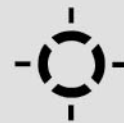# SPHERICAL BEARINGS

DSF

DSG

DSA

Contents	Page

Millennium Bridge, Montenegro

Sliding plane with ROBO®SLIDE

Operating principle

DOSHIN® SPHERICAL bearings are designed to transmit vertical forces in the bridge sub-structure and to facilitate rotations by means of a calotte and a concave lower part.

The flat sliding surface between the top of the calotte and a sliding plate accommodates longitudinal and transverse movements. Guide bars and a restraining ring are used to transmit horizontal forces.

Depending on whether the bearing is fixed, guided or free sliding, it accommodates vertical loads, horizontal forces, rotations and longitudinal or transverse movements.

Quality

Main reasons for the quality and durability of the bearings:

• Qualified and experienced specialised staff
• Sophisticated and reliable individual components
• High-quality materials: min. 8mm thick DR SLIDE sliding material, long-lasting silicone grease, etc.
• Quality standard (certified to ISO9001)

DSF (fixed)
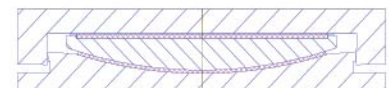
The fixed bearing accommodates horizontal forces and rotations from any direction.

DSG (guided sliding)

The guided sliding bearing moves in one direction only and can accommodate horizontal forces at right angles to the direction of movement and rotations from any direction.

DSA (free sliding)
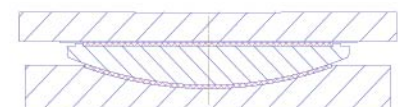
The free sliding bearing is movable and can be rotated in all directions and therefore cannot accommodate any horizontal forces.

Construction

The construction varies slightly depending on the type of bearing. However, all DOSHIN® SPHERICAL bearings are manufactured exclusively from high-quality materials.
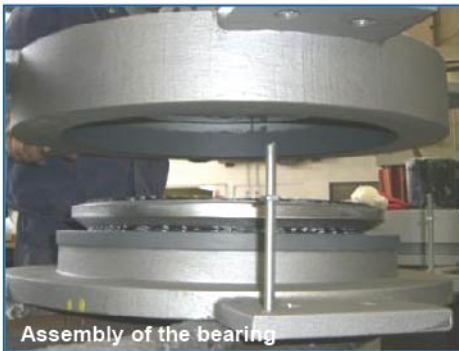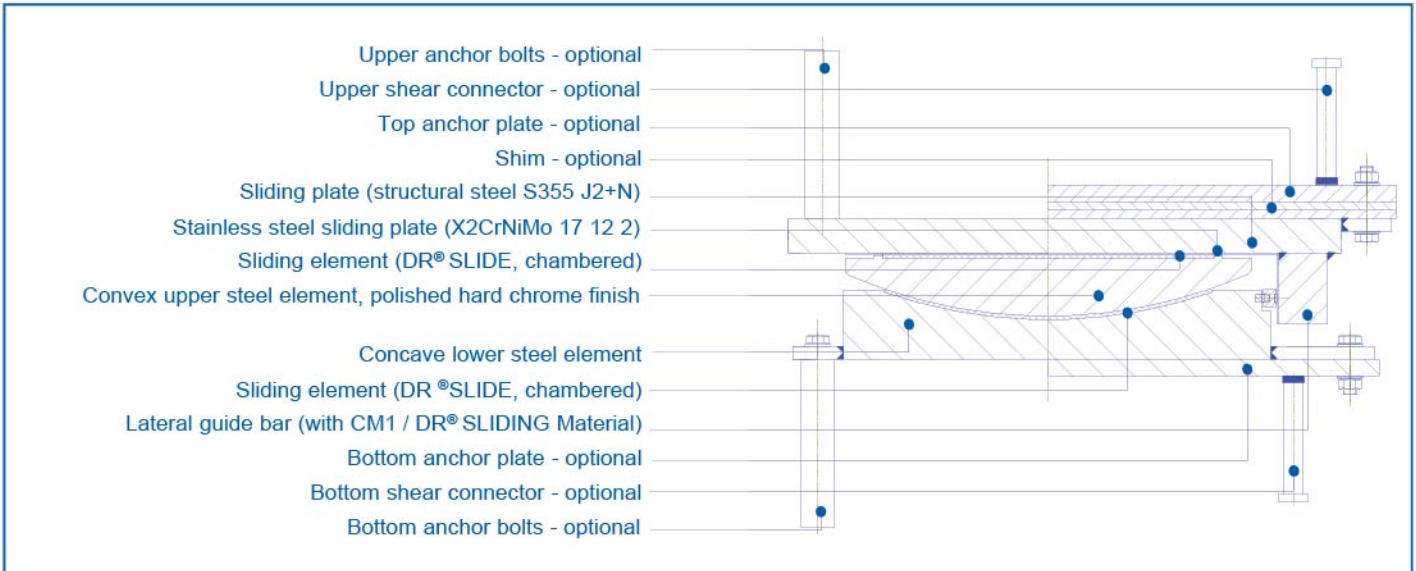
Upper anchor bolts - optional
Upper shear connector - optional
Top anchor plate - optional
Shim - optional
Sliding plate (structural steel S355 J2+N)
Stainless steel sliding plate (X2CrNiMo 17 12 2)
Sliding element (DR® SLIDE, chambered)
Convex upper steel element, polished hard chrome finish

Concave lower steel element
Sliding element (DR® SLIDE, chambered)
Lateral guide bar (with CM1 / DR® SLIDING Material)
Bottom anchor plate - optional
Bottom shear connector - optional
Bottom anchor bolts - optional

Assembly of the bearing

Mode of operation

Free rotation is facilitated by the concave bored lower element, which is lined with DR® SLIDE sliding disc. A convex calotte forms the other half of the sliding pairing. With its polished, hard chrome surface, friction between the calotte and the concave lower element is negligible.

In the case of guided or free sliding bearings, a DR® SLIDE sliding disc is provided on top of the calotte and, in conjunction with the upper sliding plate, this permits bridge movement in one or two axes. In order to keep the frictional resistance to a minimum, a shear-resistant polished austenitic stainless steel sheet is welded to the underside of the sliding plate

Sliding plate of a spherical bearing

Materials

Principal components of the spherical bearings and materials used:
- S355 or S235 steel components
- High quality , DR® SLIDE, with grease dimples
- Sliding plate made of austenitic stainless steel sheet
- Convex calotte surface coated with layers of hard chrome
- Lubricant in the form of high quality certified silicone grease

Thermal spray galvanising

Corrosion protection

All exposed steel components are corrosion-protected. DOSHIN adjusts the corrosion protection to suit exposure conditions or according to individual customer requirements.

Standard corrosion protection (type C4 in accordance with ISO12944) is as follows:
- Sandblasting SA2.5
- Thermal spray galvanising (alternatively zinc rich primer)
- Epoxy coating

Actions – loads according to EC 1

The load combinations on pages 8 to 13 conform to the "new design concept" according to Eurocode 1 (EN 1991-2: Actions on structures, Traffic loads on bridges). If the input loads do not conform to the Eurocode, verification is to be carried out in accordance with the appropriate standard (DIN, AASHTO, BS, SIA, etc.).

Notes on requirements of EN 1337

DR® SPHERICAL bearings satisfy all requirements of the European bearing standard EN 1337. This places special demands on the bearing manufacturer, such as:

(1) Requirement of EN 1337-2: "Provision against contamination of the sliding surface shall be made by suitable devices. Such protection devices shall be easily removable for the purpose of inspection."

(2) Requirement of EN 1337-2: "In order to ensure bearing alignment in accordance with EN 1337-11 a reference surface or other suitable device shall be installed on the sliding element. The deviation from parallel of the reference surface with respect to the plane sliding surface shall not exceed 1%."

Design criteria

Movements: The dimension sheets on pages 8 to 13 list the main bearing dimensions. They apply to the following movements:
DSG **longitudinal:** 100 mm total **transverse:** 0 mm
DSA **longitudinal:** 100 mm total **transverse:** 40 mm total
Larger longitudinal and transverse movements are possible at any time. In such cases the dimensions of the sliding plate and the top anchoring should be adjusted accordingly.

Rotations: The standard rotation about the main axis is 0,010 radians plus the increased movement in accordance with EN 1337-1. For larger rotations DOSHIN adapts the bearings individually.

Friction: Slide resistance is calculated on the basis of the DR® SLIDE stress with relevant superimposed load and horizontal force (for DR®SLIDE: see box on p.6).

Measuring gauge and nameplate

Bearings ready for shipping

Labelling

The DOSHIN® SPHERICAL bearing is marked with a typographic image on the upper surface. This facilitates efficient installation of the bearing.

The labelling on the cover or sliding plate gives information about the type, size and number of a bearing.

In addition on the upper site of the bearing arrows indicate the movement axis and pre-setting direction as follows:

- **Arrows**
  Arrows indicate the main movement directions of the sliding bearing
- **Double arrows**
  Double arrows on the sliding bearing indicate the pre-setting direction
- **Note**
  Detents used during the construction phase and other special designs are specially marked. They should be meticulously checked during installation in accordance with the bearing layout plan.

CE conformity

DOSHIN® SPHERICAL bearings are manufactured in accordance with European Standard EN 1337-7.

Movement gauge

The movement gauge indicates the horizontal movement and the pre-setting value of the bearing:

e_{vx} = Pre-setting value at installation

$\frac{W}{2} + e_{vx}$ = Slide path to the fixed bearing

$\frac{W}{2} - e_{vx}$ = Slide path away from the fixed bearing

Example:
e_{vx} = +75 mm
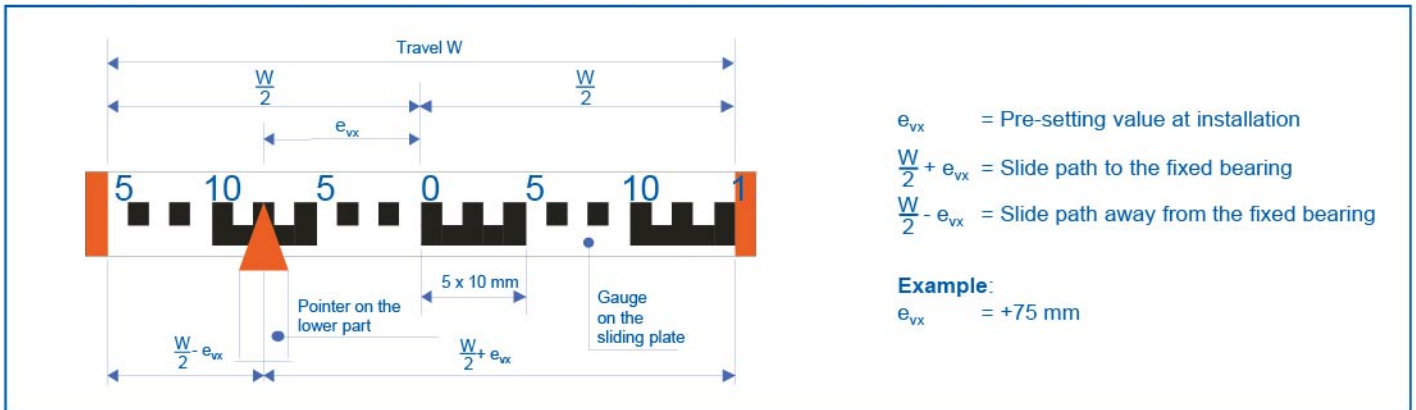
What is DR® SLIDE

DR®SLIDE is a special sliding material made of modified, ultra-high molecular polyethylene with reduced abrasion resistance and increased bearing capacity, adapted for sliding bearings in bridge and building construction.

A durable, almost frictionless sliding surface is guaranteed thanks to included grease pockets and a powerful lubricant.

DR® SLIDE advantages in brief:

- Low-wear material, a guarantee of long durability/lifetime
- High compressive strength permits smaller, and therefore less expensive, bearings
- Smaller overall dimensions of the bearing. Less space for the installation of the bearing.
- Lower frictional resistance also means that the horizontal forces associated with vertical forces are low

Advantages of DR® SLIDE

DR®SLIDE bearings are suitable for all types of construction. In addition to excellent physical properties such as low wear and high compressive strength.

Resistance to aggressive chemicals and the effects of high-energy radiation are also excellent.

DR® SLIDE has excellent formability, making it easier to accommodate irregularities in the supporting structure and flatness deviations. Wear and local overstressing are less likely.

The high durability of the sliding material means that repair and maintenance costs are noticeably reduced.
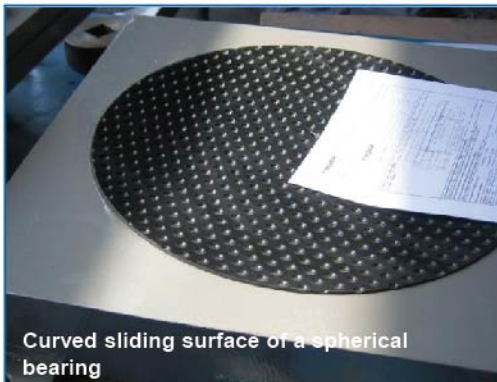
Curved sliding surface of a spherical bearing

Tests performed

Extensive static load and sliding friction tests have been carried out by DOSHIN testing laboratory in accordance with the test program for heavy-duty sliding materials.

Double the durability of a traditional bearing.

Design & verification

The product is designed in accordance with the "new design concept" and Eurocode (EN 1337).

In accordance with EN 1337-1 the minimum movements and increased movements are considered in the verifications.

In order to guarantee serviceability of the sliding components, the deformation of the sliding elements main be limited.

Frictional forces, forces due to horizontal loads and the distorted condition of the bearing generate an eccentricity of the normal force, which should be taken into consideration during the certification. This eccentricity is calculated in accordance with EN 1337-7.

Preparation of the lower part of the bearing for assembly

Areas of application

DOSHIN®SPHERICAL bearings with DR ®SLIDE are particularly suitable for the following areas of application:

• Structures with frequent high deformations from traffic
• Structures requiring fast bearing movement, such as bridges for high -speed railways
• Medium to high loads
• Structures with high accumulated bearing slide paths

Load tables and dimensions

The following load tables and dimensions (see pages 8 to 13) have reproduced the maximum chargeable loads of several types of spherical bearings.

Following design parameter are taken in consideration : the required minimum movements and movement increases in accordance with EN 1337-1, an area of application at low temperatures (> -35°C) and a sliding plate minimum thickness of 4% of the sliding plate diagonals.

Function

DOSHIN® SPHERICAL DSF bearings are fixed in position. They can accommodate horizontal forces and rotations from any direction.

Theoretically, movement is zero with fixed bearings. However, in practice there is a total clearance of up to 1 mm between top and lower bearing parts.

Lower DSF bearing part

Uplift DSF bearing

Load combination

All standard bearings are designed to be able to withstand maximum concurrent vertical and horizontal forces.

The maximum permissible horizontal forces are based on a concurrent minimum vertical load of about 30% of the maximum superimposed load. The horizontal forces V_{xy} are assumed at 10% of the vertical load. From these assumptions differing requirements on the bearing are possible at any time and appropriate bearings can be provided on request.

Concrete stress

The concrete stress is calculated in accordance with the European Standard EC 2 (partial area stress).

In order to be able to fully utilise the high stability of the DR® SLIDE L2 and, we recommend using high-strength concrete (C50/60).

Permissible loads and dimensions with concrete strength C30/37

Type & Size	Loads [kN]			Spherical bearing without anchor plate				Spherical bearing with anchor plate							
	Vertical		Horizontal	Dimensions [mm]			Weight [kg]	Dimensions [mm]							Weight [kg]
	$N_{Rd,max}$	$N_{Rd,min}$	$V_{xyRd,max}$	A	B	H		A	B	APU_x	APU_y	APO_x	APO_y	H	
DSF 1	1'000	300	100	182	228	76	32	177	223	316	316	316	316	141	69
DSF 2	2'000	600	200	236	292	80	48	236	292	330	330	350	350	137	90
DSF 3	3'000	900	300	289	340	89	66	289	338	370	370	380	380	147	120
DSF 4	4'000	1'200	400	332	375	90	80	327	375	390	390	410	410	143	139
DSF 5	5'000	1'500	500	364	415	98	100	363	401	405	405	425	425	151	161
DSF 6	6'000	1'800	600	396	441	102	117	385	432	446	430	455	455	151	185
DSF 7	7'000	2'100	700	434	487	105	145	417	472	476	460	495	495	148	215
DSF 8	8'000	2'400	800	461	523	104	163	446	514	509	485	535	535	138	232
DSF 9	9'000	2'700	900	496	581	99	186	456	530	519	500	550	550	137	245
DSF 10	10'000	3'000	1'000	514	570	108	200	489	561	580	526	585	585	138	278
DSF 12	12'000	3'600	1'200	556	602	125	257	509	580	586	562	600	600	146	314
DSF 15	15'000	4'500	1'500	620	671	147	375	595	667	684	637	690	690	160	454
DSF 20	20'000	6'000	2'000	715	761	165	538	655	769	748	732	790	790	168	624
DSF 25	25'000	7'500	2'500	802	884	172	750	787	876	848	810	900	900	189	881
DSF 30	30'000	9'000	3'000	880	1'027	167	944	812	988	912	897	1'010	1'010	191	1'140
DSF 40	40'000	12'000	4'000	1'031	1'237	168	1'389	951	1'173	1'054	1'029	1'195	1'195	215	1'776
DSF 50	50'000	15'000	5'000	1'155	1'403	181	1'920	1'133	1'374	1'193	1'155	1'402	1'401	241	2'657

$N_{Rd,max}$: maximum bearing capacity of the bearing under normal force (compression)
$N_{Rd,min}$: minimum bearing capacity of the bearing under normal force with simultaneous shear force $V_{xyRd,max}$
$V_{xyRd,max}$: maximum bearing capacity of the bearing under shear force

During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Bearing with anchor bolts

x
y

Lower part   Top

Bearing with anchor plates

x
y

Lower part / anchor plate   Top / anchor plate

Permissible loads and dimensions with concrete strength C50/60

Type & Size	Loads [kN]			Spherical bearing without anchor plate			Weight [kg]	Spherical bearing with anchor plate							Weight [kg]
	Vertical		Horizontal	Dimensions [mm]				Dimensions [mm]							
	$N_{Rd, max}$	$N_{Rd, min}$	$V_{xyRd, max}$	A	B	H		A	B	APU_x	APU_y	APO_x	APO_y	H	
DSF 1	1'000	300	100	182	228	76	32	177	219	316	316	316	316	131	66
DSF 2	2'000	600	200	236	292	80	48	225	279	325	325	340	340	139	86
DSF 3	3'000	900	300	274	340	89	65	263	327	355	355	375	375	148	112
DSF 4	4'000	1'200	400	307	375	85	74	307	373	390	390	405	405	143	136
DSF 5	5'000	1'500	500	339	413	89	90	328	404	410	410	430	430	151	161
DSF 6	6'000	1'800	600	366	446	89	103	350	432	435	435	455	455	151	182
DSF 7	7'000	2'100	700	382	472	96	122	377	463	450	450	485	485	150	204
DSF 8	8'000	2'400	800	409	503	95	135	409	497	475	475	520	520	149	230
DSF 9	9'000	2'700	900	447	541	89	144	436	526	500	500	550	550	144	251
DSF 10	10'000	3'000	1'000	469	563	95	166	458	556	515	515	580	580	142	273
DSF 12	12'000	3'600	1'200	491	593	94	184	496	600	550	550	620	620	147	324
DSF 15	15'000	4'500	1'500	545	667	96	233	528	646	580	580	670	670	164	405
DSF 20	20'000	6'000	2'000	615	771	99	320	599	747	650	650	770	770	162	527
DSF 25	25'000	7'500	2'500	680	868	117	468	653	821	705	705	845	845	188	710
DSF 30	30'000	9'000	3'000	756	972	120	599	718	926	780	780	950	950	184	894
DSF 40	40'000	12'000	4'000	896	1'184	136	1'012	821	1'101	905	905	1'125	1'125	207	1'417
DSF 50	50'000	15'000	5'000	1'032	1'366	153	1'500	940	1'274	1'025	1'025	1'305	1'304	219	2'036

$N_{Rd,max}$: maximum bearing capacity of the bearing under normal force (compression)
$N_{Rd,min}$: minimum bearing capacity of the bearing under normal force with simultaneous shear force $V_{xyRd, max}$
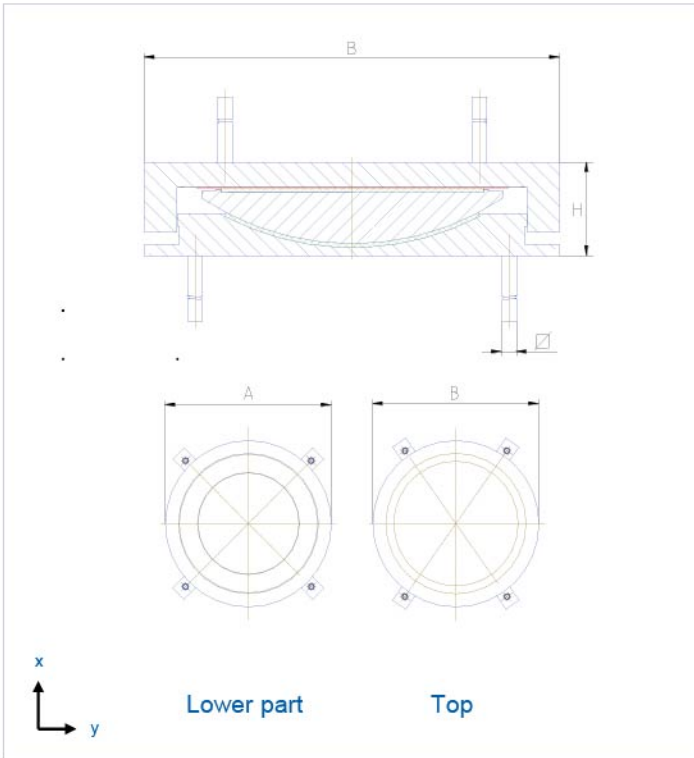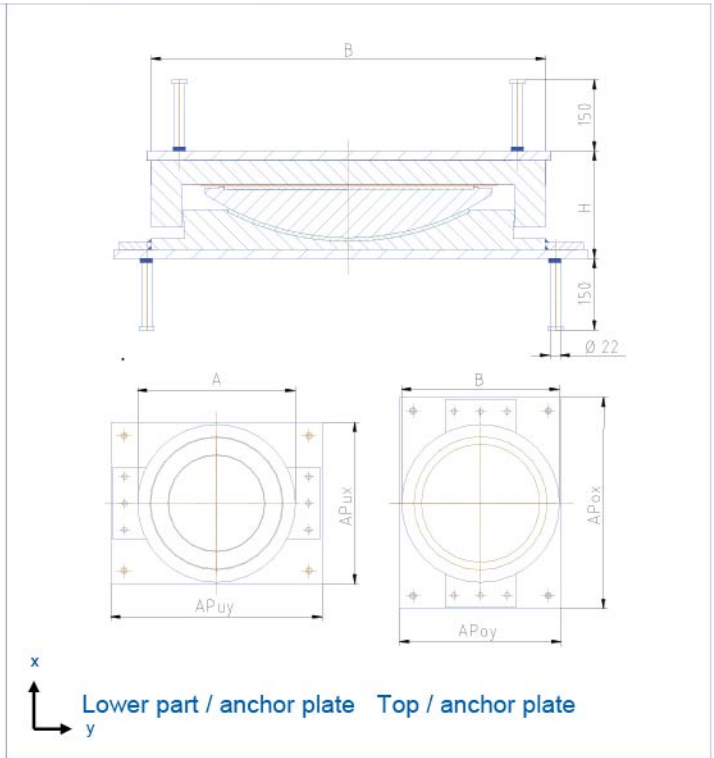$V_{xyRd,max}$: maximum bearing capacity of the bearing under shear force

During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Assembled DSG bearing
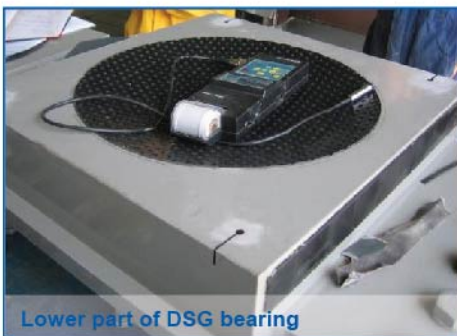
Lower part of DSG bearing

Function

DOSHIN® SPHERICAL DSG bearings allow movement in   direction and can accommodate horizontal forces and rotations perpendicular to this in any direction. Theoretically the transverse movement of this bearing is zero. However, in practice there is a total clearance of up to 2 mm. A DR® SLIDE stainless steel plate sliding pairing guarantees faultless sliding in the guide.

Load combination

All standard bearings are designed to be able to withstand maximum concurrent vertical and horizontal forces.

The maximum permissible horizontal forces are based on a concurrent minimum vertical load of about 30% of the maximum superimposed load. The horizontal forces are assumed at 10% of the vertical load. From these assumptions differing requirements on the bearing are possible at any time and appropriate bearings can be provided on request.

Concrete stress

The concrete stress is calculated in accordance with the European Standard EC 2 (partial area stress).

In order to be able to fully utilise the high stability of the DR® SLIDE L2 and to reduce the bearing weight, we recommend using high-strength concrete (C50/60).

Permissible loads and dimensions with concrete strength C30/37

Type & Size	Loads [kN]			Spherical bearing without anchor plate						Spherical bearing with anchor plate									
	Vertical		Horizontal	Dimensions [mm]					Weight [kg]	Dimensions [mm]									Weight [kg]
	$N_{Rd,max}$	$N_{Rd,min}$	$V_{xyRd,max}$	Ax	Ay	B	L	H		Ax	Ay	B	L	APU_x	APU_y	APO_x	APO_y	H	
DSG 1	1'000	300	100	224	200	310	320	95	53	178	170	265	310	410	316	405	330	150	85
DSG 2	2'000	600	200	231	231	330	351	110	76	205	175	310	345	405	316	450	365	168	113
DSG 3	3'000	900	300	286	286	390	406	117	112	259	215	375	385	470	316	515	405	170	158
DSG 4	4'000	1'200	400	333	333	445	453	117	141	270	235	400	410	490	329	540	430	192	200
DSG 5	5'000	1'500	500	369	369	495	489	127	184	297	260	435	435	530	364	575	455	195	239
DSG 6	6'000	1'800	600	402	402	530	522	132	217	315	280	455	455	545	391	595	475	205	271
DSG 7	7'000	2'100	700	440	470	565	590	127	257	360	310	505	480	590	438	645	500	201	328
DSG 8	8'000	2'400	800	463	463	600	583	148	313	375	480	505	600	595	500	645	620	181	370
DSG 9	9'000	2'700	900	490	505	630	625	143	345	402	500	540	620	635	520	680	640	181	410
DSG 10	10'000	3'000	1'000	515	520	655	640	148	379	428	520	570	640	660	540	710	660	181	445
DSG 12	12'000	3'600	1'200	561	600	705	720	153	475	476	555	640	675	730	575	780	695	192	563
DSG 15	15'000	4'500	1'500	622	622	790	742	179	644	518	605	685	725	770	629	825	745	205	700
DSG 20	20'000	6'000	2'000	716	716	890	836	203	944	583	665	765	785	845	728	905	805	237	1'009
DSG 25	25'000	7'500	2'500	814	814	1'000	934	206	1'221	623	710	820	830	895	803	960	850	269	1'312
DSG 30	30'000	9'000	3'000	869	869	1'075	989	248	1'675	670	765	885	885	950	878	1'025	905	292	1'657
DSG 40	40'000	12'000	4'000	1'010	1'010	1'235	1'130	258	2'348	799	1'015	1'010	1'135	1'080	1'035	1'150	1'155	296	2'444
DSG 50	50'000	15'000	5'000	1'128	1'155	1'370	1'275	289	3'348	930	1'125	1'170	1'245	1'235	1'152	1'310	1'265	327	3'461

The tabular dimension L is stated for a total of 100 mm longitudinal movement (W). For greater movements the dimensions are adjusted accordingly (e.g. for W= 350 mm, L must be increased by 250 mm).

$N_{Rd,max}$: maximum bearing capacity of the bearing under normal force (compression)
$N_{Rd,min}$: minimum bearing capacity of the bearing under normal force with simultaneous shear force $V_{xyRd,max}$
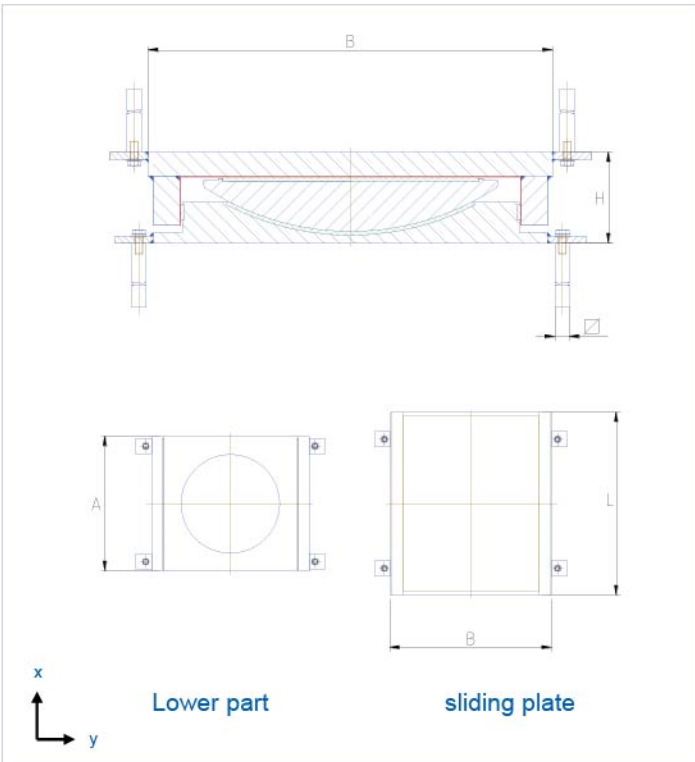$V_{xyRd,max}$: maximum bearing capacity of the bearing under shear force

    During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

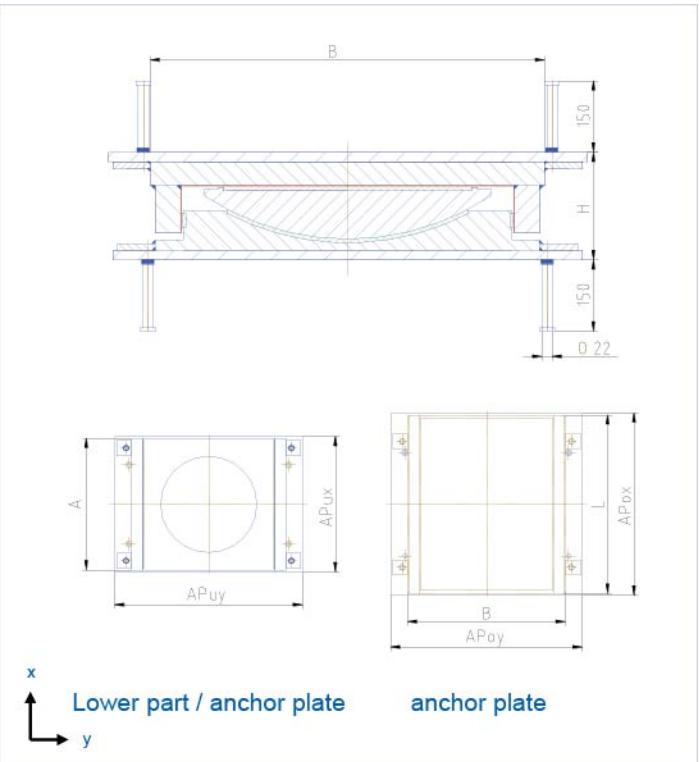Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Bearing with anchor bolts

Lower part   sliding plate

Bearing with anchor plates

Lower part / anchor plate   anchor plate

Permissible loads and dimensions with concrete strength C50/60

Type & Size	Loads [kN]			Spherical bearing without anchor plate						Spherical bearing with anchor plate									
	Vertical		Horizontal	Dimensions [mm]					Weight [kg]	Dimensions [mm]									Weight [kg]
	$N_{Rd,max}$	$N_{Rd,min}$	$V_{yRd,max}$	Ax	Ay	B	L	H		Ax	Ay	B	L	APU_x	APU_y	APO_x	APO_y	H	
DSG 1	1'000	300	100	177	170	265	310	107	52	176	170	265	310	410	316	405	330	150	85
DSG 2	2'000	600	200	221	200	320	350	110	71	205	175	310	345	405	316	450	365	168	113
DSG 3	3'000	900	300	248	230	360	380	123	97	257	215	370	385	470	316	510	405	161	147
DSG 4	4'000	1'200	400	277	255	400	410	128	124	270	235	400	410	490	316	540	430	183	188
DSG 5	5'000	1'500	500	324	325	450	445	128	155	297	260	435	435	530	322	575	455	183	217
DSG 6	6'000	1'800	600	329	310	470	455	138	181	320	280	460	455	550	342	600	475	184	241
DSG 7	7'000	2'100	700	356	340	500	480	138	203	360	310	505	480	595	372	645	500	182	284
DSG 8	8'000	2'400	800	384	370	525	505	138	227	384	330	545	505	635	392	685	525	182	324
DSG 9	9'000	2'700	900	418	400	565	525	143	266	383	340	550	515	635	402	690	535	199	360
DSG 10	10'000	3'000	1'000	409	515	550	635	139	301	426	365	595	540	680	427	735	560	192	401
DSG 12	12'000	3'600	1'200	460	445	630	570	153	352	442	390	615	565	695	452	755	585	208	471
DSG 15	15'000	4'500	1'500	493	590	660	710	154	460	485	435	675	610	750	497	815	630	220	596
DSG 20	20'000	6'000	2'000	577	580	775	700	179	636	558	500	770	675	840	562	910	695	240	839
DSG 25	25'000	7'500	2'500	662	775	845	895	172	856	612	710	810	830	885	730	950	850	241	1'124
DSG 30	30'000	9'000	3'000	697	820	900	940	191	1'072	670	765	885	885	950	785	1'025	905	255	1'396
DSG 40	40'000	12'000	4'000	816	1'015	1'030	1'135	196	1'543	750	905	990	1'025	1'055	925	1'130	1'045	288	2'071
DSG 50	50'000	15'000	5'000	917	1'015	1'170	1'135	232	2'122	831	985	1'090	1'105	1'145	1'005	1'230	1'125	314	2'684

The tabular dimension L is stated for a total of 100 mm longitudinal movement (W). For greater movements the dimensions are adjusted accordingly (e.g. for W= 350 mm, L must be increased by 250 mm).

$N_{Rd,max}$: maximum bearing capacity of the bearing under normal force (compression)
$N_{Rd,min}$: minimum bearing capacity of the bearing under normal force with simultaneous shear force $V_{xyRd, max}$
$V_{xyRd,max}$: maximum bearing capacity of the bearing under shear force

During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Assembled DSA bearing

DR®SLIDE disc on the calotte

Function

The DOSHIN® SPHERICAL DSA bearing allows movement in all directions and cannot accommodate any horizontal forces.

Minimum lateral displacement of the DSA bearing is ±20 mm. Bearings which allow greater lateral displacement can be provided on request.

The assumed longitudinal displacement is shown in the following tables to an accuracy of ±50 mm. Bearings which allow greater longitudinal displacement are of course also available on request.

Concrete stress

The concrete stress is calculated in accordance with the European Standard EC 2 (partial area stress).

In order to be able to fully utilise the high stability of the DR®SLIDE L2 and to reduce the bearing weight, we recommend using high-strength concrete (C50/60).

Permissible loads and dimensions with concrete strength C30/37

Type & Size	Loads [kN] Vertical		Spherical bearing without anchor plate Dimensions [mm]				Weight [kg]	Spherical bearing with anchor plate Dimensions [mm]								Weight [kg]
	$N_{Rd,max}$	$N_{Rd,min}$	A	B	L	H		A	B	L	APU_x	APU_y	APO_x	APO_y	H	
DSA 1	1'000	300	183	243	303	67	30	126	215	290	316	316	345	316	102	46
DSA 2	2'000	600	236	296	356	70	43	171	260	320	316	316	390	340	114	63
DSA 3	3'000	900	278	338	398	77	60	205	295	355	340	316	425	375	124	84
DSA 4	4'000	1'200	320	380	440	81	76	235	325	385	365	321	455	405	124	98
DSA 5	5'000	1'500	364	424	484	83	95	257	350	410	390	354	480	430	135	120
DSA 6	6'000	1'800	397	457	517	86	115	285	375	435	420	389	505	455	137	141
DSA 7	7'000	2'100	417	477	537	104	152	301	395	455	435	422	525	475	148	168
DSA 8	8'000	2'400	456	516	576	93	158	331	425	485	465	452	555	505	146	191
DSA 9	9'000	2'700	479	539	599	104	193	339	430	490	478	478	560	510	158	224
DSA 10	10'000	3'000	507	567	627	103	214	368	460	520	506	506	590	540	158	254
DSA 12	12'000	3'600	548	608	668	120	284	386	480	540	560	560	610	560	186	341
DSA 15	15'000	4'500	616	676	736	129	390	452	545	605	625	625	675	625	191	447
DSA 20	20'000	6'000	708	768	828	138	539	536	630	690	709	709	760	710	206	638
DSA 25	25'000	7'500	797	857	917	142	688	574	665	725	799	799	800	798	236	919
DSA 30	30'000	9'000	881	941	1'001	141	835	637	740	800	862	862	870	856	268	1'189
DSA 40	40'000	12'000	1'022	1'082	1'142	157	1'246	837	945	1'005	1'028	1'028	1'080	1'030	237	1'619
DSA 50	50'000	15'000	1'147	1'207	1'267	178	1'785	914	1'017	1'077	1'139	1'139	1'150	1'133	283	2'310

The tabular dimensions B and L are stated for a total of 100 mm longitudinal movement (W) and 40 mm transverse movement (W'). For greater movements the dimensions must be adjusted accordingly (e.g. for W=350 mm and W'=100 mm, L must be increased by 250 mm and B by 60 mm).
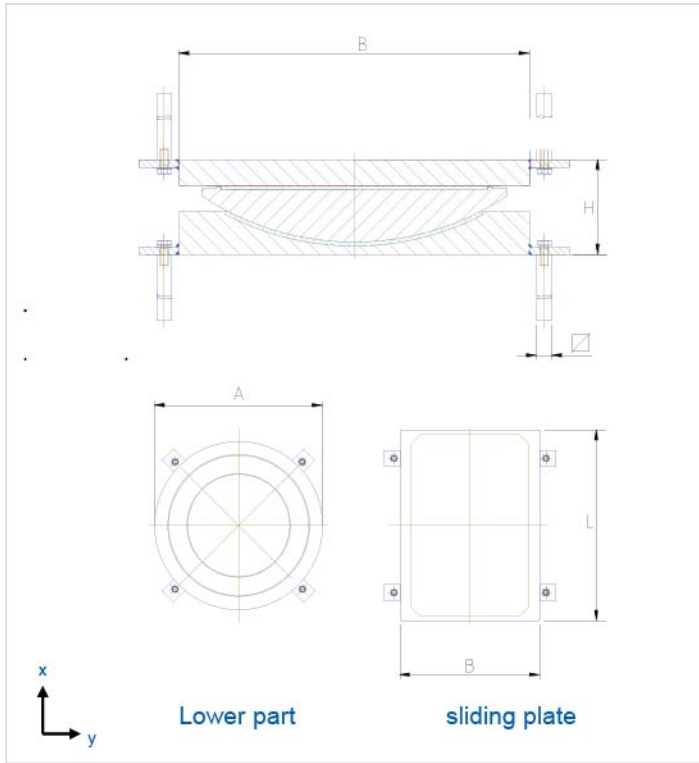
$N_{Rd,max}$ maximum bearing capacity of the bearing under normal force (compression)

During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

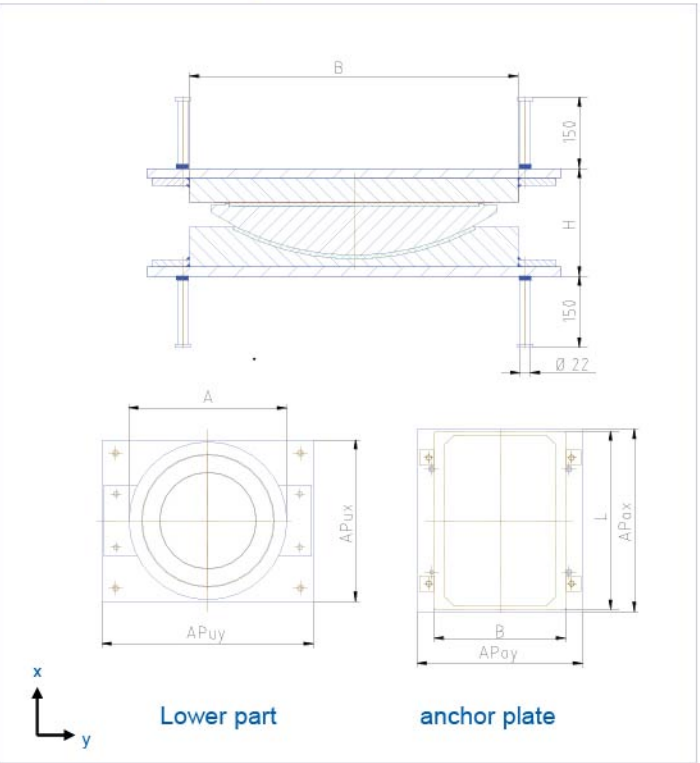Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Bearing with threaded sleeve anchors

Lower part   sliding plate

Bearing with anchor plates

Lower part   anchor plate

Permissible loads and dimensions with concrete strength C50/60

Type & Size	Loads [kN] Vertical		Spherical bearing without anchor plate Dimensions [mm]				Weight [kg]	Spherical bearing with anchor plate Dimensions [mm]								Weight [kg]
	NRd,max	NRd,min	A	B	L	H		A	B	L	APU_x	APU_y	APO_x	APO_y	H	
DSA 1	1'000	300	126	215	290	67	25	126	215	290	316	316	345	316	102	46
DSA 2	2'000	600	175	265	325	72	33	171	260	320	316	316	390	340	114	63
DSA 3	3'000	900	276	336	396	77	60	205	295	355	340	316	425	375	117	78
DSA 4	4'000	1'200	309	369	429	77	71	235	325	385	365	316	455	405	117	91
DSA 5	5'000	1'500	344	404	464	77	83	259	350	410	390	322	480	430	119	104
DSA 6	6'000	1'800	369	429	489	80	96	287	375	435	420	316	505	455	119	118
DSA 7	7'000	2'100	395	455	515	83	112	303	395	455	435	365	525	475	125	137
DSA 8	8'000	2'400	417	477	537	83	123	322	415	475	455	385	545	495	123	148
DSA 9	9'000	2'700	438	498	558	86	137	339	430	490	470	401	560	510	129	164
DSA 10	10'000	3'000	459	519	579	88	153	358	450	510	490	420	580	530	129	179
DSA 12	12'000	3'600	497	557	617	98	198	391	480	540	525	453	610	560	131	209
DSA 15	15'000	4'500	551	611	671	98	237	431	525	585	565	494	655	605	147	274
DSA 20	20'000	6'000	628	688	748	109	336	497	590	650	630	560	720	670	154	371
DSA 25	25'000	7'500	699	759	819	122	473	564	655	715	695	630	785	735	157	472
DSA 30	30'000	9'000	758	818	878	132	596	627	722	782	760	699	855	805	171	636
DSA 40	40'000	12'000	890	950	1'010	151	924	696	790	850	830	800	925	875	193	867
DSA 50	50'000	15'000	879	990	1'050	206	1'291	800	909	969	930	904	1'040	990	194	1'153

The tabular dimensions B and L are stated for a total of 100 mm longitudinal movement (W) and 40 mm transverse movement (W'). For greater movements the dimensions must be adjusted accordingly (e.g. for W=350 mm and W'=100 mm, L must be increased by 250 mm and B by 60 mm).

$N_{Rd,max}$ maximum bearing capacity of the bearing under normal force (compression)

During dimensioning the following were taken into account and complied with: Deformation constraint of the carrier plates Δw in the serviceability limit state, increased movement according to EN 1337-1, permissible stresses $f_{d,RSL}$=180/1.4 N/mm²

Note: Due to production tolerances the bearing height H may be greater by up to 10 mm.

Anchor bolts

- Suitable for DSF & DSG bearings without anchor plate
- for transmission of horizontal forces
- can be omitted in the case of sufficient minimum vertical force
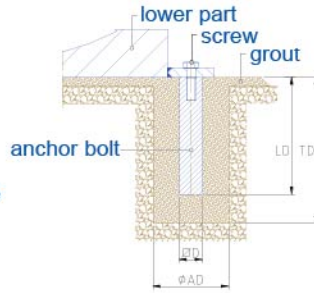
Anchoring with anchor bolts

Screw	Anchor bolts		Recess	
	⌀D	LD	ØAD	TD
M 12	30	180	150	250
M 16	40	200	150	250
M 20	50	250	150	300
M 24	60	300	150	350
M 27	70	300	150	350

Note:
If there is sufficient friction between bearing and sub- or superstructure to accommodate the horizontal forces, the anchor bolts or threaded sleeve anchors can be omitted, except where dynamic stresses with large load fluctuations are probable, such as railway bridges and in areas prone to earthquakes.

Recess:
Static requirements determine the screw size. Suitable recesses (øA, T) are presented in the tables.

Threaded sleeve anchors

- Suitable for DSA bearings without anchor plate
- structural connection to the bearing socket
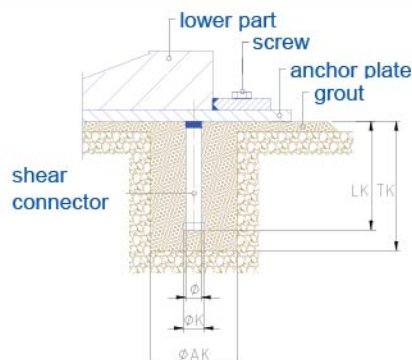- can be omitted if necessary
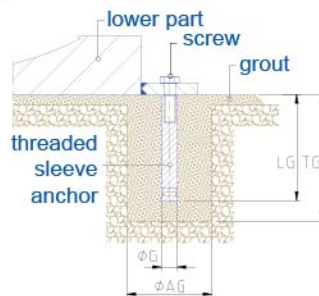
Screw	Threaded sleeve anchor		Recess	
	ØG	LG	ØAG	TG
M 12	17	100	150	150
M 16	22	150	150	200
M 20	26	150	150	200
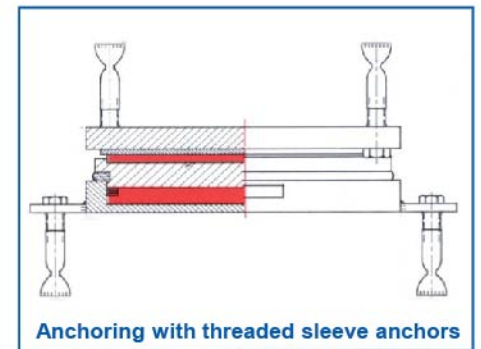
Anchoring with threaded sleeve anchors

Shear connector

- Anchoring of the anchor plate with shear connectors
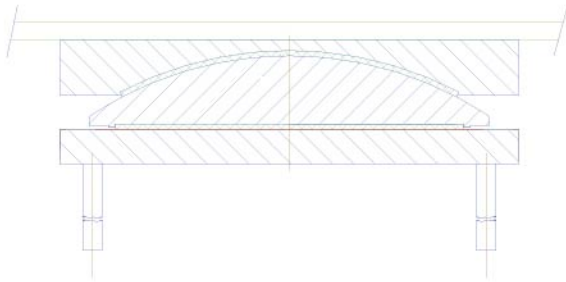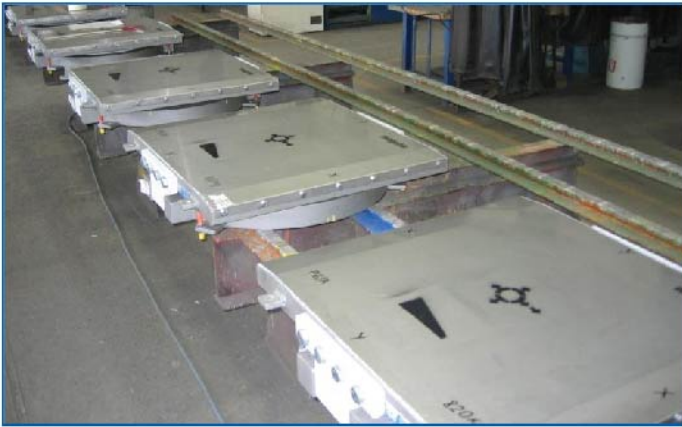- Number of shear connectors depends on the static circumstances

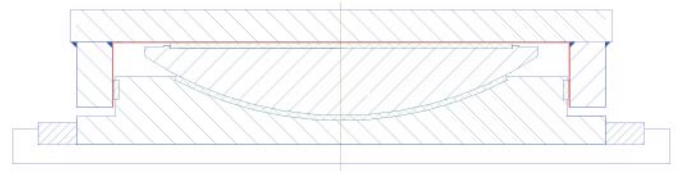| Ø	Shear connector		Recess	
	ØK	LK	ØAK	TK
22	35	150	150	200

Anchoring with shear connector

one
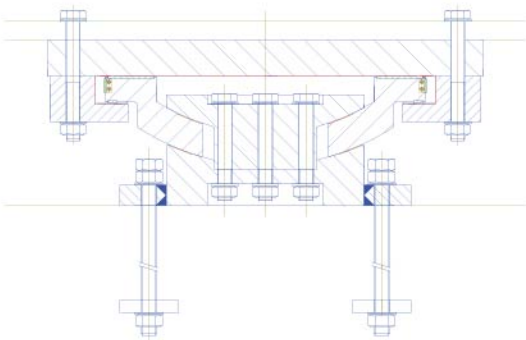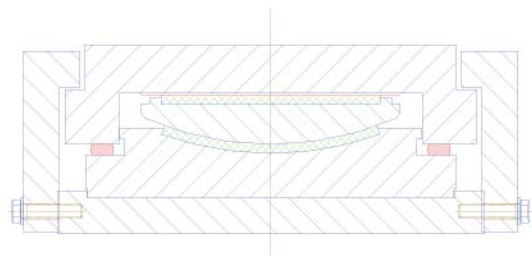
Bearing installed reversed for steel superstructure

Lateral safety catch with blocks

Bearing with internal uplift protection (uplift bearing)

Bearing with external uplift protection (uplift bearing)

Required information for design

For a detailed quotation DOSHIN needs the following information:

- Maximum and permanent and life load vertical superimposed load ($N_{Sd,max}$, $N_{Sk,perm}$)
- Maximum horizontal force in longitudinal and transverse directions on the bridge (F_{yd}, F_{xd})
- Most adverse load combination of maximum horizontal force and minimum vertical superimposed load
- Movement of the bridge in longitudinal and transverse directions
- Rotations of the bridge in longitudinal and transverse directions
- Concrete strength
- General structural details (concrete or steel bridge, fixing details of the bridge bearings, arrow and counter bearing size etc.)
- Layout drawing of the structure
- Pre-setting values

A more detailed list with the necessary information is defined in the European Standard EN 1337, part 1, pages 25 – 27.
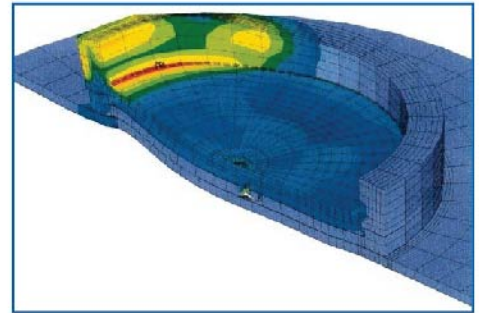
Technical Partner worldwide references

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