GUCHEN® Rubber Bearings

Engineered for Movement. Built for Longevity.

Hebei Guchen Engineering Rubber Co., Ltd.

COMPANY PROFILE

Guchen Bridge Systems is a premier manufacturer and Leading Global Supplier of Seismic Isolation Rubber Bearings. Operating from our advanced production facilities in Hebei, China, we engineer durability and reliability into every product, ensuring the safety and longevity of critical infrastructure projects worldwide.

For over 15 years, we have combined precision engineering with rigorous quality control to deliver solutions that stand up to the most demanding conditions—from heavy traffic loads and extreme weather to seismic events. Our commitment is not just to meet expectations but to exceed them, providing unparalleled value and support at every stage of your project.

Why Partner With Guchen?

Engineering Excellence: Our in-house team of experienced engineers utilizes state-of-the-art design and finite element analysis (FEA) to create joints that perform flawlessly under specified movement ranges and dynamic loads. We offer custom-designed solutions tailored to your project's unique requirements.

Uncompromising Quality: From the selection of high-grade, corrosion-resistant steels and advanced, weather-proof elastomers to our meticulous manufacturing processes, every step is controlled to ensure superior product life. Our products comply with major international standards, including EN, AASHTO, and DIN.

Proven Global Performance: Our Seismic Isolation Rubber Bearings have been specified and installed for over 30 projects worldwide, encompassing a wide range of structures including High-rise Buildings, Bridge Engineering, and Industrial Facilities. This global experience equips us with a deep understanding of the diverse challenges faced by engineers and contractors.

Total Project Support: We are more than just a supplier; we are your partner. We provide comprehensive technical documentation, detailed installation guidance, and responsive after-sales support to ensure seamless integration and optimal performance of our systems.

Our Commitment

At Guchen Bridge Systems, our mission is to empower engineers and builders with reliable, innovative, and cost-effective Seismic Isolation Rubber Bearings that ensure the structural integrity and safety of bridges for decades to come.

Let us help you build smarter, safer, and longer-lasting.

CERTIFICATIONS & COMPLIANCE


外观设计专利证书
实用新型专利证书
实用新型名称：钢结构球铰支座
发 明 人：连鹏飞
专利权人：河北古晨工程橡胶有限公司
局长 申长雨


检验检测
型式检验报告
检 验 报 告
报告编号：A34915F202208020
产品名称：球型钢支座
委托单位：中冶天工集团有限公司
检验类别：委托检验
国家工程橡胶产品质量检验检测中心（河北）
恒为检验检测认证（河北）集团有限公司


检 验 报
建筑摩擦摆隔震支座
检 测 报 告
工程名称：FPS-II-3500-300-4.4 型式检验
样品名称：建筑摩擦摆隔震支座
委托单位：河北古晨工程橡胶有限公司
检测日期：2024 年 01 月 15 日~2024 年 03 月 15 日
报告总页数：共 17 页
委托编号：ZHA2-F119-2024000050
报告编号：ZHA2-B119-2024000102
武汉中和工程技术有限公司

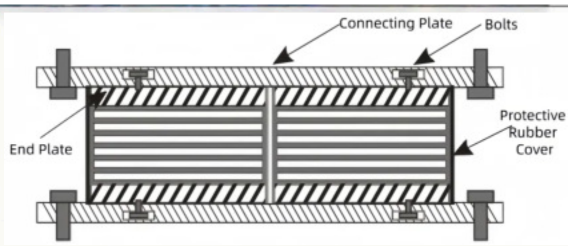
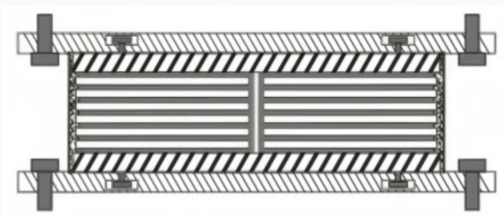
1. Classification by Material and Presence of Lead Core:

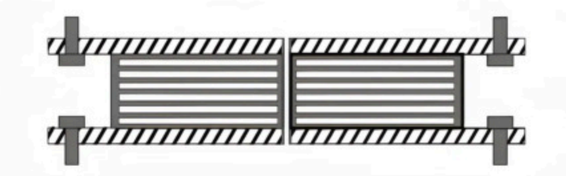
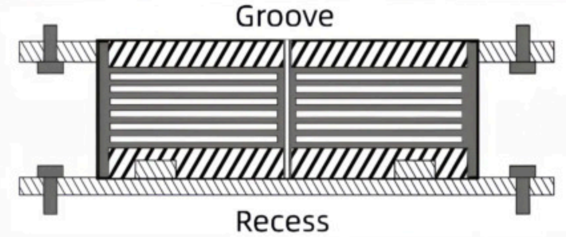
- Seismic Isolation Rubber Bearings
  - Natural Rubber Bearing (LNR)
  - High Damping Rubber Bearing (HDR)
  - Lead Rubber Bearing (LRB)

Natural Rubber Bearing (LNR) is primarily made from natural rubber. High Damping Rubber Bearing (HDR) is made by adding carbon or other elements to the rubber compound, giving the laminated rubber high damping properties. Lead Rubber Bearing (LRB) contains a lead core to improve the damping ratio of the isolation bearing and increase its initial stiffness, which helps control wind response and minor vibrations.

Regardless of which type of seismic isolation rubber bearing is used, they all provide at least the following functions: Sufficient durability, exceeding the standard design life of ordinary building structures; sufficient vertical and horizontal stiffness to reliably support the superstructure and extend its fundamental period to approximately 1.5 to 3.0 seconds; adequate horizontal deformation capacity to ensure stability is maintained during strong earthquakes; horizontal stiffness is less affected by vertical compression loads; and they are convenient for design and construction.

2. Classification by Structural Configuration

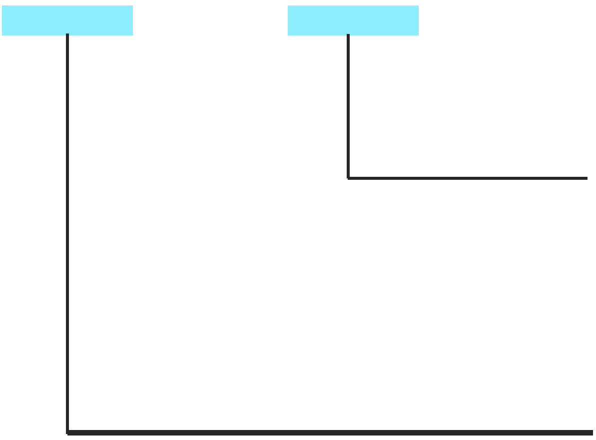
Type I	The connecting plate and end plate are connected with bolts. The end plate is bonded to the inner rubber. The protective rubber cover is wrapped prior to the vulcanization of the bearing	
	The connecting plate and end plate are connected with bolts. The end plate is bonded to the inner rubber. The protective rubber cover is wrapped after the vulcanization of the bearing	

Type II	The connecting plate is directly bonded to the inner rubber	
Type III	The bearing is connected to the connecting plate via grooves or dowels	

3. Representation Method for Isolation Bearings

Natural Rubber Bearing (LNR) is primarily made from natural rubber. High Damping Rubber Bearing (HDR) is made by adding carbon or other elements to the rubber compound, giving the laminated rubber high damping properties. Lead Rubber Bearing (LRB) contains a lead core to improve the damping ratio of the isolation bearing and increase its initial stiffness, which helps control wind response and minor vibrations.

Regardless of which type of seismic isolation rubber bearing is used, they all provide at least the following functions: Sufficient durability, exceeding the standard design life of ordinary building structures; sufficient vertical and horizontal stiffness to reliably support the superstructure and extend its fundamental period to approximately 1.5 to 3.0 seconds; adequate horizontal deformation capacity to ensure stability is maintained during strong earthquakes; horizontal stiffness is less affected by vertical compression loads; and they are convenient for design and construction.



Bearing Dimensions: Circular bearings can be designated as "D-Diameter Dimension"; Rectangular bearings can be designated as "Long Side Dimension x Short Side Dimension"; Square bearings can be designated as "S-Side Dimension". The unit of dimension is millimeters (mm).

Bearing Types: Natural Rubber Bearing (LNR); High Damping Rubber Bearing (HDR); Lead Rubber Bearing (LRB)

Examples: A lead rubber bearing with a diameter of 800mm is designated as: LRB D-800; A rectangular natural rubber bearing with side dimensions of 800mm x 600mm is designated as: LNR 800x600; A square high damping rubber bearing with a side length of 800mm is designated as: HDR S-800 or HDR 800x800.

Technical Specifications and Standards for Seismic Isolation Rubber Bearings for Bridges

1. Standards and Basis for Bridge Seismic Isolation Rubber Bearings:

The seismic isolation rubber bearings for bridges manufactured by our company are designed and produced in accordance with the following Chinese National Standards:
GB 20688.2-2006 "Rubber bearings - Part 2: Seismic isolation rubber bearings for bridges"
GB/T 20688.1-2007 "Rubber bearings - Part 1: Test methods for seismic isolation rubber bearings"

2. Classification of Ultimate Performance for Bridge Seismic Isolation Rubber Bearings:

Compressive Stress due to Static Load (N/mm²)	Ultimate Shear Strain γ_u			
	$\gamma_u \geq 300\%$	$300\% > \gamma_u \geq 250\%$	$250\% > \gamma_u \geq 200\%$	$\gamma_u < 200\%$
6.0	A1	B1	C1	D1
8.0	A2	B2	C2	D2
10.0	A3	B3	C3	D3
12.0	A4	B4	C4	D4

3. Tolerance Classification for Horizontal Equivalent Stiffness of Bridge Seismic Isolation Rubber Bearings

Category	Tolerance
S—A	±10%
S—B	±20%

4. Tensile Property Specifications for Rubber Materials in Bridge Seismic Isolation Bearings:

Rubber Material Properties		Specification		
Shear Modulus, G (MPa)		0.8	1.0	1.2
Tensile Strength (MPa)	High Damping Rubber Bearing (HDR)	≥8		
	Natural Rubber Bearing (LNR)	≥13		
Elongation at Break (%)	High Damping Rubber Bearing (HDR)	≥600	≥550	≥500
	Low-Damping Neoprene Bearing	≥400	≥400	≥400
	Natural Rubber Bearing and Lead Rubber Bearing (LNR, LRB)	≥500	≥500	≥450
Note:G is the shear modulus at a shear strain of 100% to 175%.				

Technical Specifications and Standards for Seismic Isolation Rubber Bearings for Building Structures:

1. Standards and Basis for Building Seismic Isolation Rubber Bearings:

The seismic isolation rubber bearings for building structures manufactured by our company are designed and produced in accordance with the following Chinese National Standards:
GB 20688.3-2006 "Rubber bearings - Part 3: Seismic isolation rubber bearings for building structures" GB/T 20688.1-2007 "Rubber bearings - Part 1: Test methods for seismic isolation rubber bearings"

2. Ultimate Performance Classification for Building Seismic Isolation Rubber Bearings:

Ultimate Shear Strain	Category	Ultimate Shear Strain	Category
$\gamma_u \geqslant 350\%$	A	$250\% > \gamma_u \geqslant 200\%$	D
$350\% > \gamma_u \geqslant 300\%$	B	$200\% > \gamma_u \geqslant 150\%$	E
$300\% > \gamma_u \geqslant 250\%$	C	$\gamma_u < 150\%$	F

3. Tolerance Classification for Shear Properties of Building Seismic Isolation Rubber Bearings:

Category	Individual Test Value	Batch Average Test Value
S-A	± 15%	± 10%
S-B	± 25%	± 20%

4. Physical Property Specifications for Rubber Materials in Building Seismic Isolation Bearings:

Physical property specifications for the internal rubber material used in Natural Rubber Bearings and Lead Rubber Bearings:

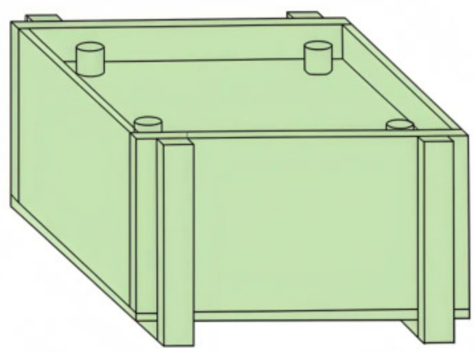
Test Items	Measured Parameters	Units	Shear Modulus/MPa						
			0.30	0.35	0.40	0.45	0.60	0.80	1.0
Tensile Properties	Tensile Strength	MPa	≥12.0	≥14.0	≥14.0	≥15.0	≥15.0	≥20.0	≥20.0
	Elongation at Break	%	≥650	≥600	≥600	≥600	≥500	≥500	≥500
Hardness	Hardness	IRHD	30±5	35±5	35±5	40±5	45±5	50±5	65±5
Bonding Properties	Rubber-to-Metal Bond Strength	N/mm	≥6	≥6	≥6	≥6	≥6	≥6	≥6
	Failure Type	–	Rubber Failure	Rubber Failure	Rubber Failure	Rubber Failure	Rubber Failure	Rubber Failure	Rubber Failure
Brittle Temperature Performance	Brittle Temperature	℃	≤-40	≤-40	≤-40	≤-40	≤-40	≤-40	≤-40

Physical Property Specifications for Internal Rubber Material of High Damping Rubber Bearings (HDR)

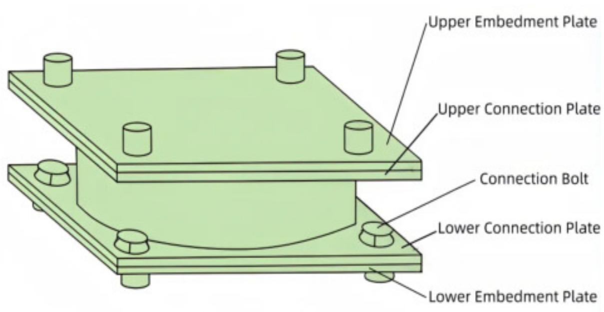
Test Items	Measured Parameters	Units	Shear Modulus/MPa		
			0.40	0.60	0.80
Tensile Properties	Tensile Strength	MPa	⩾8.0	⩾8.0	⩾10.0
	Elongation at Break	%	⩾650	⩾650	⩾650
Hardness	Hardness	IRHD	(60~70)±5	(60~70)±5	(60~70)±5
Brittle Temperature Performance	Brittle Temperature	℃	⩽-40	⩽-40	⩽-40

Installation and Construction of Seismic Isolation Rubber Bearings:

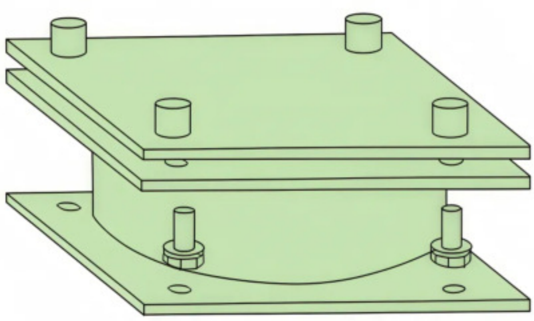
1. Schematic Diagram of Bridge Seismic Isolation Rubber Bearing Assembly:



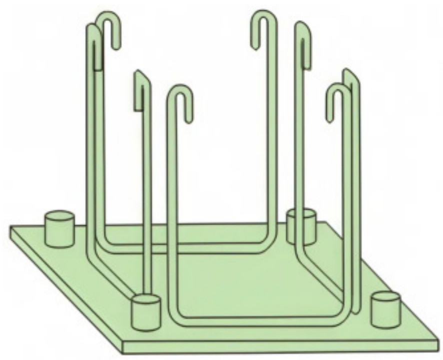
A. Open the packaging crate of the seismic isolation rubber bearing. Remove and read the enclosed instructions and quality inspection certificate.



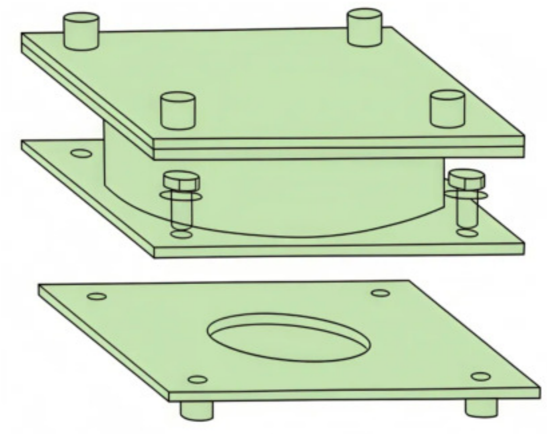
B. Remove the packaging crate. Refer to the diagram above for the names of each component.

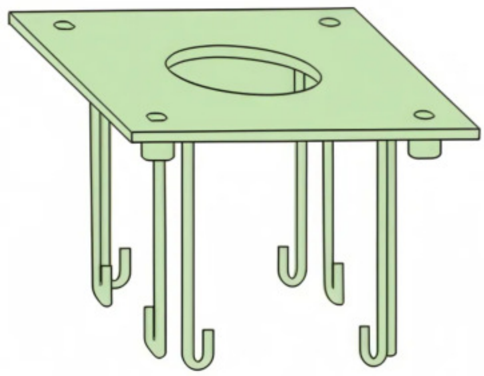


C. Unscrew the connecting bolts between the upper connection plate and the upper embedment plate. Remove the upper embedment plate.



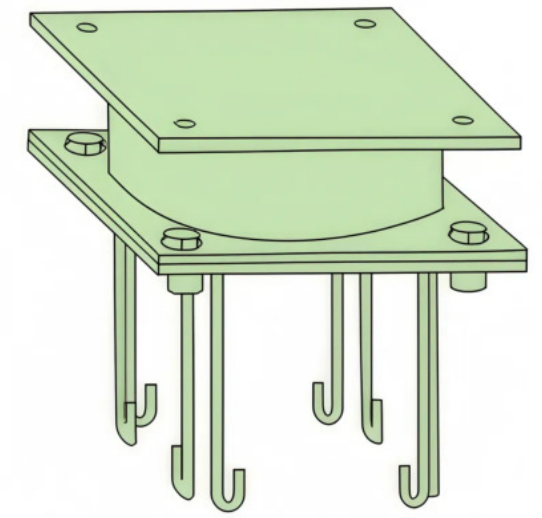
D. Tack-weld the upper embedment plate to the upper anchoring system. Then, verify that its levelness meets specifications. Upon verification, complete the welding securely.

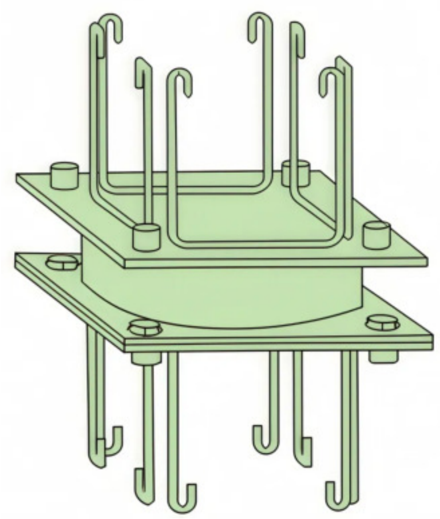




E. Remove the connecting bolts between the lower embedment plate and the lower connection plate. Detach the lower embedment plate.

F. Set the correct elevation and axial alignment for the lower embedment plate. Adjust its height, position, and levelness. Tack-weld the lower embedment plate to the lower structure's anchoring system. After verifying the position, complete the welding securely. Protect the bolt holes and pour the concrete for the lower structure.



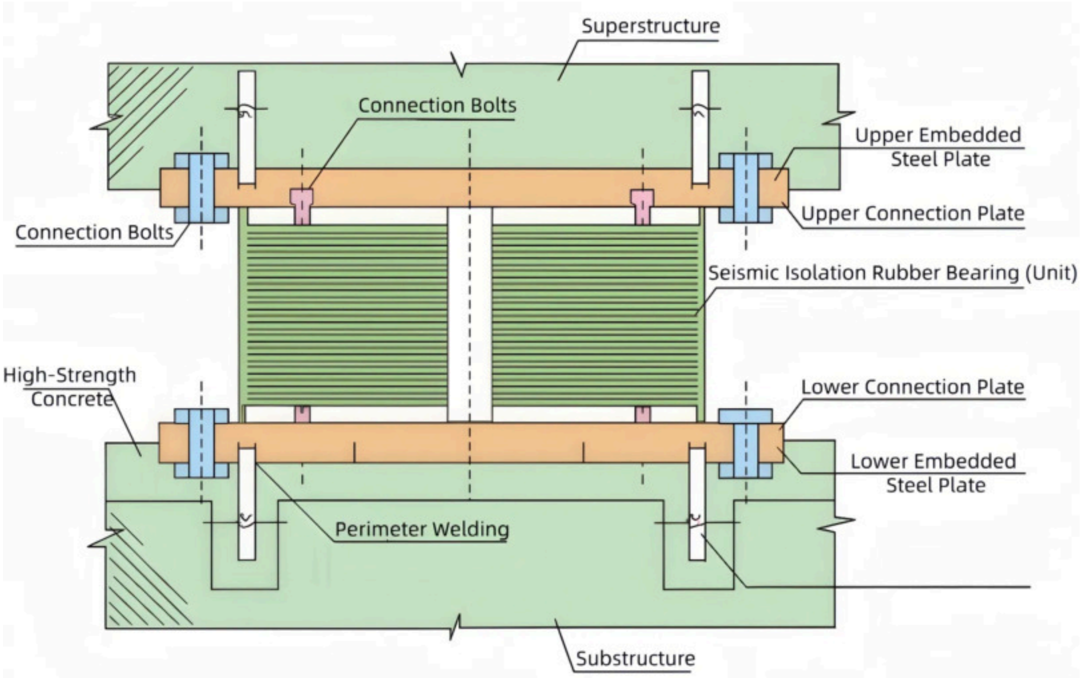


G. Hoist the seismic isolation rubber bearing into position. Ensure the lifting points are safe and secure during hoisting. Tighten the connecting bolts between the lower connection plate and the lower embedment plate.

H. Tighten the connecting bolts between the upper connection plate and the upper embedment plate. Proceed with the construction of the superstructure, ensuring all components of the seismic isolation rubber bearing are protected during the process.

2. Installation of Bridge Seismic Isolation Rubber Bearings:

Seismic isolation rubber bearings are located at critical connection points between the superstructure and substructure of a bridge or building. Their reliability directly impacts the structural safety and durability of the entire construction. Therefore, in addition to ensuring the proper design selection of the bearings and that their manufacturing quality complies with technical standards, correct construction and installation are critical factors for the successful application of seismic isolation rubber bearings.



General Installation and Construction Process:

The construction process is as follows: Weld anchor bars to embedded plates -> Position, install, and secure the lower embedded plate -> Set up pier template -> Pre-pouring inspection -> Pour pier concrete and cure until 80% strength is achieved -> Install rubber bearings and upper embedded plate according to identification numbers and protect them -> Special inspection -> Tie reinforcement for superstructure -> Set up formwork -> Pre-pouring inspection -> Pour superstructure concrete -> Remove formwork... (After structural completion) Remove temporary protective plates -> Apply anti-corrosion coating -> Install permanent protection.

(1) Welding Anchor Bars to Embedded Plates: According to drawing requirements, weld the upper and lower anchor bars to the lower embedded steel plate. Ensure the quantity, length, and specification of the bars, as well as the weld length, width, and type of electrode comply with the drawings.

(2) Positioning, Installing, and Securing the Lower Embedded Plate: Based on the foundation line and positioning marks on the lower embedded plate, position the lower embedded plate with welded anchor bars. Securely fix it to the foundation rebar cage by tack welding or using support stools.

(3) Erecting Pier Formwork: After the lower embedded plate is secured and additional reinforcement at the bearing location is installed, erect the formwork according to the pier's design dimensions and ensure it is robustly reinforced.

(4) Pre-Pouring Inspection: The quality and technical departments shall inspect and review. Complete a specialized pre-pouring inspection report for embedded parts. Once approved, submit this along with the concrete pouring application and formwork inspection report to the supervisor for approval.

(5) Pouring Foundation Concrete: When pouring the foundation concrete, protect the position and elevation of the lower embedded plate. If the lower embedded plate area is large, consult with the design department in advance to ensure concrete can be placed smoothly into the formwork.

(6) Curing and Formwork Removal: Cure the concrete until it reaches 80% of its specified compressive strength, as verified by test cubes cured under the same conditions. Subsequently, remove the pier formwork.

(7) Installation of Seismic Isolation Bearings and Upper Embedded Plate with Protection: After transporting the rubber bearings and accessories to the work area, connect the seismic isolation rubber bearing and the upper embedded plate using the bolts specified in the drawings or product manual. Before positioning the assembled bearing, re-check the center position, elevation, and surface levelness of the lower embedded plate. If deviations exceed allowable tolerances, consult the design department for remedial measures. Prior to setting the superstructure formwork, protect the installed bearings using impact-resistant materials like wooden planks. To prevent corrosion, apply the first coat of the specified anti-corrosion coating to the steel components in advance. If conditions permit, implement the final protective measures for the bearings as per the drawings in a single step.

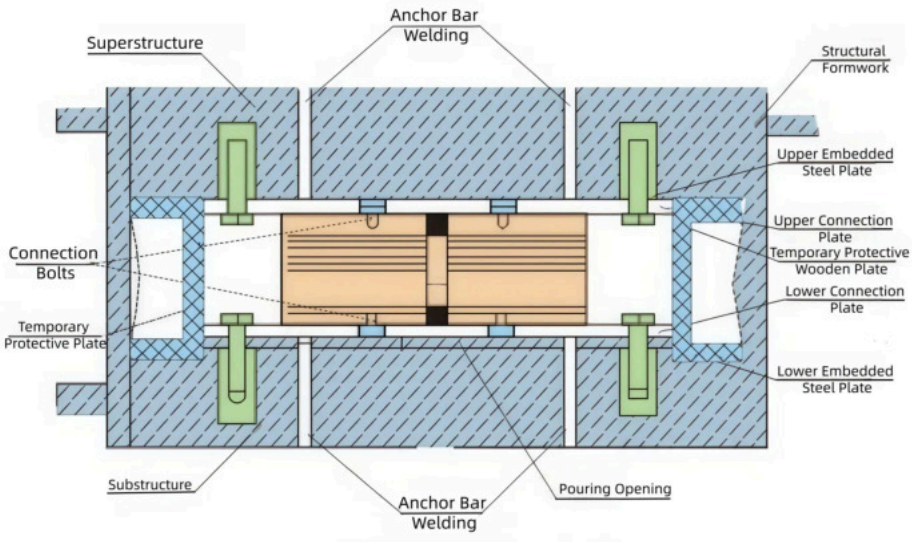


Figure 1 Construction Structural Diagram of Seismic Isolation Rubber Bearing

(8) Special Inspection: Complete the bearing installation quality assessment form. Submit the concealed acceptance report for the upper embedded steel plate and the installation layout drawing.

(9) Reinforcement and Formwork: Tie the superstructure reinforcement and erect the formwork according to the drawing requirements.

(10) Pre-Pouring Inspection: Submit the formwork inspection report, concealed acceptance report for structural reinforcement, special inspection report for the bearings, and the concrete pouring application to the supervisor for approval.

(11) Final Protection: Install the final protective covers or systems for the seismic isolation rubber bearings as specified in the drawings.

Installation Tolerance Schedule

Item	Inspection Item		Tolerance	Inspection Method	Inspection Quantity
1	Lower Embedded Steel Plate	Top Surface Elevation	±5mm	Level Gauge Measurement	10% of total, minimum 2 locations
2		Levelness	0.2%	Straightedge Measurement	
3	Seismic Isolation Rubber Bearing	Center Plane Position	5mm	Steel Tape Measurement	
4		Top Surface Level	0.3	Straightedge Measurement	
5	Reserved Bolt Hole	Bolt Hole Diameter	0mm~+1mm	Steel Tape Measurement	
6		Bolt Hole Position	±1mm	Steel Tape Measurement	

3. Precautions:

3.1 Handling and Storage

(1) Products must be stored in a dry, well-ventilated area, free from corrosive gases, protected from direct sunlight (UV) and heat sources, and must not be exposed to rain.
(2) Accessories should be sorted by model, stacked neatly and securely. Mixed or loose storage is prohibited. Strictly avoid contact with acids, alkalis, oils, organic solvents, etc.
(3) After opening and inspecting the goods, the original protective packaging should be restored.
(4) During handling and lifting, use only the lifting points provided by the manufacturer. Never insert slings (e.g., wire ropes) through the bolt holes.
(5) During lifting and handling, ensure the rubber bearing remains level (horizontal). Tilting is strictly prohibited.
(6) Handle with care, lifting and lowering gently. Avoid sudden lifts or drops.

3.2 Construction

(1) Seismic isolation rubber bearings must conform to design and standard requirements, and must possess a factory certificate of compliance and factory test reports.
(2) Before installing the lower embedded plate, verify that the model corresponds to the installation location as specified in the design.
(3) The lower embedded plate must be securely fixed to prevent displacement during the pouring of the pile cap concrete. After pouring, re-check the position of the lower embedded plate for any deviation.
(4) The levelness of the lower embedded plate is critical. During installation, use a high-precision level (error $\leqslant$ 0.02 mm/m) to control its levelness within 1/500 of the side length, secured with no fewer than 3 firm fixing points.
(5) Bolts connecting the upper and lower embedded plates to the seismic isolation rubber bearing must be tightened. Verification using a torque wrench is mandatory.
(6) After formwork removal, promptly apply anti-corrosion treatment to exposed metal parts.

3.3 Product Protection

(1) Seismic isolation rubber bearings must conform to design and standard requirements, and must possess a factory certificate of compliance and factory test reports.

(2) Immediately after installation, implement protective measures to prevent accidental damage.
(3) If high-strength bolts are specified in the drawings, the threads of both bolts and nuts must be protected with custom-made plastic (or rubber) caps (or plugs) to prevent thread damage.
(4) When applying anti-corrosion coatings, protect the surrounding structural reinforcement from contamination by wrapping it with plastic film.
(5) Immediately after installing the connection bolts, fit protective caps to prevent corrosion of the exposed bolt sections.

HDR (II) Series High Damping Rubber Seismic Isolation Bearings

I. General

The HDR series High Damping Rubber Seismic Isolation Bearings are bridge components designed for vibration mitigation and seismic isolation, developed in accordance with current Chinese National Standards (GB 20688), relevant industry specifications, and with reference to European standards. These products represent patented technological achievements resulting from major provincial/ministerial level scientific and technological research projects. This series has passed provincial/ministerial level scientific and technological achievements appraisal and relevant certifications, and has been elevated to a Chinese Transportation Industry Standard. They are suitable for various highway and municipal bridges located in seismic zones with intensity 8 and below.

II. Design Basis

General Specifications for Highway Bridge and Culvert Design (JTG D60-2004)
Specifications for Design of Highway Reinforced Concrete and Prestressed Concrete Bridges and Culverts (JTG D62-2004)
Guidelines for Seismic Design of Highway Bridges (JTG/T B02-01-2008)
Urban Bridge Design Guidelines (CJJ 11-93)
Rubber Bearings - Part 2: Elastomeric Seismic Isolation Bearings for Bridges (GB 20688.2-2006)
Rubber Bearings - Part 1: Test Methods for Seismic Isolation Bearings (GB/T 20688.1-2007)
Laminated Rubber Bearings for Highway Bridges (JT/T 4-2004)
Size Series for Laminated Rubber Bearings for Highway Bridges (JT/T 663-2006)
Specification for Large Polytetrafluoroethylene Sheet (GJB 3026-1997)
Structural bearings - Part 2: Sliding elements (EN 1337-2:2004)
Structural bearings - Part 3: Elastomeric bearings (EN 1337-3:2005)

III. Bearing Classification

3.1 Classification by Functional Type

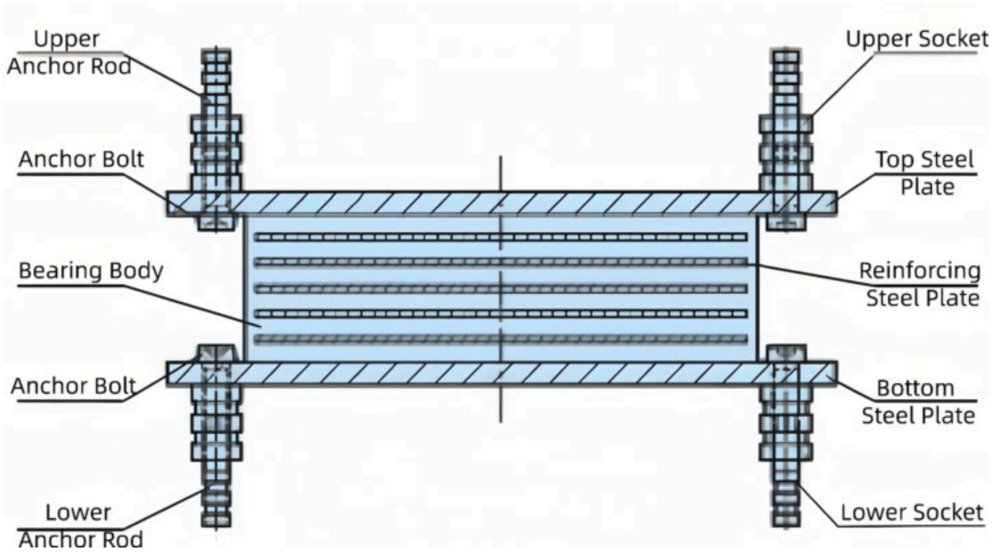
Fixed Seismic Isolation Bearings: Displacement is achieved through shear deformation of the rubber. The horizontal shear capacity of the rubber enables it to withstand significant horizontal forces. Based on their structure, they are further subdivided into Type I, Type II, and Type III (refer to Clause 3.2.1). Their seismic mitigation and isolation functionality is realized through the large horizontal displacement shear deformation and hysteretic energy dissipation of the high-damping rubber.

Sliding Seismic Isolation Bearings: Displacement is achieved through the sliding movement of a friction pair, consisting of a PTFE (Polytetrafluoroethylene) slide plate on the top surface and a stainless steel plate. The low coefficient of friction allows the bearing to withstand minimal frictional force. Seismic mitigation and isolation are achieved through the sliding action of this friction pair.

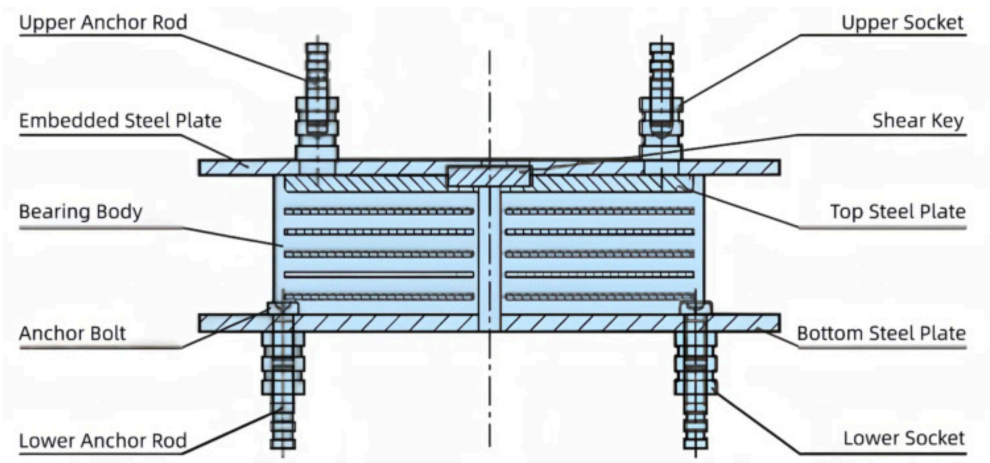
3.2 Classification by Structural Type

3.2.1 Fixed Bearings are categorized into the following three types (three series, see figure below) based on their specific seismic technical performance characteristics, the connection method between the bearing body and anchorages (or embedded parts), and the anchorage (connection) method between the bearing and the girder/pier:

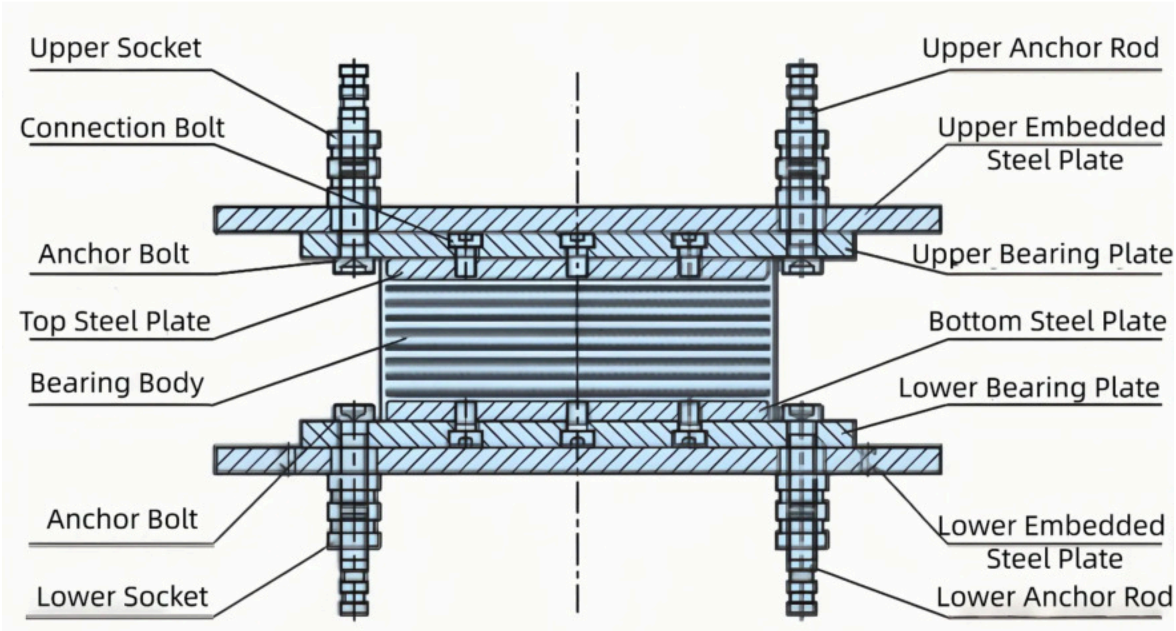
Type I - Connection between the bearing and the pier/beam uses sockets. The top and bottom steel plates of the bearing are bonded to the bearing body via vulcanization. The top/bottom plates and the sockets are connected using anchor bolts.



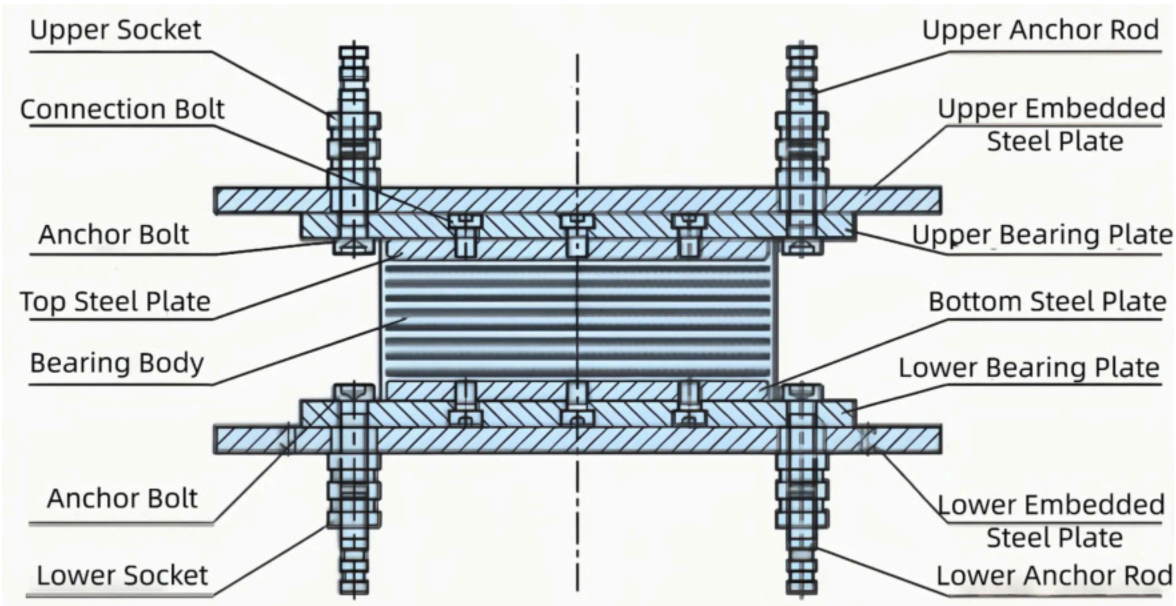
Type II - Connection between the bearing and the pier/beam uses sockets. The bearing has no embedded steel plate at its bottom. The bottom steel plate and the sockets are connected using anchor bolts. The top embedded steel plate and the top steel plate are connected using shear keys. The top embedded steel plate and the sockets are connected using fitted welding.



Type II - Connection between the bearing and the pier/beam uses sockets. The bearing has no embedded steel plate at its bottom. The bottom steel plate and the sockets are connected using anchor bolts. The top embedded steel plate and the top steel plate are connected using shear keys. The top embedded steel plate and the sockets are connected using fitted welding.



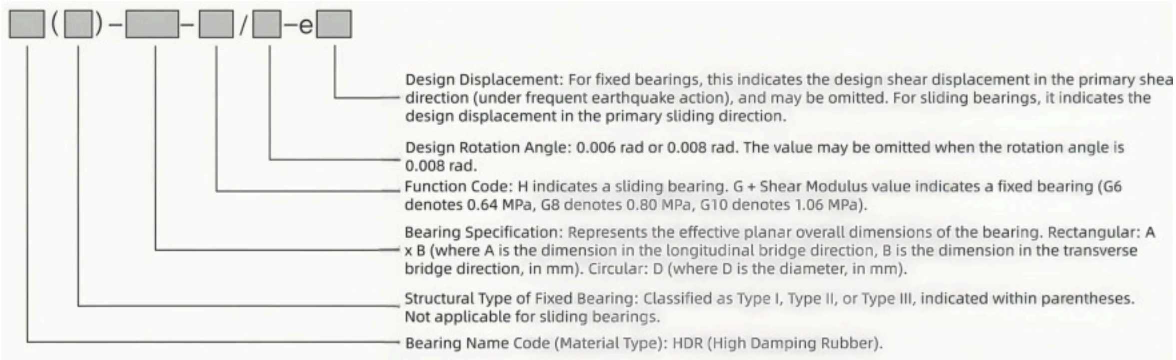
3.2.2 The structural schematic of a sliding bearing is shown below.



3.3 Classification by Body Shape

Circular Seismic Isolation Rubber Bearing - The planar shape of the bearing body is circular.
Rectangular Seismic Isolation Rubber Bearing - The planar shape of the bearing body is rectangular.

3.3 Classification by Body Shape



Examples:

HDR(I)-D500-G10/6-e108 denotes a circular fixed-type High Damping Rubber seismic isolation bearing with a diameter of 500mm, a rubber design shear modulus of 1.06 MPa, a design rotation angle of 0.006 rad, and a design shear displacement of ±108mm. It can be abbreviated as HDR(I)-D500-G10/6.

HDR(II)-350x400-G8/8-e126 denotes a rectangular fixed-type High Damping Rubber seismic isolation bearing with a longitudinal bridge dimension of 350mm, a transverse bridge dimension of 400mm, a rubber design shear modulus of 0.80 MPa, a design rotation angle of 0.008 rad, and a design shear displacement of ±126mm. It can be abbreviated as HDR(II)-350x400-G8.

HDR(III)-450x500-G6/8-e193 denotes a rectangular fixed-type High Damping Rubber seismic isolation bearing with a longitudinal bridge dimension of 450mm, a transverse bridge dimension of 500mm, a rubber design shear modulus of 0.64 MPa, a design rotation angle of 0.008 rad, and a design shear displacement of ±193mm. It can be abbreviated as HDR(III)-450x500-G6.

HDR-350x400-H/8-e150 denotes a rectangular sliding-type High Damping Rubber seismic isolation bearing with a longitudinal bridge dimension of 350mm, a transverse bridge dimension of 400mm, a design rotation angle of 0.008 rad, and a design displacement in the primary sliding direction of ±150mm. It can be abbreviated as HDR-350x400-H-e150.

Note:

1. The planar dimensions in the specification do not include the thickness of the rubber protective cover.

2. For sliding-type high damping rubber isolation bearings, the design shear modulus of the rubber is 0.64 MPa. In principle, bearings in this series are installed with the long side of the bearing body oriented in the transverse bridge direction. Considering potential space constraints in the bridge's transverse direction, a dedicated series of rectangular fixed-type bearings (e.g., HDR(I/II)-A×B-G[Z]*) has been custom-designed, where the long side of the bearing body is oriented in the longitudinal bridge direction. Among these, rectangular Type I fixed bearings with a rotation angle of 0.008 rad can be directly installed with the long side in the longitudinal direction, but verification is required to ensure the rotation capacity meets the bridge's requirements.

V. Product Features

- High horizontal displacement capacity, effectively absorbing seismic energy.
- Strong self-centering capability, with minimal residual displacement.
- Excellent material damping effect, providing good energy dissipation capacity.
- Flexible and diverse product structures and functions, suitable for a wide range of applications.
- Easy installation, inspection, and replacement, with low operating and maintenance costs.

VI. Technical Performance

6.1 Bearing Specifications

- Circular Bearings are classified into 35 types:
  D150, D175, D200, D225, D250, D275, D300, D325, D350, D375, D400, D425, D450, D475, D500, D550, D600, D650, D700, D750, D800, D850, D900, D950, D1000, D1050, D1100, D1150, D1200, D1250, D1300, D1350, D1400, D1450, D1500.

- Rectangular Bearings are classified into 62 types:
  200x200, 200x250, 200x300, 250x250, 250x300, 250x350, 300x300, 300x350, 300x400, 300x450, 350x350, 350x400, 350x450, 350x500, 400x400, 400x450, 400x500, 400x550, 400x600, 450x450, 450x500, 450x550, 450x600, 450x650, 500x500, 500x550, 500x600, 500x650, 500x700, 550x550, 550x600, 550x650, 600x600, 600x650, 600x700, 600x750, 650x650, 650x700, 650x750, 650x800, 700x700, 700x750, 700x800, 700x850, 750x750, 750x800, 750x850, 750x900, 800x800, 800x850, 800x900, 800x950, 850x850, 850x900, 850x950, 850x1000, 900x900, 900x950, 900x1000, 950x950, 950x1000, 1000x1000.

6.2 Design Rotation Angle θ (rad)

The design rotation angles for this bearing series are divided into two grades: 0.006 rad and 0.008 rad. The attached tables only list the relevant parameters for bearings with the recommended value of 0.008 rad.

6.3 Design Horizontal Force

The design horizontal force for Fixed Bearings can be found in the design parameter tables for each specific size. The design horizontal force for Sliding Bearings is 3% of the bearing's design vertical load capacity.

6.4 Bearing Design Displacement

The design displacement in the longitudinal direction for Sliding Bearings is ±100 mm or ±150 mm, and ±30 mm in the transverse direction. The design shear strain for Fixed Bearings is shown in Table 1.

Table 1. Design Shear Strain for HDR Fixed Bearings

Bearing Structure Type	Type I	Type II	Type III
Design Shear Strain at Serviceability Limit State γ	1.0	1.0	1.0
Allowable Shear Strain under Frequent Earthquake γ	1.5	2.0	2.5
Ultimate Shear Strain under Rare Earthquake γ	2.5	3.0	3.5

Note: Shear displacement = Shear strain × Total thickness of the effective rubber layers.

6.5 Design Friction Coefficient for Bearings

The design friction coefficient for sliding bearings is ≤ 0.03.

6.6 Applicable Temperature Range

The design temperature range for this series of bearings is -40°C to +60°C.

6.7 Design Damping Ratio

The design damping ratios for this bearing series are as follows: Type I > 10%, Type II > 12%, Type III > 15%.

6.8 Beam Bottom Slope Adjustment

The top surface of the bearing is flat (has no slope).
For cast-in-place beams: The slope is adjusted using an embedded steel plate or a wedge-shaped concrete block set at the beam bottom.
For precast beams: The slope can be adjusted during beam fabrication via the embedded steel plate on top of the bearing, or by adding a wedge-shaped leveling steel plate on the bearing's top surface after embedding a flat steel plate in the beam bottom.
For large slopes, a wedge-shaped concrete block should be set at the beam bottom for adjustment.

Note: Should the project have specific requirements, all the above technical performance parameters for this bearing series can be custom-designed.

VII. Bearing Layout Principles

The layout principles for this series of bearings should be specifically determined based on parameters such as the bridge's structural system, span length, continuous length, and deck width.

7.1 Schematic diagrams of the typical bearing layout for major bridge types are provided below for design reference:

- Simply Supported Girder (Schematic)

Figure 1: Bearing Layout Example for Simply Supported T-Girder

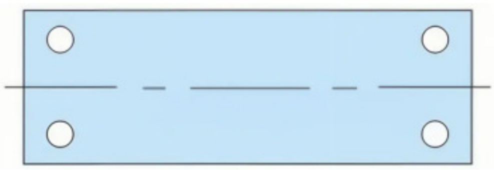


Figure 2: Bearing Layout Example for Simply Supported Box Girder

Legend: Indicates Fixed Bearing Indicates Sliding Bearing

- Continuous Girder (Schematic)

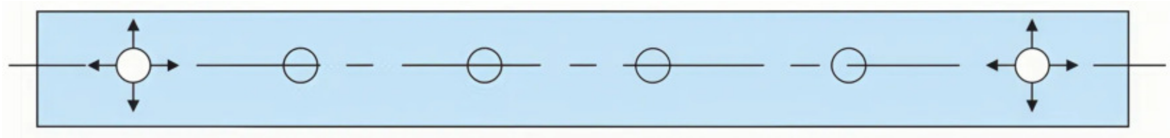


Figure 3: Bearing Layout Example for Continuous T-Girder

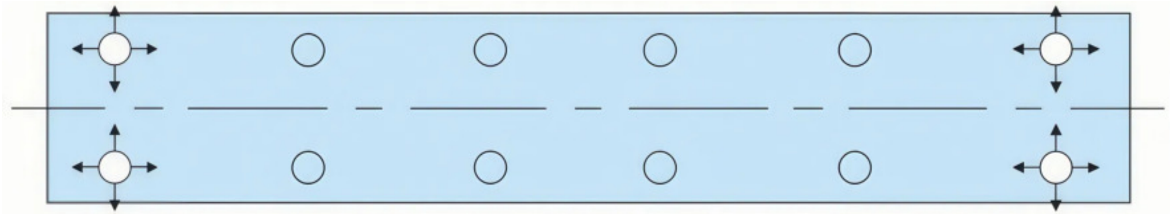


Figure 4: Bearing Layout Example for Continuous Box Girder

7.2 During bearing layout, it must be verified that the design displacement of the bearings satisfies the displacement demands on the bridge resulting from the combined effects of braking force, concrete creep and shrinkage, temperature, as well as seismic forces.

7.3 Under normal service conditions, the displacement of Fixed Bearings shall not exceed the design shear strain for serviceability. Under seismic conditions, the displacement shall not exceed the design shear strain for seismic conditions.

7.4 The length of a single continuous girder unit should preferably not exceed 200m, and the number of spans should preferably not exceed six. If more than six spans are required, the bearing layout must be checked to verify that the displacement of the fixed bearings adjacent to the sliding bearings meets the demand. Additional sliding bearings or custom design should be provided based on the verification results.

7.5 For rectangular Fixed Bearings, the shorter side should generally be oriented parallel to the longitudinal bridge direction. When the transverse dimension of the bridge is restricted, the longer side can be oriented along the longitudinal direction (refer to the dedicated series HDR(I/II)-A×B-G[Z]*).

7.6 When installing Sliding Bearings, care must be taken to ensure their sliding direction is aligned with the primary displacement direction of the bridge.

VIII. Bearing Selection Principles

8.1 When selecting bearing types, appropriate models and specifications can be chosen directly based on the Peak Ground Acceleration (PGA) for the bridge's location (refer to Table 2). However, it must be verified that parameters such as the horizontal stiffness and maximum shear strain of the selected bearing meet the requirements under the corresponding seismic forces. Factors such as the bridge's structural system, technical performance characteristics, construction requirements, and cost should be comprehensively considered.

8.2 During bearing selection, the appropriate design shear displacement capacity should be chosen based on span length, temperature variation range, and considering factors such as construction tolerances. (The displacement value provided in installation drawings is the maximum allowable design shear displacement under frequent earthquake conditions).

8.3 This bearing series is designed with variations based on the value of the rubber's design shear modulus, G. For bearings with the same vertical load capacity, the horizontal stiffness increases with a higher G value, but the ability to accommodate deformation correspondingly decreases. Therefore, bridge engineers should make selections based on the specific circumstances or key performance requirements of each bridge to optimize structural behavior and service performance.

8.4 The conventional selection process for the HDR series High Damping Rubber Seismic Isolation Bearings is: Determine the bearing structural type (Type I, II, III) -> Rubber shear modulus G (G6, G8, G10) -> Suitable rotation angle θ (0.006 rad, 0.008 rad) -> Bearing body shape (Circular, Rectangular) -> Design vertical load capacity -> Design shear displacement -> Verification calculations or optimization -> (Iterate as necessary).8.3 This bearing series is designed with variations based on the value of the rubber's design shear modulus, G. For bearings with the same vertical load capacity, the horizontal stiffness increases with a higher G value, but the ability to accommodate deformation correspondingly decreases. Therefore, bridge engineers should make selections based on the specific circumstances or key performance requirements of each bridge to optimize structural behavior and service performance.

8.5 To facilitate selection by engineers and technicians, the technical performance of various types of Fixed Bearings is shown in Table 2, which also lists recommended values for typical situations, provided for design reference.

Table 2. Technical Performance and Recommended Selection for HDR Fixed Bearings

Technical Performance		Type I	Type II	Type III
Seismic Intensity	Design Value	0.05g~0.10g	0.05g~0.20g	0.05g~0.30g
	Recommended Value	0.05g	0.10g~0.15g	0.20g~0.30g
Shear Modulus	Design Value	G6、G8、G10		
	Recommended Value	G8	G6	G6
Suitable Rotation Angle	Design Value	0.006rad、0.008rad		
	Recommended Value	0.008rad		
Body Shape	Design Value	Circular, Rectangular		
	Recommended Value	Continuous End: Circular Bearings Non-continuous End: Rectangular Bearings		
Damping Ratio	Design Value	≥10%	≥12%	≥15%

Note: HDR (Type III) bearings can also be selected for bridges in seismic intensity 9 zones, but calculation and verification based on actual design parameters are required.

8.6 During bearing selection, their compatibility with the bridge structure and the spatial requirements of the actual bridge must be considered. The design and selection of ancillary components such as embedded steel plates, sockets, and anchor rods should be safe, suitable, economical, and rational, avoiding interference or conflict with the main structural reinforcement. If necessary, custom optimization should be performed.

IX. Seismic Isolation Calculation

The HDR series High Damping Rubber Seismic Isolation Bearings not only maintain the excellent mechanical properties of laminated rubber bearings but also possess a high damping ratio. During an earthquake, they absorb seismic energy through the large horizontal displacement shear deformation and hysteretic energy dissipation of the high-damping rubber, decoupling the seismic motion between the bridge superstructure and substructure, elongating the structural natural period, and reducing seismic forces, thereby achieving seismic isolation functionality.

Seismic analysis of bridge structures should be conducted according to the relevant provisions of the Guidelines for Seismic Design of Highway Bridges (JTG/T B02-01-2008). Methods such as the response spectrum method, dynamic time-history analysis, and power spectrum method are typically applicable. For the seismic isolation design stage, nonlinear dynamic time-history analysis is recommended for complex bridge types, bridges employing special seismic isolation devices, and structures with complex dynamic characteristics. In line with advanced national and international codes, this product recommends the use of nonlinear dynamic time-history analysis.

The calculation model for seismically isolated bridges shall correctly represent the mechanical characteristics of the isolation devices (HDR Series High Damping Rubber Seismic Isolation Bearings). When the response spectrum analysis method is employed, the mechanical properties of this bearing series can be simulated using equivalent horizontal stiffness and equivalent damping ratio. The equivalent horizontal stiffness and equivalent damping ratio for the bearings are provided by the parameters listed in the accompanying charts. When the nonlinear dynamic time-history analysis method is used, the mechanical properties of this series can be simulated using an equivalent bilinear restoring force model. The restoring force models for the fixed and sliding bearings are shown in Figure 5 and Figure 6, respectively.

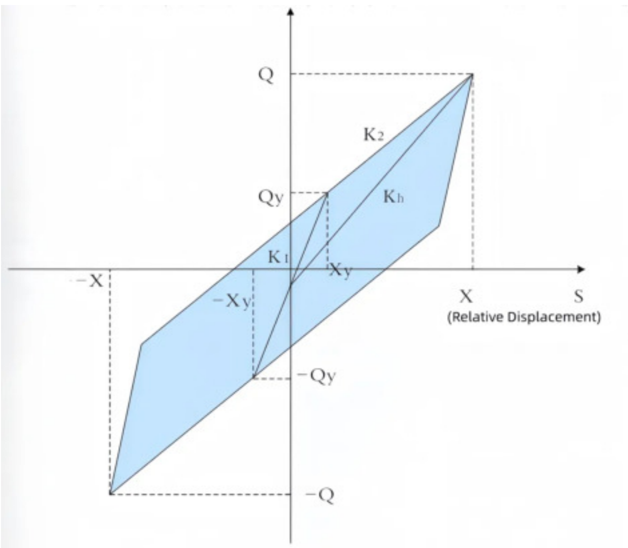


Figure 5 Bilinear Restoring Force Model for Fixed Bearings

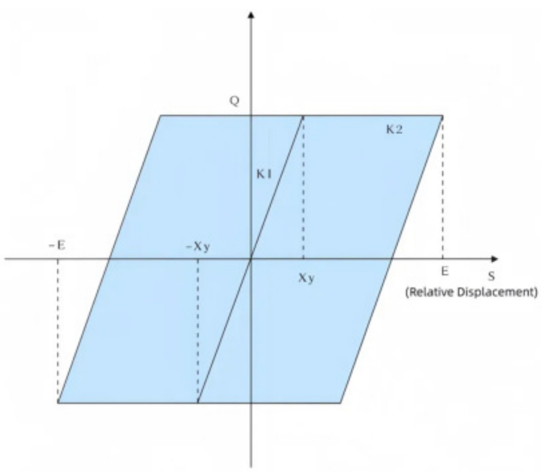


Figure 6 Bilinear Restoring Force Model for Sliding Bearings

HDR Sliding Type Series High Damping Rubber Seismic Isolation Bearings

The HDR Sliding Type High Damping Rubber Bearing is a specialized type of high damping isolation rubber bearing incorporating a sliding layer, designed specifically to accommodate large bridge displacements, based on the HDR (Type II) and (Type III) models.

1. The specification series for HDR Sliding Type High Damping Rubber Seismic Isolation Bearings is the same as that for the HDR (Type I) and (Type II) series.
1.1 Circular bearings are divided into 35 categories; refer to the Type III bearing classification for details.
1.2 Rectangular bearings are divided into 62 categories; refer to the Type III bearing classification for details.

2. Design Rotation Angle, θ (rad): The design rotation angles for this series are: 0.006 rad and 0.008 rad.

3. Design Horizontal Force: The design horizontal force that sliding bearings can withstand is 3% of the bearing's vertical load-bearing capacity.

4. Bearing Design Displacement:
The design displacement in the longitudinal bridge direction for sliding bearings is ±100 mm or ±150 mm. The design displacement in the transverse bridge direction is ±30 mm.
Special (custom) design can be provided based on actual requirements for projects with specific needs.

5. Bearing Design Friction Coefficient: The design friction coefficient for sliding bearings is ≤ 0.03.

6. Applicable Temperature Range: -40°C to +60°C.

7. Design Damping Ratio: HDR Sliding Type bearings use high damping rubber, with a damping ratio > 10%.

8. Sliding Bearing Bilinear Restoring Force Model: Refer to the diagram for Fixed Type III bearings.

9. Material Performance Requirements for HDR Sliding Bearings:
9.1 Stainless steel plates shall conform to the requirements of GB/T 3280.
9.2 The physical and mechanical properties of the PTFE sheet shall meet the requirements listed in the table below:

Material Parameter	Unit	Test Standard	Performance Requirement
Density	kg/m3	GB/T 1003	2140–2200
Tensile Strength	Mpa	GB/T 1040	≥30
Elongation at Break	%	GB/T 1040	≥300
Ball Indentation Hardness	Mpa	GB/T 3398	H132/60=23–33

Note: The Ball Indentation Hardness H132/60 is measured under a load of 132N, held for 60 seconds, at a test temperature of 23±2°C.

PTFE sliding plates shall comply with the relevant provisions of GJB 3026. The sheets must be