm	$e_{p,b}$ =	0 mm	
Preload	$\mathbf{q_p}$ =	**1538 kN / m**	***BG 3***
Moment at rib 300 mm	$\mathbf{m_{p,a}}$ =	**154 kNm / m**	***BG 3***
Moment at deck 200 mm	$\mathbf{m_{p,b}}$ =	**0 kNm / m**	***BG 3***
Prestressing loss	$\mathbf{q_p}$ =	**-154 kN / m**	***BG 10***
Moment at rib 300 mm	$\mathbf{m_{p,a}}$ =	**-15 kNm / m**	***BG 10***
Moment at deck 200 mm	$\mathbf{m_{p,b}}$ =	**0 kNm / m**	***BG 10***

Tax case **4: Bridge jacks**

After adding the slabs for the precast concrete deck, the bridges are jacked at the intermediate support points. For this purpose it is used SCIA applied an imposed deformation of the 4 bearings of the intermediate supports of 400 mm in z-direction according to drawing [A.23791] and calculation [BBV-0010-00].

Imposed deformation Zu_z = 400 mm ***BG 4***

Tax case **6: Bridge indentations**

After adding the slab elements for the reinforced concrete deck, the bridges are released again at the intermediate support points. To this end in SCIA an imposed deformation of the 4 bearings of the intermediate supports is applied of -400 mm in the z-direction.

Imposed deformation Zu_z = -400 mm ***BG 6***

Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **7: Asphalt pavement**

Based on the archive information, the asphalt thickness of the various bridges is as far as possible obsolete, both in accordance with the design and the current thickness.

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.

The asphalt thickness has been checked on the basis of measurements between the top of the cut edge and the top of the pavement. This resulted in a slightly thicker asphalt package. Becomes calculated with the average thickness per bridge.

Density of asphalt	$\gamma_{asphalt}$ =	23.0	kN / m 3	
1st side span	$d_{asphalt}$ =	102.5	mm	(based on measurements)
2nd side span	$d_{asphalt}$ =	85.0	mm	(based on measurements)
Main span	$d_{asphalt}$ =	82.0	mm	(based on measurements)

Loads due to asphalt pavement		[mm]		[kN / m 3]			
Side spans	**p a. side $_{span, 1}$ =**	$d_{asphalt}$	*	$\gamma_{asphalt}$	=	**2.36 kN / m 2**	***BG7***
Side spans	**p a. side $_{span, 2}$ =**	$d_{asphalt}$	*	$\gamma_{asphalt}$	=	**1.96 kN / m 2**	***BG7***
Main span	**p a. main $_{span}$ =**	$d_{asphalt}$	*	$\gamma_{asphalt}$	=	**1,89 kN / m 2**	***BG7***

Initially, the side spans with the high load will be taken into account. If it appears that the bridge does not meet the strength, a distinction will be made between the 2 side spans.

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Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **8: Other permanent taxes**

There are various permanent loads on the bridge. A distinction is made between the permanent loads on the flank side, the inspection path next to the bridge and the inspection path o / d bridge.

Ramp edge (BG8a)

For the main span, the asphalt load is extended to the edge of the steel deck. There is no grazing edge, only a guardrail.

For the side span, the flank side is split into a UDL load on the deck and a line load due to the edge element.

$q_{guardrail}$

$q_{guardrail}$

p_{edge}

$p_{scratch\ side}$

Edge

(h = 500 mm)

Main span *Side span*

Height of the cut edge	$d_{scratching\ side}$ =	235	mm	(based on [A.23315-I, average height)
Concrete deck edge height	d_{edge} =	500	mm	(based on [A.23315-I])
Concrete deck edge width	b_{edge} =	150	mm	(based on [A.23315-I])
Guardrail weight	$F_{guardrail}$ =	1258	kN	(based on [Renovation States 1906 folder 22A]
Total length of guardrail	$l_{guardrail}$ =	2160	m	

Taxes Schampkant

Schampkant concrete deck	$\mathbf{p_{scratch\ side}} = d_{scratch\ side}$	*	$\gamma_{concrete}$	=	**5.88 kN / m 2**	***BG8a***
Edge concrete deck	$\mathbf{p_{edge}} = d_{edge}$	*	$\gamma_{concrete}$	=	**12.50 kN / m 2**	
Guardrail	$\mathbf{q_{guardrail}}$ = $F_{guardrail}$	/	$l_{guardrail}$	=	**0.60 kN / m**	***BG8a***

The load on the edge has been translated into a line load and a moment on the edge of the (structural) concrete deck

Line load edge concrete deck	$\mathbf{q_{edge}} = p_{edge}$	*	0.15	m =	**1.88 kN / m**	***BG8a***
Line moment edge concrete deck	$\mathbf{m_{edge}} = q_{edge}$	*	0.075	m =	**0.14 kNm / m**	***BG8a***

Inspection path next to the bridge deck (BG8b)

The consoles are loaded by the handrail, the grid floor and the cable tray. The loads are determined based on the specifications and are entered as point or line load in the calculation by multiplying the load by the center-to-center distance of the console.

$q_{handrail}$

$p_{inspection\ pa}$

705 mm

$F_{cable\ tray}$

$q_{handrail}$

$p_{inspection\ path}$

470 mm

$F_{cable\ tray}$

Main span *Side span*

Handrail weight	$F_{handrail}$ =	243	kN	(based on [Renovation States 1906 folder 22A]
Inspection path weight	$F_{inspection\ path}$ =	479	kN	(based on [Renovation States 1906 folder 22A]
Length inspection path br	$l_{inspection\ path}$ =	960	m	(4 pieces)
Width inspection path br	$b_{inspection\ path}$ =	0.60	m	
Length inspection path hfdbr	$l_{inspection\ path}$	1200	m	(4 pieces)
Inspection path width hdbr	$b_{inspection\ path}$	0.84	m	
Surface inspection path	$A_{inspection\ path}$ =	1580	m²	
Console	$q_{console}$ =	0.11	kN / m l	(based on drawing A.50928-C, IPE120 profile)
Length console bracket	$l_{console}$ =	0.60	m	(based on drawing A.50928-C)
Length console bridge	$l_{console}$ =	0.86	m	(based on drawing A.50928-C)
Cable tray lighting	$q_{cable\ tray}$ =	0.75	kN / m l	(estimate based on drawing [A.50928-C]

Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **8: Other permanent taxes**

Loads Inspection path (normal console)

Handrail	$q_{handrail}$ =	$F_{handrail}$	/	$l_{inspection\ path}$ =	0.30 kN / m l
Inspection path	$p_{inspection\ path}$ =	$F_{inspection\ path}$	/	$A_{inspection\ path}$ =	0.40 kN / m²
Console	$q_{console}$ =				0.11 kN / m l
Cable tray lighting	$q_{cable\ tray}$ =				0.75 kN / m l

Loads Inspection pad (normal console) on bridges

The load is translated into a point load on the edge of the (structural) concrete deck, based on the center-to-center distance of the consoles

Heart to heart hoh 2000 mm (based on drawing [A.50937]

Handrail	$F_{handrail}$ =	$q_{handrail}$	*	2.00	m =	0.60 kN	
Inspection path	$F_{inspection\ path}$ =	$p_{inspection\ path}$	*	2.00	m * $b_{inspection\ path}$ =	0.48 kN	
Console	$F_{console}$ =	$q_{console}$	*	0.60	m =	0.07 kN	
Cable tray lighting	$F_{cable\ tray}$ =	$q_{cable\ tray}$	*	2.00	m =	1.50 kN +	
						2.65 kN	***BG8b***

In addition to a point load, a moment also occurs through the arm relative to the edge of the structural deck

Armrest to deck edge	$a_{handrail}$ =	841	mm
Arm inspection path	$a_{inspection\ path}$ =	462	mm
Arm console	$a_{console}$ =	450	mm
Arm cable tray	$a_{cable\ tray}$ =	620	mm

Handrail	$M_{handrail}$ =	$F_{handrail}$	*	0.84	m =	0.50 kNm	
Inspection path	$M_{inspection\ path}$ =	$F_{inspection\ path}$	*	0.46	m =	0.22 kNm	
Console	$M_{console}$ =	$F_{console}$	*	0.45	m =	0.03 kNm	
Cable tray lighting	$M_{cable\ tray}$ =	$F_{cable\ tray}$	*	0.62	m =	0.93 kNm +	
						1.69 kNm	***BG8b***

Loads Inspection pad (normal console) on main span

The load is translated into a point load on the edge of the (structural) concrete deck, based on the center-to-center distance of the consoles

Heart to heart hoh 1800 mm (based on drawing [A.50937]

Handrail	$F_{handrail}$ =	$q_{handrail}$	*	1.80	m =	0.54 kN	
Inspection path	$F_{inspection\ path}$ =	$p_{inspection\ path}$	*	1.80	m * $b_{inspection\ path}$ =	0.60 kN	
Console	$F_{console}$ =	$q_{console}$	*	0.86	m =	0.09 kN	
Cable tray lighting	$F_{cable\ tray}$ =	$q_{cable\ tray}$	*	1.80	m =	1.35 kN +	
						2.59 kN	***BG8b***

In addition to a point load, a moment also occurs through the arm relative to the edge of the steel deck

Armrest to deck edge	$a_{handrail}$ =	926	mm					
Arm inspection path	$a_{inspection\ path}$ =	429	mm					
Arm console	$a_{console}$ =	432	mm					
Arm cable tray	$a_{cable\ tray}$ =	705	mm					
Handrail	$M_{handrail}$ =	$F_{handrail}$	*	0.93	m =	0.50 kNm	
Inspection path	$M_{inspection\ path}$ =	$F_{inspection\ path}$	*	0.43	m =	0.26 kNm	
Console	$M_{console}$ =	$F_{console}$	*	0.43	m =	0.04 kNm	
Cable tray lighting	$M_{cable\ tray}$ =	$F_{cable\ tray}$	*	0.71	m =	0.95 kNm +	
						1.75 kNm	***BG8b***

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Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **8: Other permanent taxes**

Reinforced console with lighting (BG8c)

At the location of the light poles mounted in a "reinforced" console which is longer than the other consoles. There is a light pole on this extension. There is also a heavier console applied. The other taxes are equal to the normal consoles.

$q_{handrail}$
$F_{lighting}$
$p_{inspection\ path}$
705 mm
$F_{cable\ tray}$

Main span

$q_{handrail}$
$F_{lighting}$
$p_{inspection\ path}$
470 mm
$F_{cable\ tray}$

Side span

Lighting weight	$F_{lighting}$ =	3	kN	(based on calculation [BBV-0010-00])
Console	$q_{console}$ =	1.00	kN / m	(based on [A.50939] tube 260 * 260 * 11)
Length console bracket	$l_{console}$ =	1104	mm	(based on [A.50939])
Length console bridge	$l_{console}$ =	1359	mm	(based on [A.50939])

Loads Inspection pad (reinforced console) on bridges

Handrail	$F_{handrail}$ =				0.60 kN
Inspection path	$F_{inspection\ path}$ =				0.48 kN
Console	$F_{console}$ =	$q_{console}$	*	1.104 m =	1.10 kN
Cable tray lighting	$F_{cable\ tray}$ =				1.50 kN
Lighting	$\mathbf{F_{lighting}}$ =				3.00 kN +

					6.68 kN	***BG8c***

In addition to a point load, a moment also occurs through the arm relative to the edge of the structural deck

Arm lighting	$a_{lighting}$ =	1029	mm	(based on [A.50939])
Arm console	$a_{console}$ =	702	mm	(based on [A.50939])

Handrail	$M_{handrail}$ =	$F_{handrail}$	*	0.84 m =	0.50 kNm	
Inspection path	$M_{inspection\ path}$ =	$F_{inspection\ path}$	*	0.46 m =	0.22 kNm	
Console	$M_{console}$ =	$F_{console}$	*	0.70 m =	0.78 kNm	
Cable tray lighting	$M_{cable\ tray}$ =	$F_{cable\ tray}$	*	0.62 m =	0.93 kNm	
	$M_{lighting}$ =	$F_{lighting}$	*	1.029 m =	3.09 kNm +	
					5.52 kNm	***BG8c***

Loads Inspection pad (reinforced console) on main bridge

Handrail	$F_{handrail}$ =				0.54 kN	
Inspection path	$F_{inspection\ path}$ =				0.60 kN	
Console	$F_{console}$ =	$q_{console}$	*	1.359 m =	1.36 kN	
Cable tray lighting	$F_{cable\ tray}$ =				1.35 kN	
Lighting	$\mathbf{F_{lighting}}$ **=**				3.00 kN +	
					6.85 kN	***BG8c***

In addition to a point load, a moment also occurs through the arm relative to the edge of the steel deck

Arm lighting	$a_{lighting}$ =	1114	mm	(based on [A.50939])
Arm console	$a_{console}$ =	680	mm	(based on [A.50939])

Handrail	$M_{handrail}$ =	$F_{handrail}$	*	0.93 m =	0.50 kNm	
Inspection path	$M_{inspection\ path}$ =	$F_{inspection\ path}$	*	0.43 m =	0.26 kNm	
Console	$M_{console}$ =	$F_{console}$	*	0.68 m =	0.92 kNm	
Cable tray lighting	$M_{cable\ tray}$ =	$F_{cable\ tray}$	*	0.71 m =	0.95 kNm	
	$M_{lighting}$ =	$F_{lighting}$	*	1.114 m =	3.34 kNm +	
					5.98 kNm	***BG8c***

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Tax cases

Project:	Recalculation IJssel Bridge A12	Date:	5/25/2018
Project number:	BF7387	Name:	EKL
Description:	Permanent taxes	Version:	F1.0

Tax case **8: Other permanent taxes**

Inspection path under the bridge (BG8d)

The inspection path under the bridge is taken into account as 2 point loads on the cross beams, center to center 700 mm, symmetrical with respect to the center of the crossbars.

700 mm

$F_{inspection\ path}$ $F_{inspection\ path}$

Inspection path

	Number	Length	Width	Weight	Total
Cross beam (L50 * 6)	0.50 x	0.88 mx		0.04469 kN / m 1 =	0.02 kN
Pendants (L50 * 6)	1.00 x	1.407 mx		0.04469 kN / m 1 =	0.06 kN
Bottom rail (L50 * 6)	1 x	1.8 mx		0.04469 kN / m 1 =	0.08 kN
Handrail (L50 * 6)	1 x	1.8 mx		0.04469 kN / m 1 =	0.08 kN
Grate (25 mm)	0.5 x	1.8 mx	0.75 mx	0.40 kN / m² =	0.27 kN
Surcharge for confirmations				10%	0.05 kN +
				$F_{\text{inspection path}}$ =	**0.60 kN (BG8d)**

Source: Drawing [A.85343], [A.85401]

Hot water pipe (BG8e)

The NUON hot water pipes (two pieces) are only present under the western bridge, under the main bridge (1st to 4th spans). The tax case is therefore introduced as a separate tax case, so that if necessary, a distinction can be made for the eastern and western bridges.

Leadership

Outer diameter	$Ø_{\text{outside}}$ =	450 mm
Wall thickness	t_{outside} =	7.11 mm
Specific weight	ρ_{sample} =	7850 kg / m 3
Inner diameter	$Ø_{\text{inside}}$ =	300 mm
Wall thickness	t_{inside} =	10 mm
Specific weight PE	ρ_{PE} =	1000 kg / m 3
Specific weight PE	ρ_{PUR} =	60 kg / m 3

680 1220 680

$F_{\text{ww, dw}}$ $F_{\text{ww, dw}}$ $F_{\text{ww, dw}}$ $F_{\text{ww, dw}}$

Point loads due to weight of hot water pipe and suspension frame

Frame

Tube 100x100x8	q_{profile} =	0.21 kN / m	
Length A	L =	1670 mm	2 pieces
Length B	L =	580 mm	2 pieces
Length C.	L =	1800 mm	2 pieces
Shaft around 35 mm	q_{profile} =	0.08 kN / m	
Length	L =	580 mm	1 piece
Surcharge for connections		20%	

NUON hot water pipe	$q_{\text{WW leadership}}$ =	0.50 kN / m 1
Frame	F_{frame} =	2.1 kN

Heart to heart size frame hoh = 10.71 m

Total force per suspension frame F_{ww} = $q_{\text{WW management}}$ * 10.71 m + F_{frame} = 7.4 kN

Force on cross beam **$F_{\text{ww, dw}}$ =** F_{ww} / 4 = **1.86 kN** ***BG8e***

Creep and shrinkage according to Eurocode 2

Project:	IJssel Bridge	Date:	5/25/2018
Project number:	BF7387	Name:	Ernst Klamer
Description:	Shrinkage load	Version:	v0.5 Beta

Tax case 9 : Shrinkage load

Shrinkage

The shrinkgage strain is determined in correspondence with NEN-EN1992-1-1 art. 3.1.4 (6)

$\varepsilon_{\text{cs}} = \varepsilon_{\text{cd}} + \varepsilon_{\text{approx}}$ formula 3.8

ε_{cd}	=	drying shrinkage		
ε_{approx}	=	autogenous shrinkage		

Drying shrinkage

$\varepsilon_{cd,\infty}$	=	$k_h\ \varepsilon_{cd,0}$	shrinkage at $t = \infty$	
$\varepsilon_{cd}(t)$	=	$\beta_{ds}(t, t_s) * k_h * \varepsilon_{cd,0}$	shrinkage at $t = t$	formula 3.9

Environment:		Out	
Relative humidity:		80 %	
Concrete class:		C32 / 40	
Type of cement		CEM 32.5 N	(Portland is rapid and blast furness is normal)
Cement class		S	
α_{ds1}	=	3	
α_{ds2}	=	0.13	
f_{cm}	=	40 N / mm²	
f_{cmo}	=	10 N / mm²	
RH	=	80%	
RH_0	=	100%	
β_{RH}	=	0.756	

$\varepsilon_{cd,0}$	=	0.21 ‰			
h	=	200 mm			
w	=	1000 mm			
you	=	2000 mm			
h_0	=	200 mm			
k_h	=	0.85			
$\varepsilon_{cd,\infty}$	=	0.85	X	0.21 ‰ =	0.18 ‰

t	=	36500 days		
t_s	=	1 days	(age at the beginning of the drying shrinkage)	
$\beta_{ds}(t, t_s)$	=	0.997		formula 3.10
$\varepsilon_{cd}(t)$	=	0.178 ‰		formula 3.8