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PROJEKAT I GRADNJA ŽELEZNIČKO-DRUMSKOG MOSTA U NOVOM SADU

DESIGN AND CONSTRUCTION OF THE RAILWAY ROAD BRIDGE IN NOVI SAD

JV **Azvi** S.A., **Taddei** S.p.A., **Horta Coslada** S.L.
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www.deling.rs

Železničko-drumski most u Novom Sadu

Railway Road Bridge in Novi Sad

Sadržaj

Content

Basically about the Bridge and Design
Osnovno o mostu i projektu

Projektni zadatak / Terms of Reference

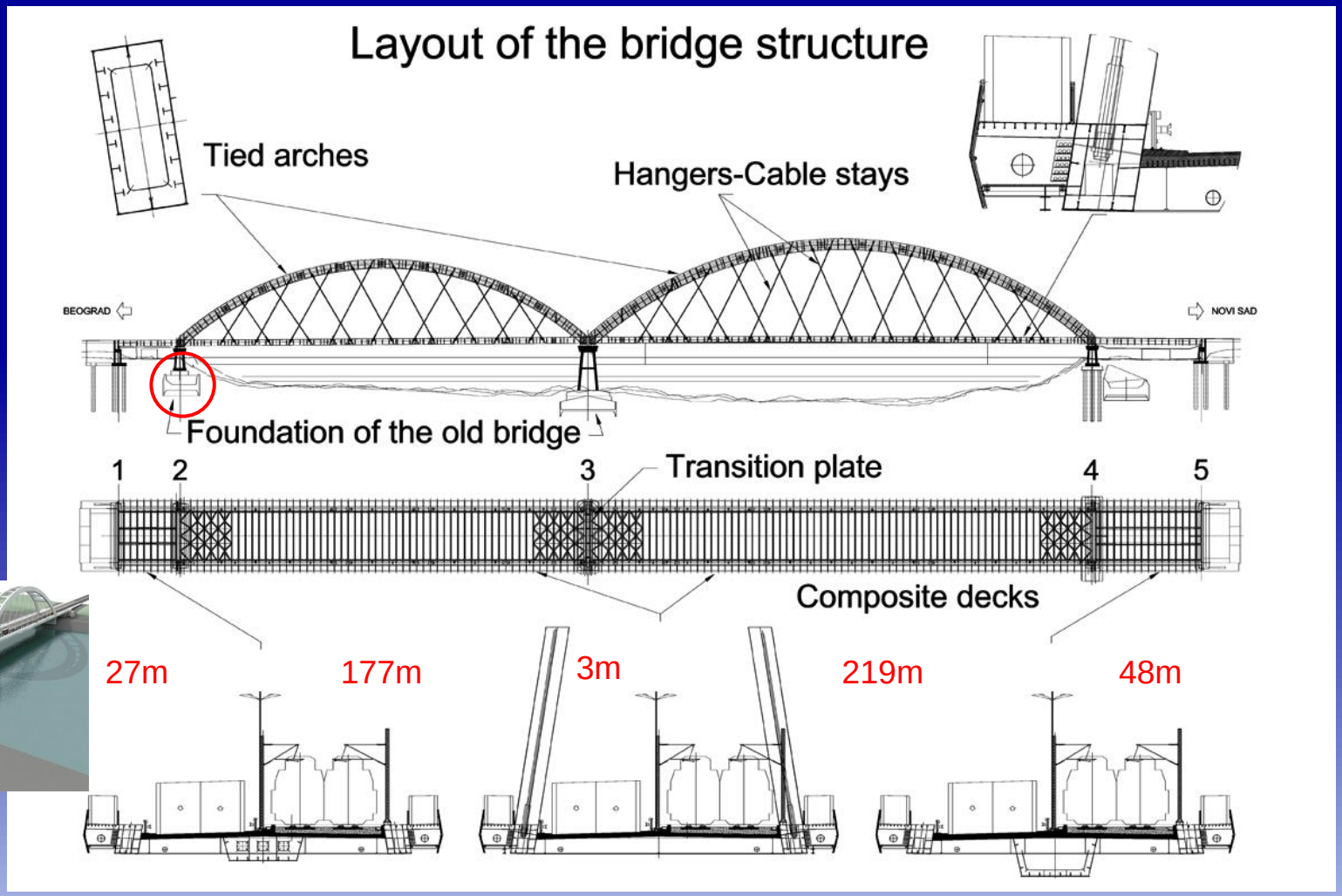
Zahtev	*Sadržaj*
Lokacija Fundiranje	Starog mosta Starog mosta, koliko je moguće
Saobraćaj na mostu	2 koloseka + 2 trake + 2 staze
Brzine vozova	Teretni / Putnicki = 120/160 km/h
Vertikalno ubrzanje	max 1,3 m/s^2
Dinamički proračun	Vozovi Tipa 2 i 5
Instalacije i oprema	Prema korisnicima
Norme za projekt.	Ril 804:2003 DIN-Fb 101do 104:2009 EN 1990 do 1994, 1998
Koštanje: Zahtev Delegacije Evropske komisije za Srbiju	**max 60 mil. EUR** Most + Demontaža Privr. mosta + Monitoring

Request	*Content*
Location Foundation	Old bridge location Of the old bridge as possible
Traffic on bridge	2 tracks + 2 lanes + 2 paths
Train velocities	Freight / Passenger = 120/160 km/h
Vertical accelerations	max 1,3 m/s^2
Dynamic analysis	Trains Type 2 and 5
Accessories	Acc. to beneficiaries
Design norms Execution norms	Ril 804:2003 DIN-Fb 101to 104:2009 EN 1990 to 1994, 1998
Costs Request European Delegation for Serbia	**max 60 Mio. EUR** Bridge + Dismantling of Temporary bridge + Monitoring

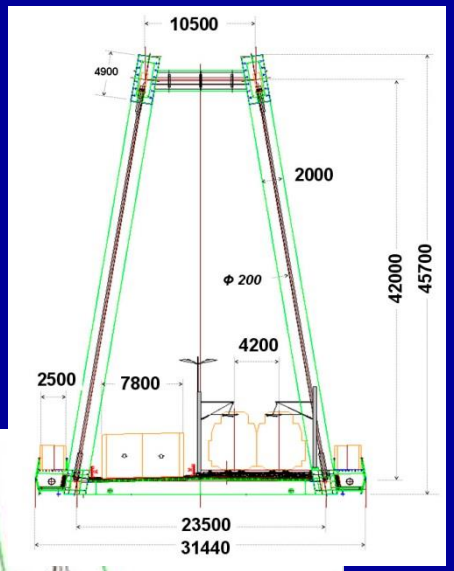
Urbanistički uslov: Lučni, čelični most

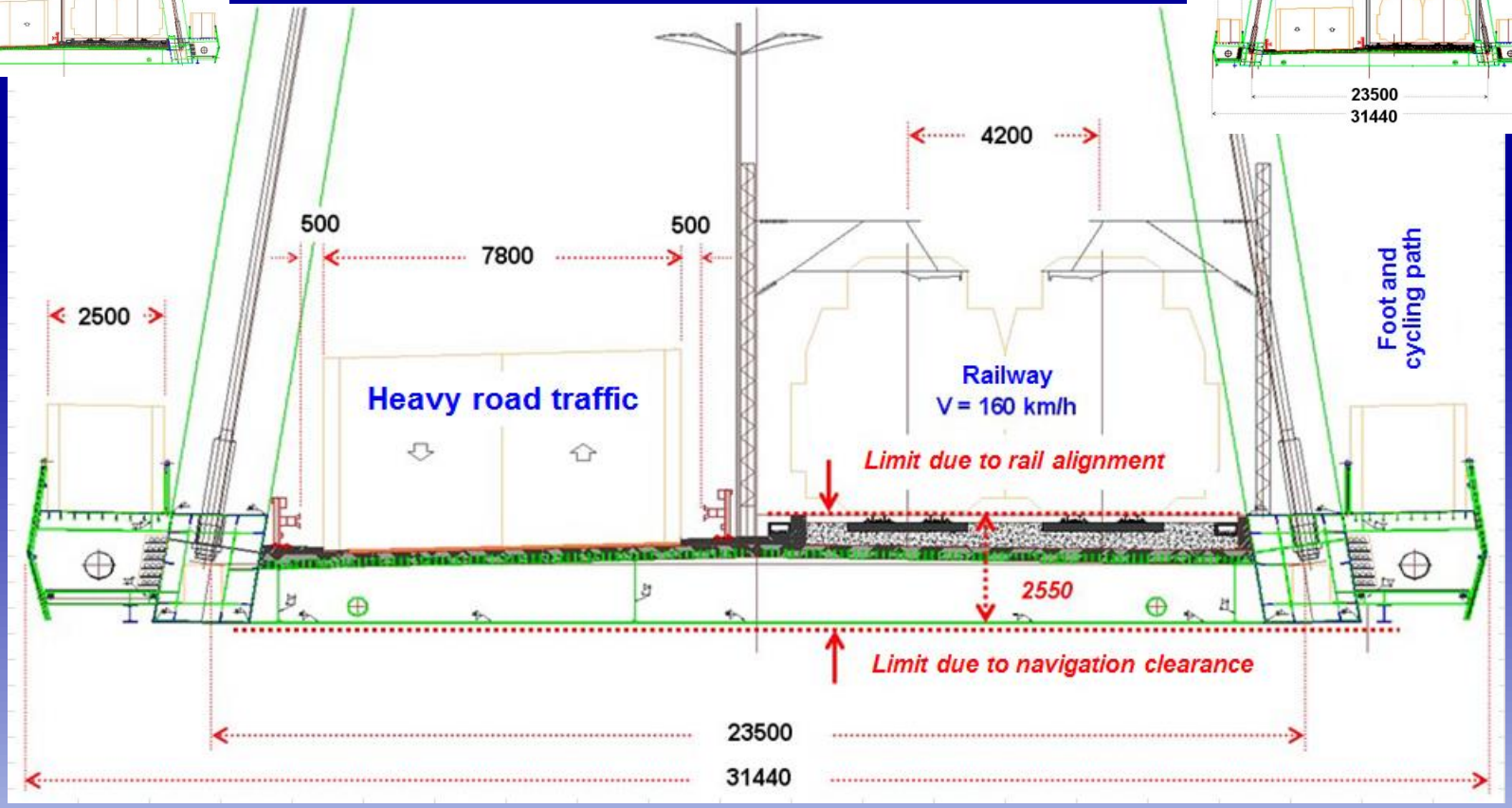
Urban planning condition: Arch steel bridge

Steel: S355
Hangers: Parallel strands $f_{u,k}$ = 1860 N/mm^2
Concrete: C35/45
Reinforcement: B500C



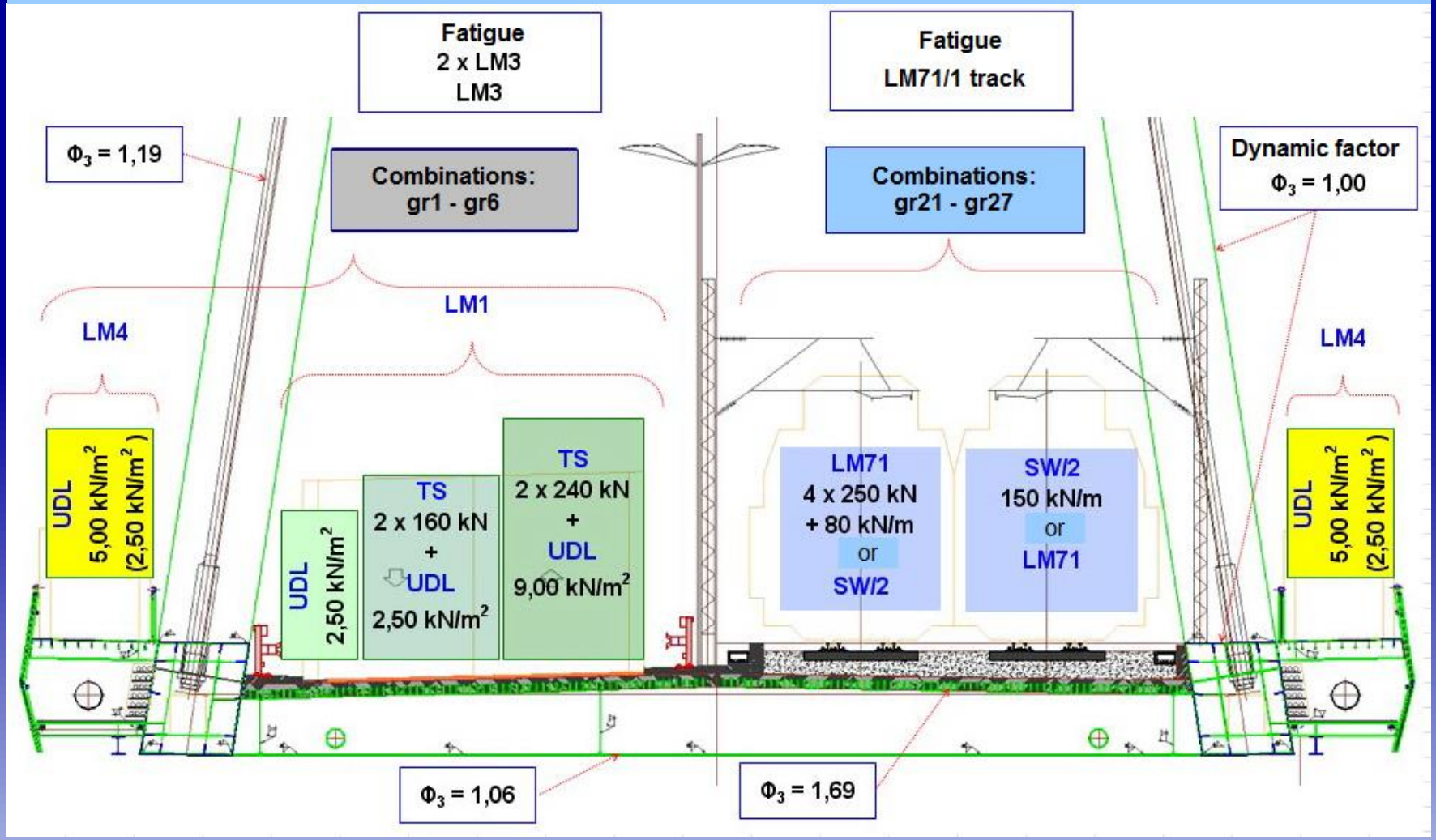
Kolovoz / Deck

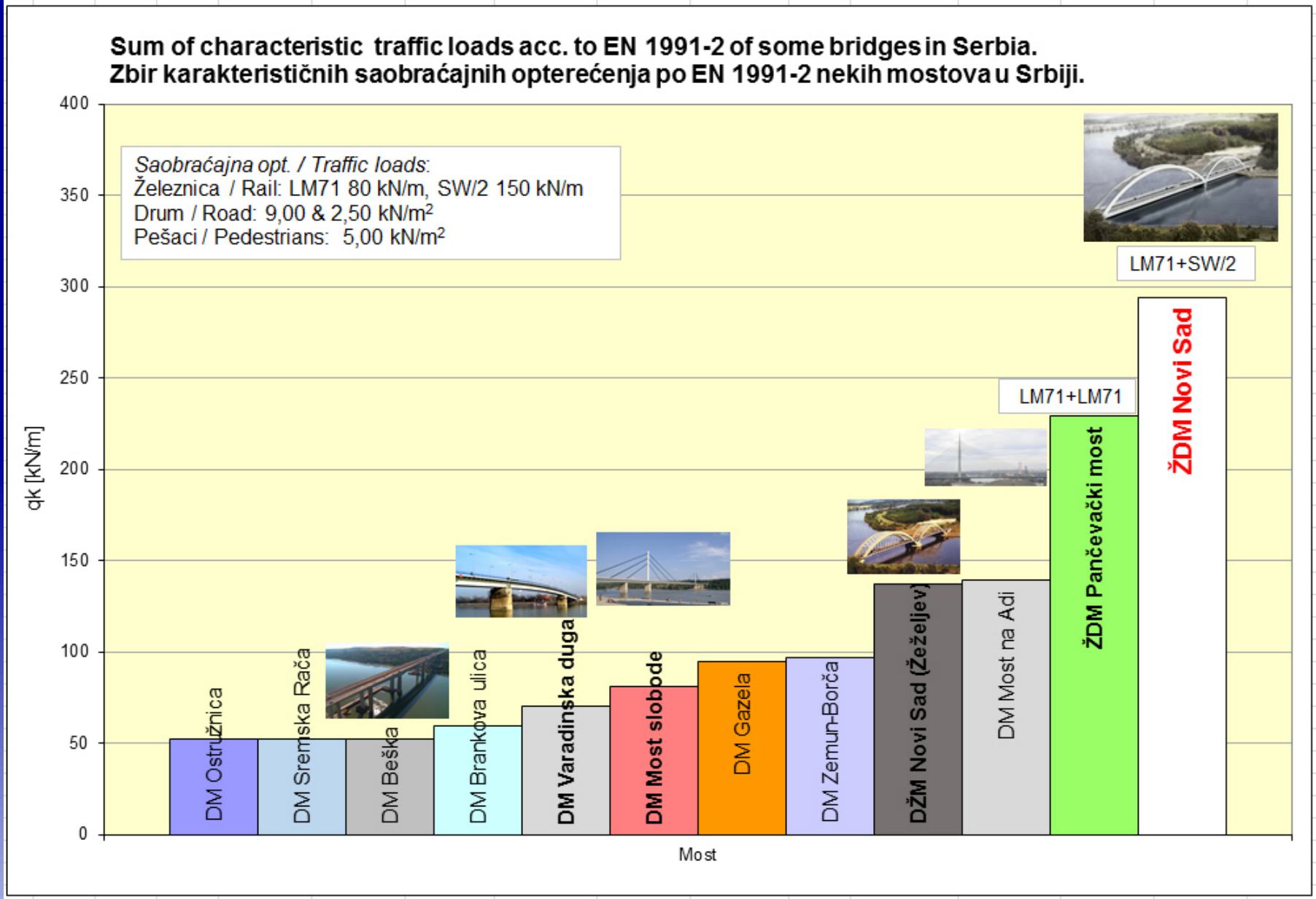




Stalan teret / Permanent load: $G_{2,k}$ = 223 kN/m

Saobraćajna opterećenja / Traffic loads



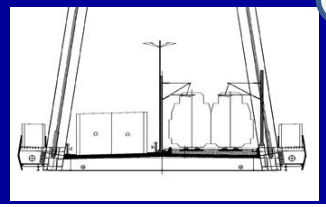

Sum of characteristic traffic loads acc. to EN 1991-2 of some bridges in Serbia.
Zbir karakterističnih saobraćajnih opterećenja po EN 1991-2 nekih mostova u Srbiji.
Saobraćajna opt. / Traffic loads:
Železnica / Rail: LM71 80 kN/m, SW/2 150 kN/m
Drum / Road: 9,00 & 2,50 kN/m²
Pešaci / Pedestrians: 5,00 kN/m²
qk [kN/m]
400
350
300
250
200
150
100
50
0
LM71+SW/2
LM71+LM71
DM Ostružnica
DM Sremska Rača
DM Beška
DM Brankova ulica
DM Varadinska duga
DM Most slobode
DM Gazela
DM Zemun-Borča
DŽM Novi Sad (Žeželjev)
DM Most na Adi
ŽDM Pančevački most
ŽDM Novi Sad
Most

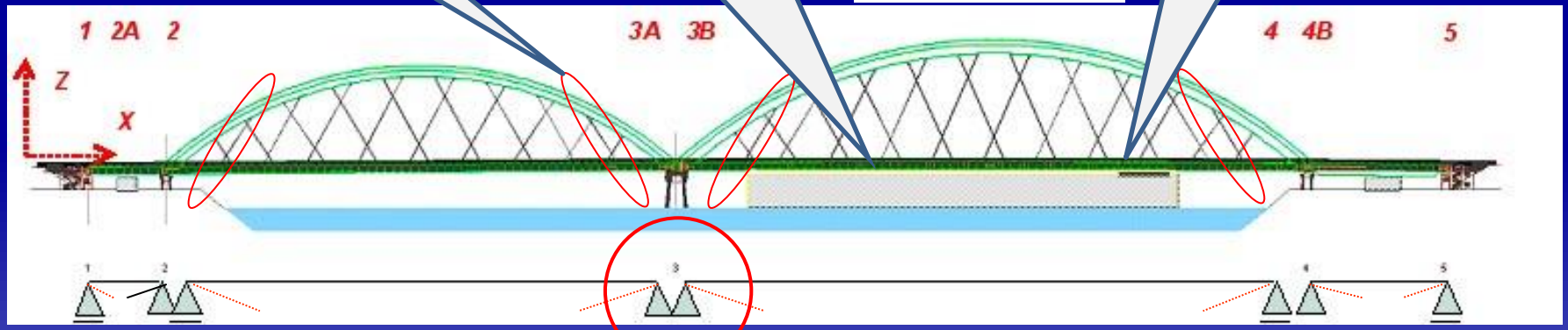
Najkritičniji uslovi projektovanja / Most critical requirements for designing

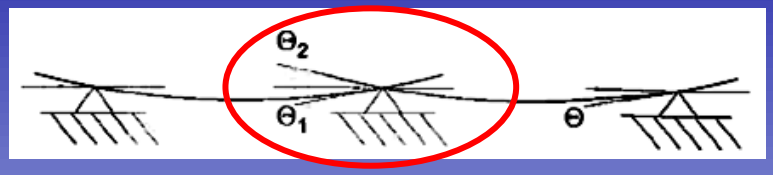
Most critical hangers
Najkritičnije vešaljke:
min N(G+extrQ) > 0

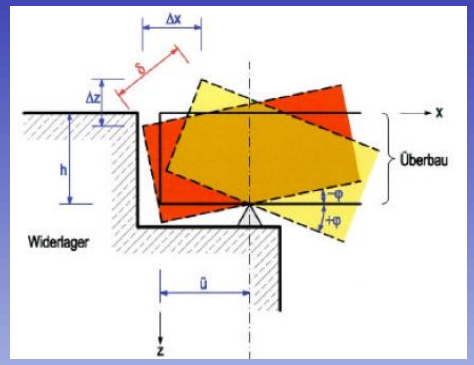
Vertical deck accelerations
Vertikalna ubrzanja:
$a_V \leq 1{,}3\ m/s^2$

Deck slab crack width
Širina prslina kol. ploče:
$w_k \leq 0{,}3$ mm









Ril 804:2003

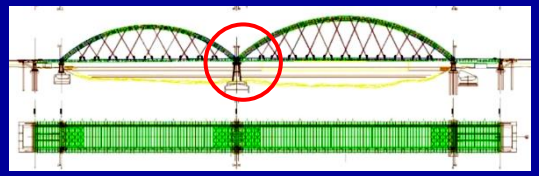
DIN-Fb 101:2009

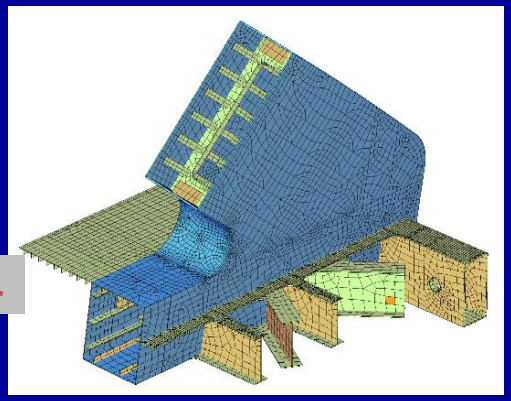
$\theta_1 + \theta_2$ **(LM71/1 track+ΔT_M) ≤ 5 mrad**

takođe i / and also

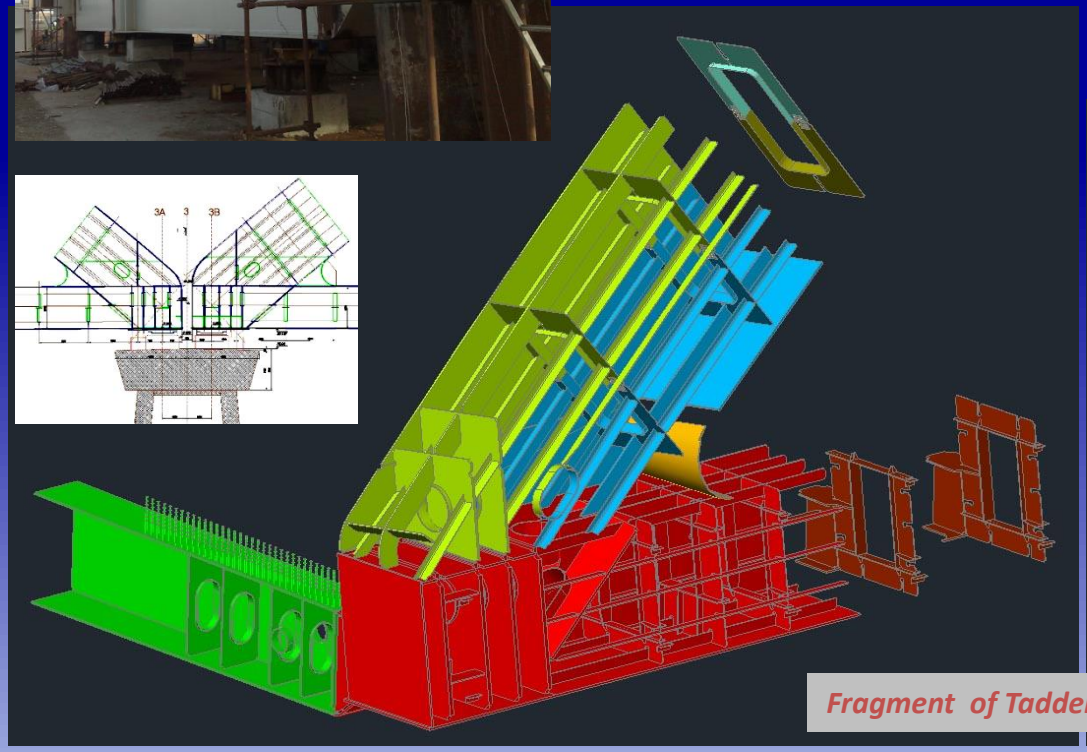
u osi / in axis 3: $\delta = \delta_1 + \delta_2 \leq 9$ **mm**

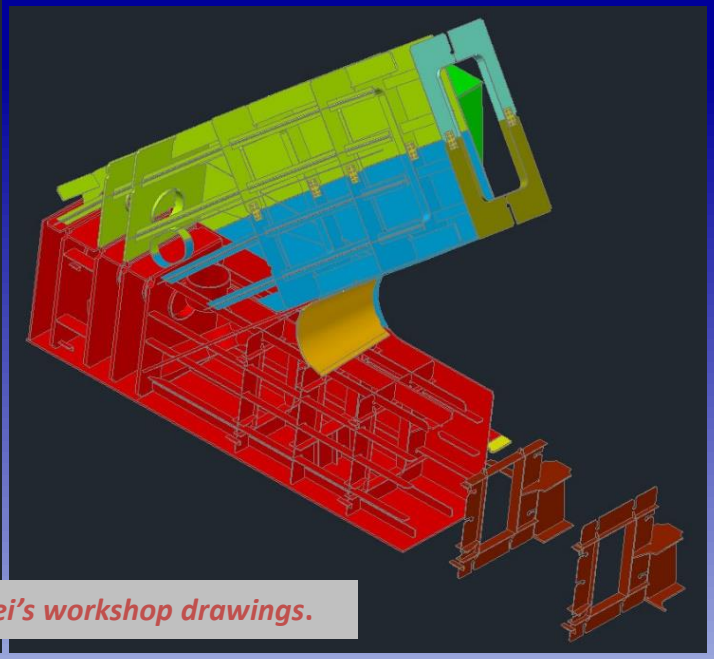
Detalji čelične konstrukcije / Details of the steel structure
Čvor luk / zatega / krajnji poprečni nosač
Node Arch / Tie / End cross beam





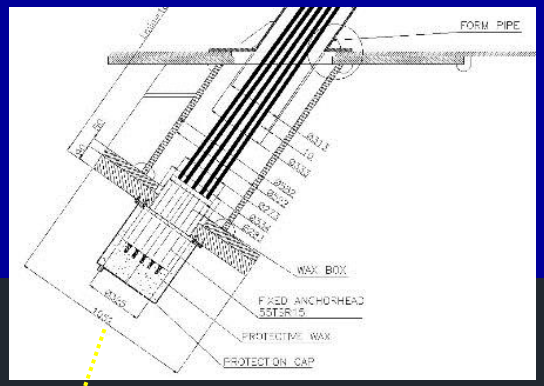
Fragment of structural model.

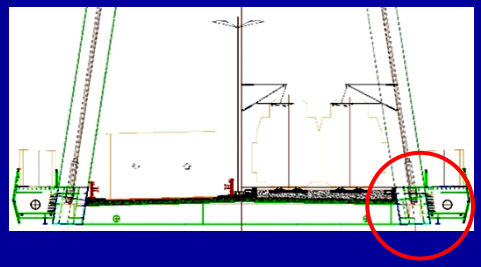


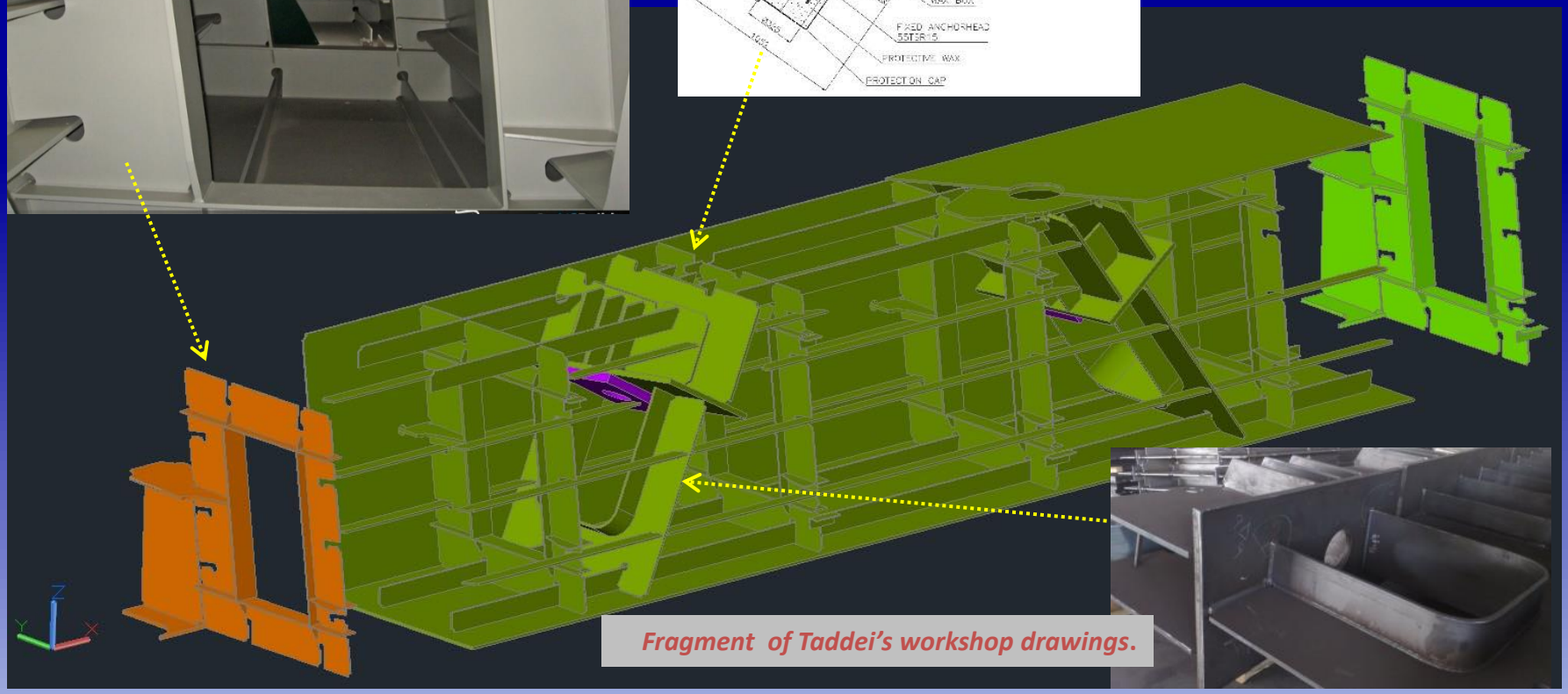


Fragment of Taddei's workshop drawings.

Detalji čelične konstrukcije / Details of the steel structure
Zatega sa ankernim konstrukcijama kablova vešaljki.
Tie with hangers anchorages.

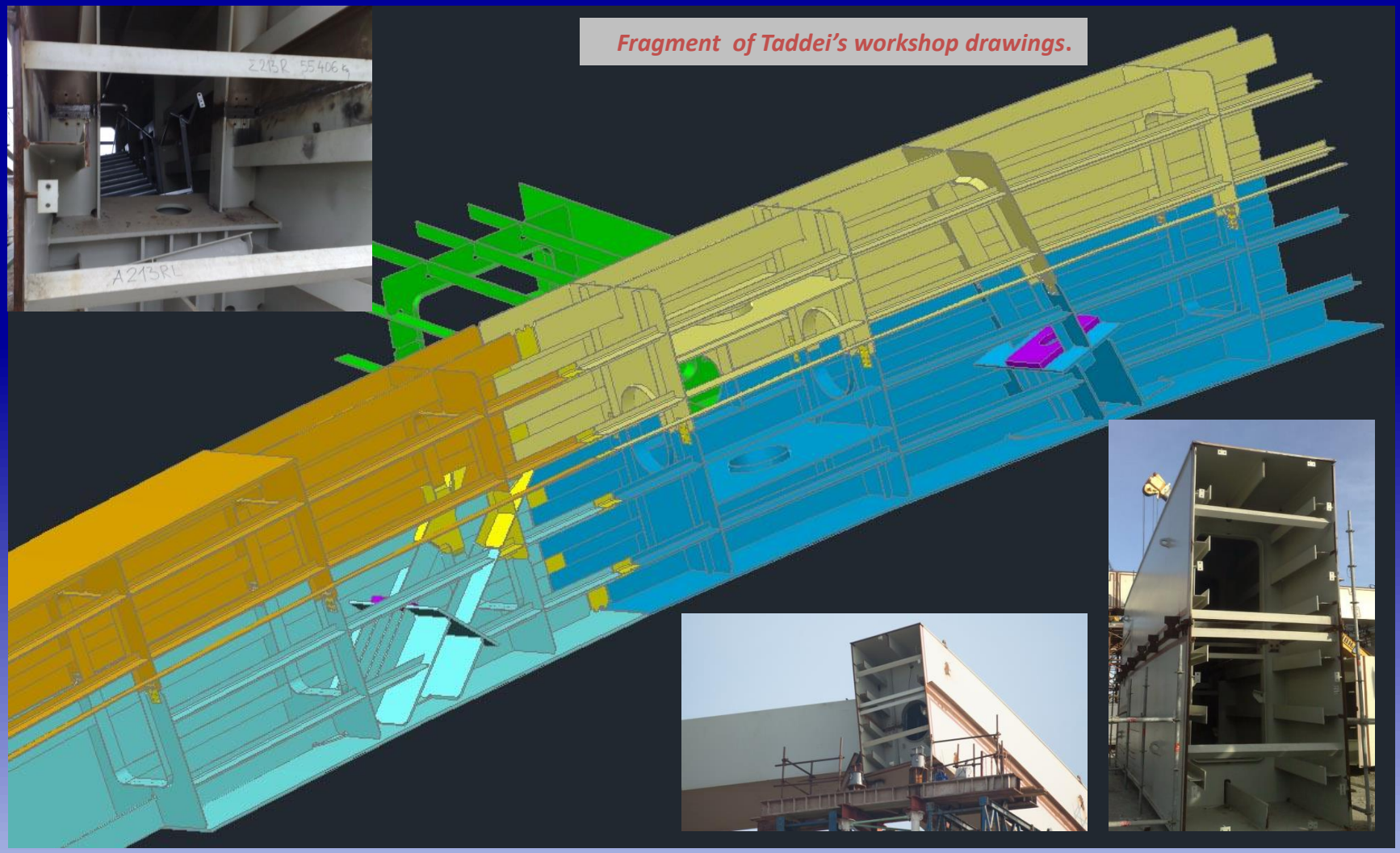




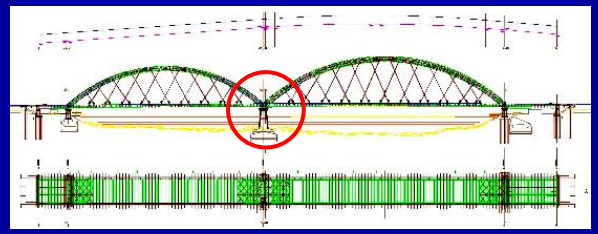


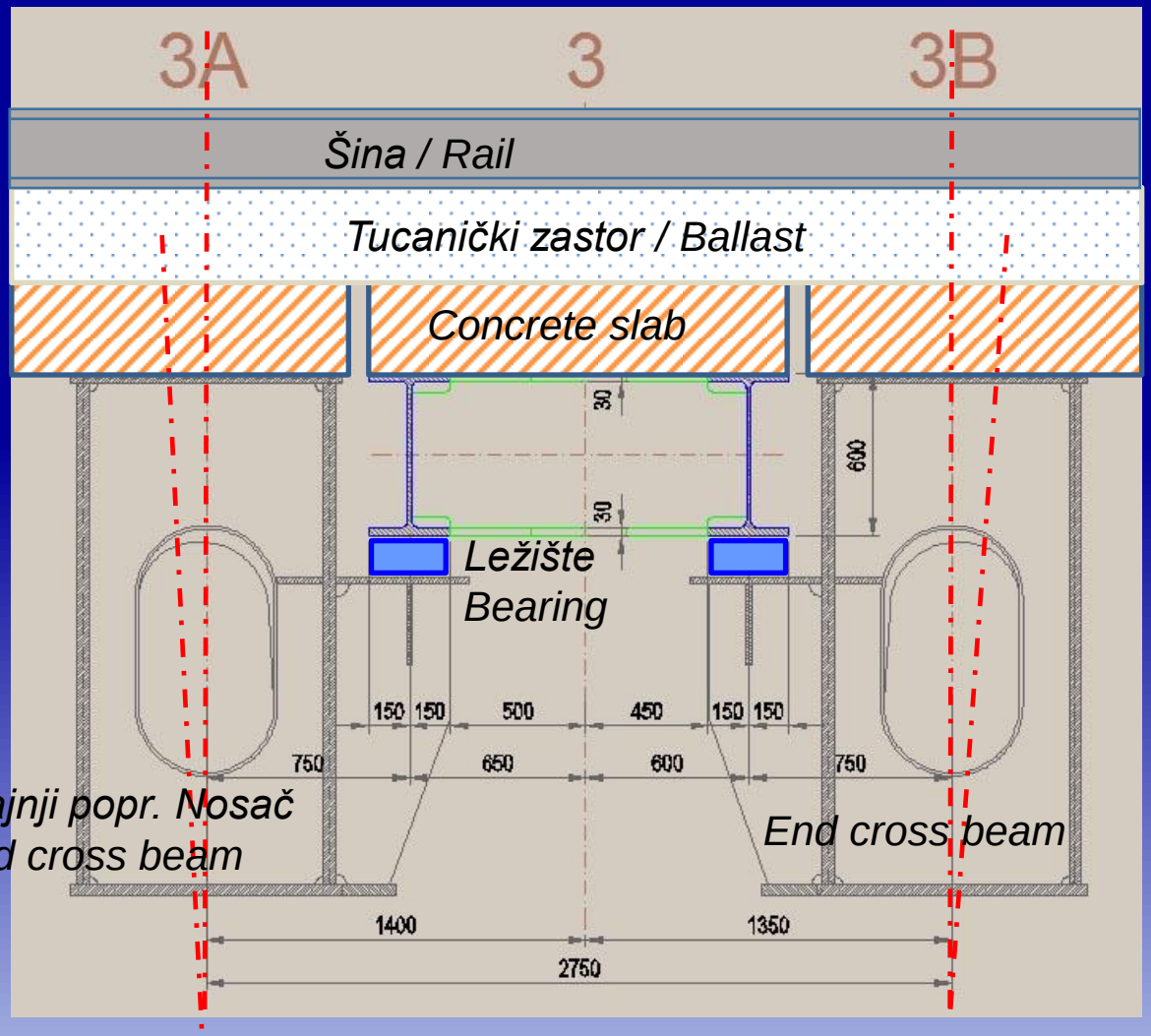
Fragment of Taddei's workshop drawings.

Detalji čelične konstrukcije / Details of the steel structure
Luk sa ankernim konstrukcijama kablova vešaljki.
Arch with hangers anchorages.



Detalji čelične konstrukcije / Details of the steel structure.
Prelazna konstrukcija *3A-3B* između lučnih mostova.
Transition structure *3A-3B* between arch bridges.



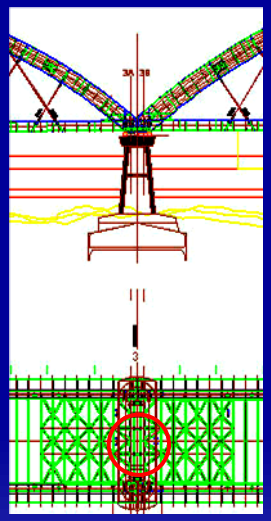


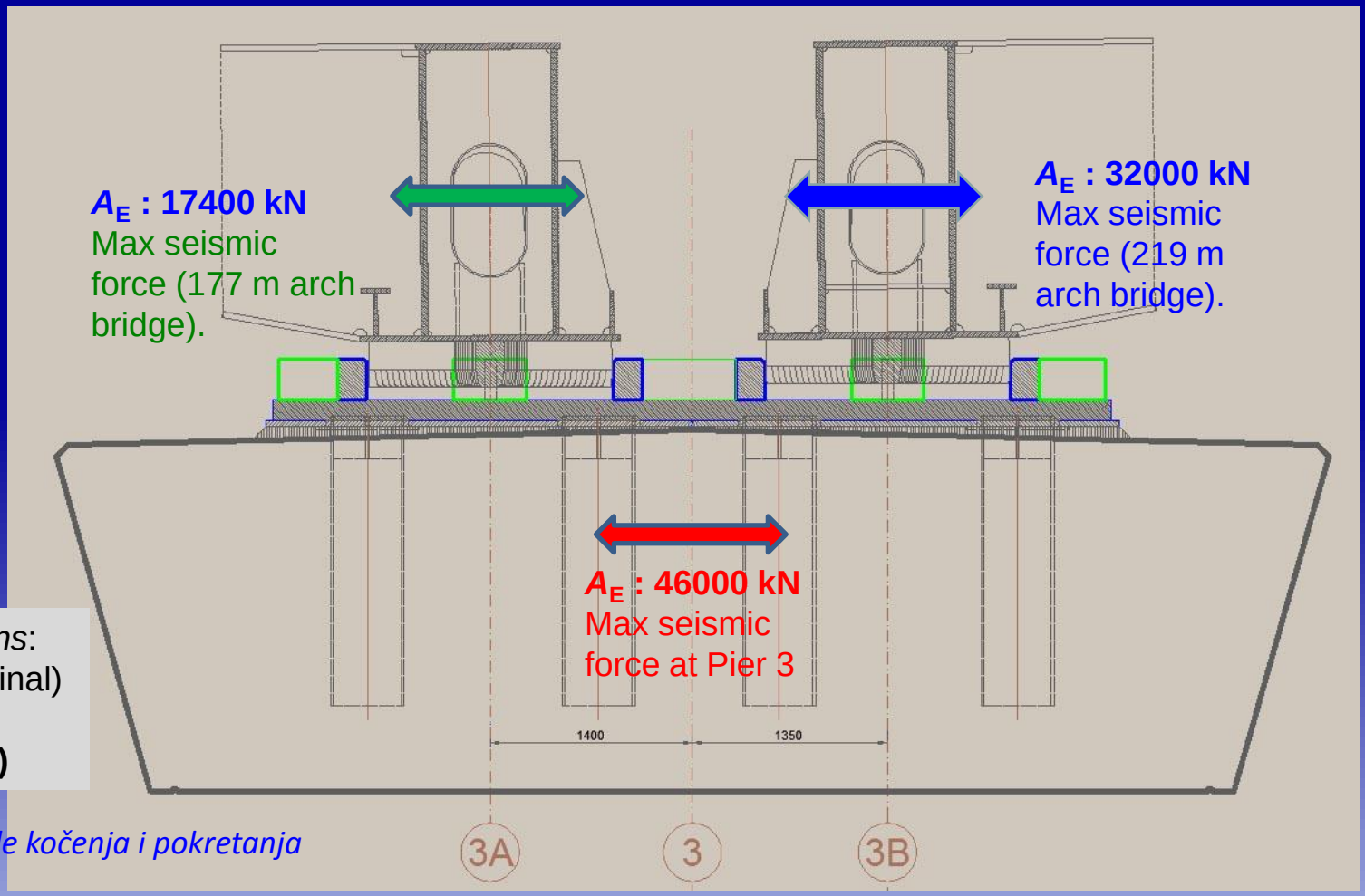
Request about limitations of the sum of rotation angles is fulfilled.

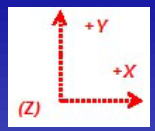
Transition structure improves additionally the state of rails bending.

Fiksna horizontalna ležišta (oslonci) u *3A-3B*.

Fixed horizontal bearings (supports) in *3A-3B*.



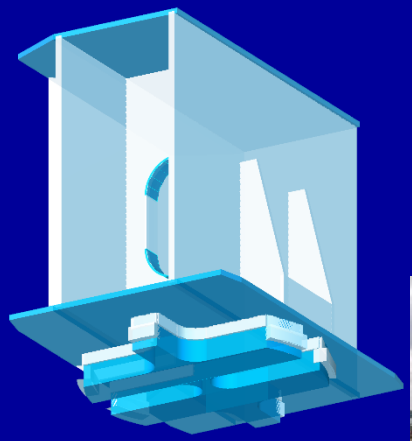




Support reactions:
$R_X > 0$ (longitudinal)
$R_Y > 0$ (lateral)
$R_Z = 0$ (vertical)

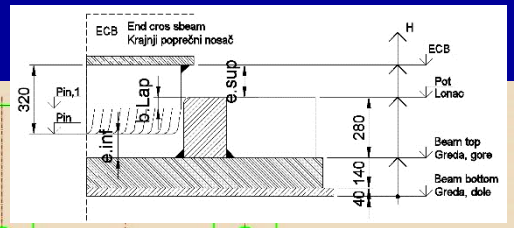
Seizmičke sile >> Sile kočenja i pokretanja

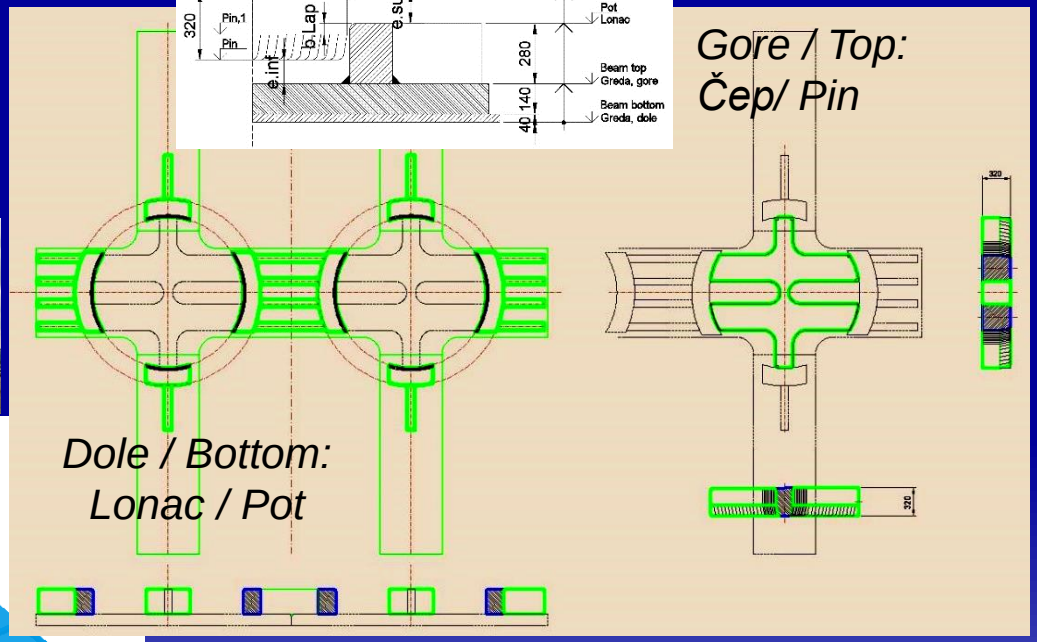
Fiksna horizontalna ležišta u *3A-3B* / Fixed horizontal supports at *3A-3B*.

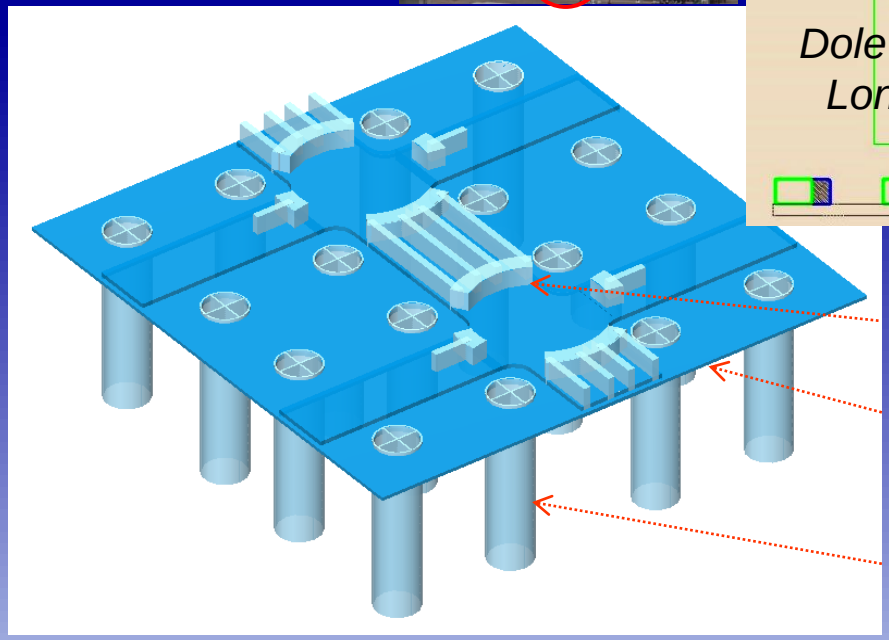


Deo krajnjeg poprečnog nosača

Part of the end cross beam



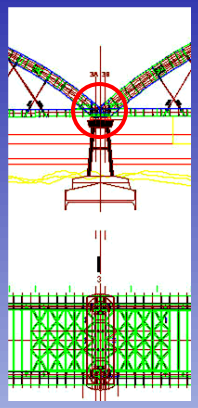




Lonac ležišta / Pot

Oslonačka ploča na vrhu stuba
Support plate on the pier top

Cevasti moždanici u bet. stubu
Pipe pins in concrete pier



Factory production of the steel structure
Izrada konstrukcije

Izrada konstrukcije u firmi *Taddei*, L'Aquila.

Manufacturing of the steel structure in *Taddei* Company, L'Aquila.

Čelik / Steel

Execution class of steel structure: **EXC4**, **EN 1990-2:2011**.

Structural steel: **S355J0,J2,K2** , **EN 10025-2:2004**.

(Very limited volume of **S460Q,N,L** , **EN 10025-2:2004**)

Special requirements for steel:

Ril 804:2003 , **BN 918002:2000** , **SEL 072:1977**,

SEL 072/Beiblatt:1977 , **SEP 1390:1996**.

Moždanici / Headed studs

Automatic welded headed studs,

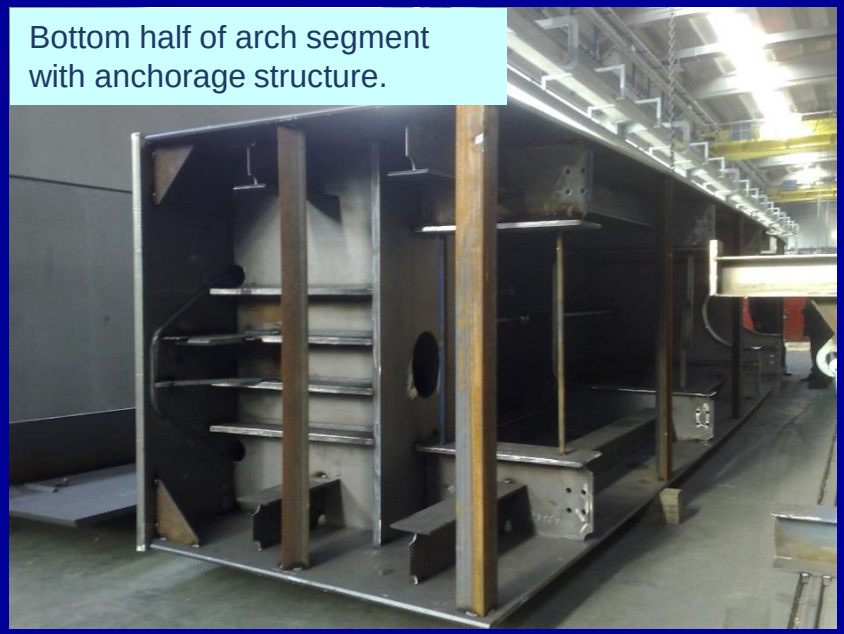
EN ISO 13918:2008, **EN ISO 14555:2006**.

Kablovi / Cable stays

Group C, Class 5, $f_{uk} \geq 1860{,}0$ N/mm^2 ,

EN 1993-1-11:2006, **SETRA:2002**, **fib:2005**.

Inferior arch flange with reinforcement around hole for hanger.



Bottom half of arch segment with anchorage structure.

Tie box segment with anchorage structure

End cross beam

Trial assembly Ties + End cross beam.

Cable stays as hangers
Kablovi vešaljki

Vešaljke – kablovi / Hangers – cable stays

VSL cable stay system SSI 2000

55 parallel strands, F_{SLS} = 6905 kN

d **= 200 mm**

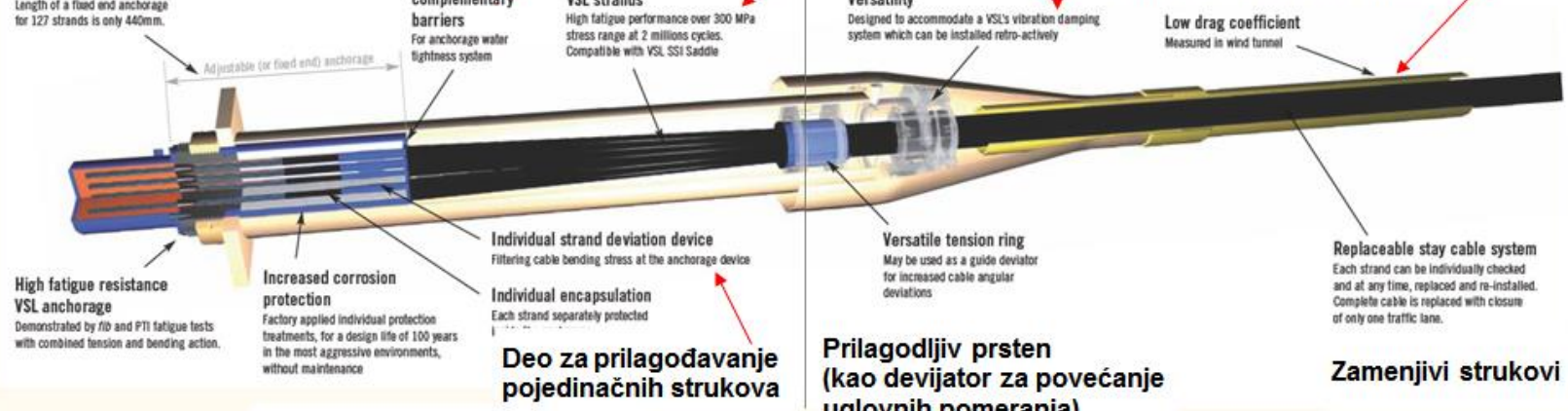
Kompaktno ankerovanje

Zaštite za vodonepropusnost

Strukovi visoke otpornosti na zamor

Sistem prigušenja oscilacija kabla

Obloga od polietilena visoke gustine (HDPE), sa malim koeficijentom otpora u struji vazduha



Deo za prilagođavanje pojedinačnih strukova

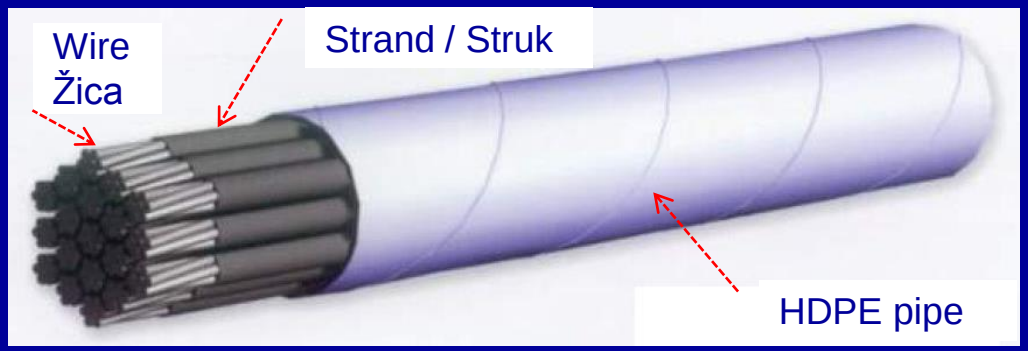
Prilagodljiv prsten (kao devijator za povećanje uglovnih pomeranja)

Zamenjivi strukovi

Povećana zaštita od korozije

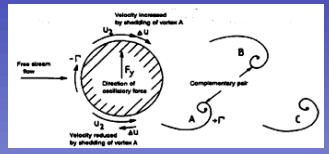
Velika otpornost na zamor ankernog dela

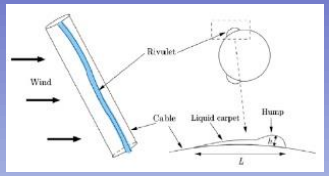
Vešaljke – kablovi / Hangers – cable stays

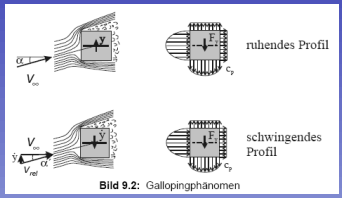


Cable testing acc. to *fib*:2005	Ispitivanja kablova po *fib*:2005
Qualification testing tensile testing, fatigue testing, water leak tightness test, tests for corrosion protection barriers	Ispitivanja kvalifikacije zatezna čvrstoće kabla, zamor pod aksijalnim silama zatezanja, vodonepropustljivost, zaštita od korozije
Suitability testing strands, pipes, anchorages (fatigue and tensile test)	Ispitivanja podobnosti strukovi, cevi, ankeri (ispitivanje zamora i zatezanja)
Quality control testing (wires, strands, PE (polyethylene), HDPE pipes, soft filling material (wax and grease)	Ispitivanja kvaliteta žice i strukovi, PE (polietilen) obloge, HDPE (polietilen velike gustine) cevi, materijali ispune (vosak i masti)

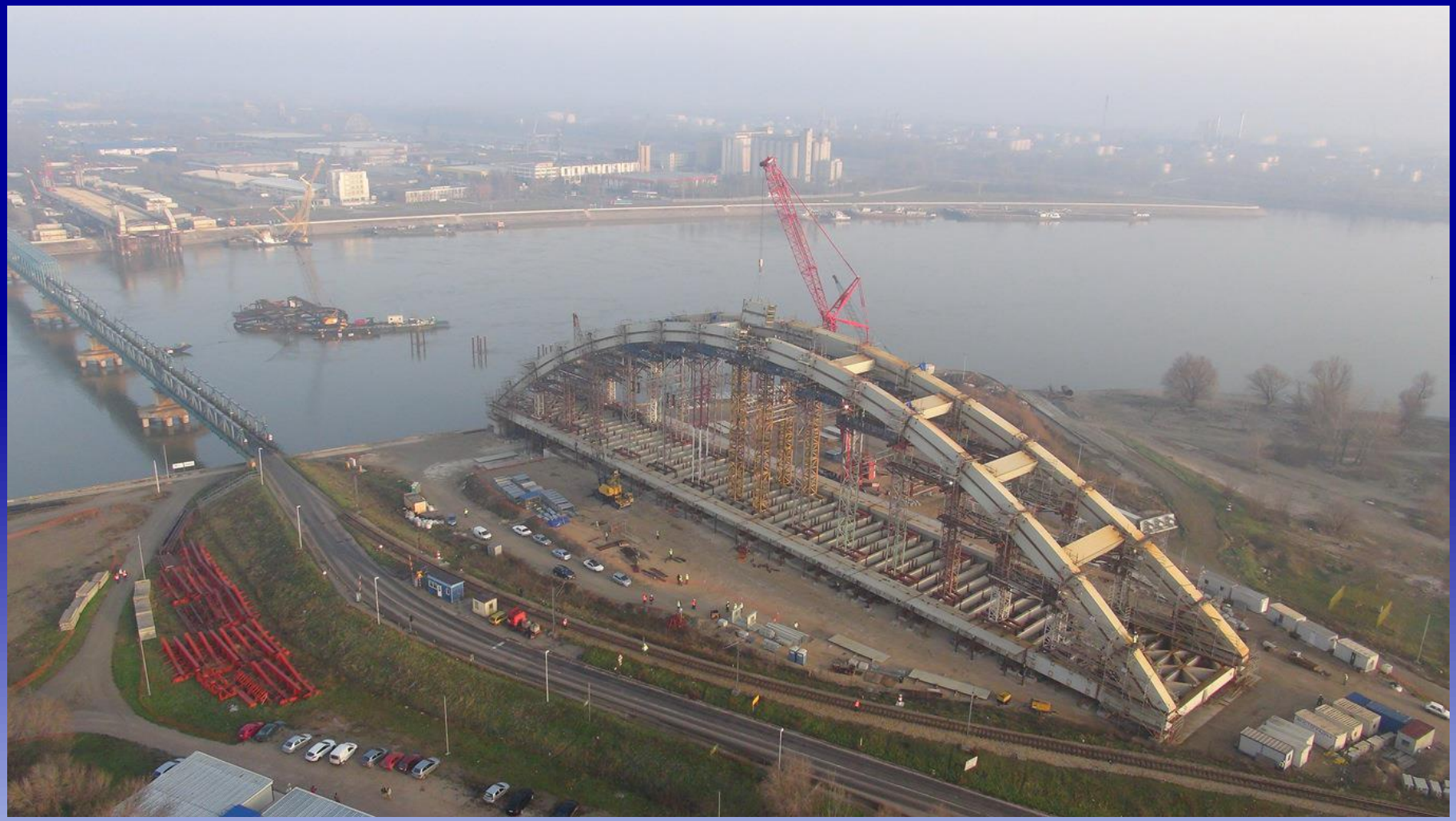
Aerodynamic stability of cable stays	***Aerodinamička stabilnost kablova***
Vortex shedding	Odvajanje vrtloga
Galloping	Galopiranje
Rain and wind-induced vibrations	Vibracije izazvane kišom i vetrom



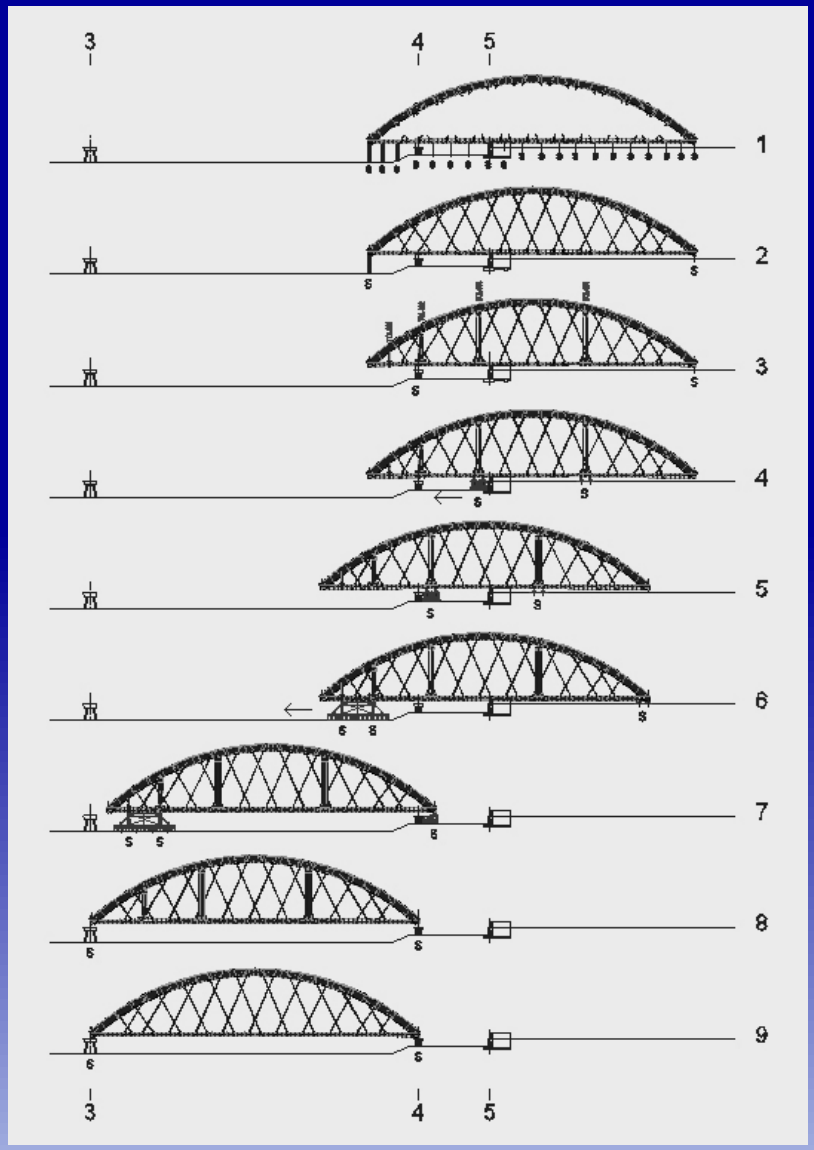




Erection of the bridge
Montaža mosta



Osnovne faze montaže / Basic erection phases



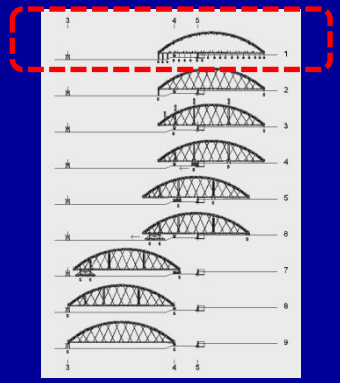
Assembling / Sklapanje

Cable stays installation
Montaža kablova

Launching / Lansiranje

Concreting, permanent loads
Betoniranje, stalni tereti

Step 1: Assembling / Korak 1: Sklapanje

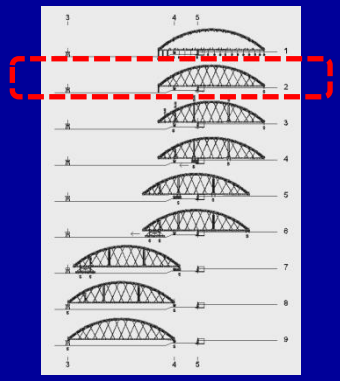


Ties + Cross beams + Bracings
Zatege + Poprečni nosači + Spregovi

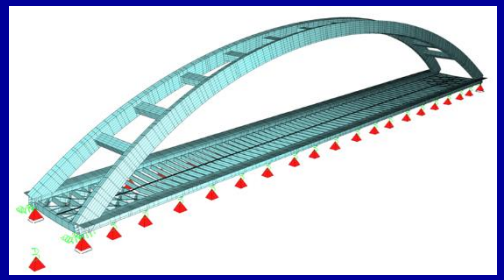
Temporary columns under arch connection joints

Welded connection joints, quality B+

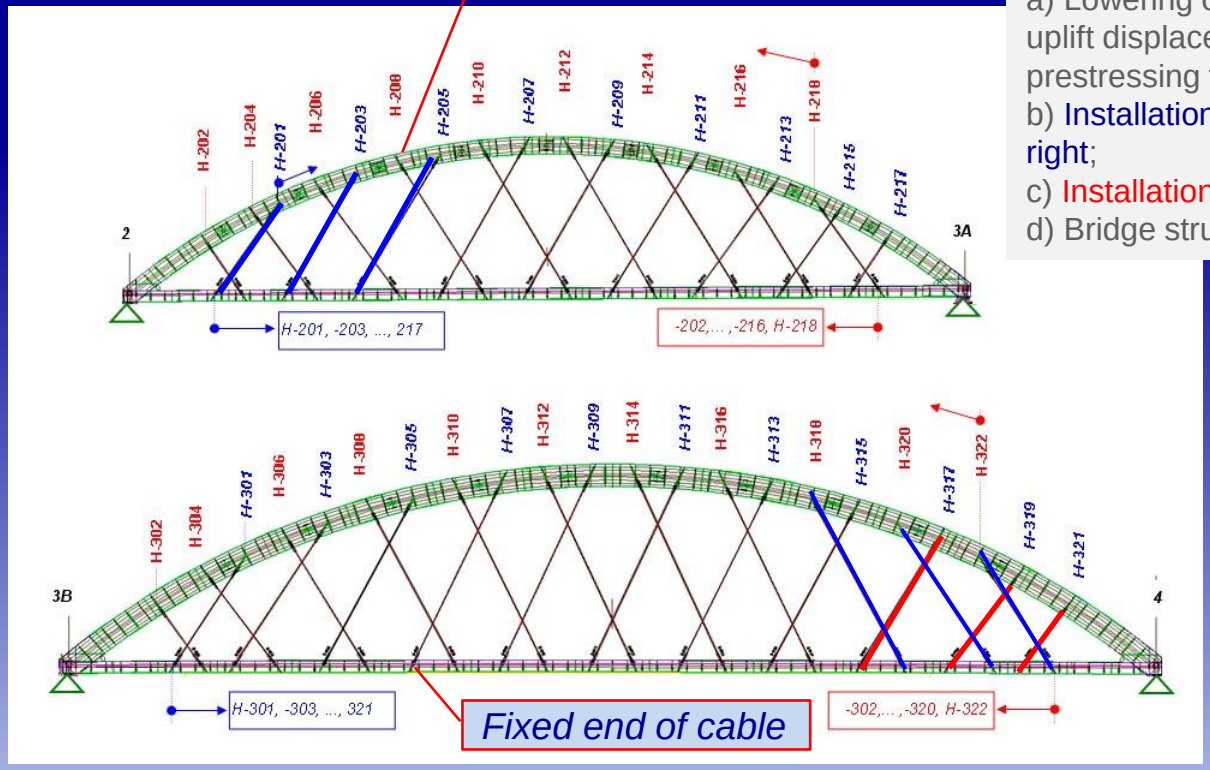
Step 2: Cable stays installation / Korak 2: Montaža kablova



***Start state*:**
Structure assembled, temporary structures removed;
Ties on temporary supports.

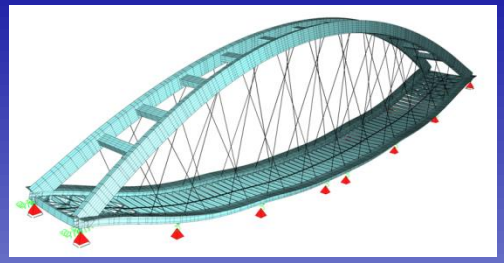


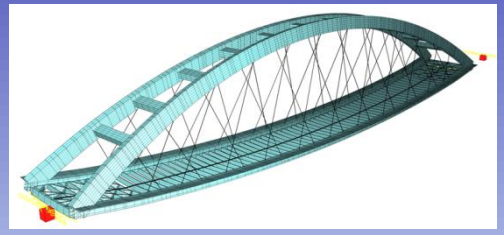
Adjustable end of cable



Fixed end of cable

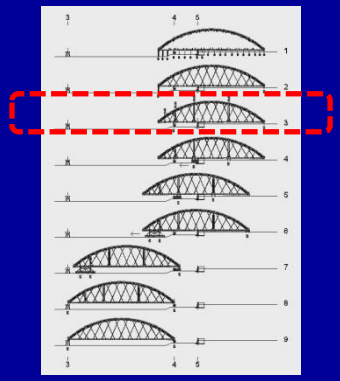
***Cable stay installation*:**
a) Lowering of ties to the level equal to the uplift displacements arising of cable prestressing forces;
b) Installation of cable stays inclined to the right;
c) Installation of cable stays inclined to the left;
d) Bridge structure is on 4 supports.

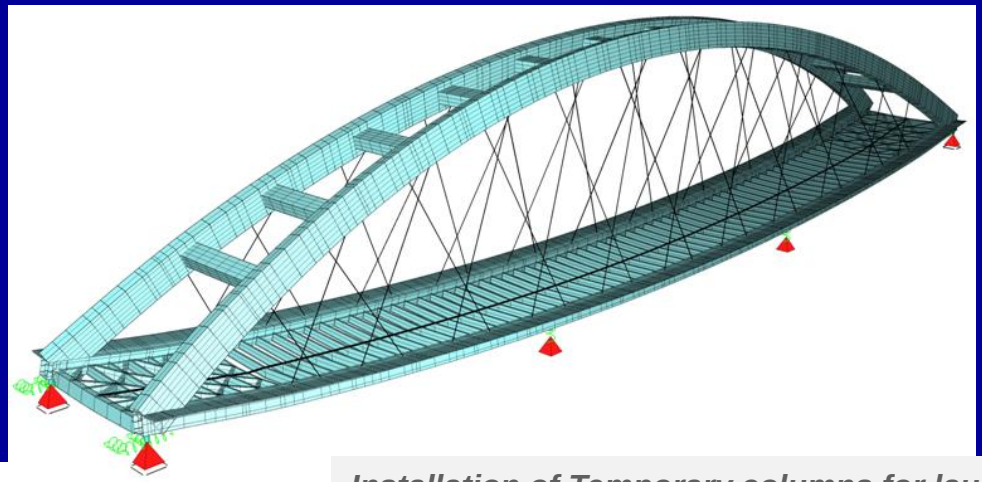




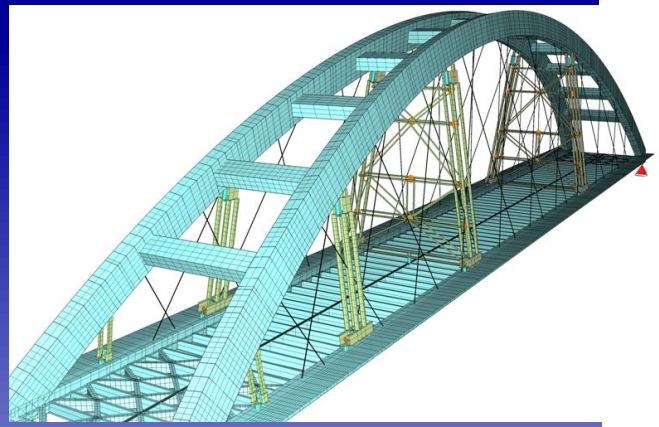
Step 3: Temporary columns for launching

Korak 3: Privremeni stubovi za lansiranje

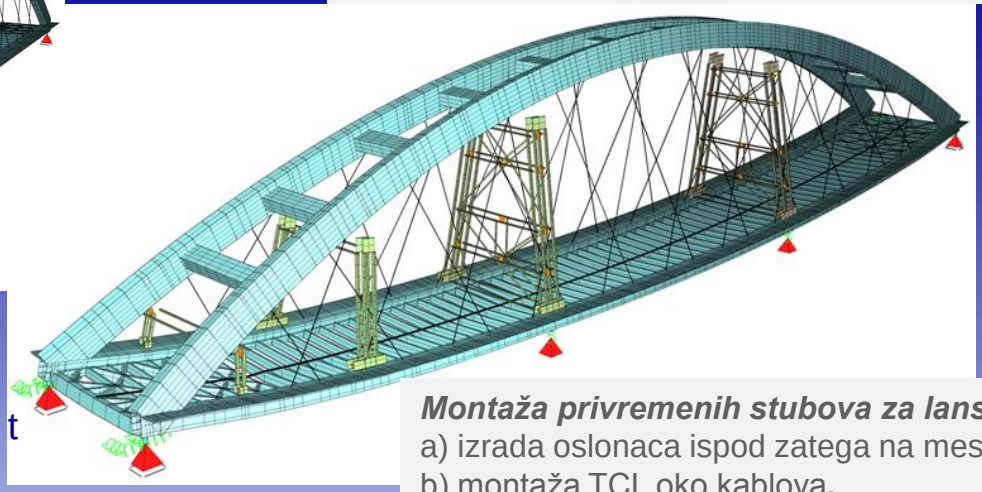




Bridge 3B-4
L = 219 m



Installation of Temporary columns for launching (TCL):
a) Supports on TCL-location under the ties;
b) Installation of TCL around the cables.

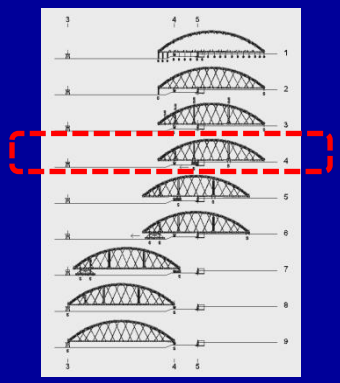


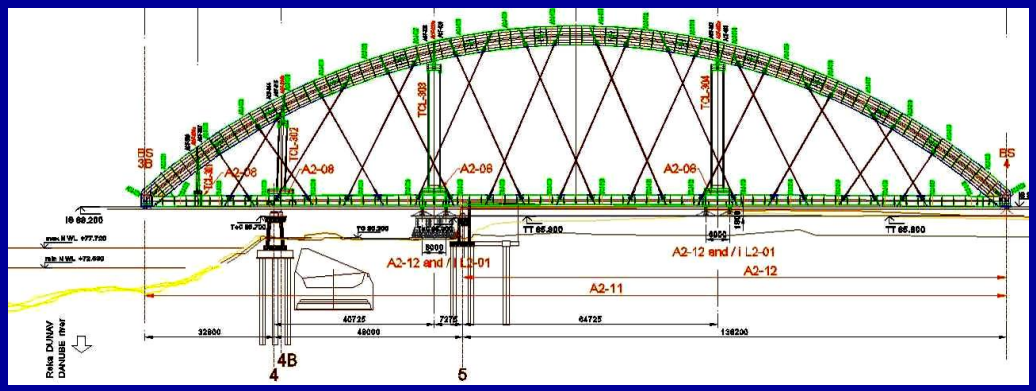
Montaža privremenih stubova za lansiranje (TCL):
a) izrada oslonaca ispod zatega na mestu TCL;
b) montaža TCL oko kablova.

Mases for launching:
Bridge structure = 5324 t
Secondary structures inside = 124 t
TCL = 264 t
Total = 5712 t

Step 4: Transfer of supports to Pier 4 and BS-4

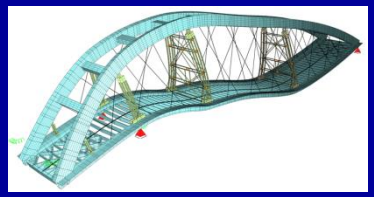
Korak 4: Prenošenje oslanjanja na stub 4 i BS-4

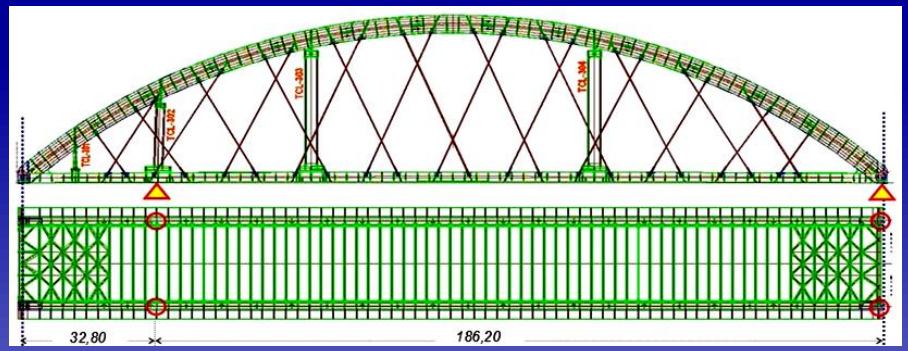




Bridge 3B-4
L = 219 m

min δ_Z = -226 mm;
-282 mm

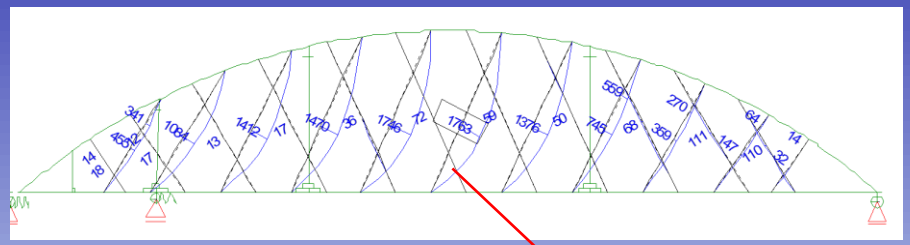


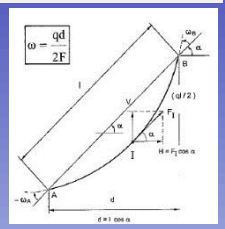


The cable stays were calculated acc. to **Third Order Theory**, (analysis with large cable sags) with E_Q = 195000 N/mm^2 . The **anchorages rotations** were also analyzed.

Activating of supports on Pier 4 and at BS-4:
a) Removal of supports under TCL;
b) Activating of supports on Pier 4 and at BS-4.

Aktiviranje oslonaca na stubu 4 i kod BS-4:
a) uklanjanje privremenih oslonaca ispod TCL;
b) aktiviranje oslonaca na stubu 4 i kod BS-4.

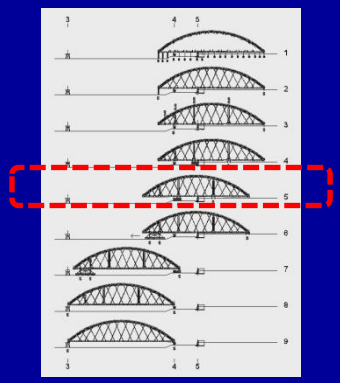


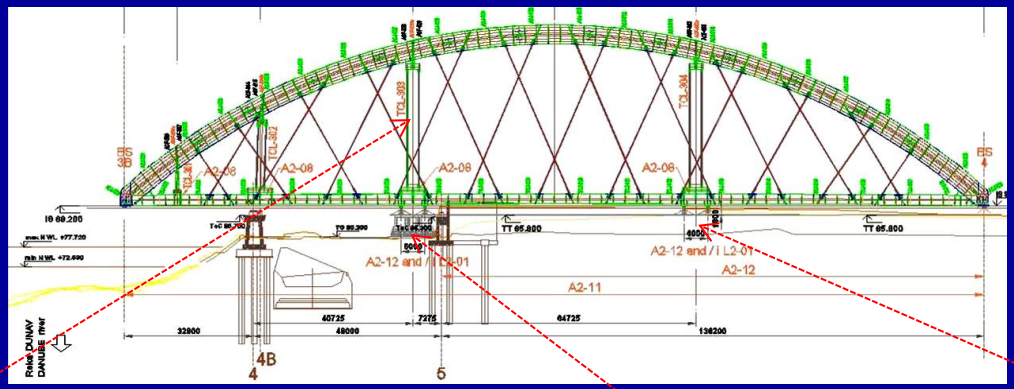


"Compressed" cable, f = 1764 mm

Step 5: Transfer of supports to skids

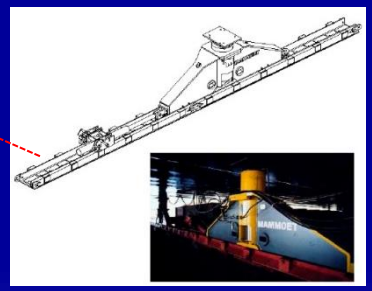
Korak 5: Prenošenje oslanjanja na sanke

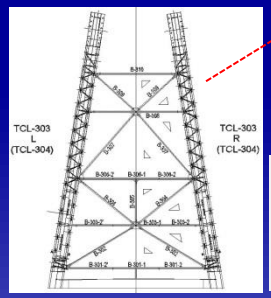




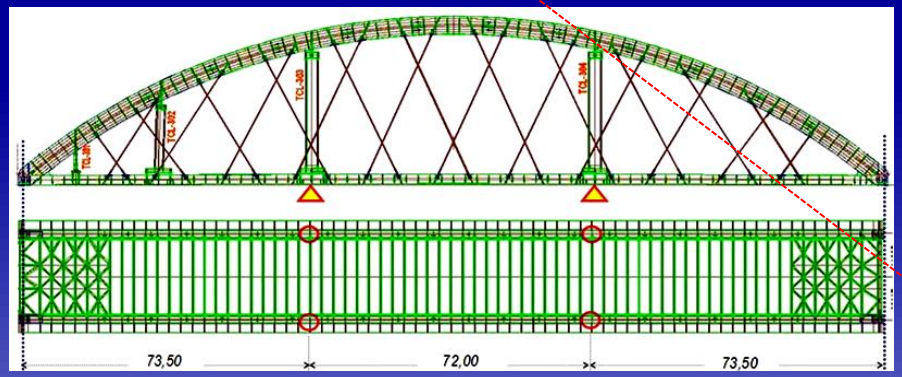
Bridge 3B-4
L = 219 m

Skid / Sanke

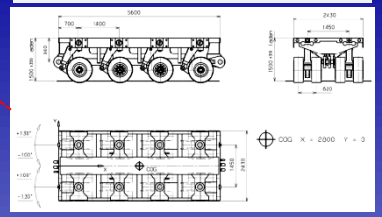


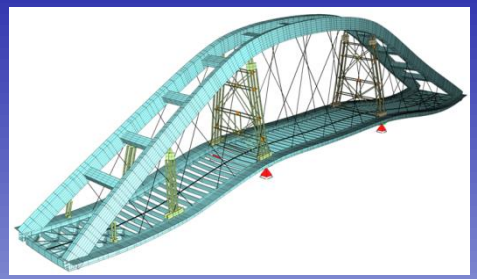


TCL-302 and bracing

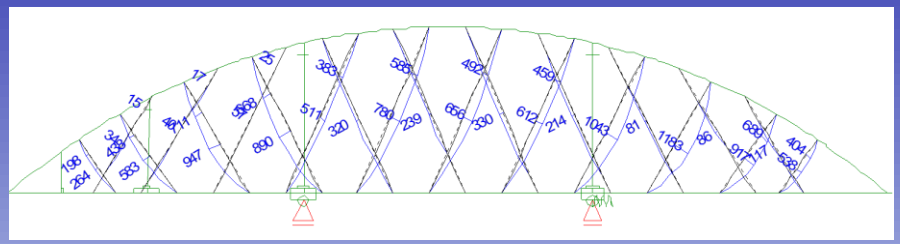


Platform





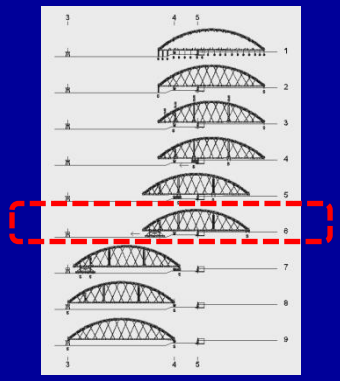
min δ_Z = -182 mm

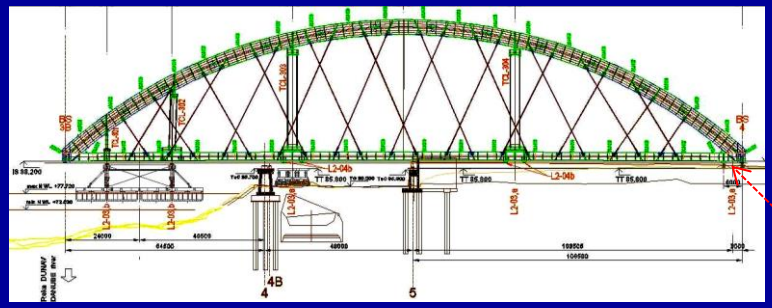


Loads during launching: $G_{1,a}$, F_W, T, A_E .

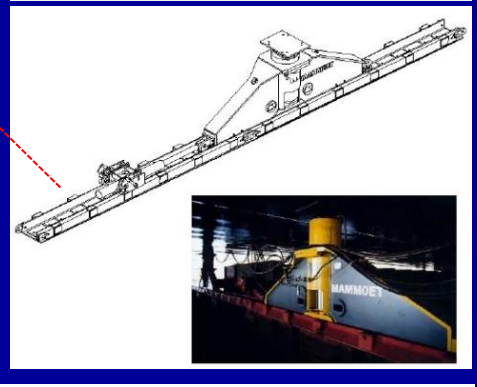
Step 6: Transfer of supports to barges and skids at *BS-4*.

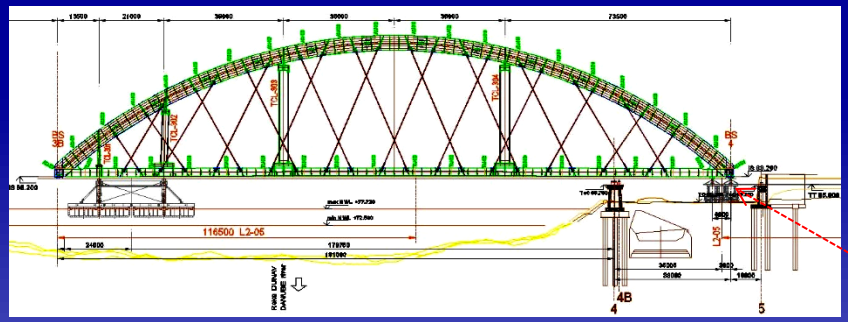
Korak 6: Prenošenje oslanjanja na barže i sanke kod *BS-4*

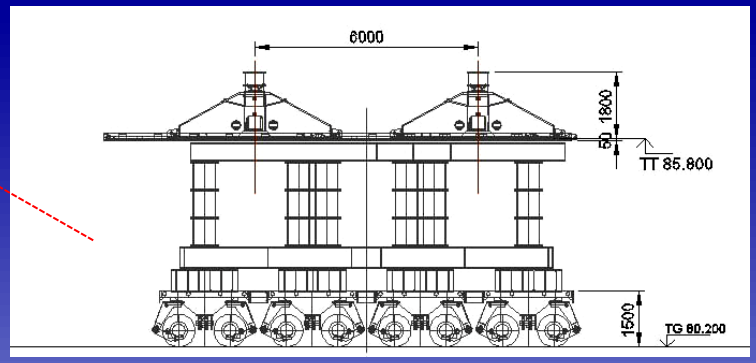


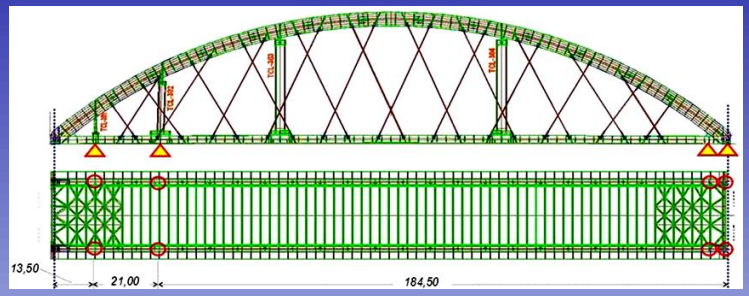


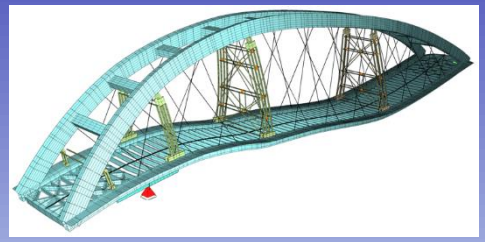
Skid / Sanke









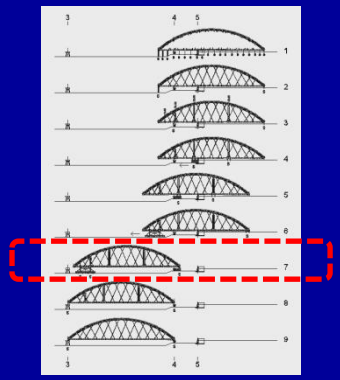


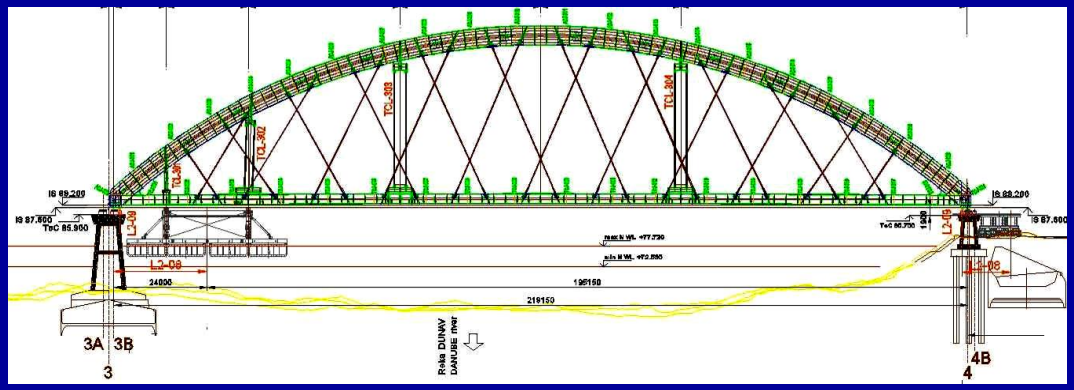
Skid + Platform

Subcontractor for launching: *Mammoet*, Rotterdam.

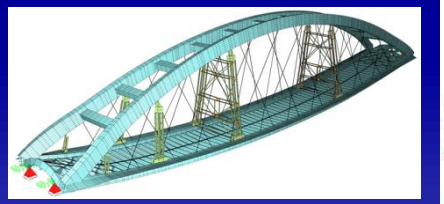
Step 7: Final location. Transfer of supports to End cross beams.

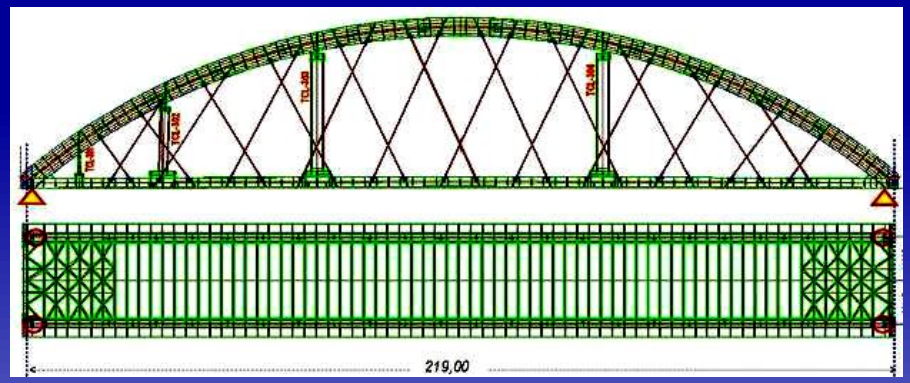
Korak 7: Krajnja lokacija. Prenošenje oslanjanja na krajnje poprečne nosače



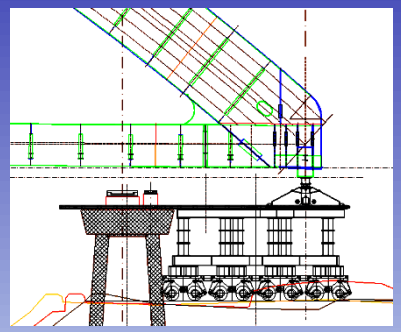


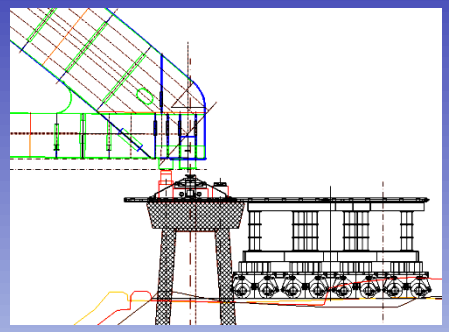
Bridge 3B-4
L = 219 m



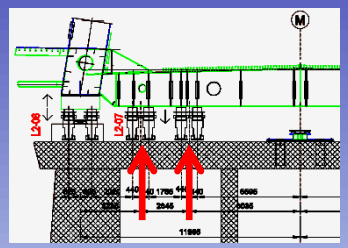


Transport to the final position.
Transfer of supports to end cross beams (ECB).
Supports under ECB on skids and then the transfer to wooden pads.

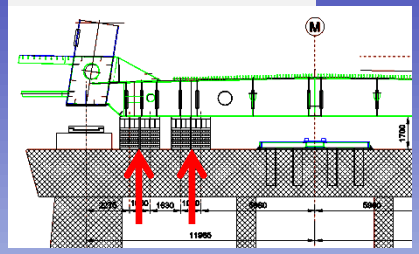




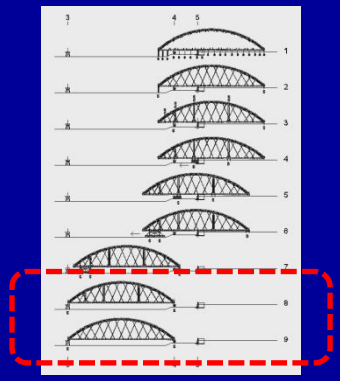
At Pier 4

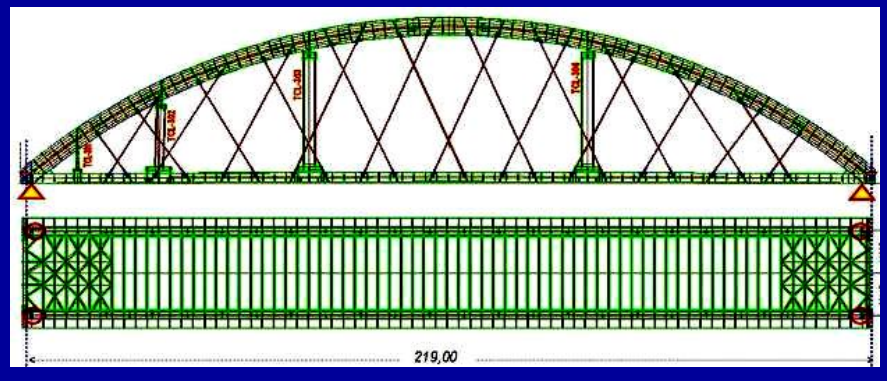


At Pier 3, (also 4)

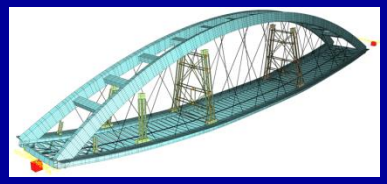


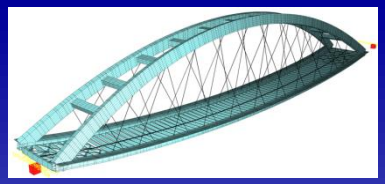
Step 8 and 9: Transfer of supports to baerings and rest of works.
Korak 8 i 9: Prenošenje oslanjanja na ležišta i preostali radovi

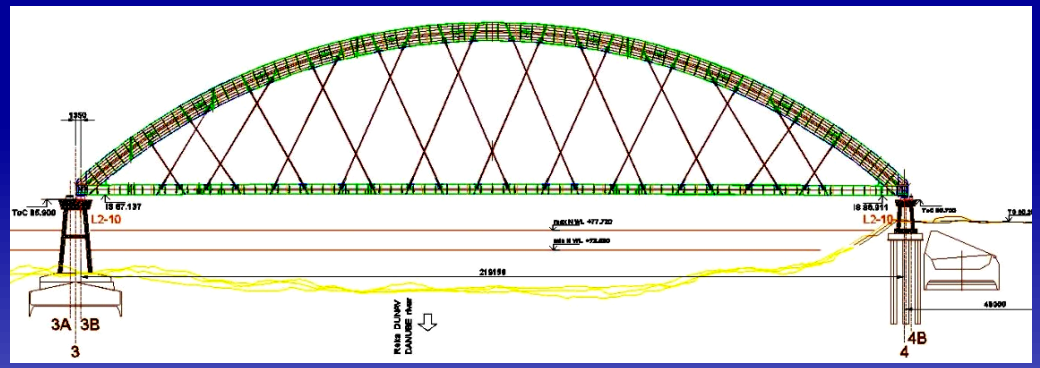


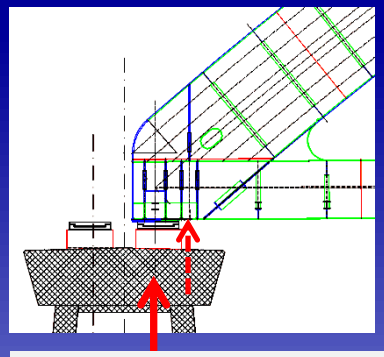


Bridge 3B-4
L = 219 m

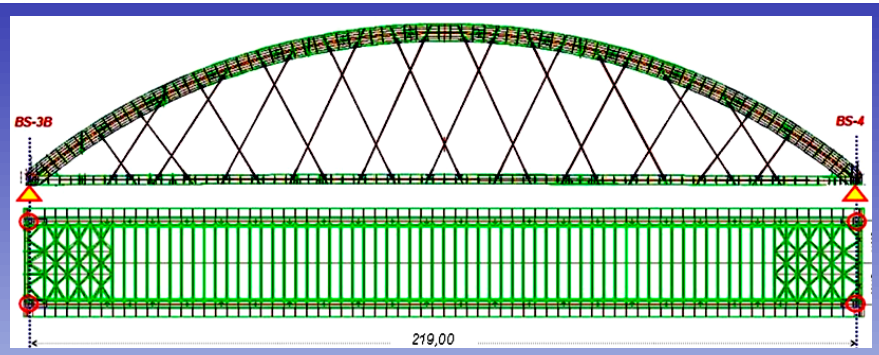






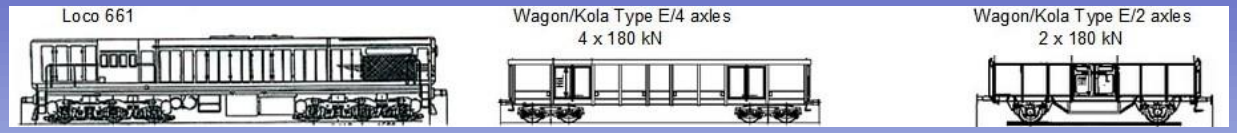


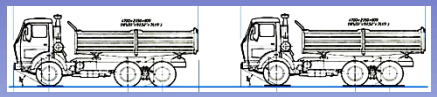
Transfer of supports from ECB to ties:
1) Supports under diaphragms for bearings replacement;
2) Transfer of supports to bearings.



Step 9: Rest of works:
Dismantling of TCL.
Check of hangers forces.
Concreting of deck slab.
Ballast, asphalt equipment and accessories.
Final check of hangers forces

Test load
Probno opterećenje

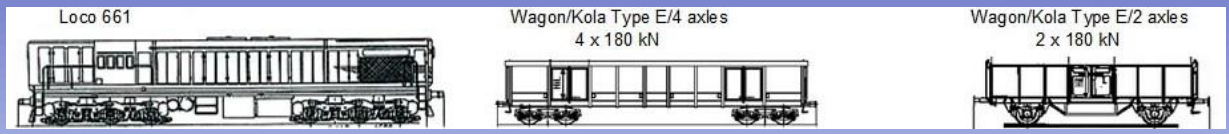


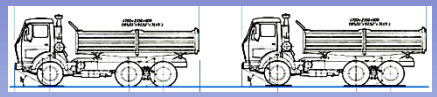


Test load / Probno opterećenje

Topic	*Content*
Standard	SRPS U.M1.046:1984
Testing	Static testing Dynamic testing
Vehicles	3 locos Type 661, 109 t 38 wagons Type E/4, 72 t 10 wagons Type E/2, 36 t 38 trucks 3 axles, 23,5 t
Static testing (Wagons + Trucks)	Stresses: σ, τ ; Deformations: δ, θ ; Frequencies: n_V, n_H ;
Dynamic testing (Three Locos)	Stresses: σ, τ ; Deformations: δ, θ ; Frequencies: n_V, n_H ; Dynamic factor: Φ ; Accelerations: a_V, a_H .

Tema	*Sadržaj*
Standard	SRPS U.M1.046:1984
Ispitivanja	Statička ispitivanja Dinamička ispitivanja
Vozila	3 lokom. tip 661, 109 t 38 vagona tip E/4, 72 t 10 vagona tip E/2, 36 t 38 kamiona 3 os., 23,5 t
Statička ispitiv. (vagoni + kamioni)	Naponi: σ, τ ; Deformacije: δ, θ ; Frekvencije: n_V, n_H ;
Dinamička ispit. (Tri lokomotive)	Naponi: σ, τ ; Deformacije: δ, θ ; Frekvencije: n_V, n_H ; Dinamički faktor: Φ ; Ubrzanja: a_V, a_H .

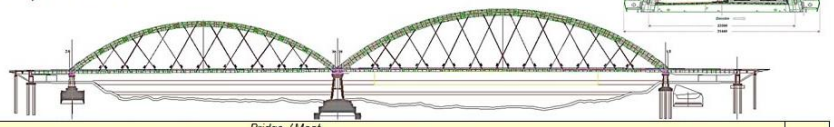




Static test load / Statičko probno opterećenje

Sequences of static test loading
Faze statickog opterecivanja

Empty zone / Prazna zona
Loaded zone / Opterecena zona

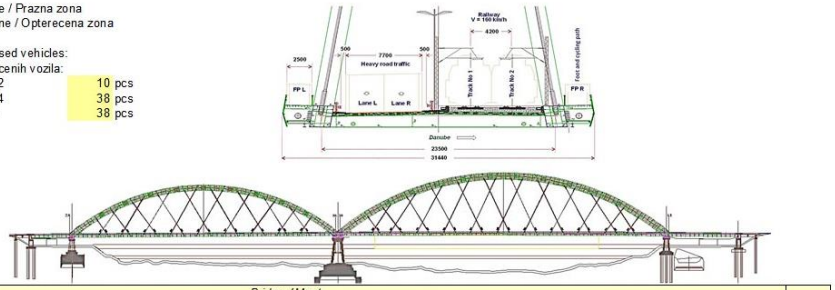


	Bridge / Most				
	1-2A	2-3A	3B-4	4B-5	
Longitudinally and transversally unsymmetrical load / Poduzno nesimetricno opterecenje					
					Tr2
					Tr1
Phase/Faza	**101** $L_{T,1}$; 3	**201** $L_{T,1}$ 11 pcs	**301** $L_{T,1}$ 13 pcs	**401** $L_{T,1}$; 5	**La-R**
					La-L
Longitudinally and transversally unsymmetrical load / Poduzno nesimetricno opterecenje					
					Tr2
					Tr1
Phase/Faza	**102** $L_{T,1}$; 3	**202** $L_{T,1}$ 11 trucks	**302** $L_{T,1}$ 13 trucks	**402** $L_{T,1}$; 3	**La-R**
Phase/Faza	**102** $L_{T,1}$; 3	**202** $L_{T,1}$ 11 trucks	**302** $L_{T,1}$ 13 trucks	**402** $L_{T,1}$; 3	**La-L**
Longitudinally symmetrical load; Transversally unsymmetrical load / Poduzno simetricno opterecenje; Poprecno nesimetricno opterecenje					
					Tr2
					Tr1
Phase/Faza		**203** $L_{T,2}$ 21 trucks	**303** $L_{T,2}$ 26 trucks		**La-R**
					La-L
Longitudinally symmetrical load; Transversally unsymmetrical load / Poduzno simetricno opterecenje; Poprecno nesimetricno opterecenje					
					Tr2
					Tr1
Phase/Faza		**204** $L_{T,2}$ 15 trucks	**304** $L_{T,2}$ 19 trucks		**La-R**
Phase/Faza		**204** $L_{T,2}$ 15 trucks	**304** $L_{T,2}$ 19 trucks		**La-L**

Empty zone / Prazna zona
Loaded zone / Opterecena zona

Total number of used vehicles:
Ukupan broj koriscenih vozila:

Wagons / Kola E/2	10 pcs
Wagons / Kola E/4	38 pcs
Trucks / Kamioni:	38 pcs



	Bridge / Most				
	1-2A	2-3A	3B-4	4B-5	
Phase/Faza	**105** 3 x E/2	**205** 16 x E/4	**305** 19 x E/4	**405** 5 x E/2	**Tr2**
					Tr1
					La-R
					La-L
Phase/Faza	**106** 3 x E/2	**206** 16 x E/4	**306** 19 x E/4	**406** 5 x E/2	**Tr2**
Phase/Faza	**106** 3 x E/2	**206** 16 x E/4	**306** 19 x E/4	**406** 5 x E/2	**Tr1**
					La-R
					La-L
Phase/Faza	**107** 3 x E/2	**207** 16 x E/4	**307** 19 x E/4	**407** 5 x E/2	**Tr2**
Phase/Faza	**107** 3 x E/2	**207** 16 x E/4	**307** 19 x E/4	**407** 5 x E/2	**Tr1**
Phase/Faza	**107** $L_{T,1}$; 3	**207** $L_{T,2}$ 15 trucks	**307** $L_{T,2}$ 19 trucks	**407** $L_{T,1}$; 5	**La-R**
Phase/Faza	**107** $L_{T,1}$; 3	**207** $L_{T,2}$ 15 trucks	**307** $L_{T,2}$ 19 trucks	**407** $L_{T,1}$; 5	**La-L**

7 phases of loading
7 faza opterećivanja

Unsimetric loads
Longitudunaly, transversaly

Nesimetrična opterećenja
Podužno, poprečno

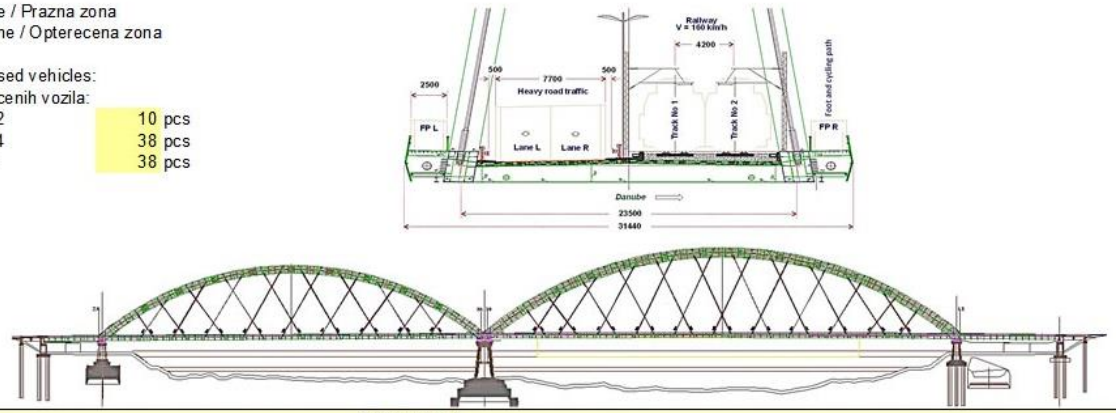
Simetric loads
Simetrična opterećenja

Static test load / Statičko probno opterećenje

Empty zone / Prazna zona
Loaded zone / Opterecena zona

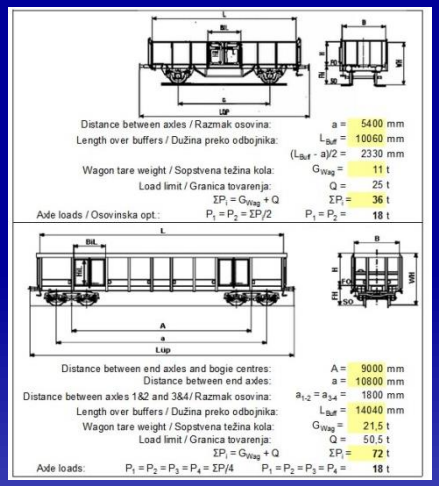
Total number of used vehicles:
Ukupan broj koriscenih vozila:

Wagons / Kola E/2	10 pcs
Wagons / Kola E/4	38 pcs
Trucks / Kamioni:	38 pcs



	Bridge / Most							
	1-2A	2-3A			3B-4		4B-5	
Phase/Faza	107 3 x E/2	207	16 x E/4		307	19 x E/4	407 5 x E/2	Tr2
Phase/Faza	107 3 x E/2	207	16 x E/4		307	19 x E/4	407 5 x E/2	Tr1
Phase/Faza	107 $L_{T,1}$; 3	207	$L_{T,2}$	15 trucks	307	$L_{T,2}$ 19 trucks	407 $L_{T,1}$; 5	La-R
Phase/Faza	107 $L_{T,1}$; 3	207	$L_{T,2}$	15 trucks	307	$L_{T,2}$ 19 trucks	407 $L_{T,1}$; 5	La-L

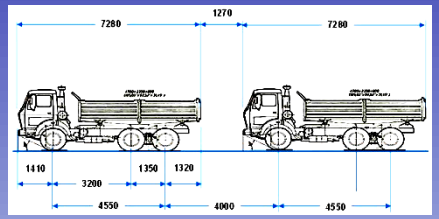
Wagons E/2, 36 t
Wagons E/4, 72 t



Total mass of vehicles = 1290 t
max δ_Z = 56 mm
= L /3161

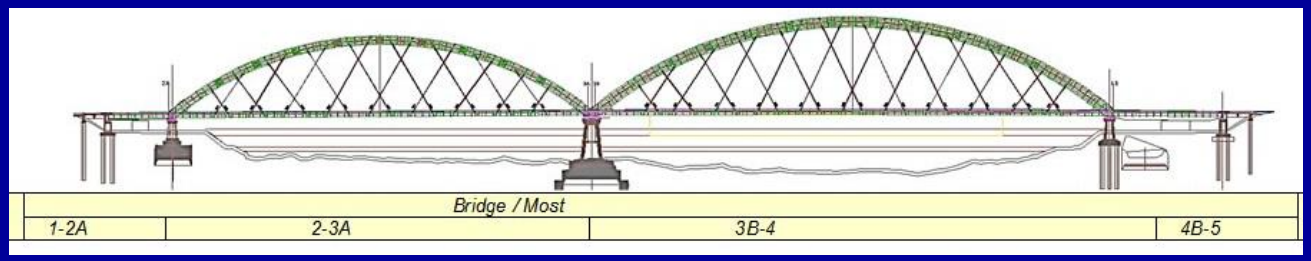
Total mass of vehicles = 1600 t
max δ_Z = 69 mm
= L /3174

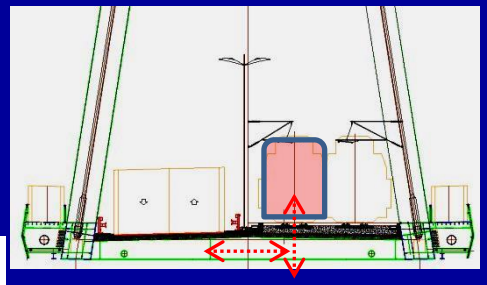
Three axle trucks
23,50 t



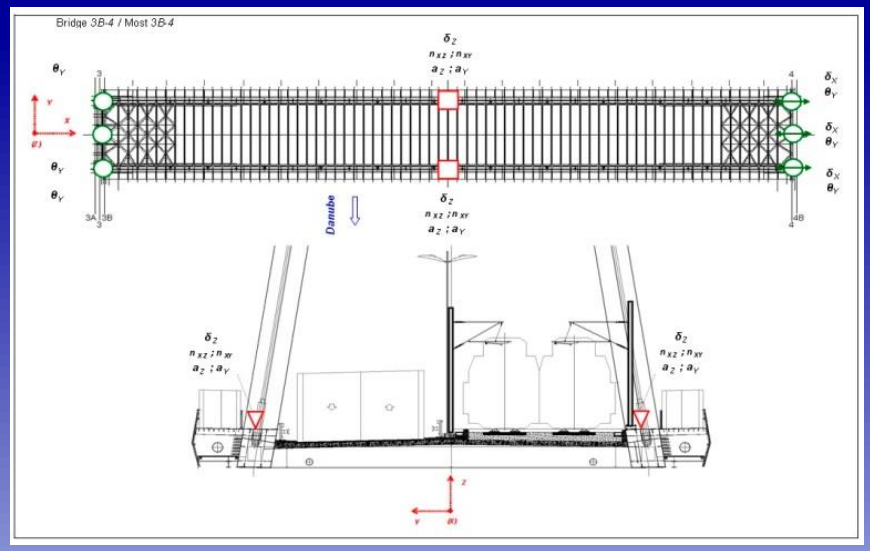
Number of vehicles – as much, as possible to accommodate

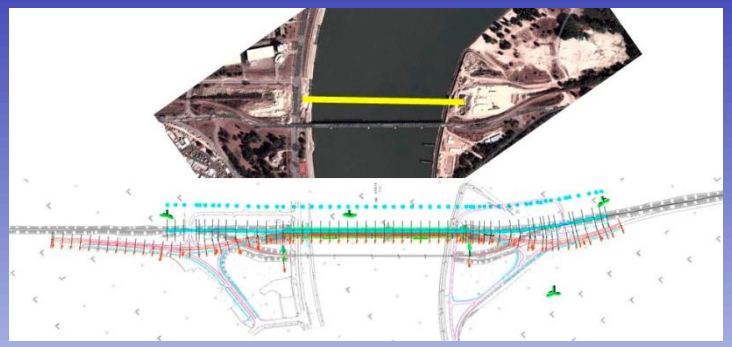
Dynamic test load / Dinamičko probno opterećenje





Three locos Type 661
3 x 109 t
Velocity = 55 km/h
Accelerations of the deck at Track No 1:
2-3A: a_V = 0,62 m/s^2, a_H = 0,21 m/s^2
3B-4: a_V = 0,59 m/s^2, a_H = 0,21 m/s^2

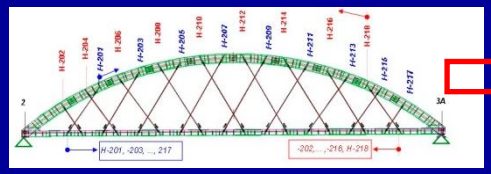


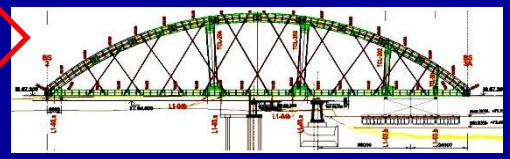


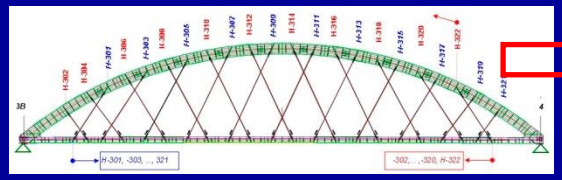
Location of the bridge and approach rail tracks
Lokacija mosta i prilaznih koloseka

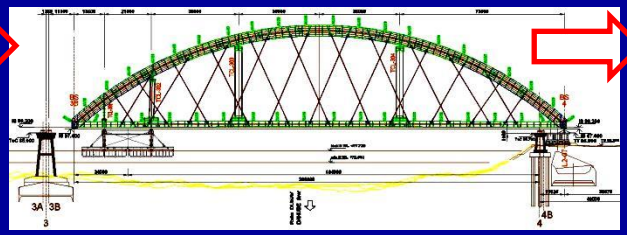
Monitoring

Monitoring







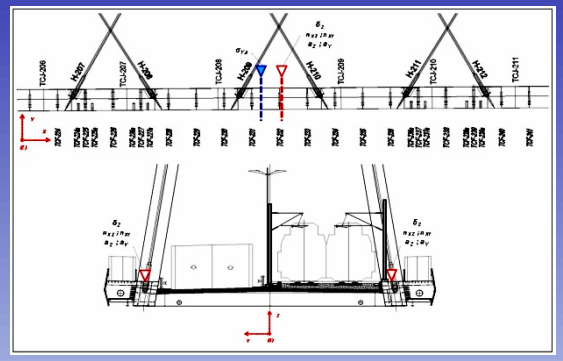


First bridge in Serbia with monitoring system

Start of monitoring: Cable stay installation, launching
Početak monitoringa: Montaža kablova, lansiranje

Monitoring during exploitation
Monitoring u eksploataciji mosta

Measured data	*Equipment locations*
Stresses: σ, τ ; Deformations: δ, θ ; Frequencies: n_V, n_H ; Accelerations: a_V, a_H ; Ambient values: T, v_{Wind} .	Arches Ties Girders Deck cross beams Deck slab



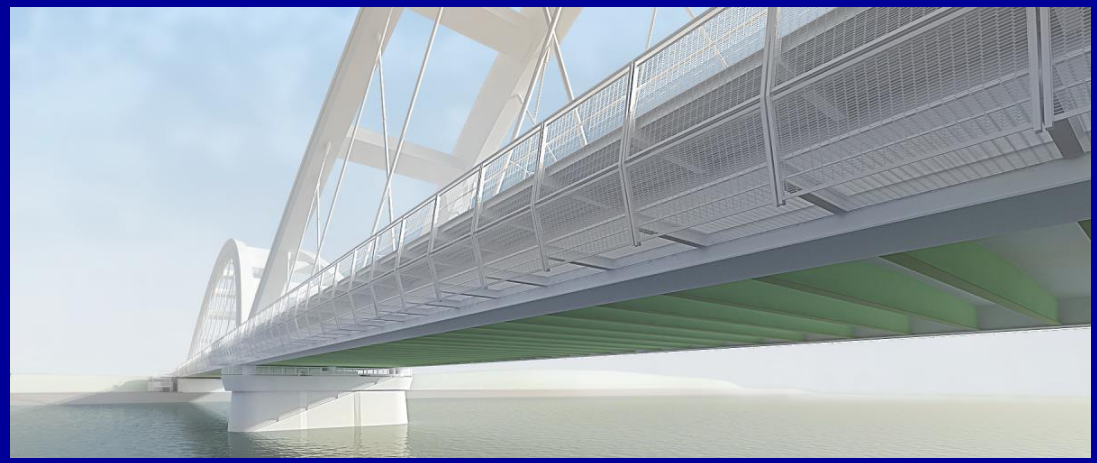
Bridge in Novi Sad and similar rail bridges in the world
Most u Novom Sadu i slični želez. mostovi u svetu

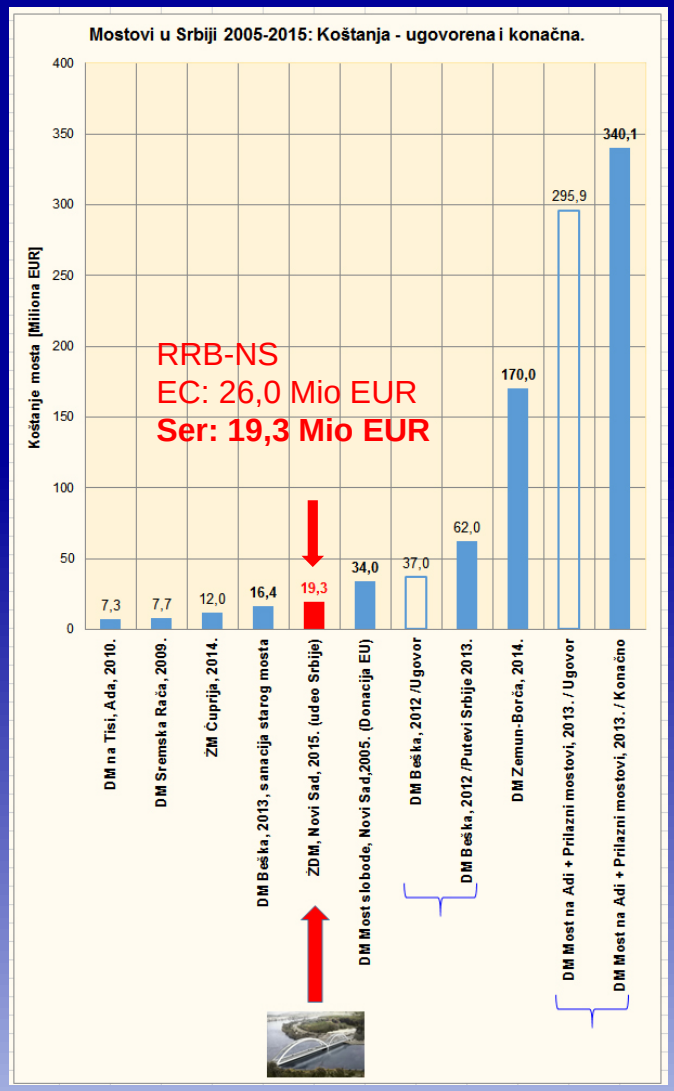



Rank	*Trussed tied arches*	*Arches with tie as girder*	*Teid arches 1 track*	*Tied arches 2 tracks*
1	**Wanzhou Bridge** China, 2005, **360 m**, 1 track	**Caiyuanba Bridge** China, 2009, **420 m** 2 tracks M + 6 lanes	**Fehmarnsund** (NW) Germany, 1963, **248 m**, 1 track + 2 lanes	**RRB Novi Sad** (NW) Serbia, 2015, **219 m** 2 tracks + 2 lanes
2	**Dashengguan Bridge** China, 2005, **336 m**, 6 tracks	**Yiwan Bridge** China, 2008, **275 m**, 2 tracks	**Main Bridge** Germany, 1993, **160 m**, 1 track	**RRB Novi Sad** (NW) Serbia, 2015, **177 m** 2 tracks + 2 lanes
3	**Hell Gate Bridge** USA, 1918, **298 m**, 3 tracks	**Hammer Bridge** Germany, 1987, **250 m**, 4 tracks	**Vahldorf Bridge** Germany, 2005, **150 m**, 1 track	**Ogatayama Bridge** (NW), Japan, 1995, **139 m**, 2 tracks

M = Metro; NW = Network hangers

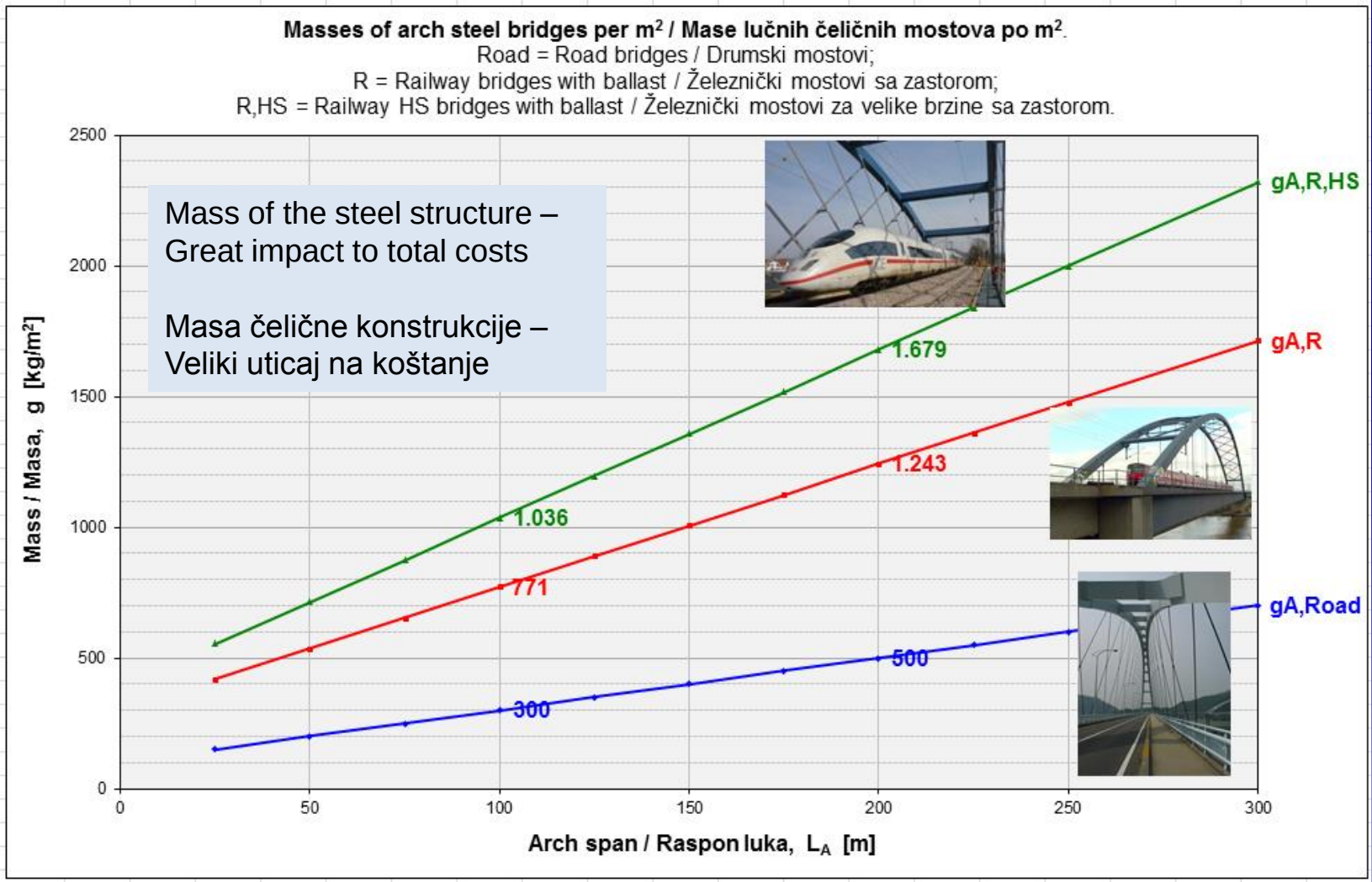
Bridge in Novi Sad: Rationality and costs
Most u Novom Sadu: Racionalnost i koštanje



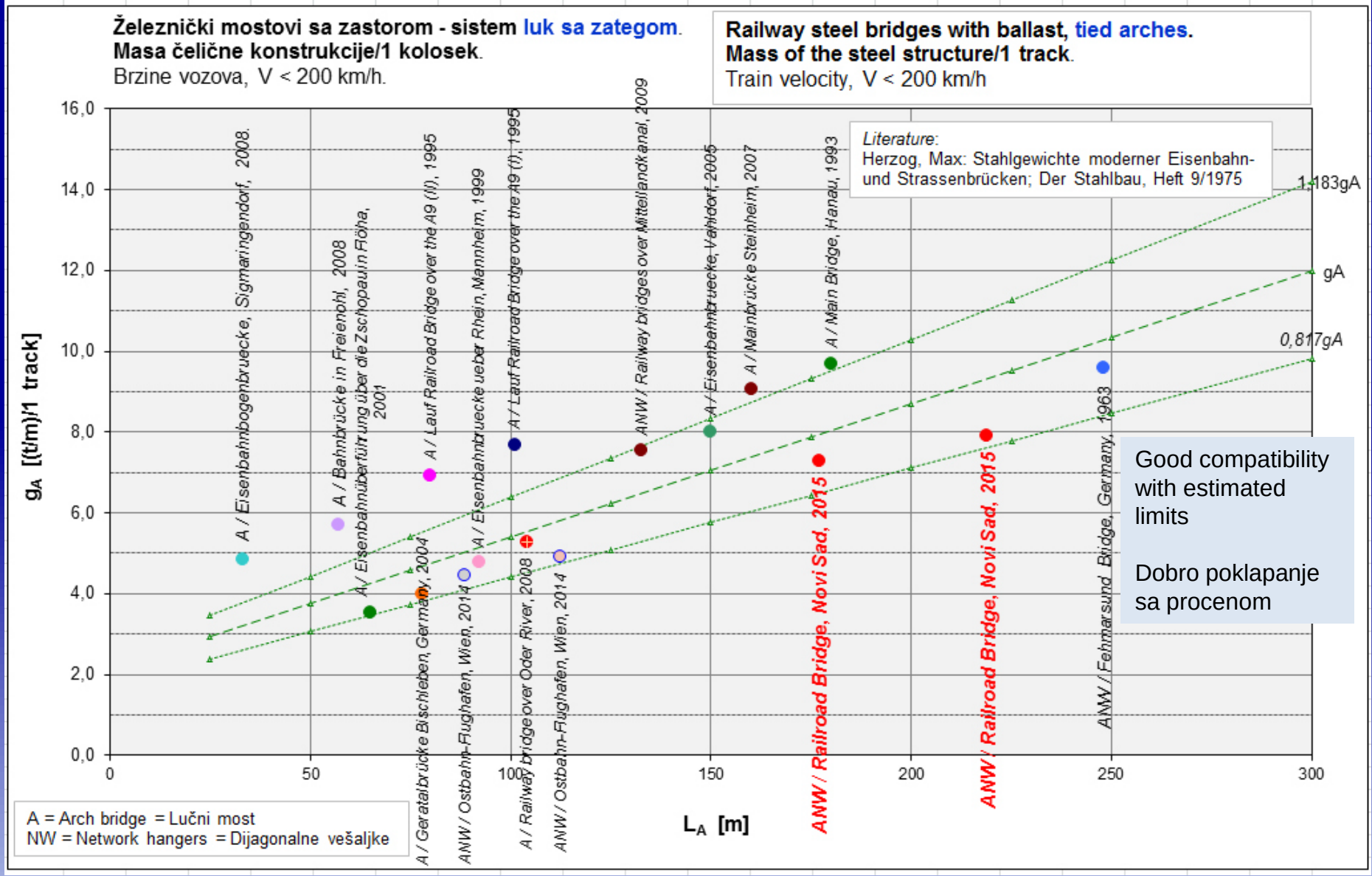


Masses of arch steel bridges: Masses of steel per m².

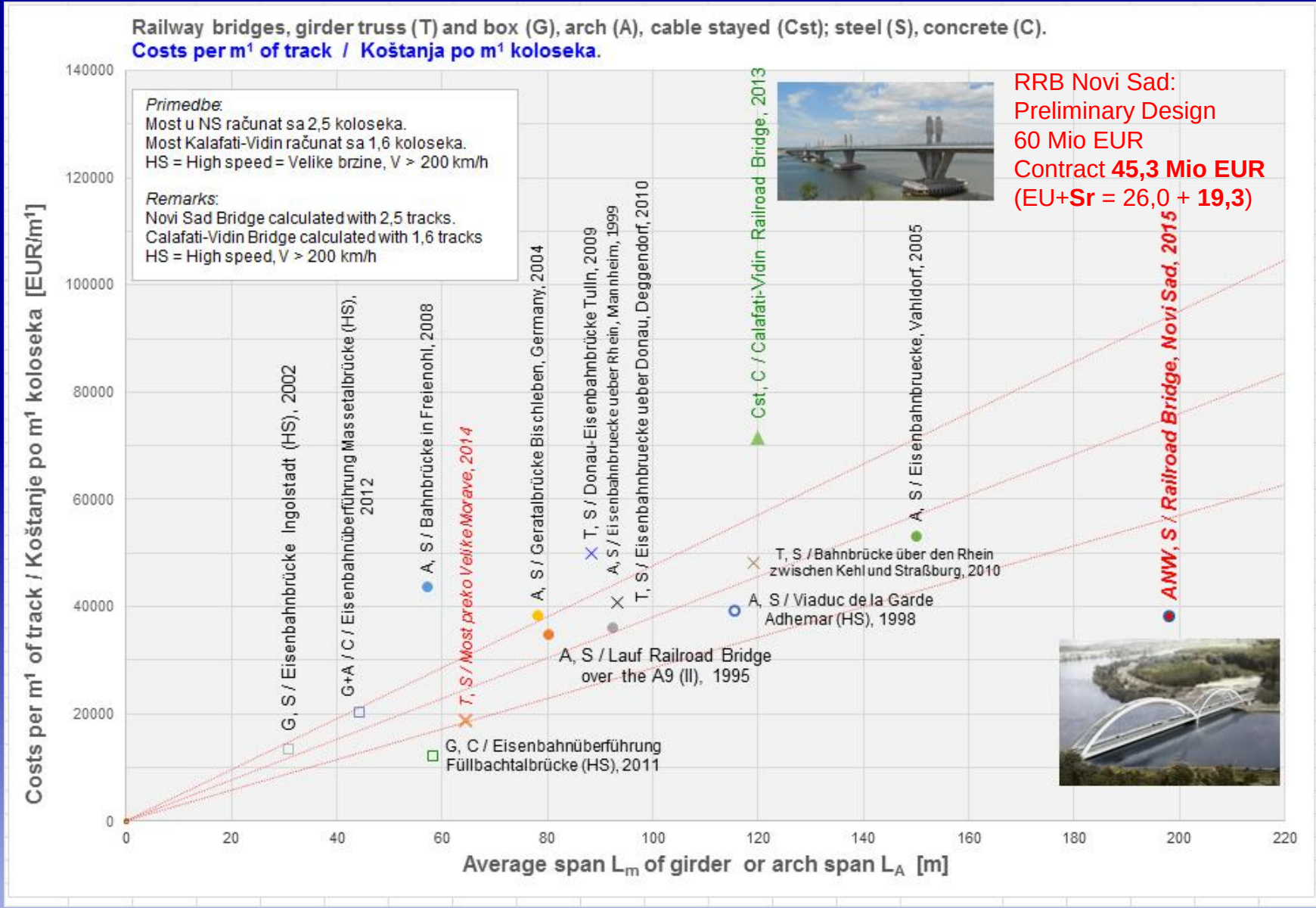
Masses ratios: (Road) : (Railway) : (Railway ≥ 200 km/h) ≈ 1 : 2,5 : 3,5.



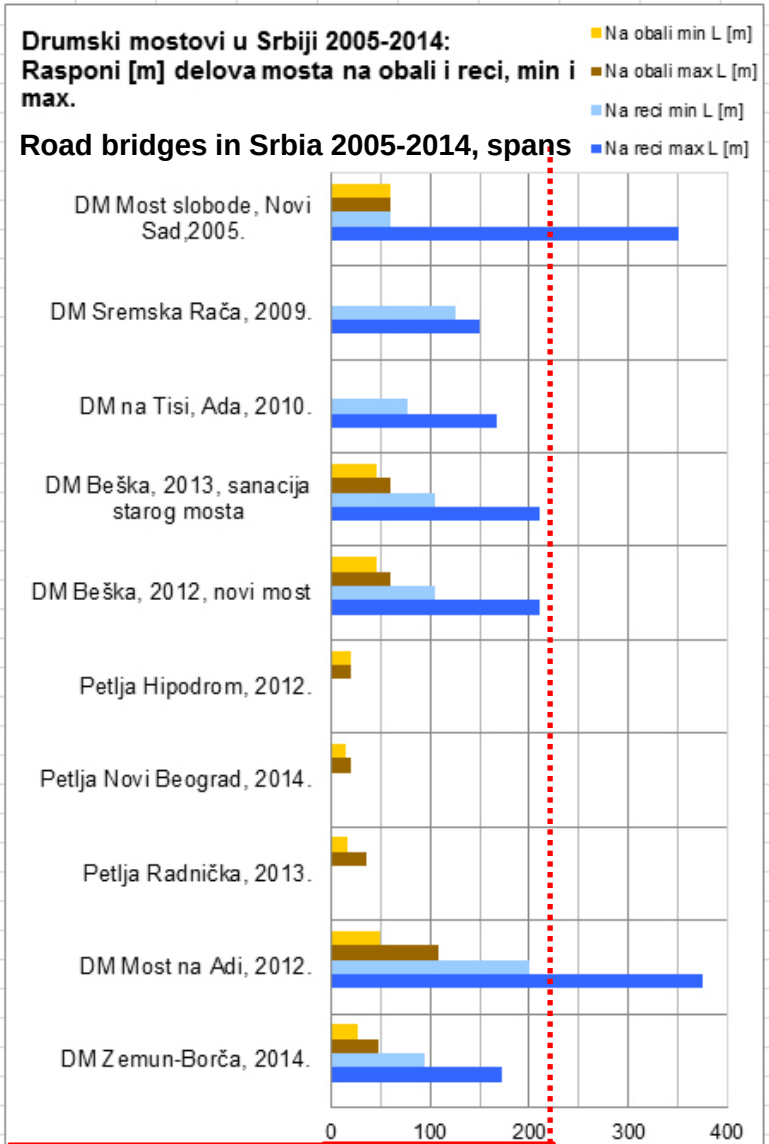
Railway steel bridges: Masses of steel per m[1] of track. Examples



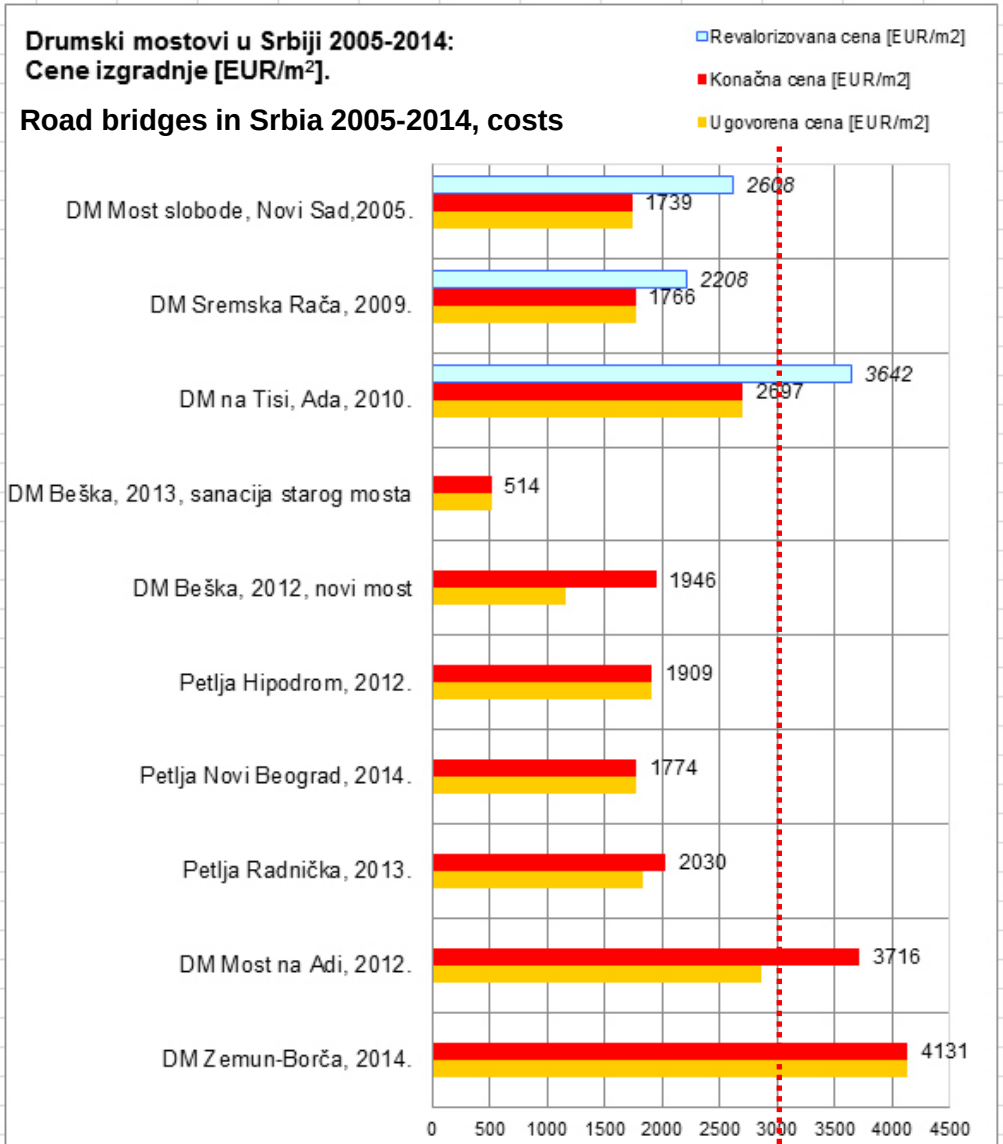
Railway bridges: Costs per m¹ of track



Road bridges in Serbia and RR Bridge in Novi Sad: Costs EUR/m²



RRB Novi Sad | **219 m**



RRB Novi Sad | **3044 EUR/m²**


Road bridges in Serbia and RRB Novi Sad, Costs / Drumski mostovi u Srbiji i ŽDM Novi Sad, koštanje
Mio EUR
200
150
100
50
0
179
62
161
170
45
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015


Road bridges in Serbia and RRB Novi Sad, Costs / Drumski mostovi u Srbiji i ŽDM Novi Sad, koštanje
EUR/m2
5000
4000
3000
2000
1000
0
1.924
1.946
3.716
4.131
3.044
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015


Road bridges in Serbia and RRB Novi Sad, Traffic load
Drumski mostovi u Srbiji i ŽDM Novi Sad, Saobraćajno opterećenje
kN/m
400
300
200
100
0
52
52
140
97
294
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015


Road bridges in Serbia and RRB Novi Sad, Costs / Drumski mostovi u Srbiji i ŽDM Novi Sad, koštanje EUR/m2
5000
4000
3000
2000
1000
0
1.924
1.946
3.716
4.131
3.044
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015


Road bridges in Serbia and RRB Novi Sad, Part over water %
Drumski mostovi u Srbiji i ŽDM Novi Sad, Deo preko reke %
100
80
60
40
20
0
0
19
60
25
84
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015


Road bridges in Serbia and RRB Novi Sad / Drumski mostovi u Srbiji i ŽDM Novi Sad, max L [m]
400
300
200
100
0
25
210
376
172
219
DM Petlje Beograd, 2013
DM Beška, novi, 2012
DM na Adi, Beograd, 2013
DM Zemun-Borča, 2014
ŽDM Novi Sad, 2015

Bridge in Novi Sad: Rationality and costs
Most u Novom Sadu: Racionalnost i koštanje

Structural materials / Materijali za konstrukciju

Foundation and Piers not included
Fundiranje i stubovi nisu uključeni

Material / Materijal	*Quantity / Količina*
Structural steel Čelik konstrukcije	10200 t
Secondary steel structures Sekundarne čelične konstrukcije	400 t
Cable stays Kablovi	200 t
Concrete Beton	3800 m^3
Reinforcement bars Armatura	1200 t
Headed studs Moždanici sa glavom	77000 pcs

Railway Road Bridge in Novi Sad is a vary rational and cheap bridge

Železničko-drumski most u Novom Sadu je vrlo racioanalan i jevtin most

Railway Road Bridge in Novi Sad: Participants
Železničko-drumski most u Novom Sadu: Učesnici

Financing	**Delegation of the European Commission to the Rep. Serbia** **Autonomy Province of Vojvodina** **Municipality of Novi Sad.**	
Contractor	**JV Azvi, Taddei, Horta Coslada**	
	Azvi S.A., Seville, Spain **Taddei** S.p.A., L'Aquila, Italy **Horta Coslada** S.L., Madrid. Spain	www.azvi.es www.gruppoedimo.it/taddei
Subcontractors for designing	*Detailed design of the bridge structure*: **DEL ING** d.o.o., Belgrade, Serbia *Detailed design of the foundation and piers*: **ENCODE** d.o.o., Belgrade, Serbia	www.deling.rs
Subcontractors for construction	*Assembling of the steel structure and Pier 3*: **Mostogradnja** a.d., Belgrade, Serbia	www.mostogradnja.rs
	Cable stays: **VSL** Ltd., Switzerland / Poland	www.vsl.com
	Launching: **Mammoet**, Rotterdam, Netherland	www.mammoet.com
	Bearings and expansion joints: **FIP Industriale** S.p.A., Servazzano, Italy	www.fip-group.it

Railway Road Bridge in Novi Sad: Participants
Železničko-drumski most u Novom Sadu: Učesnici

Team	*Role*	*Persons*
Contractor (JV Azvi – Taddei – Horta Coslada)	Project Manager Deputy Project Manager Engineering Department Manager (until 2013-08) Engineering Department Manager	**Antonio Mora**, M.Sc.CE **Luciano Casasola**, M.Sc.CE **Jorrit Blom**, M.Sc.ME **Lazar Pavić**, M.Sc.CE
Bridge structure design (DEL ING)	Lead Bridge Structure Design Engineer Design Engineers Associate Design Engineers	**Aleksandar Bojović**, M.Sc.CE **Zlatko Marković**, Prof. Ph.D.CE **Dimitrije Aleksić**, M.Sc.CE **Marko Pavlović**, Ph.D.CE, **Milan Spremić**, Ph.D.CE **Novak Novaković**, M.Sc.CE, **Uroš Kostić**, M.Sc.CE **Boško Janjušević**, M.Sc.CE
Foundation and piers design (ENCODE)	Lead Foundation and Piers Designer Design Engineer	**Damir Peco**, M.Sc.CE **Ivan Bojović**, M.Sc.CE, **Stevan Šijan**, M.Sc.CE
Engineer (JV DB International, Egis International)	Engineer's Project Team Leader Chief Check Engineer Resident Chief Supervising Engineer	**Dragi Marjanović**, M.Sc.CE **Goran Tadić**, M.Sc.CE **Stanislav Kolundžija**, M.Sc.CE

Railway Road Bridge in Novi Sad
Železničko-drumski most u Novom Sadu