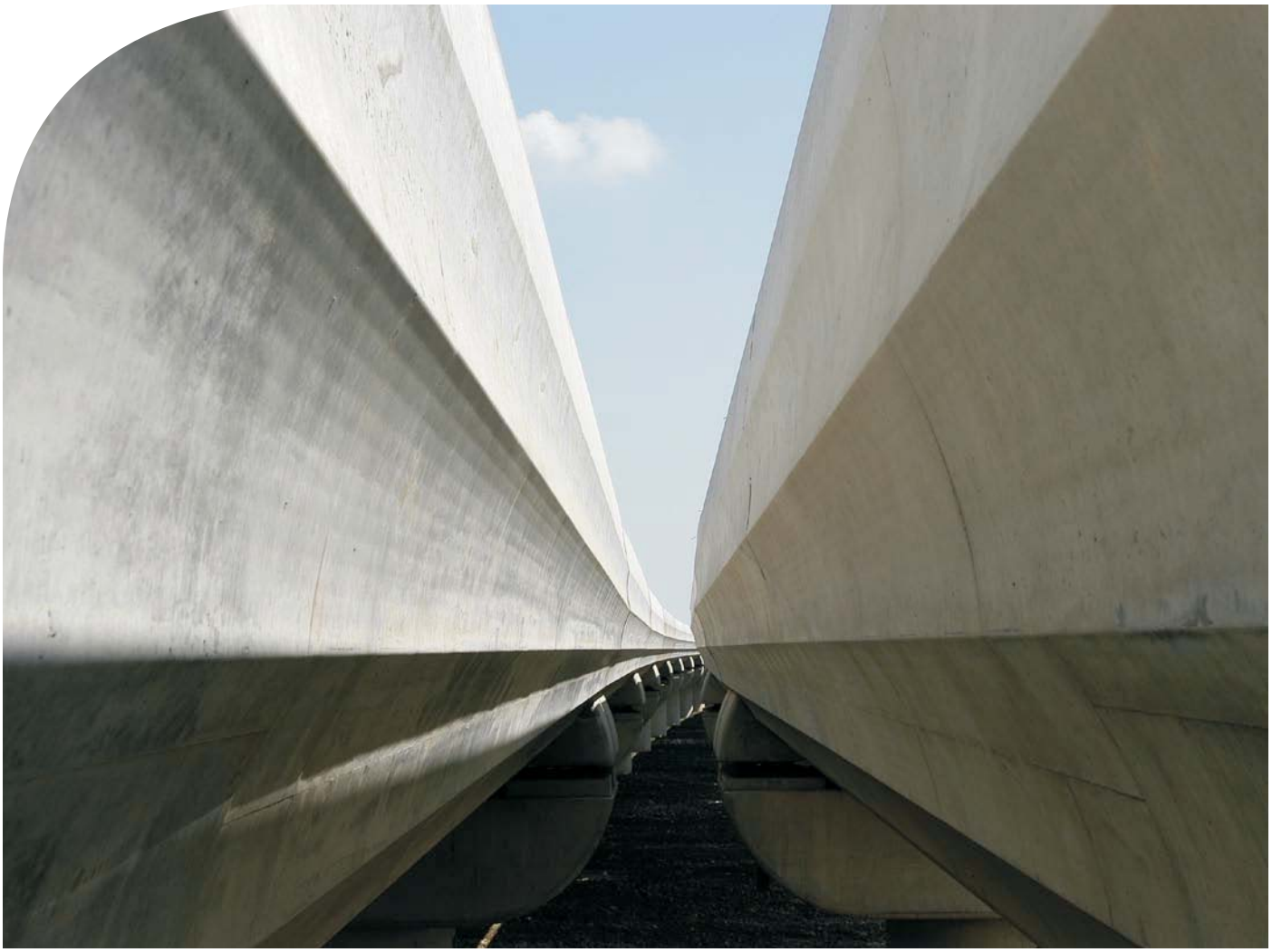
TRI OMEGA INŽENJERING

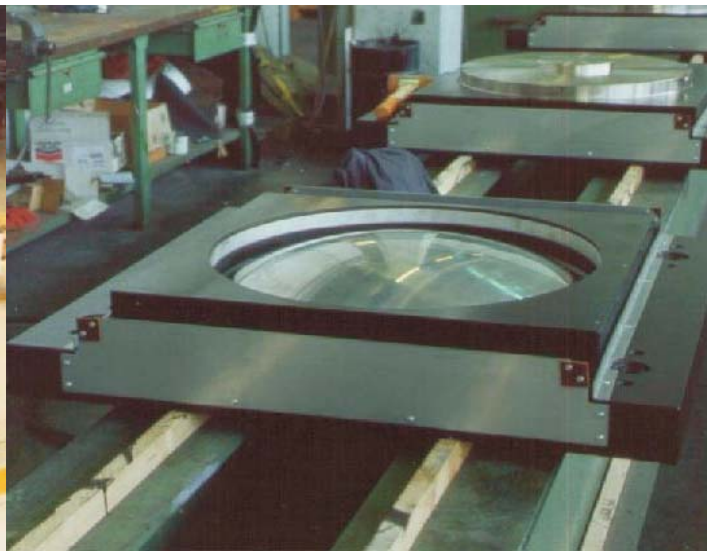
Alga
TECHNOLOGICAL THINKING

Algalink

Sferon



Proizvodnja SFERON ležišta kapaciteta 110.000 kN za most Plok u Varšavi
Fabrication of 110.000 kN capacity SFERON bearings for the Plok Bridge in Warsaw.



Proizvodnja SFERON ležišta za mostove u okviru Italijanske brze železnice
Fabrication of the SFERON bearings for the bridges of the Italian High Speed Railway.

1. Osnovne karakteristike

ALGALINK SFERON ležišta su rezultat najnovije tehnologije. Ona su napravljena za železničke mostove preko kojih idu brze pruge, ali su pogodne i za druge konstrukcije.

Njihove glavne karakteristike su:

• Klizeći materijal, nazvan XLIDE je inovativan proizvod i rezultat je zajedničkog istraživanja ALGE u saradnji sa Politecnico di Milano. Upotreba ovog proizvoda umesto teflona ima mnoge prednosti:
- Produžen životni vek ležišta najmanje za 5 godina. Poznato je da će na mostovima koji su svakodnevno izloženi teškom saobraćaju klizni materijal stalno kliziti i da će posle izvesnog perioda biti istrošen. XLIDE ima 5 puta veću otpornost na habanje nego teflon.
- Polje temperature ležišta je veće, do -50ºC, dok je kod teflona -35ºC.
- Dimenzije ležišta mogu biti manje, zahvaljujući čvrstoći na pritisak XLIDE-a koja je dvostruko veća nego kod teflona.

• Proračun rotacije SFERON ležišta uobičajeno je ±3º (0,005 rad). Ovo omogućava kompenzaciju ne samo elastičnih rotacija mosta, nego i nagibu greda, proizvodnje i ugradnje montažnih greda.
Sa ovom dozvoljenom rotacijom, instalacija montažnih greda je u velikoj meri pojednostavljena, jer se izbegava upotreba skupih klinastih ploca. Ovim se omogucava značajna ušteda i ubrzava montaža greda.

• Fiksna ležišta mogu imati apsorbujući prsten koji izjednačava horizontalne sile kada je potrebno montirati dva ili više ležišta na istom stubnom mestu (osi). Apsorbujući prsten otklanja neizvesnost od horizontalnog opterećenja omogućavajući jednaku raspodelu među različitim ležištima.

1. General features

ALGALINK SFERON bearings are the result of the most updated technology. They have been developed for the bridges of the high speed railways but are suitable for all kinds of structures. Their main characteristics are the following:

• The sliding material is an innovative product, called XLIDE, the result of a research performed by ALGA in collaboration with Politecnico di Milano. The use of this product in substitution of the PTFE leads to the following great advantages:
- The useful life of the bearings is extended by a factor at least 5. It is well known that for bridges subjected to heavy traffic the sliding material will continuously slide and will be worn out after a certain period. XLIDE has a resistance to wear at least 5 times greater than PTFE
- The field of temperature of the bearings is extended to -50°C instead of the -35°C actually allowed for PTFE
- The dimensions of the bearings may be reduced because the characteristic compression strength of XLIDE® is more than twice that of PTFE.

• The design rotation of the SFERON bearings is normally ± 3° (0,05 rad). This allows the compensations not only of the elastic rotations of the bridge but also that due to the inclination of the beams or the manufacturing and installation tolerances of the prefabricated beams. With such an allowable rotation the installation of prefabricated beams is greatly simplified, avoiding the use of expensive wedge plates. It is possible to achieve a considerable saving and speed up the erection of the beams
The fixed bearings may be equipped with a damping ring that will equalize the horizontal loads when it is necessary to install 2 or more fixed bearings on the same bearing axe. The damping ring avoids the uncertainty of the repartition of the horizontal load allowing to share it in equal parts between the different bearings.

Kontrola kvaliteta SFERON ležišta kapaciteta 110.000 kN izrađenih za most Plok u Varšavi. Proveru sproveo dr Njemierko iz Instituta IBDIM iz Varšave.

Quality control of the SFERON bearings with 110.000 kN Capacity for the Plok Bridge in Warsaw. The checks are performed by Dr. Njemierko of IBDIM Warsaw.

2. Osobine

XLIDE klizni materijal

XLIDE je inovativni klizni materijal, rezultat bio-medicinskih istraživanja, prikladno modifikovan tako da smanji koeficijent trenja i poveća njegovu karakterističnu snagu kompresije. S hemijske tačke gledišta, XLIDE je modifikovan polietilen sa molekularnom težinom blizu ∞. Pored toga, XLIDE je ispunjen posebnim aditivima kako bi se smanjio koeficijent trenja ili povećao, ako je to potrebno, radi rasipanja energije. To je rezultat istraživanja koje je izvršeno na Politecnico di Milano, Katedra za konstrukcije, po nalogu ALGE.

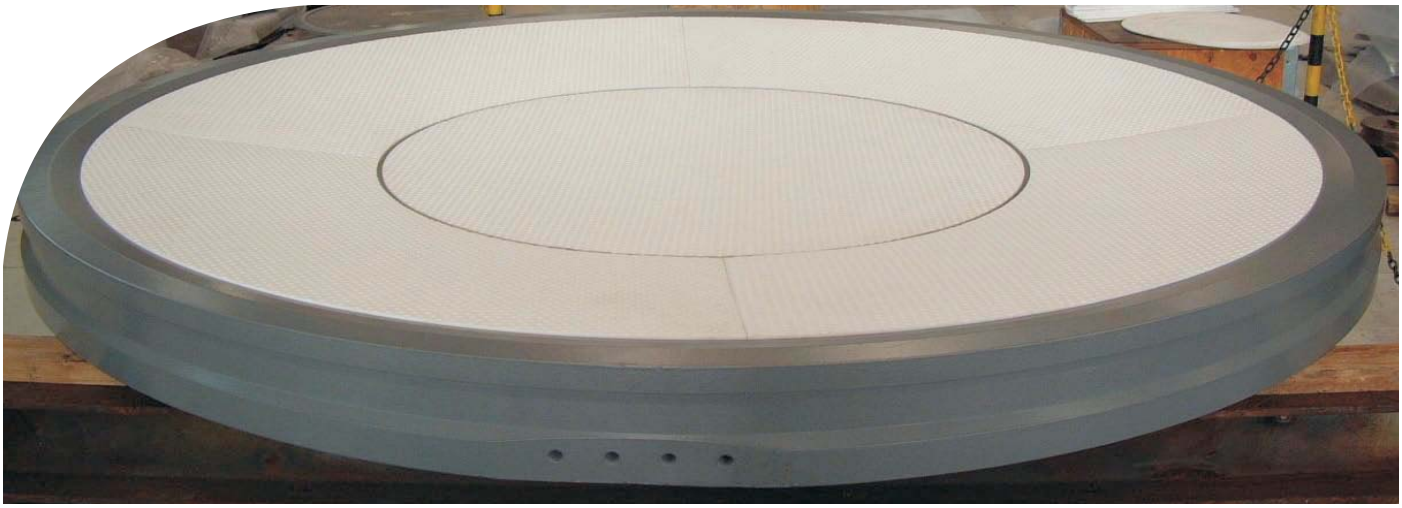
Njegove glavne fizičko-mehaničke osobine, kao i koeficijent trenja, dati su u sledećim tabelama.

2. Performances

XLIDE sliding material

XLIDE is an innovative sliding material, derived from the bio-medical research and suitably modified to reduce its friction coefficient and increase its characteristic compression strength. From the chemical point of view XLIDE is a modified polyethylene having molecular weight near to ∞. In addition XLIDE is filled with special additives to reduce its friction coefficient or to increase it if required for energy dissipation purposes. It is the result of a research committed by ALGA to Politecnico di Milano, Structural Engineering Department. Its main physical-mechanical properties as well as the friction coefficients are given in the following tables.

Svojstva / *Property*	**Norma / *Standard***	**Zahtevi / *Requirement***	**Tolerantnost / *Tolerance***
Specifična masa / *Specific mass*		940 kg/m3	± 5%
Čvrstoća na pritisak / *Compression strength*		190 MPa	⩾
Modul elastičnosti / *Elasticity modulus*	EN ISO 527-1 e 3	850 MPa	± 20%
Prinos stresa / *Yield stress*		21,5 MPa	± 10%
Zatezna čvrsoća / *Tensile strength*		30 MPa	⩾
Izduženje pri prekidu / *Elongation at failure*		250%	⩾
Čvrstoća / Hardness	EN ISO 2039-1	33	± 20%



Koeficijent trenja - Dugoročni test
Friction coefficient – Long term test

Temperaturni test	Klizna dužina 22 m		Klizna dužina 51320 m	
	$\mu_{s,T}$	$\mu_{dyn,T}$	$\mu_{s,T}$	$\mu_{dyn,T}$
0°C			0.018	0.011
-20°C			0.026	0.018
-35°C	0.018	0.012	0.035	0.025
-50°C	0.025	0,018	0,042	0,033
+21°C			0.015	0.009

NOTE:

- $\mu_{s,T}$ je statički koeficijent trenja na temperaturi T
- $\mu_{dyn,T}$ je dinamički koeficijent trenja na temperaturi T

Pored toga, XLIDE je:

- neškodljiv po prirodu
- netoksičan
- biokompatibilan
- otporan na skoro sve agresivne agense
- praktično neuništiv

NOTES:

- $\mu_{s,T}$ is the static friction coefficient at temperature T
- $\mu_{dyn,T}$ is the dynamic friction coefficient at temperature T

In addition XLIDE:

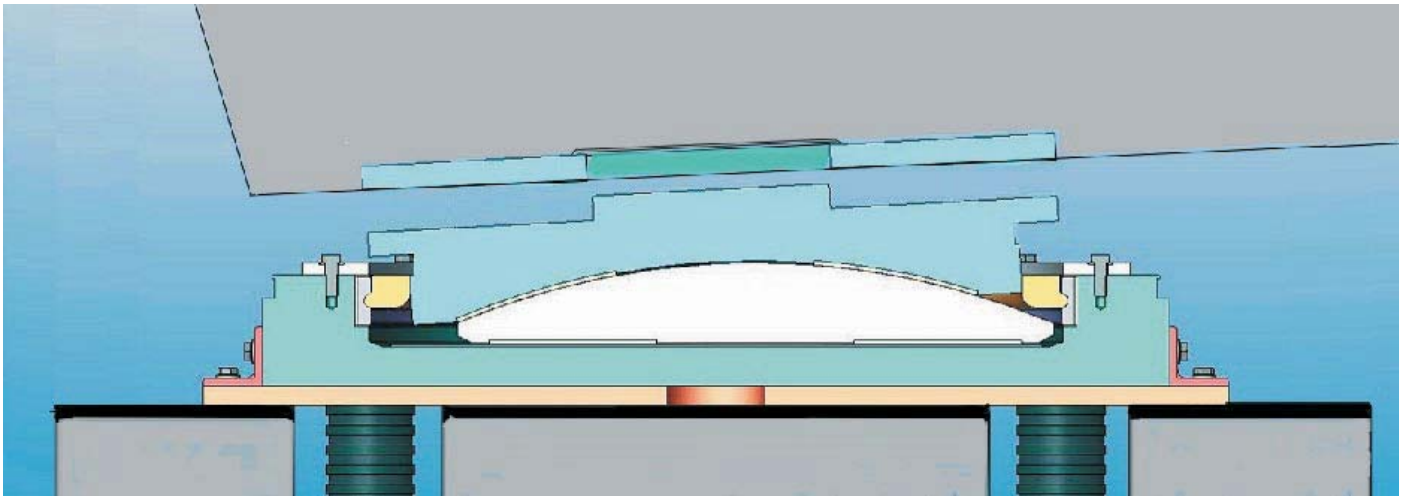
- is environment friend
- non toxic
- bio-compatible
- resistant to almost all aggres - sive agents
- practically indestructible

3. Ugradnja

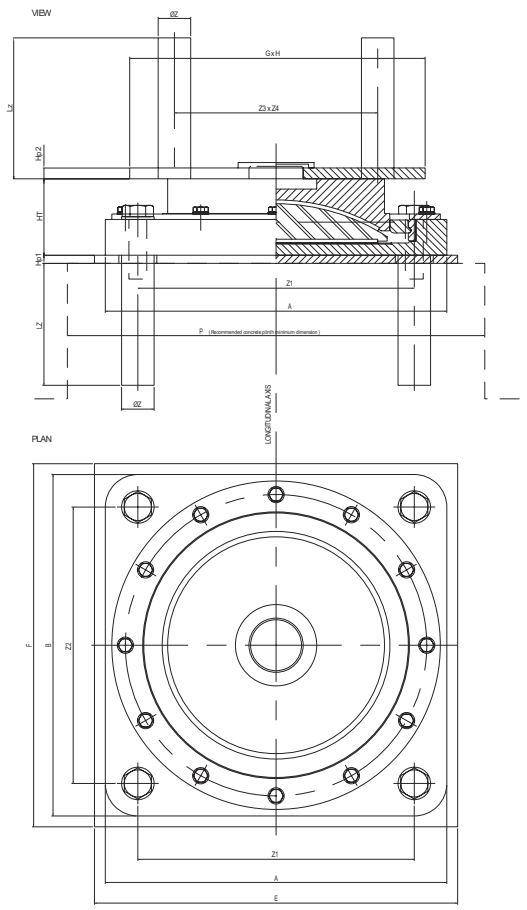
Upotrebom SFERON ležišta umanjuju se troškovi izgradnje mosta, posebno ukoliko su u pitanju gotovi betonski nosači. U tom slučaju, ležišta se montiraju sa glavnom klizajućom površinom na dnu, dok gornji deo ležišta sa sposobnošću rotacije od 0,05 rad može da primi naginjanje greda zbog fabričkih tolerancija nosača. Montaža mosta je veoma uprošćena i nisu potrebne skupe klinaste ploče ili privremena ležišta. Nosač može biti direktno spušten na ležište kako je to prikazano na slici dole.

3. Installation

The use of SFERON bearings can minimize the cost of the bridge erection, specially if the beams are prefabricated. In that case the bearings are installed with the main sliding surface at the bottom, whilst the upper part of the bear - ing, with its rotation capability of 0,05 rad can accommo - date the inclination of the beam due to the slope of the bridge or to the fabrication tolerances of the beam. The erection of the bridge is greatly simplified and there is no need of expensive wedge plates or temporary bearings. The beams may be directly laid down on the bearings as shown in the following picture.

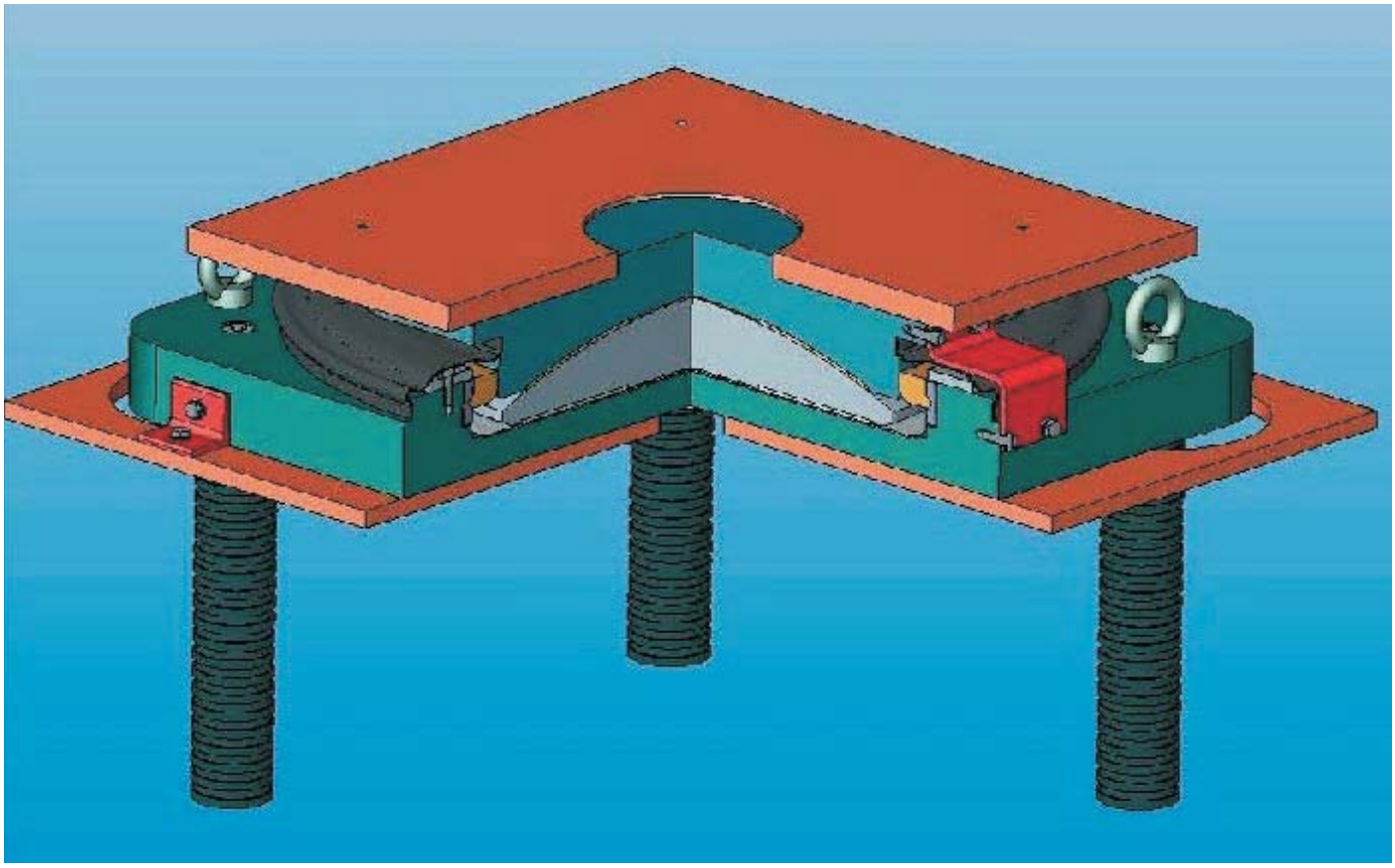


FIKSNA LEŽIŠTA / *FIXED BEARINGS*

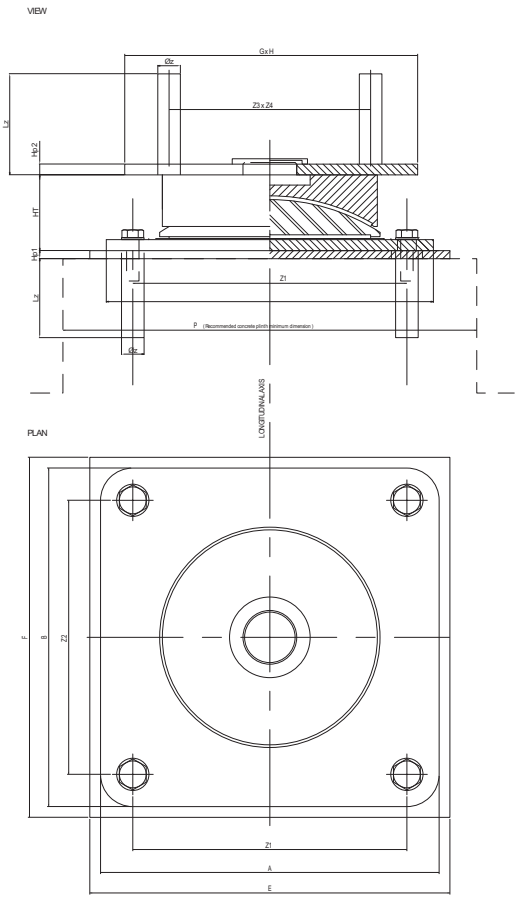


Vk	Vd	Hd	A	B	HT
kN	kN	kN	mm	mm	mm
3000	4200	600	525	525	152,5
4000	5600	800	580	580	168
5000	7000	1000	630	630	171
6000	8400	1200	680	680	181
7000	9800	1400	750	750	193
8000	11200	1600	805	805	202
9000	12600	1800	815	815	207
10000	14000	2000	860	860	216
11000	15400	2200	910	910	226
12000	16800	2400	950	950	235
13000	18200	2600	975	975	247
15000	21000	3000	1110	1110	258,5
17500	24500	3500	1140	1140	229
20000	28000	4000	1220	1220	237,5
25000	35000	5000	1350	1350	254,5
30000	42000	6000	1470	1470	278,5
40000	56000	8000	1650	1650	303,5
50000	70000	10000	1900	1900	338,5
60000	84000	12000	1990	1990	364

Vk = Karakteristično vertikalno opterećenje(SLS) / *Characteristic vertical load (SLS)*
Vd = Projektovano vertikalno opterećenje(ULS)/ *Design vertical load (ULS)*
Hd = Projektovano horizontalno opterećenje / *Design horizontal load*
A, B = Dimenzije donje ploče / *Bottom plate dimensions*
HT = Ukupna visina /*Total height*



VOĐENA LEŽIŠTA / *SLIDING GUIDED BEARINGS*



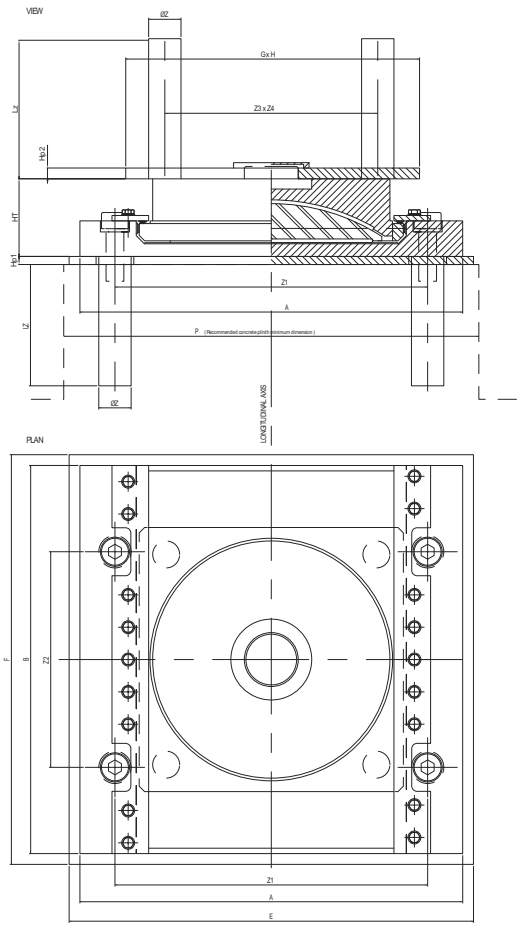
Vk	Vd	X	Y	A	B	HT
kN	kN	mm	mm	mm	mm	mm
3000	4200	±100	±25	400	550	149,5
4000	5600	±100	±25	455	605	159,5
5000	7000	±100	±25	490	640	162,5
6000	8400	±150	±25	535	785	176,5
7000	9800	±150	±25	565	815	189
8000	11200	±150	±25	605	855	191
9000	12600	±150	±25	630	880	197
10000	14000	±150	±25	660	910	201
11000	15400	±150	±25	690	940	211
12000	16800	±150	±25	715	965	220
13000	18200	±150	±25	740	990	227
15000	21000	±150	±25	795	1045	234,5
17500	24500	±150	±25	845	1095	245,5
20000	28000	±200	±25	900	1250	262
25000	35000	±200	±25	990	1340	275
30000	42000	±200	±25	1090	1440	307
40000	56000	±200	±25	1255	1605	347
50000	70000	±200	±25	1400	1750	379
60000	84000	±200	±25	1520	1870	401

Vk = Karakteristično vertikalno opterećenje(SLS) / *Characteristic vertical load (SLS)*
Vd = Projektovano vertikalno opterećnje (ULS) / *Design vertical load (ULS)*
X = Podužno pomeranje / *Longitudinal displacement*
Y = Poprečno pomeranje / *Transversal displacement*
A, B = Osnova donje ploče / *Bottom plate dimensions*
HT = Ukupna visina / *Total height*

Vijadukti kod Modene, Sekije i Panara, za Italijanske železnice, imaju preko 25 km dužine i ugrađeno je 3000 SFERON ležišta kapaciteta 3800 kN.

The Modena, Secchia and Panaro Viaducts, for the Italian High Speed railway, have over 25 km length and employs over 3000 SFERON bearings of 3800 kN capacity.

LEŽIŠTA POKRETNA U SVIM PRAVCIMA / *FREE SLIDING BEARINGS*



Vk	Vd	Hd	X	A	B	HT
kN	kN	kN	mm	mm	mm	mm
3000	4200	600	±100	580	590	159
4000	5600	800	±100	660	640	165
5000	7000	1000	±100	710	690	184
6000	8400	1200	±150	780	840	192
7000	9800	1400	±150	865	880	191
8000	11200	1600	±150	920	920	200
9000	12600	1800	±150	955	950	207
10000	14000	2000	±150	1010	985	222
11000	15400	2200	±150	1070	1025	231
12000	16800	2400	±150	1100	1055	237
13000	18200	2600	±150	1160	1140	246,5
15000	21000	3000	±150	1235	1140	258,5
17500	24500	3500	±150	1335	1200	236
20000	28000	4000	±200	1420	1380	236
25000	35000	5000	±200	1580	1485	261
30000	42000	6000	±200	1720	1570	283
40000	56000	8000	±200	1940	1740	319
50000	70000	10000	±200	2185	1895	354,5
60000	84000	12000	±200	2400	2050	383

Vk = Karakteristično vertikalno opterećenje (SLS) / *Characteristic vertical load (SLS)*
Vd = Projektovano vertikalno opterećenje (ULS) / *Design vertical load (ULS)*
Hd = Projektovano horizontalno opterećenje / *Design horizontal load*
X = Podužno pomeranje / *Longitudinal displacement*
A, B = Dimenzije donje ploče / *Bottom plate dimensions*

HT = Ukupna visina / *Total height*

TRI OMEGA INŽENJERING - Cara Dušana 48/II - 11000 Beograd- www.3omegaing.com - office@3omegaing.com - tel/fax +381 11 26 28 669, 26 38 754

Alga S.p.A. - Sede e Direzione - Main office: Via Dei Missaglia 97/A2 - 20142 Milano - www.alga.it - alga@alga.it - tel. +39 02.48569.1 - fax. +39 02.48569.245