STRUCTURAL BEARING

EN 1337

DOSHIN®
RUBBER ENGINEERING

INDEX

DOSHIN RUBBER ENGINEERING

1.0 Introduction

This catalogue serves as general indicative of the typical product range of mechanical bearings (i.e. pot bearing and spherical bearing respectively), designed in accordance to relevant parts of BS EN1337. It is meant to serve as preliminary mechanical bearing selection purpose for structural designers to have a rough idea of the geometrical properties of the potential bearing. It guides the structural designer, site engineer, and contractor in all matters relating to the selection and installation of pot-type or spherical bridge bearings.

We encourage customized design for each project requirement uniquely in order to optimize the performance as well as costing aspects. The product range shown in the tables within this catalogue is only a fraction of the wide range of mechanical bearings that Doshin Rubber can produce. The typical sizes provided in this catalogue are meant for common design requirement such as axial loading ranges from 1000 to 20000 kN. For sizes, axial loadings, movement and rotational requirement not specified in this catalogue, please contact us for customized design. All product description and design values contained herein are accurate to our best knowledge under laboratory environment and design theory. Please contact our technical department should further information is required. We would also like to highlight that besides BS EN1337, Doshin Rubber also designs pot bearing in accordance with other standards and codes such as AASHTO (American Association of State Highway and Transportation Officials) and BS5400.

We reserve the rights to update or modify the technical information at any times without prior notice.

2.0 POT BEARING

2.1 Principles of POT BEARING

Unless specified, the pot bearings contained within this catalogue are designed in accordance to EN1337-5.

Steel components are of S355 with all necessary certificates upon request. Different grade of steel is possible upon request when special requirements are to be met on project basis. Main component of the pot bearing is the elastomeric pad and steel components which build up majority of the bearing system. It consists of a hollow steel cylinder (termed as pot), with an elastomeric pad fitted inside the pot to allow for rotation. A steel disc (termed as piston) locks the top part of the bearing to the cylinder through the internal pot wall. Since the elastomeric pad is confined within the pot (steel housing), pot bearing is able to transmit high vertical loads on a smaller area compared to conventional elastomeric bearing.

Generally, all steel plates are protected from corrosion according to EN1337-9. Coating system defined in ISO12944-5: 2007 is generally used most of the time which includes:

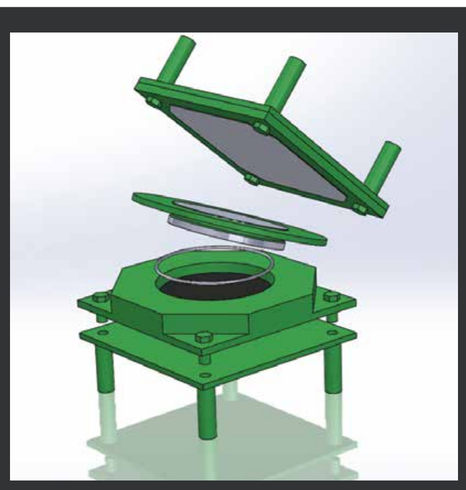
- 60 microns air sprayed zinc coating on SA2.5 grid-blasted surface
- 110 microns intermediate epoxy resin basis coating(s)
- 100 microns top epoxy coating

EN1337-5 only covers pot bearing design, regardless of a fixed-type or sliding-type, up to rotations of 0.03rad or a maximum elastomeric pad diameter of 1500mm.

2.2 Types of POT BEARING — EN 1337-5

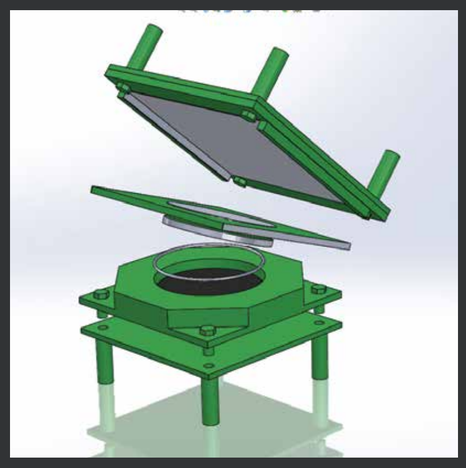
01 P-FF Series

P-FF The naming convention used in this catalogue describes the type, maximum axial load and maximum horizontal displacement. The initial P refers to pot bearing. FF refers to the free sliding pot bearing at which horizontal movement is allowed. E.g. P-FF1.00-100 means, pot bearing with free sliding capability, having an axial ULS load of 1000 kN and horizontal displacement of 100 mm.



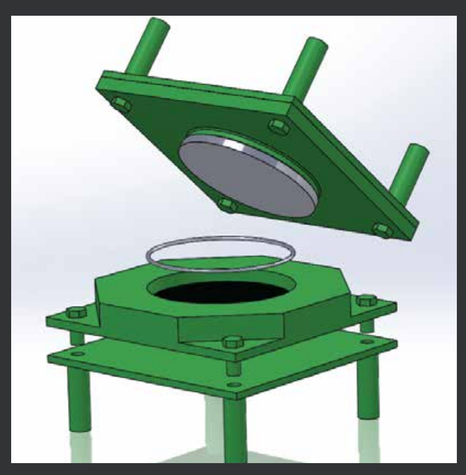
02 P-SGL / P-SGT Series

This type of pot or spherical bearing only allows horizontal movement in one single direction. SGL refers to guided longitudinal while SGT means guided transverse. Usually, the movement is restrained by guided bar (restraining steel component) to allow only movement along the unrestrained axis.



03 P-FX Series

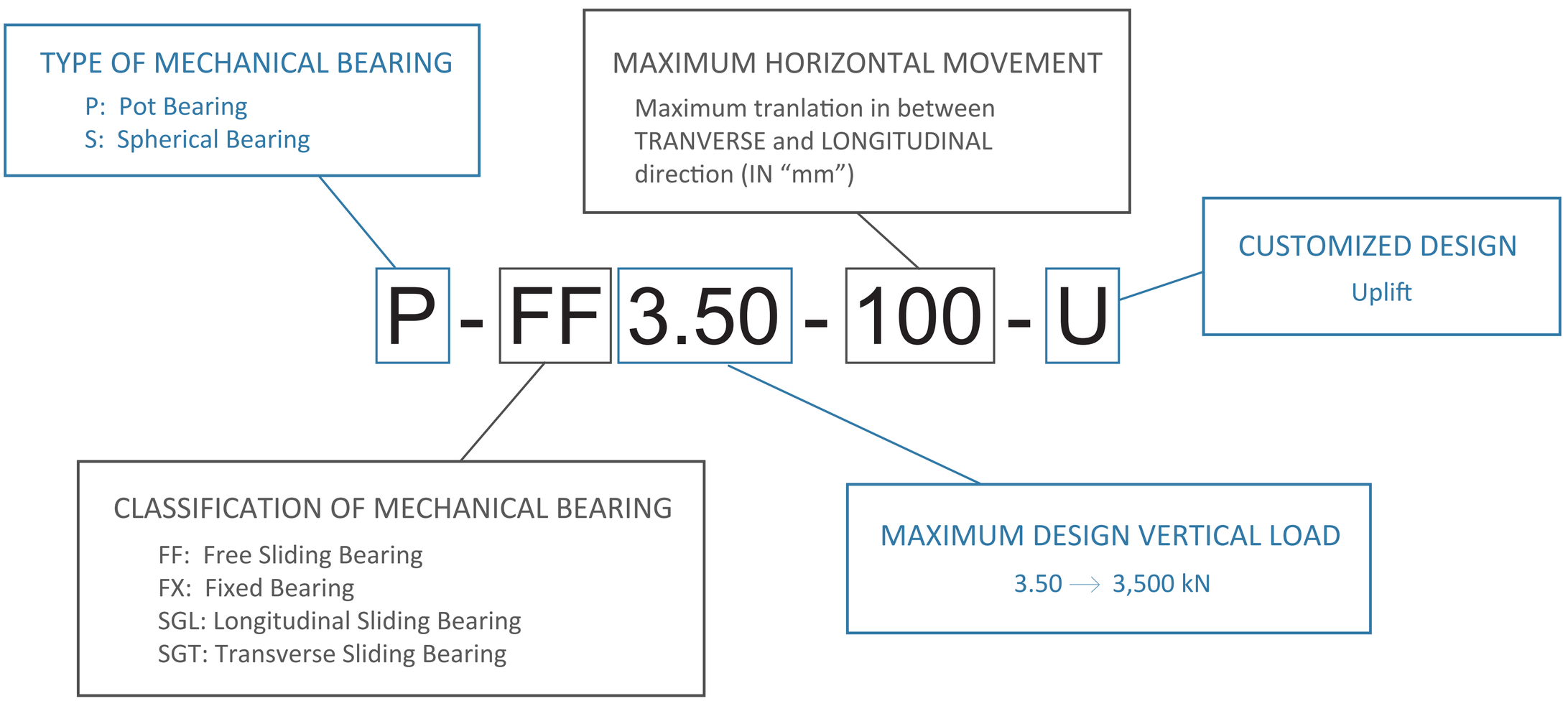
This is either pot bearing or spherical bearing with restricted movement restriction in all horizontal direction. In other words, the pot bearing transmits all horizontal forces to the substructure. Usually, these horizontal forces are originated from wind load, braking force, centrifugal force on curved elevated span, etc.



2.3 Typical POT BEARING Range

The range of pot bearing provided in the tables contained within this catalogue is designed with a total cumulative rotational capacity of 0.015 radians (inclusive of the Increased Movements required in EN1337-1:2000 5.4) and axial load demands from 1000 to 20000 kN. Concrete strength of maximum 60 MPa. For P-FF, P-SGL and P-SGT series, the horizontal displacement is kept at 100 mm in development of this catalogue. It should be noted that, custom design is highly possible by our technical department.

2.4 Legend / Label / Part No.



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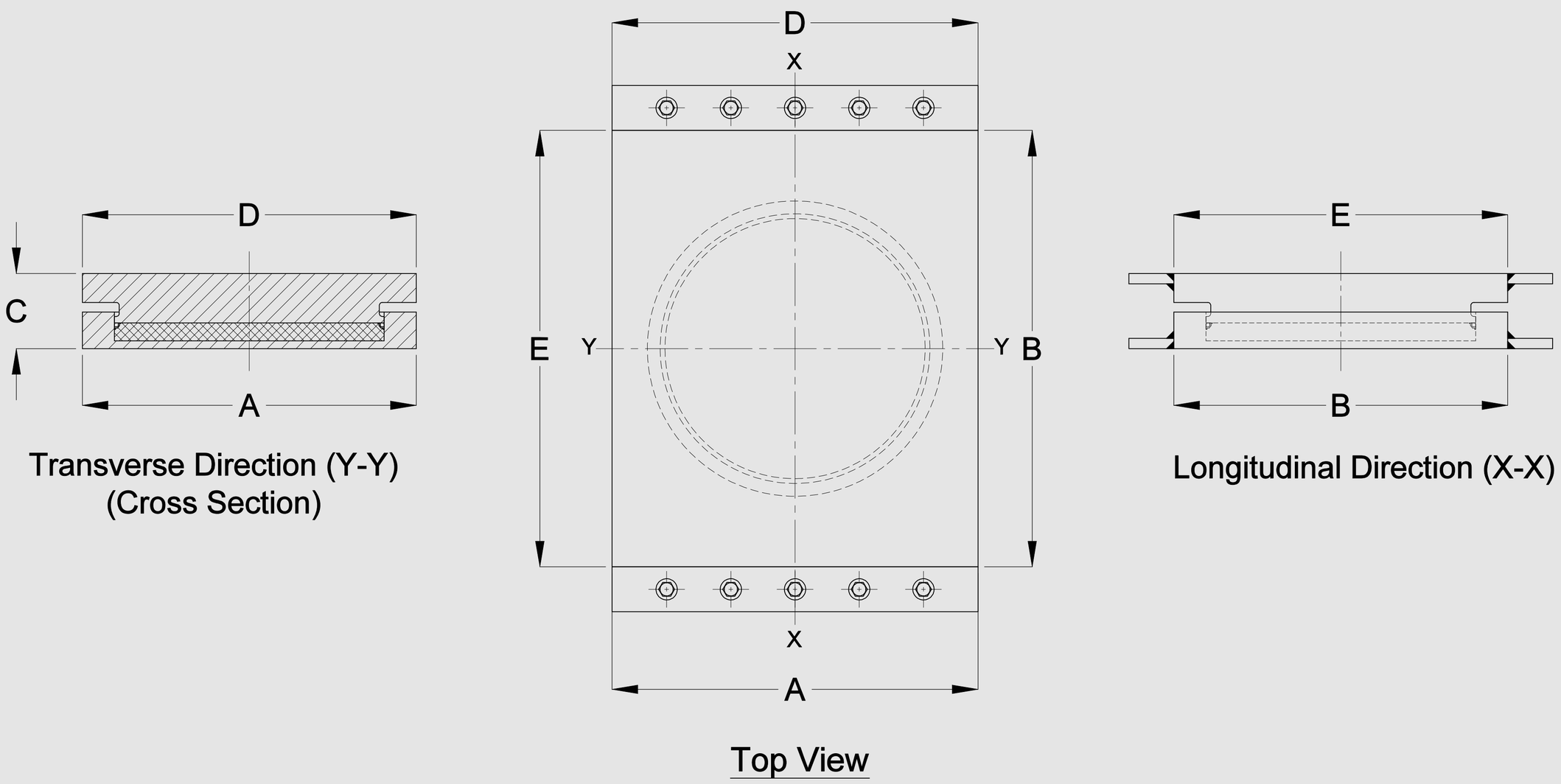
2.5 Tables of Pot Bearing

2.5.1 POT BEARING FIXED (P - FX)

Type	Vertical load (kN)	Horizontal load (kN)	B (mm * mm)	T (mm * mm)	H (mm)	Weight (kg)
P - FX 1.00 - 00	1,000	150	240	240	76	30
P - FX 2.00 - 00	2,000	300	350	350	82	67
P - FX 3.00 - 00	3,000	450	420	420	94	110
P - FX 4.00 - 00	4,000	600	480	480	104	157
P - FX 5.00 - 00	5,000	750	530	530	109	197
P - FX 6.00 - 00	6,000	900	590	590	110	247
P - FX 7.00 - 00	7,000	1,050	630	630	121	307
P - FX 8.00 - 00	8,000	1,200	680	680	128	381
P - FX 9.00 - 00	9,000	1,350	720	720	133	437
P - FX 10.00 - 00	10,000	1,500	760	760	137	510
P - FX 11.00 - 00	11,000	1,650	800	800	147	592
P - FX 12.00 - 00	12,000	1,800	840	840	147	654
P - FX 13.00 - 00	13,000	1,950	860	860	167	787
P - FX 14.00 - 00	14,000	2,100	890	890	167	844
P - FX 15.00 - 00	15,000	2,250	930	930	168	921
P - FX 16.00 - 00	16,000	2,400	950	950	183	1024
P - FX 17.00 - 00	17,000	2,550	990	990	183	1113
P - FX 18.00 - 00	18,000	2,700	1020	1020	188	1205
P - FX 19.00 - 00	19,000	2,850	1040	1040	193	1275
P - FX 20.00 - 00	20,000	3,000	1070	1070	193	1372

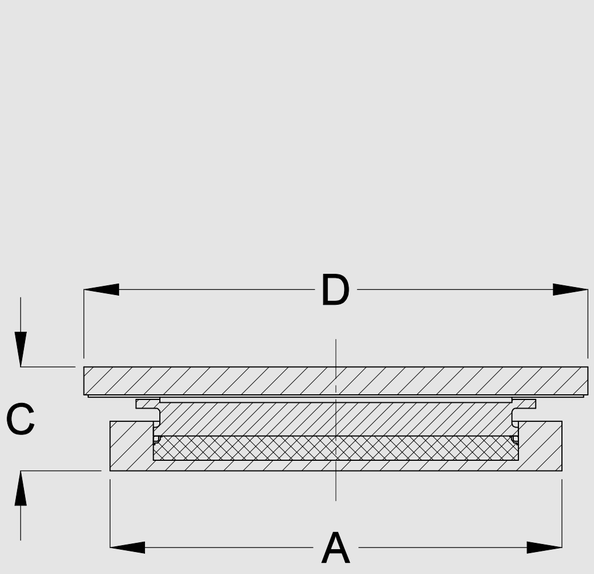
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 15% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



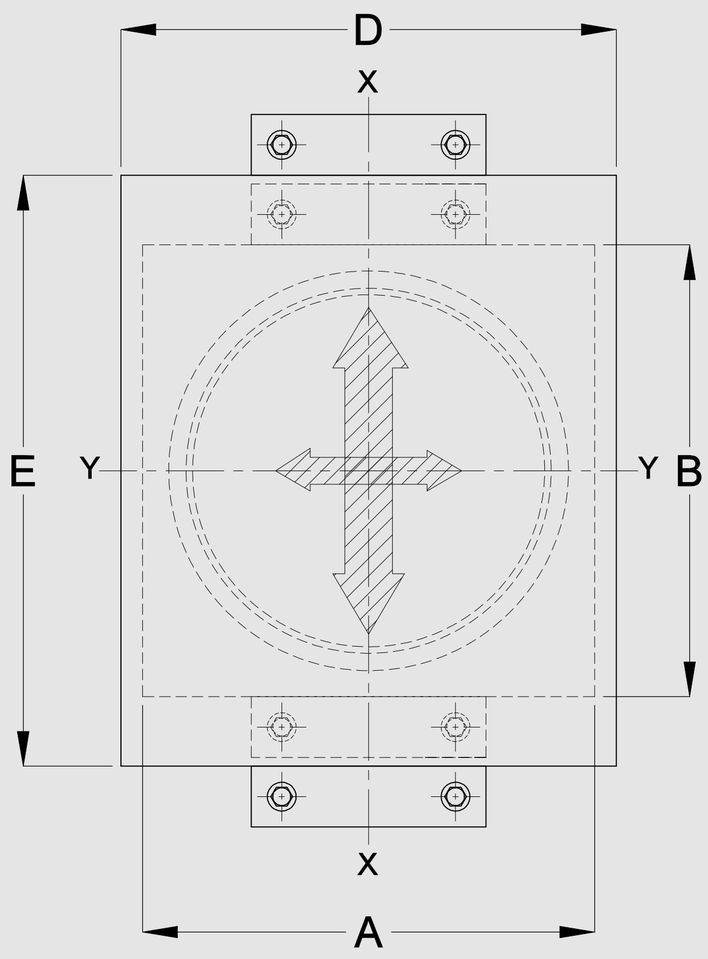
2.5.2 POT BEARING SLIDING IN ALL DIRECTIONS (P - FF)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
P - FF 1.00 - 100	1,000	150	340	340	101	350	510	87
P - FF 2.00 - 100	2,000	300	370	370	101	350	510	96
P - FF 3.00 - 100	3,000	450	440	440	106	400	560	135
P - FF 4.00 - 100	4,000	600	510	510	108	470	610	180
P - FF 5.00 - 100	5,000	750	580	580	115	520	660	238
P - FF 6.00 - 100	6,000	900	640	640	118	570	710	293
P - FF 7.00 - 100	7,000	1,050	700	700	128	610	760	377
P - FF 8.00 - 100	8,000	1,200	760	760	134	660	810	459
P - FF 9.00 - 100	9,000	1,350	780	780	141	700	810	516
P - FF 10.00 - 100	10,000	1,500	830	830	146	730	860	601
P - FF 11.00 - 100	11,000	1,650	850	850	153	770	860	664
P - FF 12.00 - 100	12,000	1,800	910	910	158	800	910	773
P - FF 13.00 - 100	13,000	1,950	960	960	164	840	960	886
P - FF 14.00 - 100	14,000	2,100	970	970	169	870	960	947
P - FF 15.00 - 100	15,000	2,250	1020	1020	174	900	1010	1073
P - FF 16.00 - 100	16,000	2,400	1040	1040	176	930	1010	1130
P - FF 17.00 - 100	17,000	2,550	1090	1090	181	950	1060	1263
P - FF 18.00 - 100	18,000	2,700	1100	1100	181	980	1060	1292
P - FF 19.00 - 100	19,000	2,850	1150	1150	187	1010	1110	1446
P - FF 20.00 - 100	20,000	3,000	1160	1160	190	1040	1110	1505

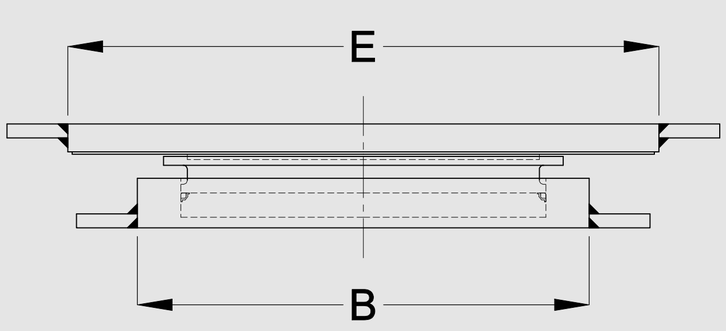
MOVEMENT : ± 100mm (L) : ± 25mm (T)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 15% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



Transverse Direction (Y-Y)
(Cross Section)



Top View

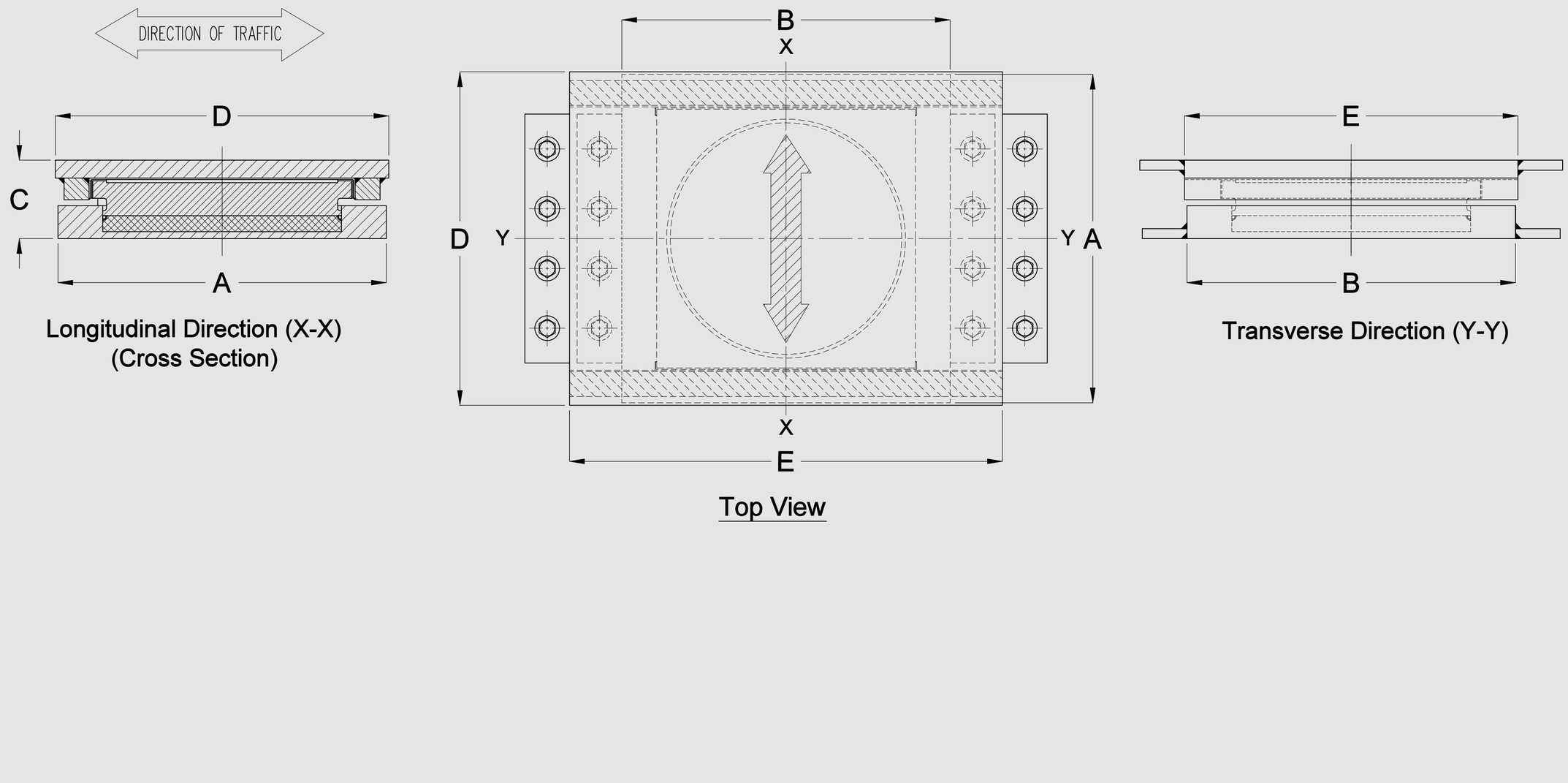


Longitudinal Direction (X-X)

2.5.3 POT BEARING SLIDING IN TRANSVERSE DIRECTIONS (P - SGT)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
P - SGT 1.00 - 100	1,000	150	340	340	117	390	550	127
P - SGT 2.00 - 100	2,000	300	370	370	119	400	550	140
P - SGT 3.00 - 100	3,000	450	440	440	124	450	600	189
P - SGT 4.00 - 100	4,000	600	510	510	127	500	650	242
P - SGT 5.00 - 100	5,000	750	580	580	132	550	700	310
P - SGT 6.00 - 100	6,000	900	640	640	136	600	750	379
P - SGT 7.00 - 100	7,000	1,050	700	700	144	650	800	473
P - SGT 8.00 - 100	8,000	1,200	760	760	155	710	850	594
P - SGT 9.00 - 100	9,000	1,350	780	780	157	710	850	619
P - SGT 10.00 - 100	10,000	1,500	830	830	164	770	900	741
P - SGT 11.00 - 100	11,000	1,650	850	850	170	780	900	796
P - SGT 12.00 - 100	12,000	1,800	910	910	175	830	950	930
P - SGT 13.00 - 100	13,000	1,950	960	960	183	880	1000	1078
P - SGT 14.00 - 100	14,000	2,100	970	970	189	890	1000	1144
P - SGT 15.00 - 100	15,000	2,250	1020	1020	197	940	1050	1317
P - SGT 16.00 - 100	16,000	2,400	1040	1040	202	950	1050	1395
P - SGT 17.00 - 100	17,000	2,550	1090	1090	206	1000	1100	1564
P - SGT 18.00 - 100	18,000	2,700	1100	1100	215	1010	1100	1659
P - SGT 19.00 - 100	19,000	2,850	1150	1150	220	1060	1150	1852
P - SGT 20.00 - 100	20,000	3,000	1160	1160	227	1080	1150	1953

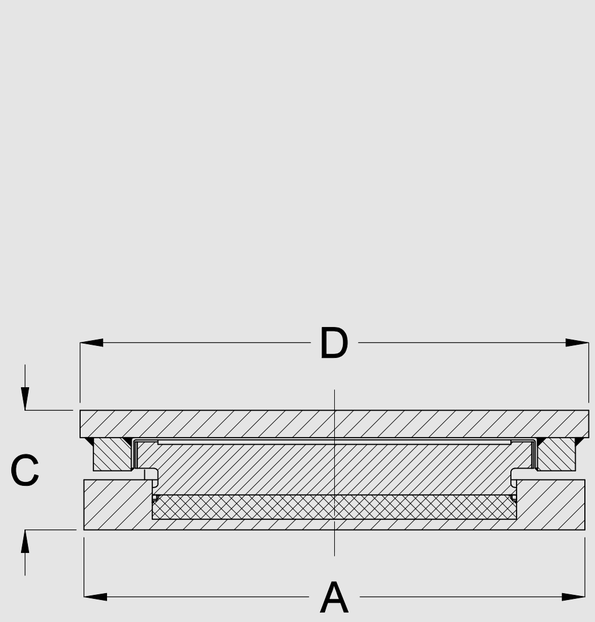
MOVEMENT : ± 100mm (T)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 15% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



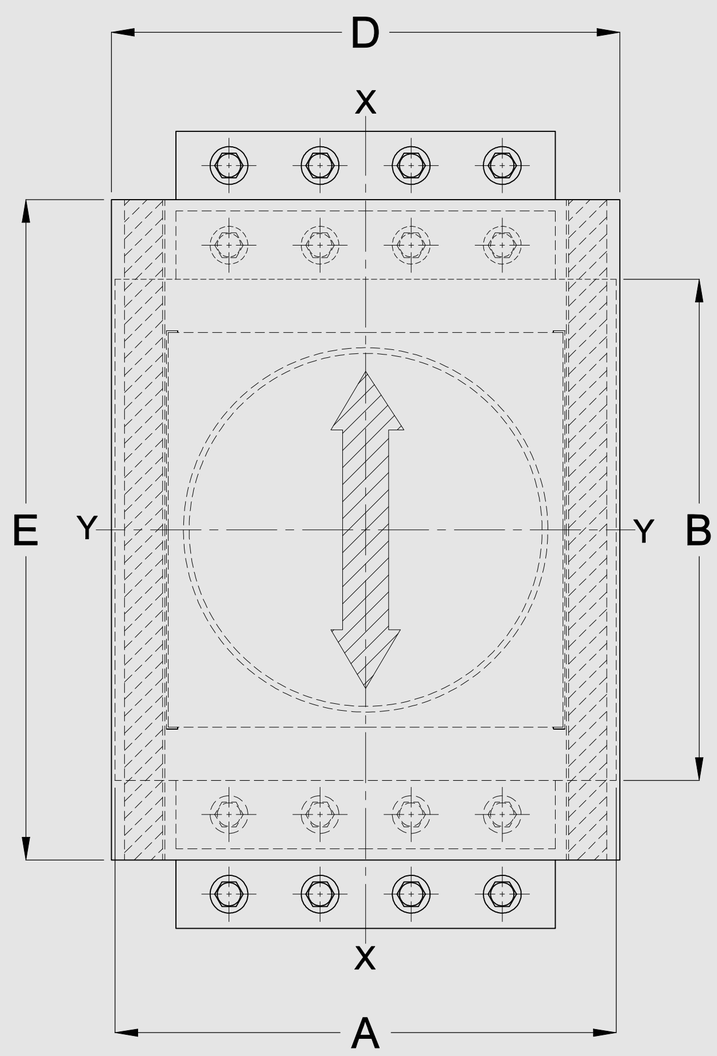
2.5.4 POT BEARING SLIDING IN LONGITUDINAL DIRECTIONS (P - SGL)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
P - SGL 1.00 - 100	1,000	150	340	340	117	390	550	127
P - SGL 2.00 - 100	2,000	300	370	370	119	400	550	140
P - SGL 3.00 - 100	3,000	450	440	440	124	450	600	189
P - SGL 4.00 - 100	4,000	600	510	510	127	500	650	242
P - SGL 5.00 - 100	5,000	750	580	580	132	550	700	310
P - SGL 6.00 - 100	6,000	900	640	640	136	600	750	379
P - SGL 7.00 - 100	7,000	1,050	700	700	144	650	800	473
P - SGL 8.00 - 100	8,000	1,200	760	760	155	710	850	594
P - SGL 9.00 - 100	9,000	1,350	780	780	157	710	850	619
P - SGL 10.00 - 100	10,000	1,500	830	830	164	770	900	741
P - SGL 11.00 - 100	11,000	1,650	850	850	170	780	900	796
P - SGL 12.00 - 100	12,000	1,800	910	910	175	830	950	930
P - SGL 13.00 - 100	13,000	1,950	960	960	183	880	1000	1078
P - SGL 14.00 - 100	14,000	2,100	970	970	189	890	1000	1144
P - SGL 15.00 - 100	15,000	2,250	1020	1020	197	940	1050	1317
P - SGL 16.00 - 100	16,000	2,400	1040	1040	202	950	1050	1395
P - SGL 17.00 - 100	17,000	2,550	1090	1090	206	1000	1100	1564
P - SGL 18.00 - 100	18,000	2,700	1100	1100	215	1010	1100	1659
P - SGL 19.00 - 100	19,000	2,850	1150	1150	220	1060	1150	1852
P - SGL 20.00 - 100	20,000	3,000	1160	1160	227	1080	1150	1953

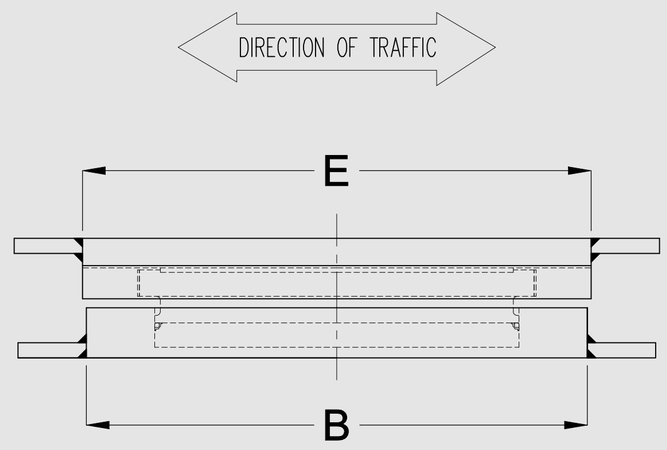
MOVEMENT : ± 100mm (L)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 15% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



Transverse Direction (Y-Y)
(Cross Section)



Top View



Longitudinal Direction (X-X)

3.0 SPHERICAL BEARING

3.1 Principles of SPHERICAL BEARING

Unless specified, the spherical bearings contained within this catalogue are designed in accordance to BS EN1337-7.

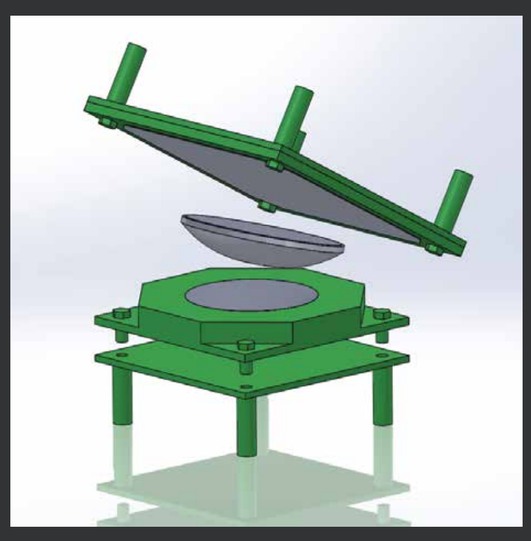
Spherical bearing consists of a convex calotte (spherical in shape as the name suggests) on the upper part supported by a matching concave lower part to accommodate higher rotation capacity. Spherical bearing is suitable to be used when there is limitation for space due to support size restraint.

Depending on the type of spherical bearing, for instance the free type spherical bearing allows sliding movement between the top of calotte and the sliding plate. Similar to pot bearing, the movement could be restrained in either single or all direction as well.

3.2 Types of SPHERICAL BEARING — EN 1337-7

01 S-FF Series

The naming convention used in this catalogue describes the type, maximum axial load and maximum horizontal displacement. The initial S refers to spherical bearing. FF refers to the free sliding pot bearing at which horizontal movement is allowed. E.g. S-FF1.00-100 means, spherical bearing with free sliding capability, having an axial ULS load of 1000 kN and horizontal displacement of 100 mm.

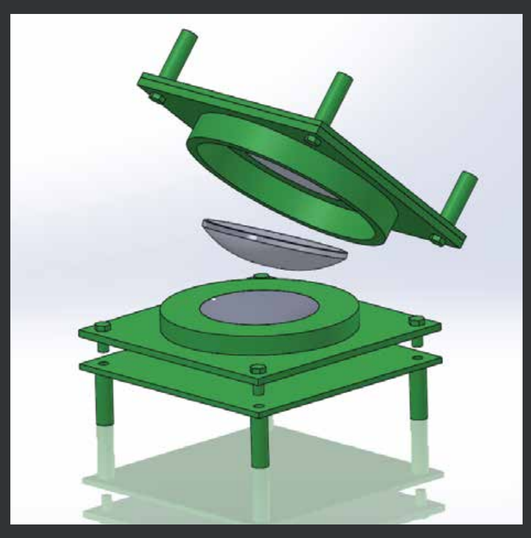


02 S-SGL / S-SGT Series

This type of spherical bearing only allows horizontal movement in one single direction. SGL refers to guided longitudinal while SGT means guided transverse. Usually, the movement is restrained by guided bar (restraining steel component) to allow only movement along the unrestrained axis.

03 S-FX Series

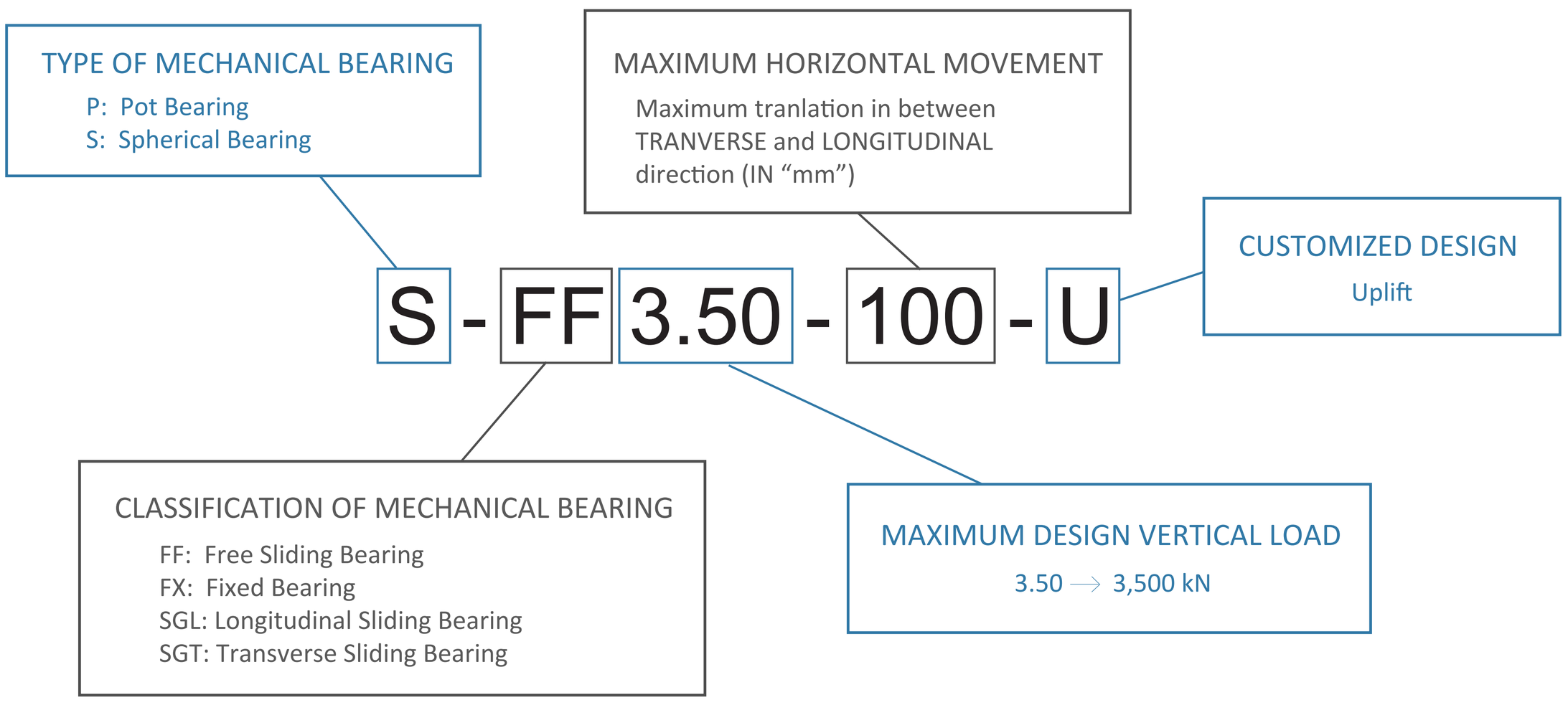
This is spherical bearing with restricted movement restriction in all horizontal direction. In other words, the spherical bearing transmits all horizontal forces to the substructure. Usually, these horizontal forces are originated from wind load, braking force, centrifugal force on curved elevated span, etc.



3.3 Typical SPHERICAL BEARING Range

The range of spherical bearing provided in the tables contained within this catalogue is designed with a total cumulative rotational capacity of 0.015 radians (inclusive of the Increased Movements required in EN1337-1:2000 5.4) and axial load demands from 1000 to 20000 kN. Concrete strength of maximum 60 MPa. For S-FF, S-SGL and S-SGT series, the horizontal displacement is kept at 100 mm in development of this catalogue. It should be noted that, custom design is highly possible by our technical department.

3.4 Legend / Label / Part No.



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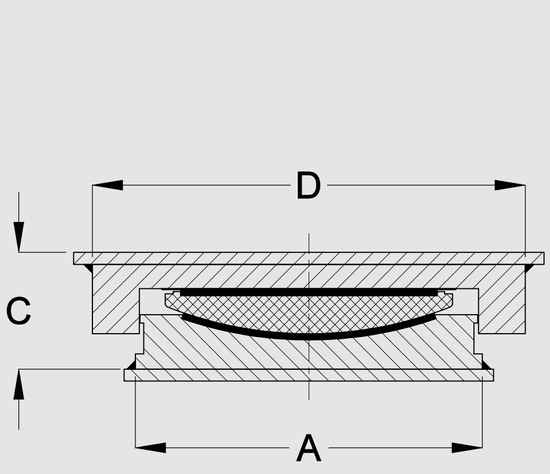
3.5 Tables of Spherical Bearing

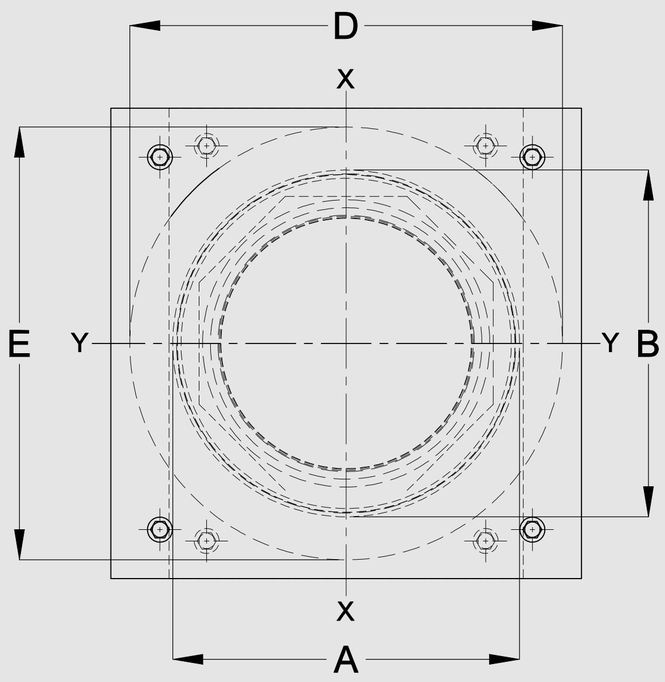
3.5.1 SPHERICAL BEARING FIXED (S - FX)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
S - FX 1.00 - 00	1000	100	182	182	76	228	228	32
S - FX 2.00 - 00	2000	200	236	236	80	292	292	48
S - FX 3.00 - 00	3000	300	274	274	89	340	340	65
S - FX 4.00 - 00	4000	400	307	307	85	375	375	74
S - FX 5.00 - 00	5000	500	339	339	89	413	413	90
S - FX 6.00 - 00	6000	600	366	366	89	446	446	103
S - FX 7.00 - 00	7000	700	382	382	96	472	472	122
S - FX 8.00 - 00	8000	800	409	409	95	503	503	135
S - FX 9.00 - 00	9000	900	447	447	89	541	541	144
S - FX 10.00 - 00	10000	1000	469	469	95	563	563	166
S - FX 12.00 - 00	12000	1200	491	491	94	593	593	184
S - FX 15.00 - 00	15000	1500	545	545	96	667	667	233
S - FX 20.00 - 00	20000	2000	615	615	99	771	771	320

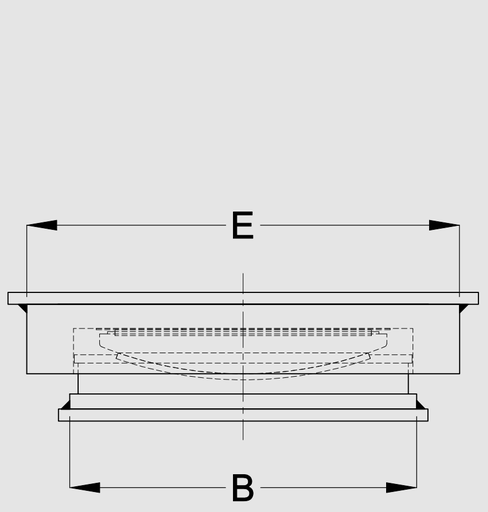
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 10% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



Transverse Direction (Y-Y)
(Cross Section)



Top View

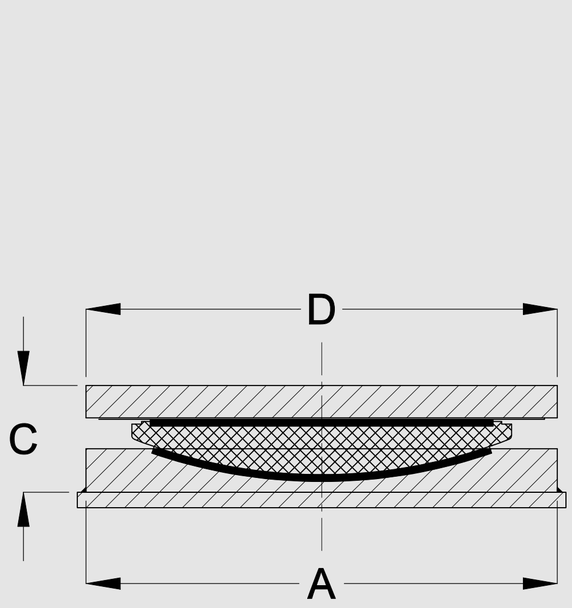


Longitudinal Direction (X-X)

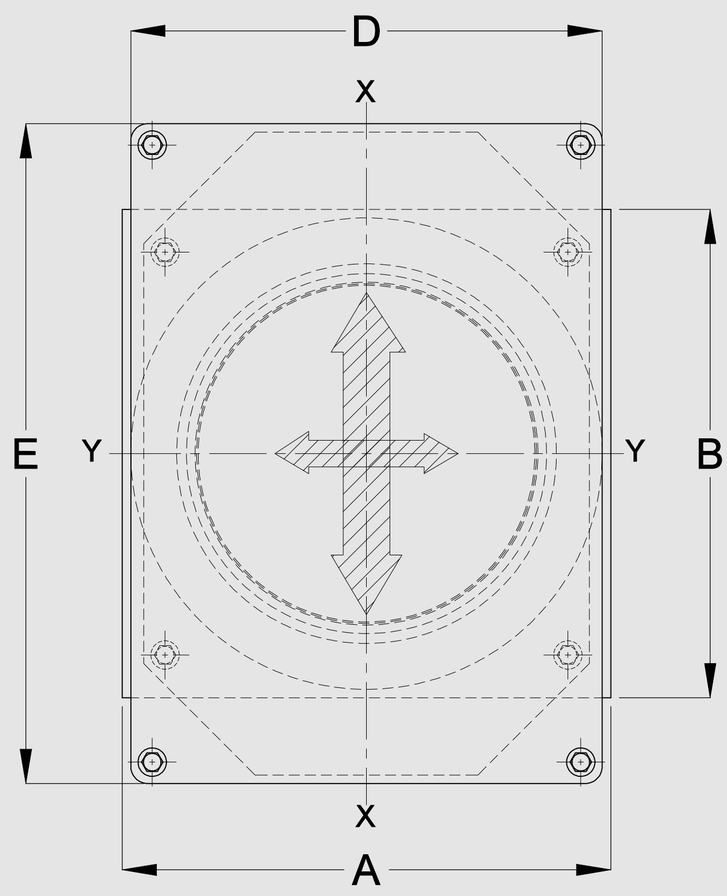
3.5.2 SPHERICAL BEARING FREE (S - FF)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
S - FF 1.00 - 00	1000	100	126	126	67	215	290	25
S - FF 2.00 - 00	2000	200	175	175	72	265	325	33
S - FF 3.00 - 00	3000	300	276	276	77	336	396	60
S - FF 4.00 - 00	4000	400	309	309	77	369	429	71
S - FF 5.00 - 00	5000	500	344	344	77	404	464	83
S - FF 6.00 - 00	6000	600	369	369	80	429	489	96
S - FF 7.00 - 00	7000	700	395	395	83	455	515	112
S - FF 8.00 - 00	8000	800	417	417	83	477	537	123
S - FF 9.00 - 00	9000	900	439	439	86	498	558	137
S - FF 10.00 - 00	10000	1000	459	459	88	519	579	153
S - FF 12.00 - 00	12000	1200	497	497	98	557	617	198
S - FF 15.00 - 00	15000	1500	551	551	98	611	671	237
S - FF 20.00 - 00	20000	2000	628	628	109	688	748	336

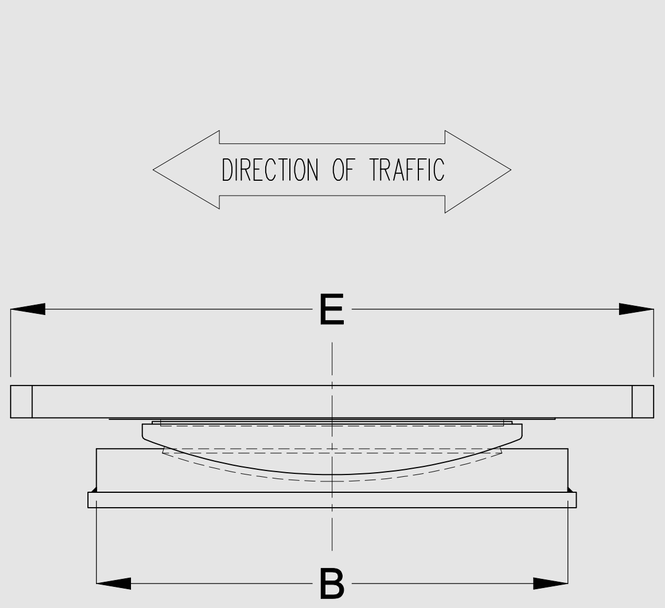
MOVEMENT : ± 100mm (L) : ± 25mm (T)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 10% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA



Transverse Direction (Y-Y)
(Cross Section)



Top View

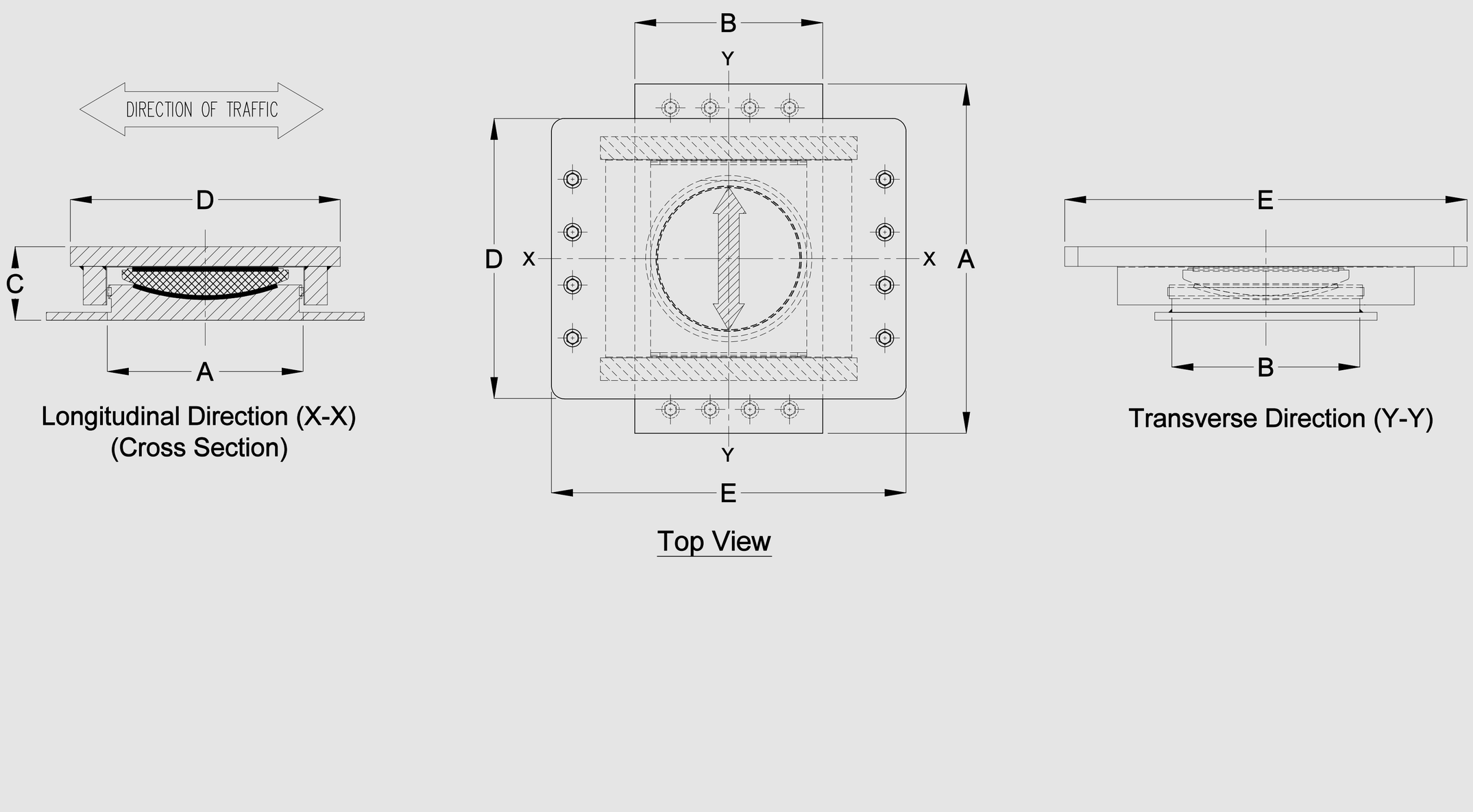


Longitudinal Direction (X-X)

3.5.3 SPHERICAL BEARING SLIDING IN TRANSVERSE DIRECTIONS (S - SGT)

Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
S - SGT 1.00 - 00	1000	100	170	177	107	265	310	52
S - SGT 2.00 - 00	2000	200	200	221	110	320	350	71
S - SGT 3.00 - 00	3000	300	230	248	123	360	380	97
S - SGT 4.00 - 00	4000	400	255	277	128	400	410	124
S - SGT 5.00 - 00	5000	500	325	324	128	450	445	155
S - SGT 6.00 - 00	6000	600	310	329	138	470	455	181
S - SGT 7.00 - 00	7000	700	340	356	138	500	480	203
S - SGT 8.00 - 00	8000	800	370	384	138	525	505	227
S - SGT 9.00 - 00	9000	900	400	418	143	565	525	266
S - SGT 10.00 - 00	10000	1000	515	409	139	550	635	301
S - SGT 12.00 - 00	12000	1200	445	460	153	630	570	352
S - SGT 15.00 - 00	15000	1500	590	493	154	660	710	460
S - SGT 20.00 - 00	20000	2000	580	577	179	775	700	636

MOVEMENT : ± 0mm (L) : ± 100mm (T)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 10% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA

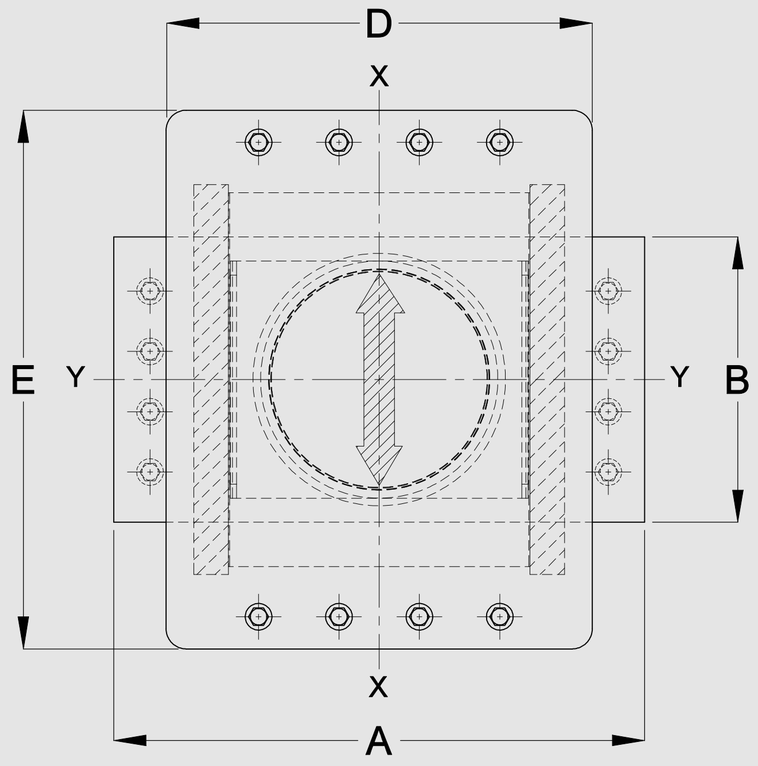


3.5.4 SPHERICAL BEARING SLIDING IN LONGITUDINAL DIRECTIONS (S - SGL)

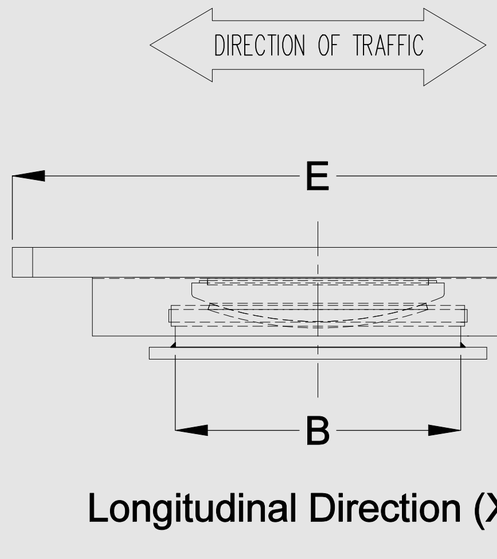
Type	Vertical load (kN)	Horizontal load (kN)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
S - SGL 1.00 - 00	1000	100	170	177	107	265	310	52
S - SGL 2.00 - 00	2000	200	200	221	110	320	350	71
S - SGL 3.00 - 00	3000	300	230	248	123	360	380	97
S - SGL 4.00 - 00	4000	400	255	277	128	400	410	124
S - SGL 5.00 - 00	5000	500	325	324	128	450	445	155
S - SGL 6.00 - 00	6000	600	310	329	138	470	455	181
S - SGL 7.00 - 00	7000	700	340	356	138	500	480	203
S - SGL 8.00 - 00	8000	800	370	384	138	525	505	227
S - SGL 9.00 - 00	9000	900	400	418	143	565	525	266
S - SGL 10.00 - 00	10000	1000	515	409	139	550	635	301
S - SGL 12.00 - 00	12000	1200	445	460	153	630	570	352
S - SGL 15.00 - 00	15000	1500	590	493	154	660	710	460
S - SGL 20.00 - 00	20000	2000	580	577	179	775	700	636

MOVEMENT : ± 100mm (L) : ± 0mm (T)
ROTATION : 0.015 RADIAN
RESULTANT HORIZONTAL LOAD : 10% VMAX
MAXIMUM CONTACT PRESSURE FOR TOP SURFACE : 24 MPA
MAXIMUM CONTACT PRESSURE FOR BOTTOM SURFACE : 20 MPA

Transverse Direction (Y-Y)
(Cross Section)



Top View



Longitudinal Direction (X-X)

DESIGN INPUT INFORMATION 4.0

DOSHIN® RUBBER ENGINEERING	MECHANICAL / POT BEARING QUOTATION FORM	V01
		Page 1 of 1

Project					
Quotation Reference					
Quote to		Company		Date	
Quoting Type	Budget	Prepared by			
	Final	Checked by			

1.0 DESIGN INPUT / INFORMATION

Bearing Type[a]					FX	FF	SG
Bearing Identification (if any)							
Seating Material[b]	Upper Surface						
	Lower Surface						
Allowable Contact Pressure	Upper Surface			Mpa			
	Lower Surface			MPa			
Design Load	Serviceability Limit State (SLS)	Permanent	Maximum	kN			
			Minimum	kN			
		Vertical	Maximum	kN			
			Minimum	kN			
		Transverse		kN			
		Longitudinal		kN			
	Ultimate Limit State (ULS)	Vertical	Maximum	kN			
			Minimum	kN			
		Transverse		kN			
		Longitudinal		kN			
Translation	Serviceability Limit State (SLS)	Reversible	Transversal	mm			
			Longitudinal	mm			
		Irreversible	Transversal	mm			
			Longitudinal	mm			
	Ultimate Limit State (ULS)	Reversible	Transversal	mm			
			Longitudinal	mm			
		Irreversible	Transversal	mm			
			Longitudinal	mm			
Rotation	Serviceability Limit State (SLS)	Reversible	Transversal	rad.			
			Longitudinal	rad.			
		Irreversible	Transversal	rad.			
			Longitudinal	rad.			
Size Restriction (if relevant)	Maximum dimension of the bearing		Transversal	mm			
			Longitudinal	mm			
	Upper Surface		Transversal	mm			
			Longitudinal	mm			
	Lower Surface		Transversal	mm			
			Longitudinal	mm			
	Height			mm			
Type of Fixing Required[c]	Upper Surface						
	Lower Surface						
Sliding Material[d]							
Adhesive / Bonding Epoxy to Sliding Material[d]							

FF = free, SG = guided, FX = fixed

[c] E.g. cement mortar, epoxy cement, in-situ concrete, etc.

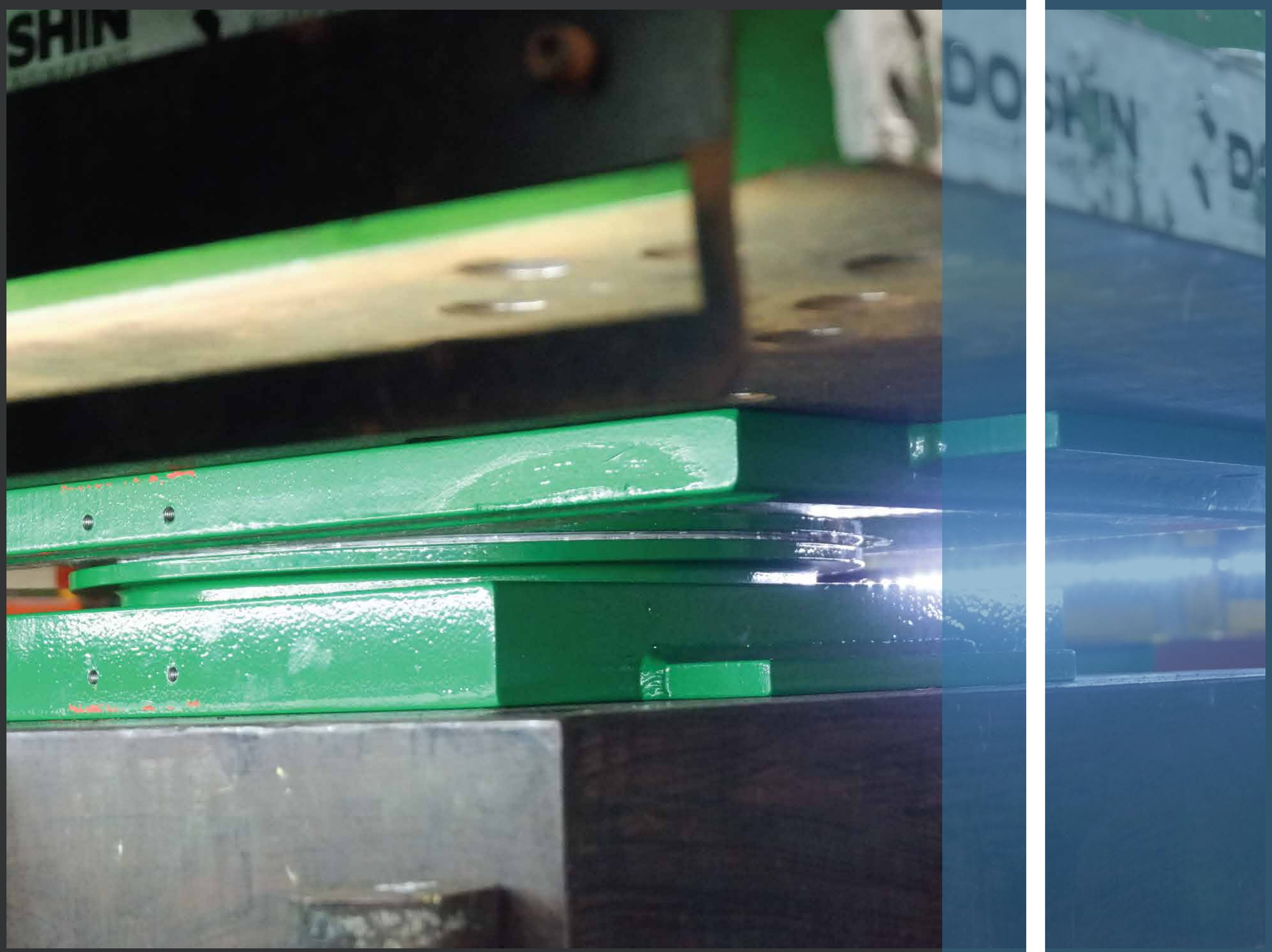
If data is absent, we will assume our typical way of anchorage system

Important for seismic application for cyclic loading to ensure durability of sliding material

**If the mechanical bearing is used in seismic application, please inform us on any special design and testing requirement*

5.0 Material Specification

Material	Property	Unit	Requirement	Reference
Rubber	Nominal hardness Ozone resistance (Elongation - 20%, 25 pphm, 40C for 96 hr)	IRHD -	50, 60, 70 ± 5 No cracking	ISO 6446
Steel	Classification and design property	-	-	EN 10025
PTFE	Density Tensile strength Elongation at break Ball hardness (H132/60)	kg/m^3 Mpa % Mpa	2140-2200 29-40 ≥ 300 23-33	ISO 1183 ISO 527-2 ISO 527-2 ISO 2039-1
Polyoxymethylene (POM)	Density Melt flow index Tensile strength Ultimate strain	kg/m^3 g/min Mpa %	1410 ± 20 10 ± 2 ≥ 62 ≥ 30	ISO 1183 ISO 1133 ISO 527-2
Stainless Steel	X5CrNi18-10 (SUS304) X5CrNiMo17-12-2 (SUS316)	- -	-	EN 10088-2



6.0 Design Basic

important design equations presented in this section are adopted from EN1337-5 for pot bearing. For the design of spherical bearing, please refer to EN 1337-7 section 6.2.

The design axial force N_{Sd} shall meet the following condition under fundamental combination of actions:

$$N_{Sd} \leqslant N_{Rd}$$

And

$N_{Rd} = \frac{N_{Rk}}{\gamma_M}$ is the design value of resistance of the elastomeric pad

---

N_{Rk} is the characteristic resistance value of the elastomeric pad, determined from:

$$N_{Rk} = \frac{\pi}{4} \times d^2 \times f_{e,k}$$

d is the diameter of elastomeric pad

$f_{e,k}$ is the characteristic contact strength of the elastomer

---

Piston-to-pot contact

Curved contact surface shall have radius R larger than $0.5 \times D$ or 100 mm (whichever is greater). It shall be verified that:

$$V_{Sd} \leqslant V_{Rd}$$

$$V_{Rd} = \frac{15 \times f_u^2 \times R \times D}{E_d \times \gamma_M^2}$$

R is the radius of contact surface

f_u is the ultimate material strength

E_d is the design modulus of elasticity

D is the maximum diameter of piston surface inclusive of *R*

Pot size is estimated through the following simplified equations. In some special cases, finite element analysis is performed to arrive at the optimum size particularly when tight requirement or limitations are to be met.

Pot wall subjected to tensile force:

$$V_{Sd} \leqslant V_{Rd}$$

$$V_{Sd} = V_{e,Sd} + V_{Fyx,Sd}$$

$$V_{e,Sd} = \frac{4N_{Sd}t}{\pi D}$$

$$V_{Fxy,Sd} = \sqrt{V_{Fx,Sd}^2 + V_{Fy,Sd}^2}$$

$$V_{Rd} = \frac{f_y \times A_R}{\gamma_M}$$

$$A_R = (D_0 - D) \times H$$

Pot wall subjected to shear force:

$$V'_{Sd} \leqslant V'_{Rd}$$

$$V'_{Sd} = \frac{V_{e,Sd} + 1.5V_{Fxy,Sd}}{D}$$

$$V'_{Rd} = \frac{f_y(D_0 - D)}{2 \times \gamma_M \times \sqrt{3}}$$

Pot base subjected to tensile force:

$$V_{Sd} \leqslant V_{Rd}$$

$$V_{Sd} = V_{e,Sd} + V_{Fyx,Sd}$$

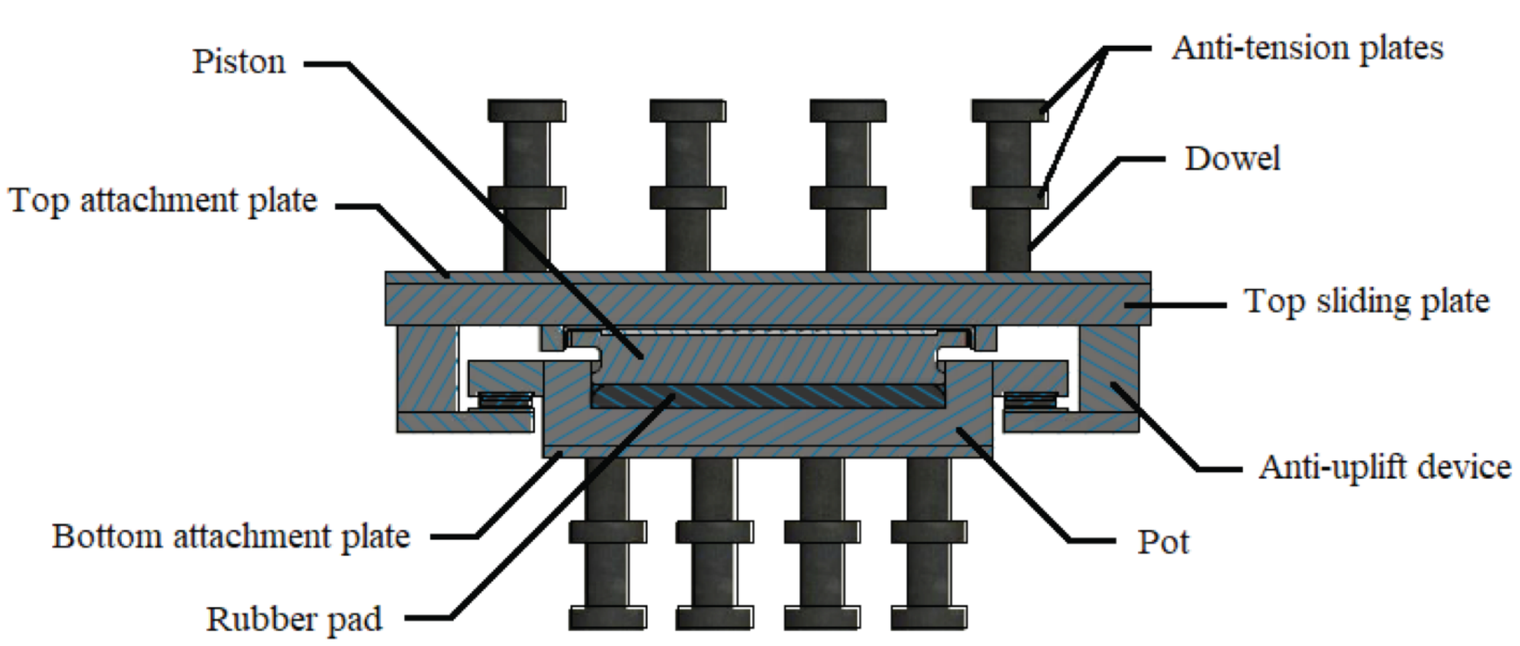
$$V_{Rd} = \frac{f_y \times A_P}{\gamma_M}$$

$$A_P = D_0 \times T$$

Minimum elastomeric pad thickness $t_{min} = 3.33 \times \alpha_{dmax} \times d \geqslant \frac{d}{15}$

7.0 Uplift Design

An uplift force is any upward pressure applied to a bearing that has the potential to raise it relative to its surroundings. This can be problematic if the upward forces are greater than the forces being exerted downwards by the superstructure to the bearing. Since the mechanical bearing is unable to take such uplift force in its original configuration, it should be designed to resist the forces be means of additional component.

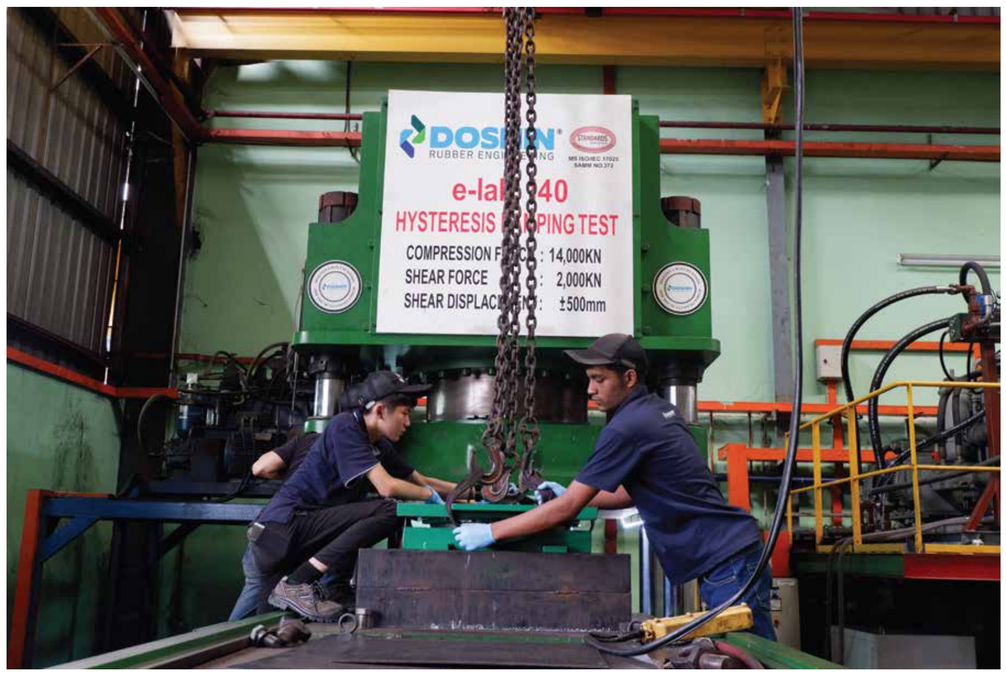


8.0 Test Method

Type of Test	Type of Bearing			Reference
	Fixed	Guided	Free	
Compression	√	√	√	AASHTO Sec. 18 BS EN 1337-5:2005 BS 5400:1983 Sec. 9.2
Friction	X	√	√	AASHTO Sec. 18 BS EN 1337-5:2005 BS 5400:1983 Sec. 9.2
Horizontal	√	√	X	AASHTO Sec. 18 BS EN 1337-5:2005 BS 5400:1983 Sec. 9.2
Rotation	√	√	√	AASHTO Sec. 18 BS EN 1337-5:2005 BS 5400:1983

Acceptance criteria for pot bearings
The bearings tested shall be rejected if they exhibit any signs of damage during or after the testing. Such signs of damage include:

a) splitting, extrusion or permanent deformation of the elastomer
b) opening, extrusion or permanent deformation of the external seal
c) tearing, cracking or permanent deformation of the PTFE sliding surfaces
d) cracking, indentation or permanent deformation of the internal seal or other part of the bearing
e) abrasive marks indicating abnormal contact between the metal surfaces of the bearing plates or piston and the pot

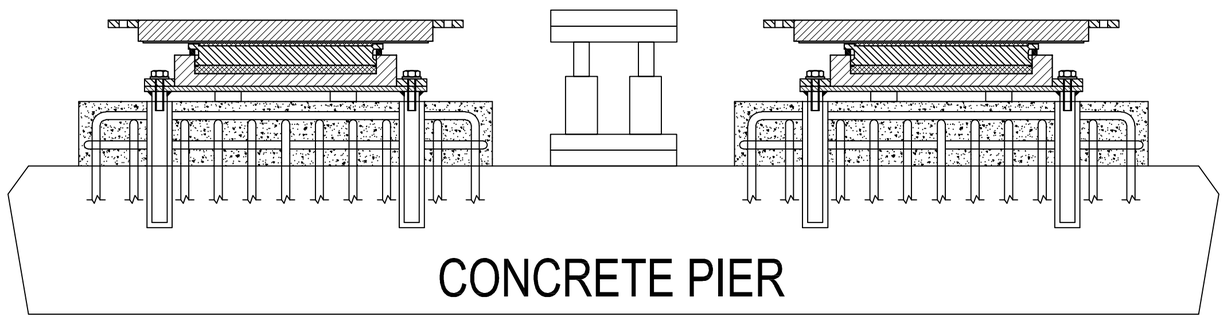


9.0 INSTALLATION

9.1 Top Structural - Steel

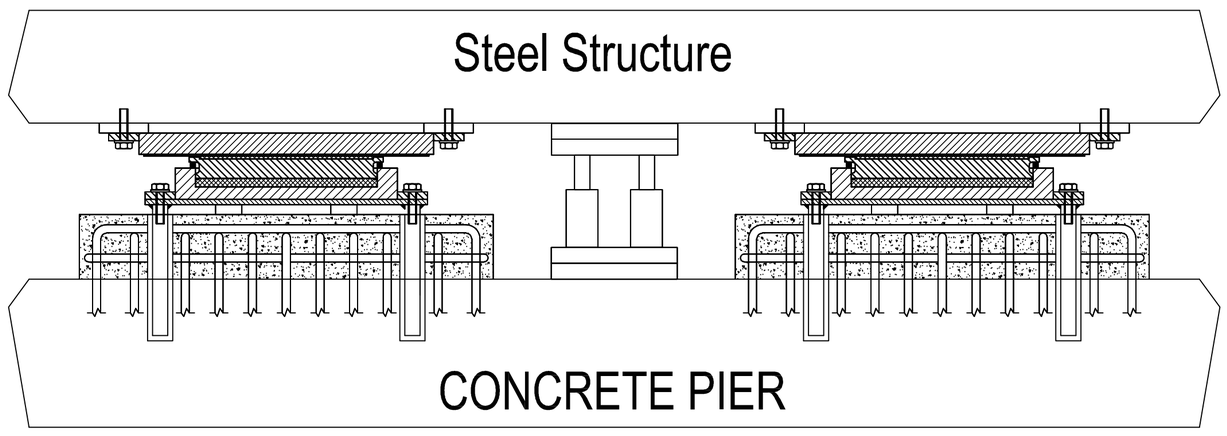
STEP 1:

Prepare block out / recess holes using template / PVC pipes and cast the bottom plinth according to the required height and size.



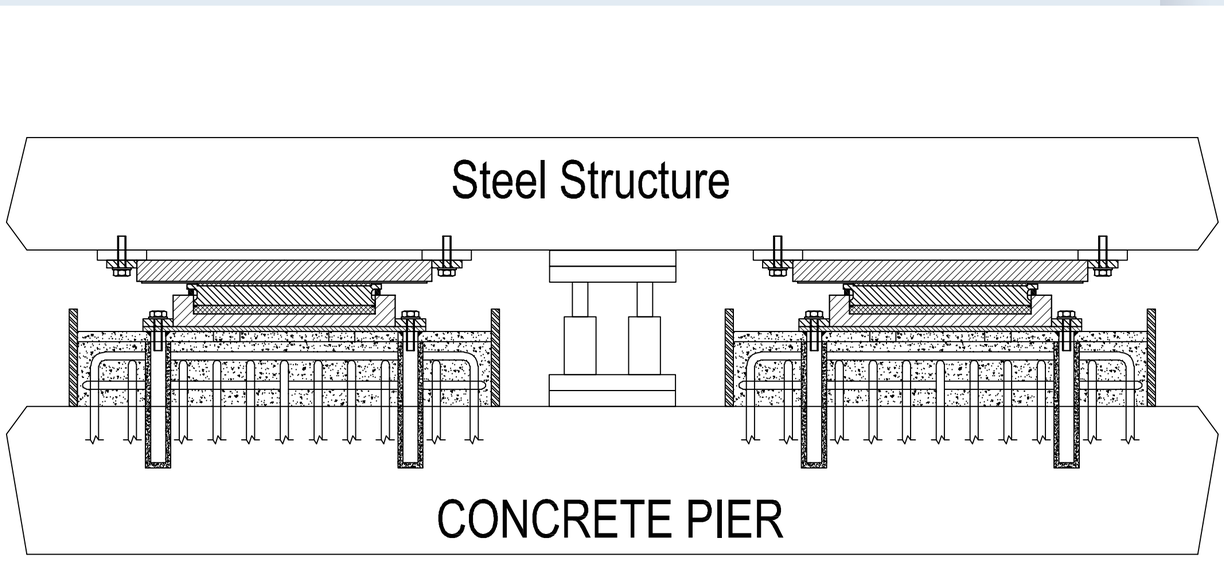
STEP 2 :

Place the bearing on the upstand plinth. Use shim plates to ensure bearing reaches the required height.



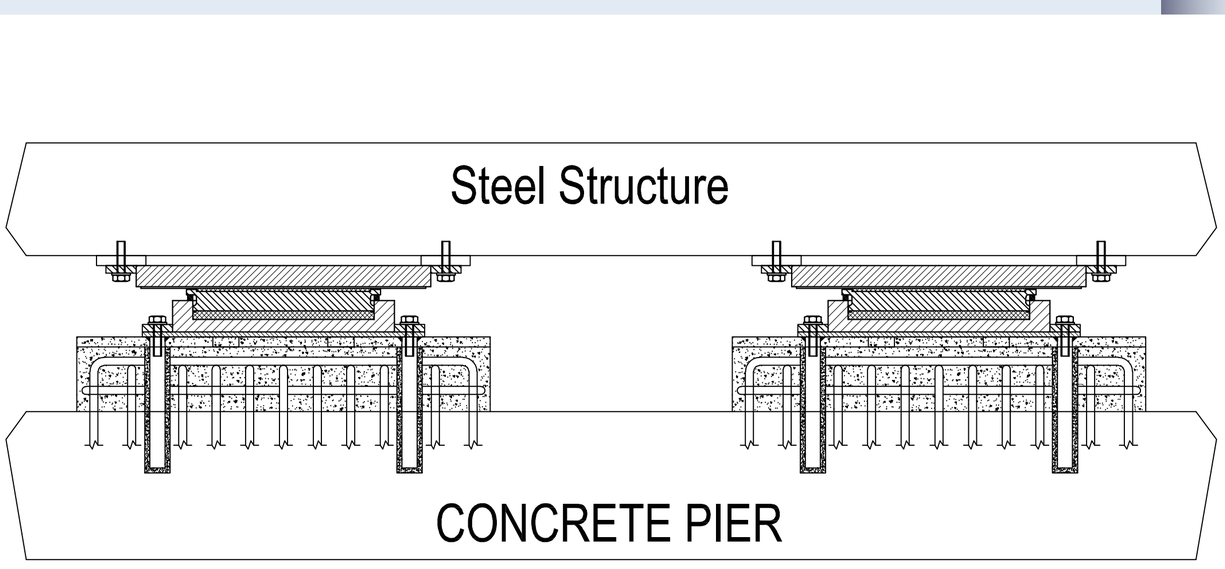
STEP 3:

Launch the super structure above the bearing. The hydraulic jacks will load on temporary support/jack.
Gradually decrease the height of the hydraulic jacks until the desired height is achieved. Tighten the bolts to their respective torque values.



STEP 4:

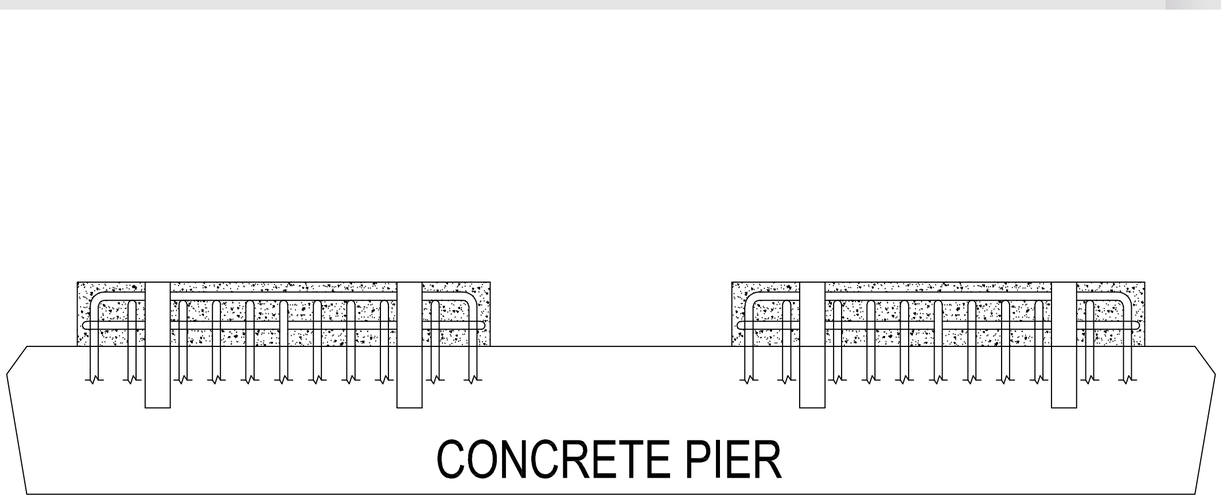
Prepare framework for grouting. Using approved grout material, grout the bottom anchor plate using manual pouring method. Pour the grout at the bottom plinth and top plinth through the grouting hose.



STEP 5:

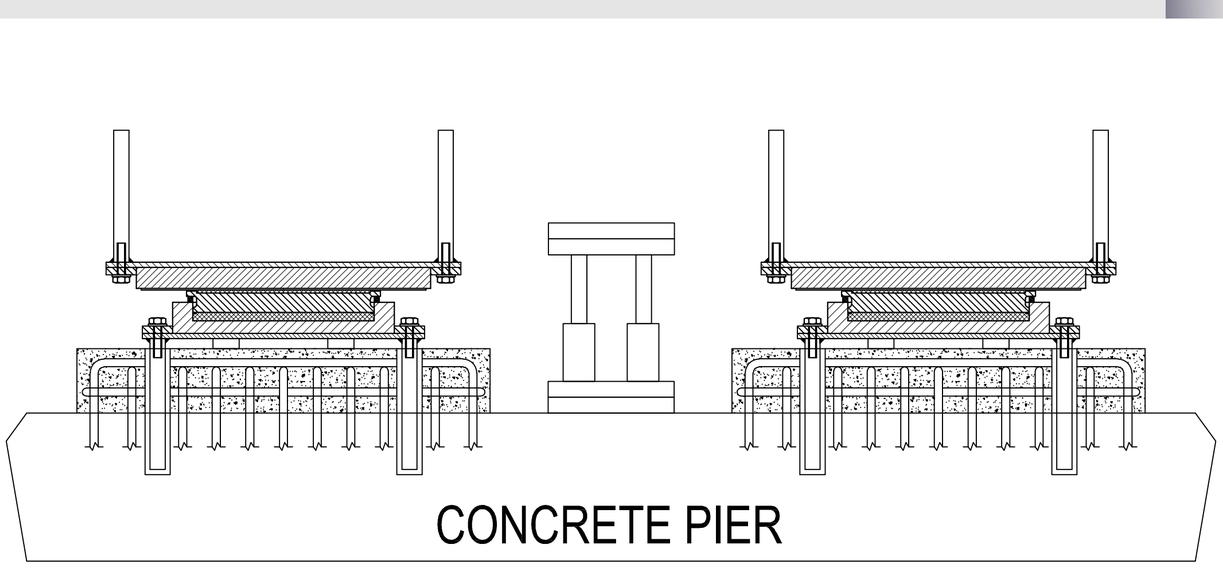
Remove the hydraulic jacks / temporary support after the grout has achieved the required strength.

9.2 Top Structural - Concrete



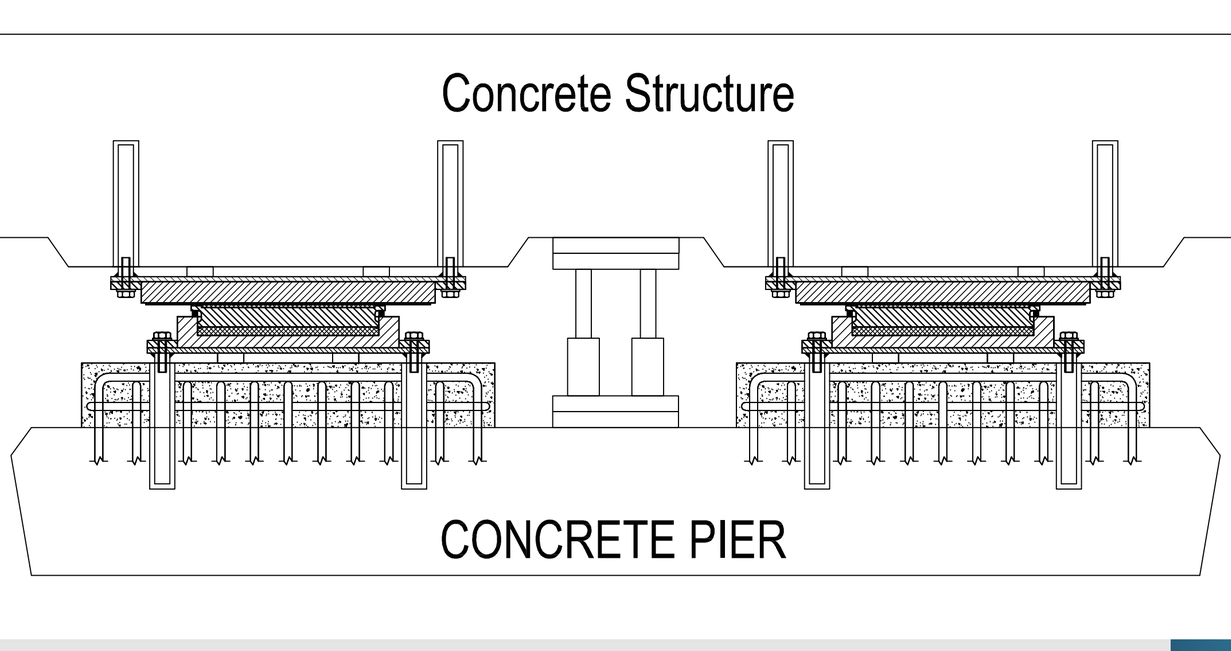
STEP 1:

Prepare block out / recess holes using template / PVC pipes and cast the bottom plinth according to the required height and size.



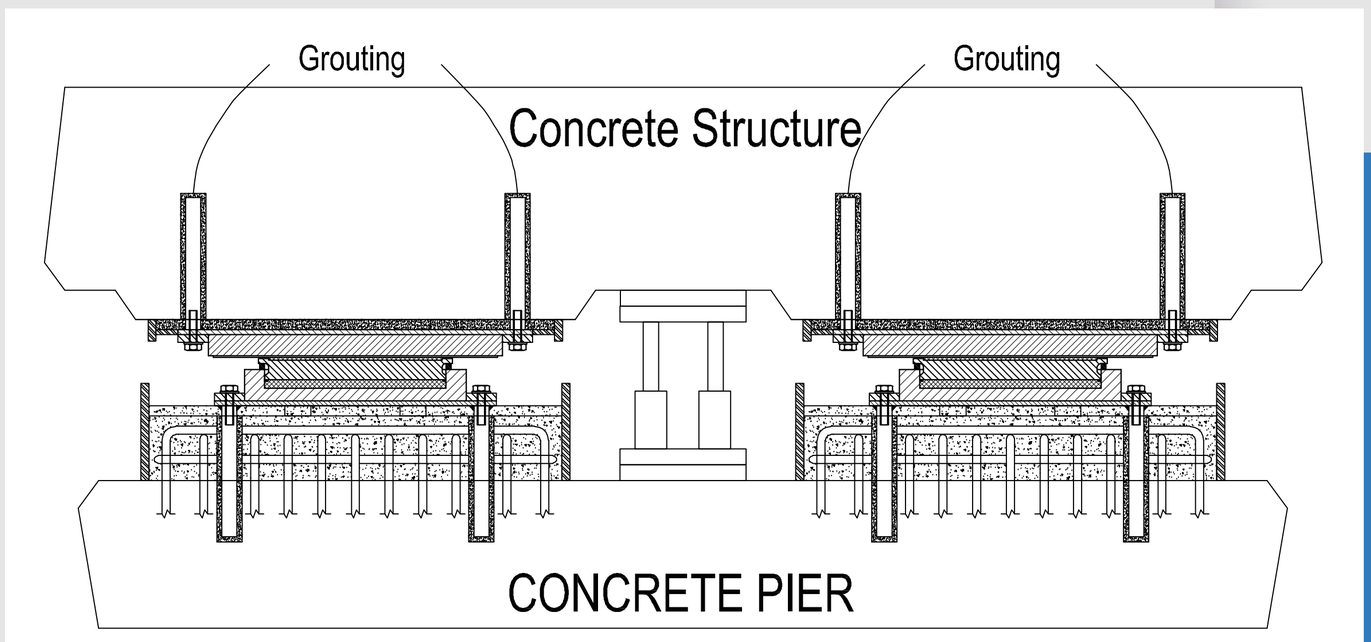
STEP 2 :

Place the bearing on the upstand plinth. Use shim plates to ensure bearing reaches the required height. Place the hydraulic jacks / temporary support at designated location.



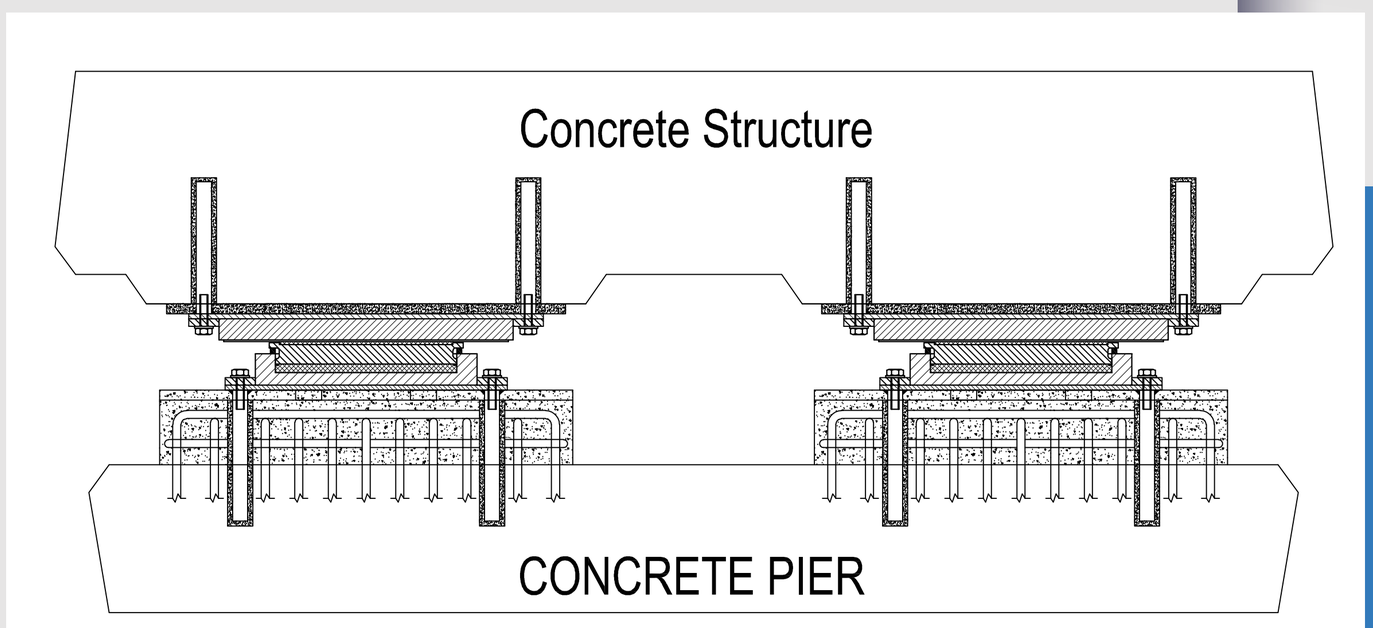
STEP 3:

Launch the super structure above the bearing. The hydraulic jacks will load on temporary support/jack. Gradually decrease the height of the hydraulic jacks until the desired height is achieved. Tighten the bolts to their respective torque values.



STEP 4:

Prepare framework for grouting. Using approved grout material, grout the bottom anchor plate using manual pouring method. Pour the grout at the bottom plinth and top plinth through the grouting hose.



STEP 5:

Remove the hydraulic jacks / temporary support after the grout has achieved the required strength.

10.0 Maintenance & Replacement

10.1 Inspection & Maintenance Procedures

10.1.1 First Inspection (After Installation)

The first inspection shall be carried out after the installation of Mechanical Bearings and full completion of top bridge construction.

10.1.2 Subsequent Routine Inspection

After carrying out the first inspection, the subsequent routine inspection shall be carried out on the
Mechanical Bearings as per the following time interval as stated below:-

1. By yearly inspection (if required)
2. Or as otherwise defined accordingly as per the findings of the previous inspection

First inspection and subsequent routine inspection must comprise of the following as stated below:-

1. Condition of bearing
2. Condition of attachment plates
3. Condition of bolts
4. Alignment of bearing and attachment plates
5. Deflection of bearing after load transfer
6. Condition of corrosion protection
7. Condition of top and bottom structure

The result of this inspection shall be recorded in the Inspection Report Sheet. The condition of every bearing that has been inspected shall be recorded under the following categories:-

Results and Action to be taken:-

N : No action needed
R : Minor repair works such as cleaning and/or painting required.
I : Repair or replacement required.
C : Further measurements and long term observations are required.

The First Inspection and Subsequent Routine Inspection for Mechanical Bearing is listed in the table below for easier understanding:-

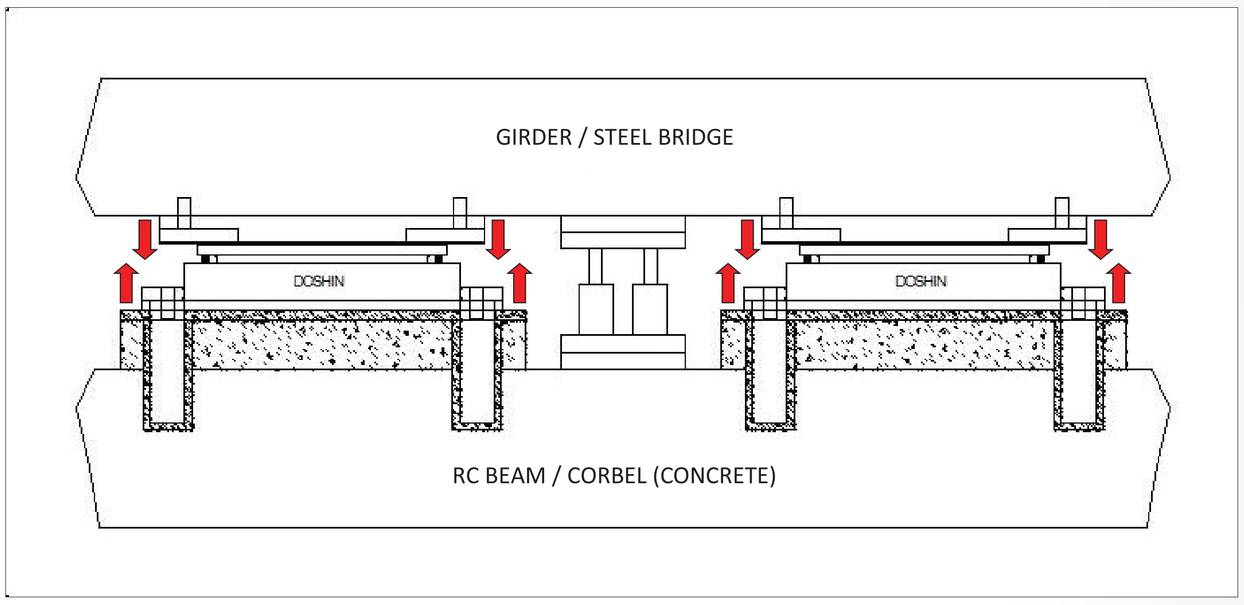
ITEM	MECHANICAL INSPECTION CHECKLIST	DEFECT CONDITIONS	REPAIR METHOD
1	Condition of bearing	Cut by sharp materials Cracked Slanting Scratches	Please consult Doshin should replacement of bearing be required. The replacement work should be carried out by qualified repair experts authorized by Doshin.
2	Condition of attachment plates	Cracked Corrosion protection damaged Unequal gap Rust and dirt staining	Cleaning dirty surfaces Apply coating materials or corrosion protection Replacement with new attachment plates
3	Condition of bolts	Loose Broken	Tighten with torque wrench Broken bolts to be replaced
4	Alignment of bearing and attachment plates	Out of alignment bearing and attachment plates	Please consult Doshin as the root cause of out of alignment of bearing and attachment plates needs to be further checked against the actual live Load and Dead Load exerted on the particular bearing as opposed to the design calculations
5	Deflection of bearing after load transfer	Lack of bearing deflection uniformity	Please consult Doshin as the possibility of inserting shims plates needs to be studied further
6	Condition of corrosion protection	Corrosion protection damaged Exposed bare metal of attachment plate	Apply coating materials or corrosion protection
7	Condition of top and bottom structure	Broken concrete Broken corners and edges Gap in the concrete Visible and laid open reinforcement bars	Consult with WPC

Table 10.1.2 : Defect Conditions and Repair Method

10.2 Replacement Procedures

(Top Steel/Concrete Structure)

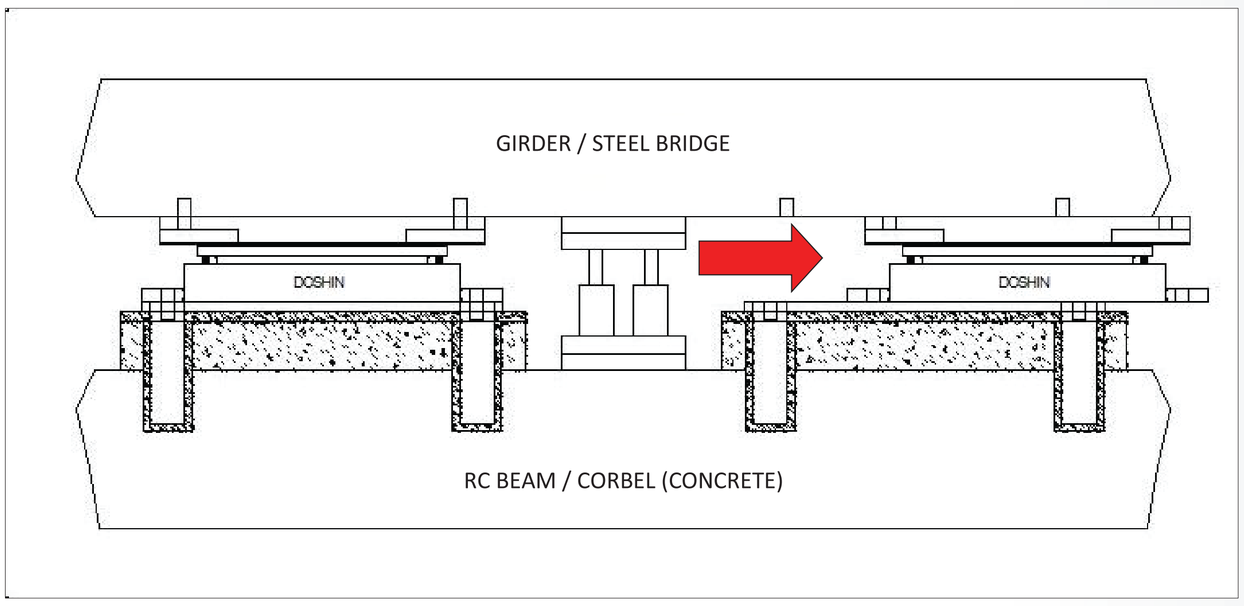
STEP 1



STEP 1:

Place the hydraulic cylinder/ temporary support at proposed jacking location. Remove all the bolts on the attachment plates and store it in a secure location. Then slowly start jacking up the top structure to an allowable jacking height (consult with Design Bridge Consultant). Stop once visible clearance is achieved between the Mechanical Bearing and top structure.

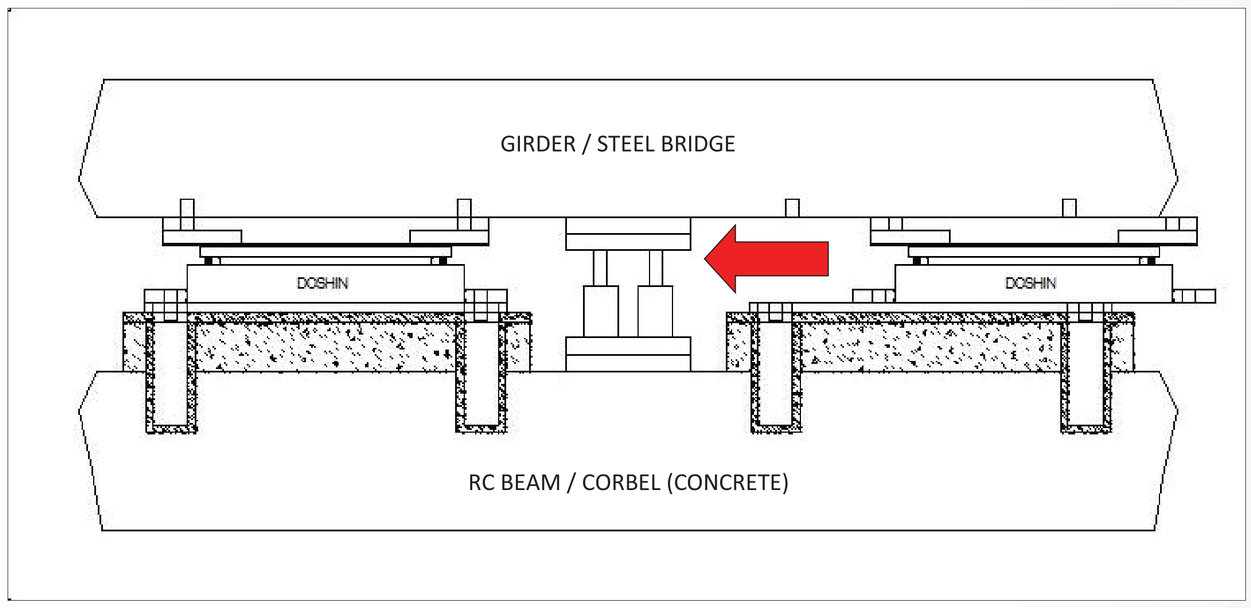
STEP 2



STEP 2:

The existing Mechanical Bearing can be removed from its plinth by sliding it out carefully using monkey jacks, belts and pipes.

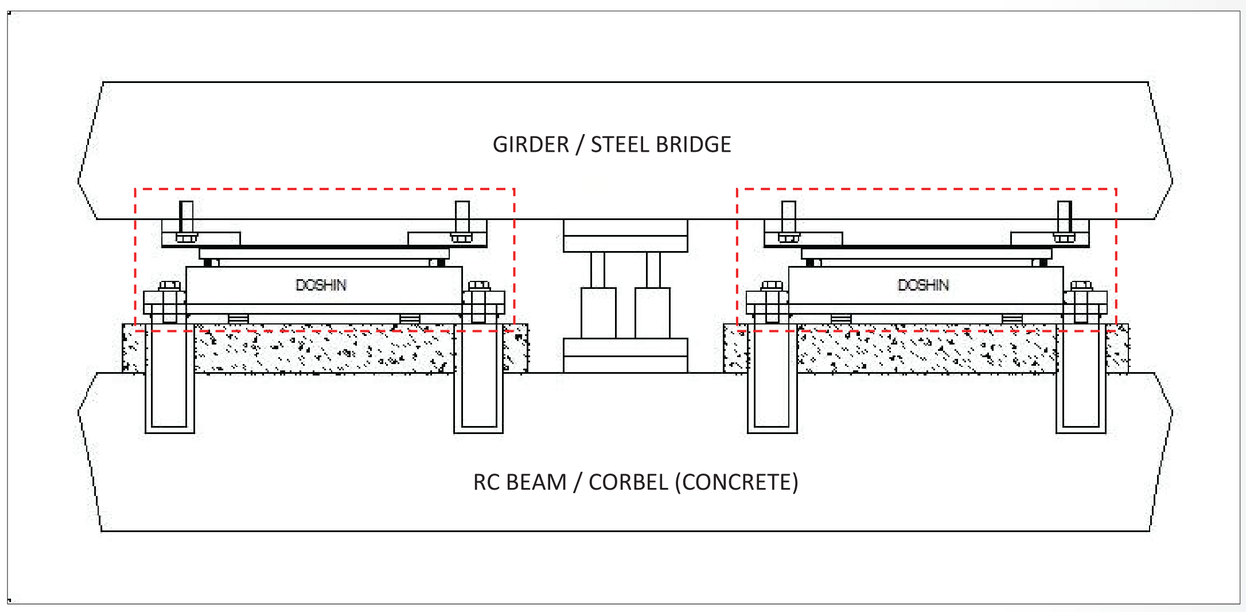
STEP 3



STEP 3:

The new Mechanical Bearing can now be installed in the correct position using monkey jacks, belts and pipes.

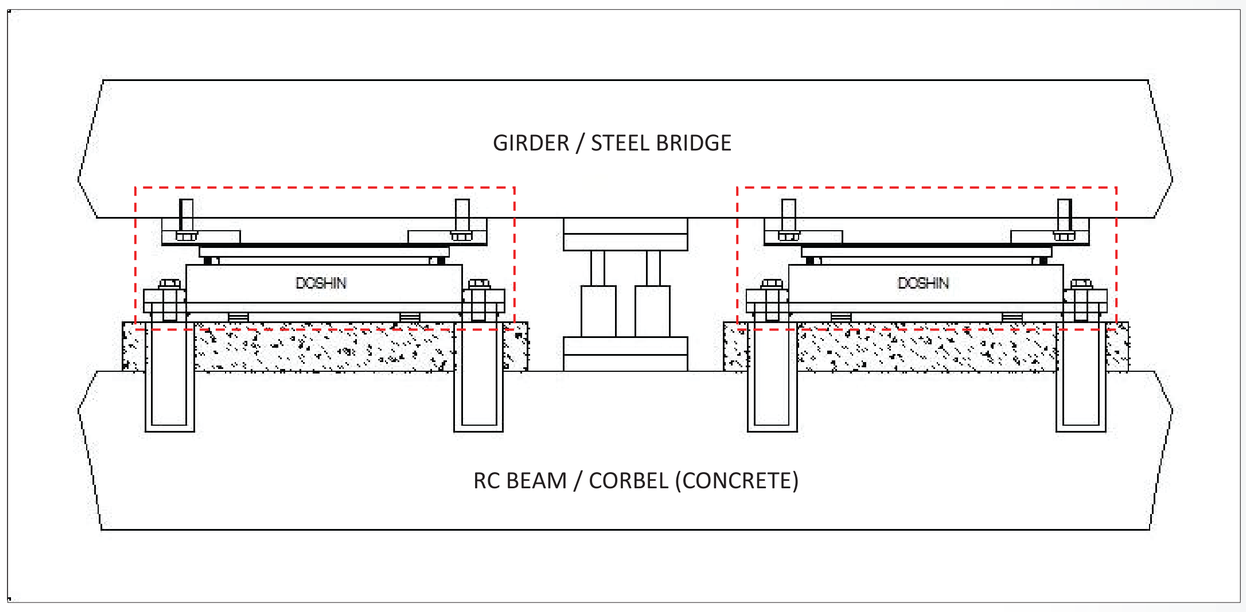
STEP 4



STEP 4:

Once the Mechanical Bearing is in the correct position, tighten the bolts to the required torque using a torque wrench.

STEP 5



STEP 5:

Qualified repair experts authorized by Doshin should then inspect the Mechanical Bearing. The hydraulic cylinder / temporary support should only be removed upon the approval of the experts. The replacement of the Mechanical Bearing is now complete.

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