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### Dimensions

All distance dimensions in this catalog are in MM (millimeter) only. Other units are denoted in metric system.

### Drawings and illustrations

All drawings and illustrations cited in this catalogue are schematically for information and may differ from an actual application

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## General information about structural bearings

A **structural bearing** is a mechanical device of a construction structure, which typically connects the substructure and substructure. It is used to provide structural restraints, specifically, transferring vertical and horizontal loads from the superstructure into the foundation whilst a certain amount of design translation and rotation (twisted) between structural elements is allowed as designed.

**Bridge bearings** connect bridge piers to the bridge deck. The appropriate selection of bridge bearings has been always a significant subject in construction engineering. There are many types of bearings which have been commonly used along with research and development of the industry. Before 1960s, the most commonly used bridge bearings were made of steel elements and nowadays a variety of different types of bearings has proven their value and largely applied, among which **Elastomeric Bearing**, **Pot Bearing**, and **Spherical Bearing** are the most worldwide acknowledged and employed in design and fabrication.

### Types

Basically, all the structural bearings can be classified to three types:

- Fixed

No horizontal movement allowed while transfer the loads in all horizontal directions.

- Guided sliding

Only one direction movement in horizontal axis allowed while transfer horizontal loads in the perpendicular direction

- Free sliding

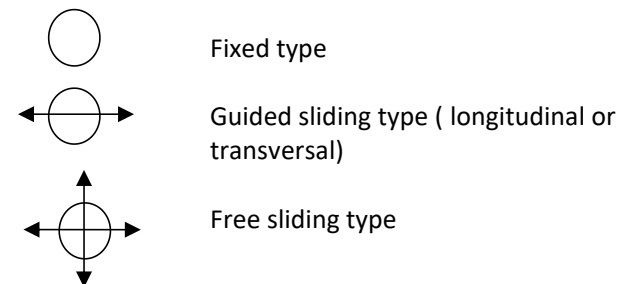
Horizontal movements in all directions allowed while transfer no horizontal forces

For the expansion bearings, usually the sliding friction is reduced to a minimum value by inserted sliding material (PTFE, Modified PTFE or UHMWPE) in contact with polished stainless steel plate (S304 or S316).



Role of bridge bearings (right on piers)

Legends normally used in drawings:



Abbreviations used in this catalogue:

F	fixed
G	guided
M	free(multi-directional)

### Corrosion prevention

All exposed steel surfaces are corrosion protection treated as per the requirements specified in the ISO12944. Standard corrosion protection procedures are listed below:

- ✓ Shotblast to Sa 2.5
- ✓ Hot aluminum spray to min. 30µm;
- ✓ Zinc-rich epoxy as primer coating;
- ✓ Polyurethane paint of intermediate and top coating;

Galvanized treatment can also be provided upon request.

foam spacer is used to prevent collision.



hot-aluminum spray



pot bearings packed in crate

Bearing shall be always stored away from extreme humidity or possible contaminants. Elastomeric bearings shall also be kept away from escalating heat.



Measurement of thickness of the dry film of paint



Finished bearings at storage prior to shipment

### Handling, Packaging and Storage

Structural bearings must be handled with care in all processing until installation is completed.

Proper packaging such as using sturdy timber/plywood crates or pallets is necessary to protect bearings from damage during transit or storage. Any possible source to contaminate the bearings shall be avoided. Ideally bearings shall be packed according to the installation position but it is also understandable to mix the bearings when they are comparably small. In this operation, hard



packaging at IEC workshop prior to delivery

## Spherical Bearing

### History of Use

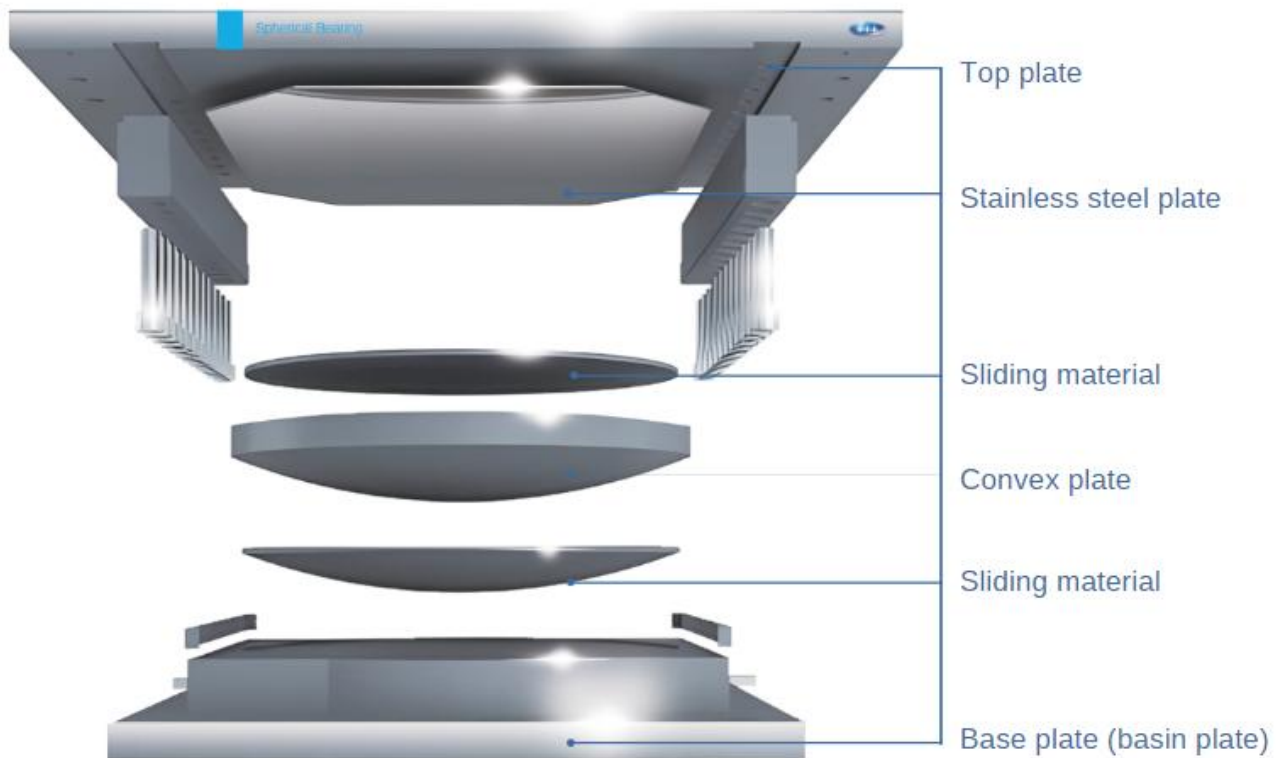
Spherical Bearings were developed in the 1970s as a solution to address the rotational limitations of Pot Bearings, particularly for large-scale cable-stayed bridges. These bridges require bearings capable of withstanding rotations up to 0.05 radians — beyond the capability of traditional Pot Bearings.

By replacing the pot and elastomeric disc with a concave/convex contact mechanism, **Spherical Bearings** offer greater rotational capacity. The largest known application of this design installed by IEC is used for the Jialing Bridge in Nanchong, Sichuan province, Southwest China, handling a vertical load of **140 MN** and a rotation of **0.05 radians**.

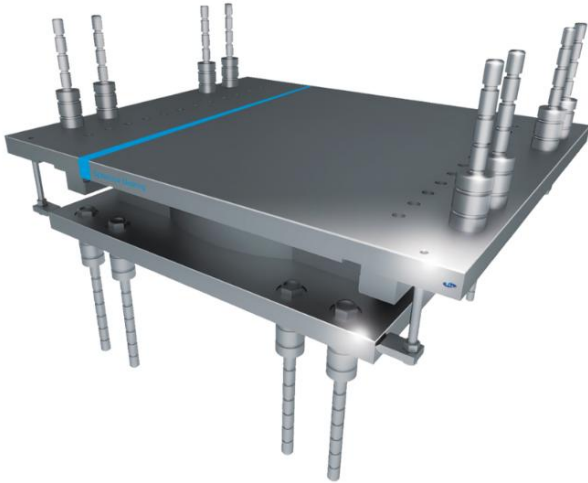
### Design principle

Spherical Bearings consist of three primary elements: a concave element, a convex element, and a top plate. PTFE, mated to a stainless steel plate, slides against the spherical surface, allowing rotational movement and accommodating structural loads.

The spherical cap is a crucial component. The sliding material (PTFE or other types) is interlocked onto the concave sphere, sliding against the stainless steel plate, typically welded to the convex sphere's back. Another piece of PTFE, fixed on the top surface of the convex sphere, works with the stainless steel plate to allow horizontal movement.



An exploded view of spherical bearing (guided sliding type)



A typical design of IEC spherical bearing

### Applied standards

- **European Standard:** EN 1337-7;
- **British Standard:** BS 5400-9.1, BS 5400-9.2;
- **American Standard:** AASHTO LRFD Bridge Design Specification and Construction specification

IEC's Spherical Bearings are CE-certified under the EN standard, and the Performance of Constancy certificate remains up to date. IEC can also design bearings according to other international standards upon request.



CE certificate

IEC's CE certificate, issued and notarized by Karlsruhe Institute of Technology (KIT), Institute of Concrete Structures and Building Materials, Building Materials and Concrete Construction, MPA Karlsruhe, Germany.

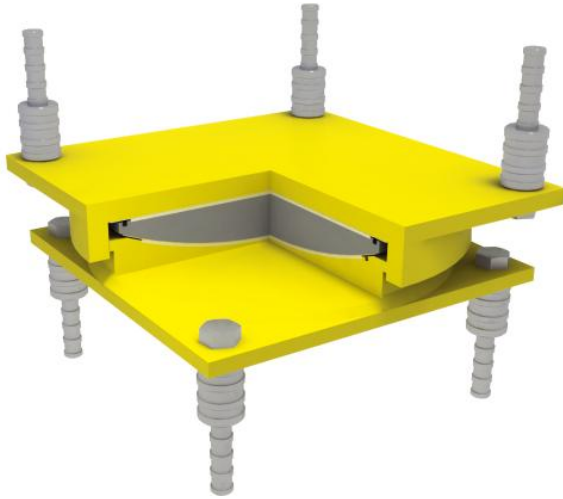
### Advantages of using Spherical Bearings

- **High Rotation Capacity:** Spherical bearings can accommodate rotations of up to 0.05 radians (approximately 2.87 degrees), making them suitable for structures experiencing significant angular shifts. In custom applications, specially designed spherical bearings can handle even larger rotations.
- **Friction-Reduced Sliding:** Bearings equipped with PTFE or UHMWPE sliding elements offer smooth horizontal movements with a friction coefficient as low as 0.03, ensuring the bearing can handle both rotational and translational movements under heavy loads.
- **No Rubber Aging Issues:** Unlike bearings that rely on elastomeric materials, spherical bearings are free from rubber-related issues such as aging, hardening, or degradation over time. This makes them particularly suited for use in extreme temperatures and environments, including frigid climates.
- **Customizable Configurations:** Spherical bearings are available in multiple configurations, including fixed, guided-sliding, and free-sliding models. Each type can be adapted to meet the specific requirements of the structure, allowing for precise control of movement and rotation.

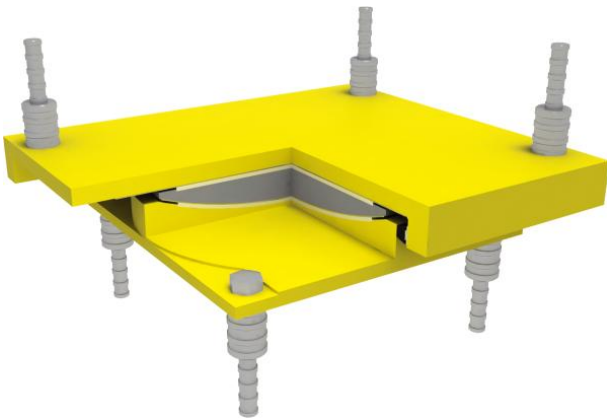
### Types

Spherical Bearings can be categorized similarly to Pot Bearings:

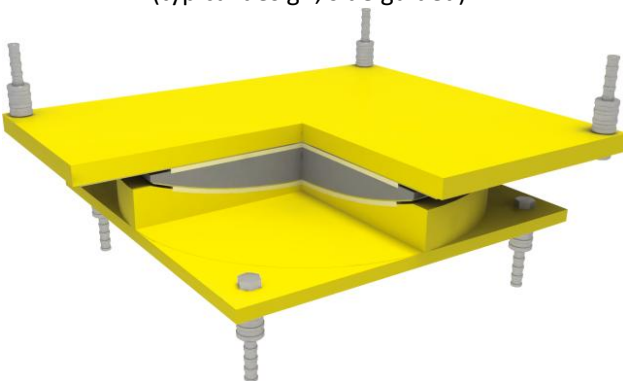
- **Fixed Bearings**
- **Guided Sliding Bearings**
- **Free Sliding Bearings**



3d view of a fixed spherical bearing (typical design)



3d view of a guided sliding spherical bearing  
(typical design, side guided)



3d view of a free sliding spherical bearing  
(typical design)

- **Masonry Plates:** Typically made from S235 steel unless otherwise specified.
- **Stainless Steel:** Typically S304 stainless steel is used.

#### Sliding Material (PTFE or UHMWPE or UHPF)

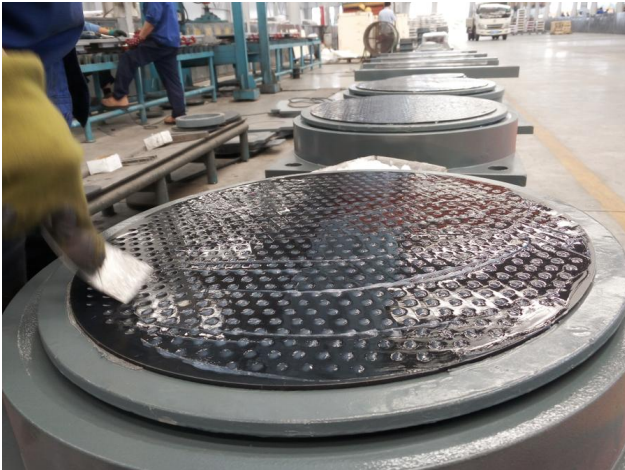
- **PTFE (Polytetrafluoroethylene):** PTFE is widely used in spherical bearings due to its low friction coefficient and excellent resistance to wear and chemicals.
- **UHMWPE (Ultra High Molecular Weight Polyethylene):** UHMWPE is increasingly used as an alternative to PTFE due to its superior compressive strength (up to 180 MPa) and wear resistance. UHMWPE can endure sliding over distances up to 50 km with minimal wear (less than 5 microns per km), providing an extended service life.
- **UHPF - Key Features of the Innovative sliding materials**
  - **High-Performance Sliding Surfaces:** The system leverages UHPF's ultra-low friction and high durability to ensure smooth and efficient movement of the bearing during seismic events, minimizing energy transfer to the structure.
  - **Reduced Maintenance Requirements:** Thanks to the self-lubricating properties of UHPF, the system requires minimal maintenance, making it cost-effective for long-term use.
  - **Superior Energy Dissipation:** UHPF enables the bearing to effectively convert seismic energy into sliding motion, reducing the forces acting on the structure during an earthquake.
  - **Long Service Life:** The wear-resistant nature of UHPF significantly extends the service life of the friction pendulum bearing, ensuring reliable performance over decades.

Consult IEC's specialist engineers for the latest advancements in sliding material technology.

## Materials

### **Steel Elements**

- **Structural Steel:** All steel elements, excluding masonry plates, conform to S355 specifications. The concave sphere can be made from cast steel for larger applications.



UHMWPE used in IEC spherical bearing



UHPF used in IEC spherical bearing

### Design and Technical Specifications

Spherical bearings are available in multiple configurations, depending on the structural requirements. Key design parameters include:

- **Rotation Capacity:** Capable of accommodating rotations of up to 0.05 radians (approximately 2.87 degrees). Custom-designed bearings can handle even larger rotations for specific engineering requirements.
- **Vertical Load Capacity:** Designed to support vertical loads ranging from 1 MN to 60 MN, depending on the size and configuration of the bearing.
- **Friction Coefficient:** The sliding elements (PTFE or UHMWPE) maintain a friction coefficient as low as 0.03, ensuring smooth movement under load.

### Quality control and production

IEC ensures the highest quality standards for spherical bearings through rigorous testing and quality control processes:

- **Rotation and Load Testing:** Bearings undergo full-load and rotational tests to verify that they can accommodate the specified loads and rotations without failure.
- **Wear and Friction Testing:** The sliding materials are tested to ensure minimal wear over extended distances and consistent friction coefficients under dynamic conditions.
- **Material Integrity Testing:** Steel elements are tested for tensile strength, fatigue resistance, and corrosion resistance to ensure long-term durability.

IEC also provides third-party inspections from accredited organizations such as SGS and BV upon request.

### Applications

The Spherical Bearing is widely used in bridges, viaducts, and large-scale structures where significant rotational movements and heavy vertical loads need to be accommodated. These bearings are particularly suited for:

- **Curved Bridges:** Where large rotational movements are required to maintain structural integrity.
- **Seismic Zones:** Where the ability to handle both vertical and lateral forces is critical.
- **Large-Span Bridges:** Where the bearing must support substantial vertical loads while allowing for rotational and horizontal movements.
- 



IEC's staff is measuring dimension of convex plate of a spherical bearing

### Installation, maintenance and replacement

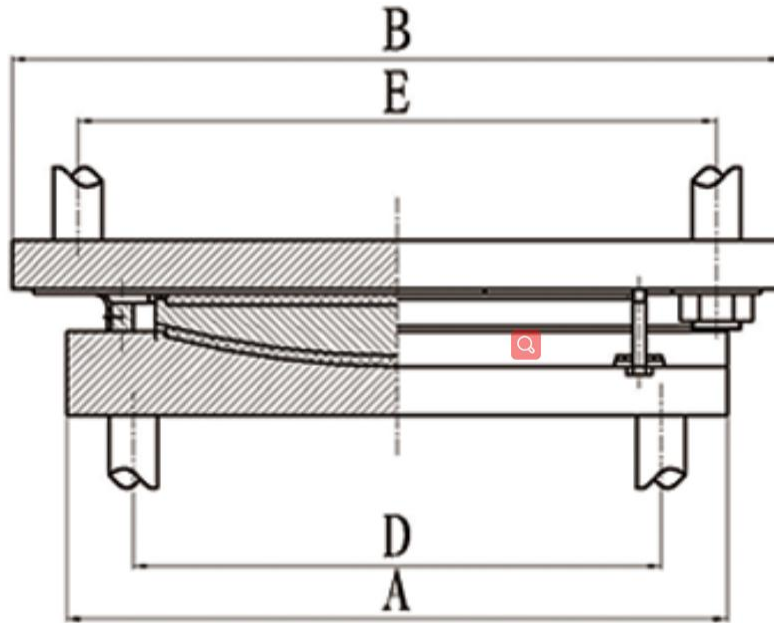
Refer to pot bearing

**Dimensions tables**

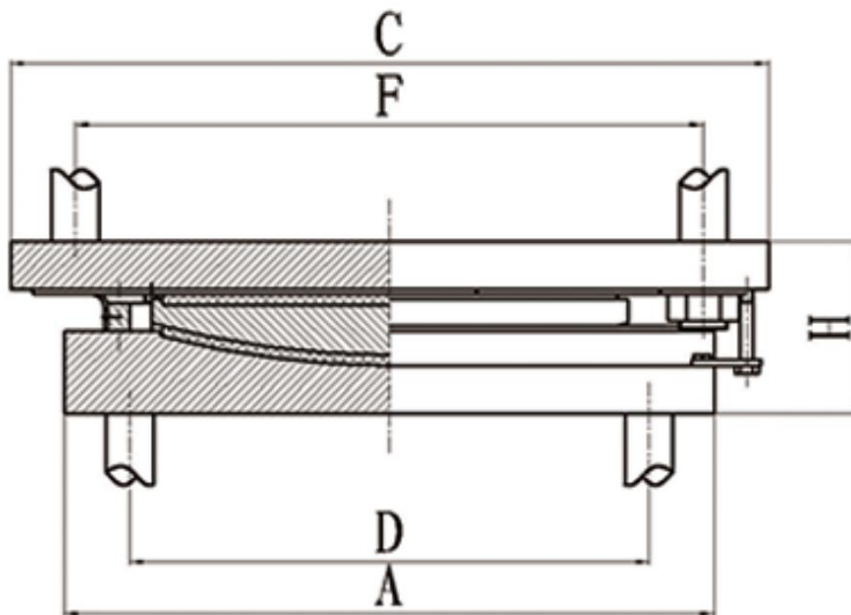
Notes:

- Allowable contact pressure is taken as 50 MPa;
- Vertical load takes as SLS value;
- Material used in the table is PTFE. Consult IEC for using UHMWPE.

Free sliding spherical bearing



Section view along longitudinal direction



Section view along transversal direction



Dimension table for free sliding

type	rotation $\theta$ (rad)	dimension (mm)														anchor bolt Dia.xL (mm)	
		A	B	C					D	E	F						H
				e=±50	e=±100	e=±150	e=±200	e=±250			e=±50	e=±100	e=±150	e=±200	e=±250		
QZM1000	0.01~0.02	300	350	410	510	/	/	/	240	290	350	450	/	/	/	79	M20×400
QZM1500	0.01~0.02	350	390	460	560	/	/	/	290	330	400	500	/	/	/	84	M20×400
QZM2000	0.01~0.02	400	440	510	610	/	/	/	320	360	430	530	/	/	/	89	M20×400
QZM2500	0.01~0.02	445	485	555	655	/	/	/	355	395	450	550	/	/	/	105	M24×460
QZM3000	0.01~0.02	480	520	590	690	790	/	/	380	420	470	570	670	/	/	110	M24×460
QZM4000	0.01~0.02	540	580	650	750	850	/	/	430	470	530	630	730	/	/	115	M27×500
QZM5000	0.01~0.02	600	640	710	810	910	/	/	490	530	580	680	780	/	/	127	M30×500
QZM6000	0.01~0.02	660	700	770	870	970	/	/	530	570	640	740	840	/	/	137	M33×500
QZM7000	0.01~0.02	710	750	820	920	1020	/	/	570	610	680	780	880	/	/	147	M36×500
QZM8000	0.01~0.02	740	780	850	950	1050	/	/	605	645	720	820	920	/	/	152	M40×600
QZM9000	0.01~0.02	790	830	900	1000	1100	/	/	640	680	760	860	960	/	/	162	M42×600
QZM10000	0.01~0.02	825	865	935	1035	1135	/	/	665	705	790	890	990	/	/	167	M42×600
QZM12500	0.010	910	940	1000	1100	1200	/	/	710	740	800	900	1000	/	/	191	M45×600
	0.015	930	960	1020	1120	1220	/	/	730	760	820	920	1020	/	/		
	0.020	960	990	1050	1150	1250	/	/	760	790	850	950	1050	/	/		
QZM15000	0.010	990	1020	1080	1180	1280	/	/	790	820	880	980	1080	/	/	207	M48×600
	0.015	1010	1040	1100	1200	1300	/	/	810	840	900	1000	1100	/	/		
	0.020	1040	1070	1130	1230	1330	/	/	840	870	930	1030	1130	/	/		

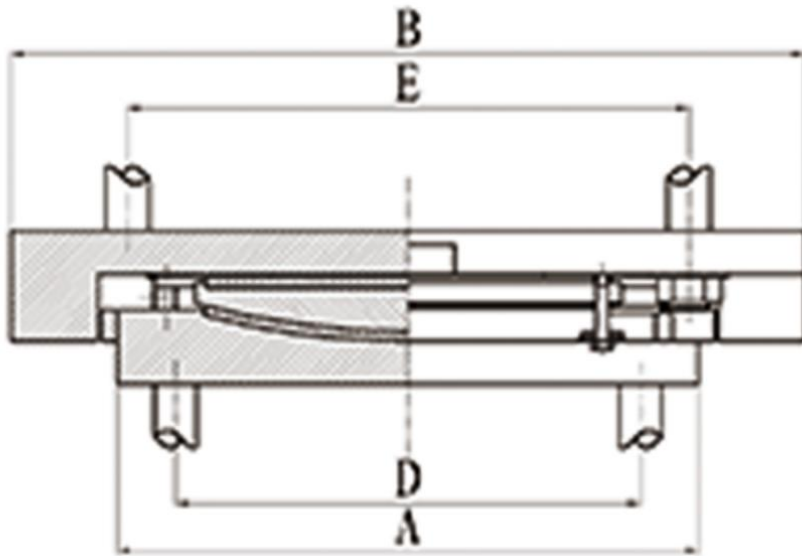
## structural bearing-spherical bearing

QZM17500	0.010	1050	108 0	1140	1240	1340	/	/	810	840	900	1000	1100	/	/	211	M56×800
	0.015	1090	112 0	1180	1280	1380	/	/	850	880	940	1040	1140	/	/		
	0.020	1120	115 0	1210	1310	1410	/	/	880	910	970	1070	1170	/	/		
QZM20000	0.010	1110	114 0	1200	1300	1400	/	/	870	900	960	1060	1160	/	/	227	M60×800
	0.015	1150	118 0	1240	1340	1440	/	/	910	940	1000	1100	1200	/	/		
	0.020	1180	121 0	1270	1370	1470	/	/	940	970	1030	1130	1230	/	/		
QZM22500	0.020	1210	129 0	/	/	1390	1490	1590	960	110 0	/	/	1160	1260	1360	260	M64×800
	0.040	1210	131 0	/	/	1390	1490	1590	960	112 0	/	/	1160	1260	1360		
	0.060	1210	135 0	/	/	1390	1490	1590	960	114 0	/	/	1160	1260	1360		
QZM25000	0.020	1234	129 0	/	/	1434	1534	1634	990	109 0	/	/	1230	1330	1430	270	M64×800
	0.040	1234	135 0	/	/	1434	1534	1634	990	115 0	/	/	1230	1330	1430		
	0.060	1234	138 0	/	/	1434	1534	1634	990	118 0	/	/	1230	1330	1430		
QZM27500	0.020	1254	134 6	/	/	1524	1624	1724	100 0	112 0	/	/	1280	1380	1480	277	M72×800
	0.040	1254	137 6	/	/	1524	1624	1724	100 0	113 0	/	/	1280	1380	1480		
	0.060	1254	143 6	/	/	1524	1624	1724	100 0	118 0	/	/	1280	1380	1480		
QZM30000	0.020	1320	140 8	/	/	1530	1630	1730	105 0	117 0	/	/	1290	1390	1490	289	M72×800

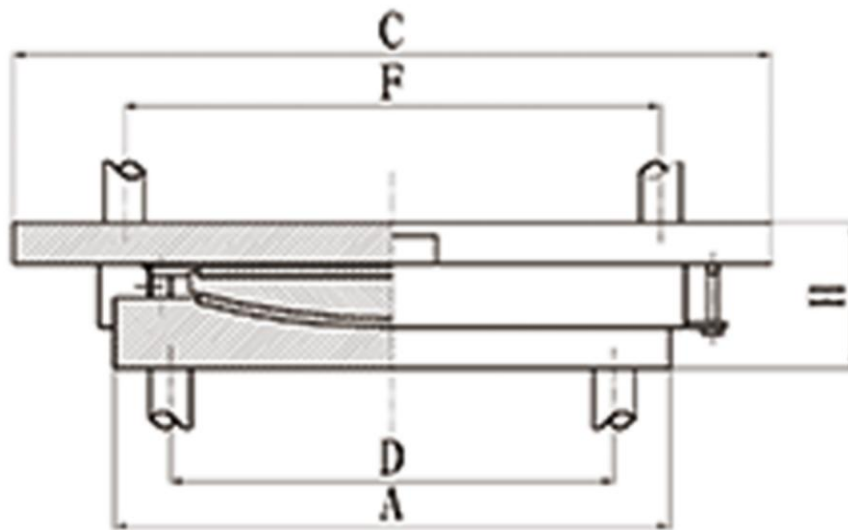
structural bearing-spherical bearing

	0.040	1320	146 6	/	/	1530	1630	1730	105 0	119 0	/	/	1290	1390	1490		
	0.060	1320	149 4	/	/	1530	1630	1730	105 0	121 0	/	/	1290	1390	1490		

Guided sliding (side)



Section view along longitudinal direction



Section view along transversal direction

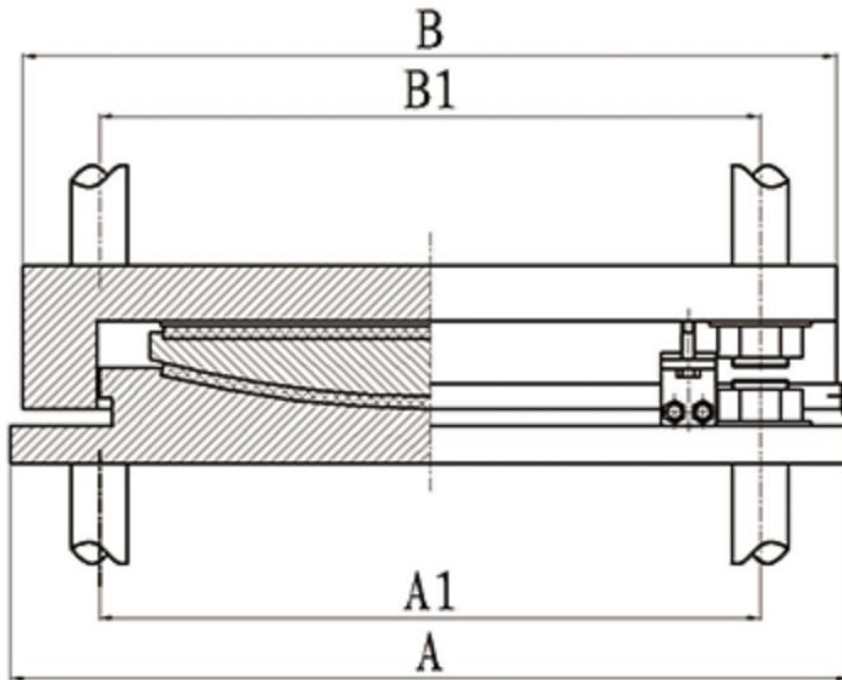
## structural bearing-spherical bearing

Dimension table for guided sliding

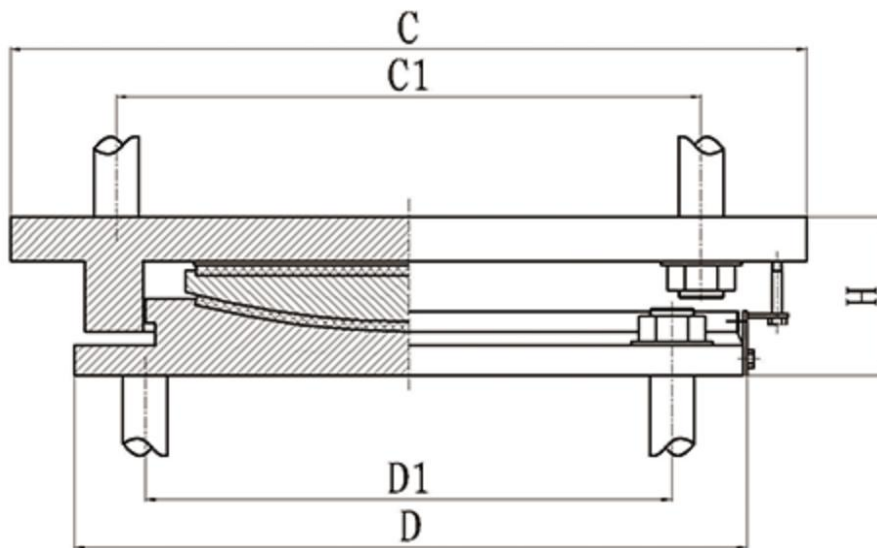
type	rotation $\theta$ (rad)	dimension (mm)														anchor bolt Dia.xL (mm) (mm)	
		A	B	C					D	E	F						H
				e=±50	e=±100	e=±150	e=±200	e=±250			e=±50	e=±100	e=±150	e=±200	e=±250		
QZG1000	0.01~	300	410	410	510	/	/	/	240	290	350	450	/	/	/	79	M20×400
QZG1500	0.01~	350	460	460	560	/	/	/	290	330	400	500	/	/	/	84	M20×400
QZG2000	0.01~	400	510	510	610	/	/	/	320	360	430	530	/	/	/	89	M20×400
QZG2500	0.01~	445	555	555	655	/	/	/	355	395	450	550	/	/	/	105	M24×460
QZG3000	0.01~	480	600	590	690	790	/	/	380	420	470	570	670	/	/	110	M24×460
QZG4000	0.01~	540	670	650	750	850	/	/	430	470	530	630	730	/	/	115	M27×500
QZG5000	0.01~	600	710	710	810	910	/	/	490	530	580	680	780	/	/	127	M30×500
QZG6000	0.01~	660	780	770	870	970	/	/	530	570	640	740	840	/	/	137	M33×500
QZG7000	0.01~	710	840	820	920	1020	/	/	570	610	680	780	880	/	/	147	M36×500
QZG8000	0.01~	740	880	850	950	1050	/	/	605	645	720	820	920	/	/	152	M40×600
QZG9000	0.01~	790	930	900	1000	1100	/	/	640	680	760	860	960	/	/	162	M42×600
QZG10000	0.01~	825	965	935	1035	1135	/	/	665	705	790	890	990	/	/	167	M42×600
QZG12500	0.010	910	990	1000	1100	1200	/	/	710	790	800	900	1000	/	/	191	M45×600
	0.015	930	101	1020	1120	1220	/	/	730	810	820	920	1020	/	/		
	0.020	960	104	1050	1150	1250	/	/	760	840	850	950	1050	/	/		
QZG15000	0.010	990	108	1080	1180	1280	/	/	790	880	880	980	1080	/	/	207	M48×600
	0.015	101	110	1100	1200	1300	/	/	810	900	900	1000	1100	/	/		
	0.020	104	113	1130	1230	1330	/	/	840	930	930	1030	1130	/	/		
QZG17500	0.010	105	115	1140	1240	1340	/	/	810	910	900	1000	1100	/	/	211	M56×800
	0.015	109	119	1180	1280	1380	/	/	850	950	940	1040	1140	/	/		
	0.020	112	122	1210	1310	1410	/	/	880	980	970	1070	1170	/	/		
QZG20000	0.010	111	121	1200	1300	1400	/	/	870	970	960	1060	1160	/	/	227	M60×800
	0.015	115	125	1240	1340	1440	/	/	910	1010	1000	1100	1200	/	/		
	0.020	118	128	1270	1370	1470	/	/	940	1040	1030	1130	1230	/	/		
QZG22500	0.020	116	142	/	/	1460	1560	1660	930	1090	/	/	1240	1340	1440	260	M64×800

structural bearing-spherical bearing

	0.040	124	149	/	/	1460	1560	1660	1000	1200	/	/	1240	1340	1440		
	0.060	136	161	/	/	1500	1600	1700	1100	1310	/	/	1280	1380	1480		
QZG25000	0.020	120	145	/	/	1484	1584	1684	960	1170	/	/	1260	1360	1460	270	M64×800
	0.040	131	156	/	/	1484	1584	1684	1050	1280	/	/	1260	1360	1460		
	0.060	139	164	/	/	1534	1634	1734	1110	1340	/	/	1300	1400	1500		
QZG27500	0.020	126	153	/	/	1564	1664	1764	1000	1270	/	/	1300	1400	1500	277	M72×800
	0.040	132	159	/	/	1564	1664	1764	1060	1330	/	/	1300	1400	1500		
	0.060	144	171	/	/	1604	1704	1804	1170	1450	/	/	1340	1440	1540		
QZG30000	0.020	129	156	/	/	1620	1720	1820	1020	1280	/	/	1340	1440	1540	289	M72×800
	0.040	137	164	/	/	1620	1720	1820	1090	1360	/	/	1340	1440	1540		
	0.060	150	177	/	/	1660	1760	1860	1220	1490	/	/	1380	1480	1580		



Section view along longitudinal direction



Section view along longitudinal direction

Dimension table for fixed type

type	Rotation $\theta$ (rad)	dimension (mm)									anchor bolt Dia.×L (mm)
		A	A1	B	B1	C	C1	D	D1	H	
QZF1000	0.01~0.02	330	260	320	260	400	340	330	260	79	M20×400
QZF1500	0.01~0.02	390	300	380	300	440	380	390	300	84	M20×400
QZF2000	0.01~0.02	440	340	430	340	480	420	440	340	89	M20×400
QZF2500	0.01~0.02	490	375	480	375	540	470	490	375	105	M24×460
QZF3000	0.01~0.02	530	410	520	410	570	500	530	410	110	M24×460
QZF4000	0.01~0.02	590	460	580	460	650	570	590	460	115	M27×500
QZF5000	0.01~0.02	650	500	640	500	710	610	650	500	127	M30×500
QZF6000	0.01~0.02	710	550	700	550	790	680	710	550	137	M33×500
QZF7000	0.01~0.02	770	600	760	600	840	730	770	600	147	M36×500
QZF8000	0.01~0.02	810	630	800	630	890	780	810	630	152	M40×600
QZF9000	0.01~0.02	860	670	850	670	940	820	860	670	162	M42×600
QZF10000	0.01~0.02	900	695	890	695	970	850	900	695	167	M42×600
QZF12500	0.010	970	750	960	750	1040	840	970	750	191	M45×600
	0.015	990	770	980	770	1060	860	990	770		
	0.020	1020	790	1010	790	1080	880	1020	790		
QZF15000	0.010	1050	810	1040	810	1100	900	1050	810	207	M48×600
	0.015	1070	830	1060	830	1120	920	1070	830		
	0.020	1100	850	1090	850	1140	940	1100	850		
QZF17500	0.010	1110	870	1100	870	1200	960	1110	870	211	M56×800
	0.015	1150	900	1140	900	1230	990	1150	900		
	0.020	1180	920	1170	920	1260	1020	1180	920		
QZF20000	0.010	1170	920	1160	920	1280	1020	1170	920	227	M60×800
	0.015	1210	940	1200	940	1310	1050	1210	940		
	0.020	1240	960	1230	960	1340	1080	1240	960		
QZF22500	0.020	1102	880	1372	1140	1372	1140	1452	1230	260	M64×800
	0.040	1228	1000	1498	1270	1498	1270	1538	1280		

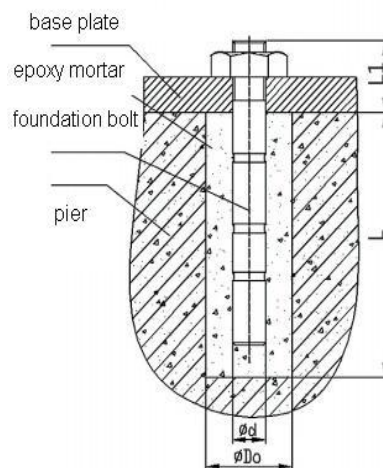


structural bearing-spherical bearing

	0.060	1344	1110	1614	1360	1614	1360	1588	1360		
QZF25000	0.020	1124	880	1396	1140	1396	1140	1484	1240	270	M64×800
	0.040	1244	1000	1516	1280	1516	1280	1564	1300		
	0.060	1364	1120	1640	1380	1640	1380	1620	1380		
QZF27500	0.020	1184	940	1454	1210	1454	1210	1544	1300	277	M72×800
	0.040	1314	1070	1584	1340	1584	1340	1614	1370		
	0.060	1434	1150	1704	1460	1704	1460	1714	1470		
QZF30000	0.020	1230	940	1504	1260	1504	1260	1670	1380	289	M72×800
	0.040	1370	1080	1640	1370	1640	1370	1720	1430		
	0.060	1500	1210	1774	1510	1774	1510	1800	1510		

## Dimensions for anchor bolt/socket

Bearing type (design horizontal load kN)	Pre-set specs for anchor bolt (mm)			
	d	D	L	L1
1000	20	70	400	45
1500	20	70	400	45
2000	20	70	400	45
2500	24	80	460	55
3000	24	80	460	55
4000	27	100	500	58
5000	30	100	500	66
6000	33	100	500	70
7000	36	120	500	76
8000	40	120	600	82
9000	42	130	600	88
10000	42	130	600	88
12500	45	140	600	92
15000	48	150	600	93
17500	56	180	800	103
20000	60	190	800	109
22500	64	200	800	112
25000	64	200	800	114
27500	72	220	800	122
30000	72	220	800	124



Sketch of the assembly of bolt/socket as anchor method