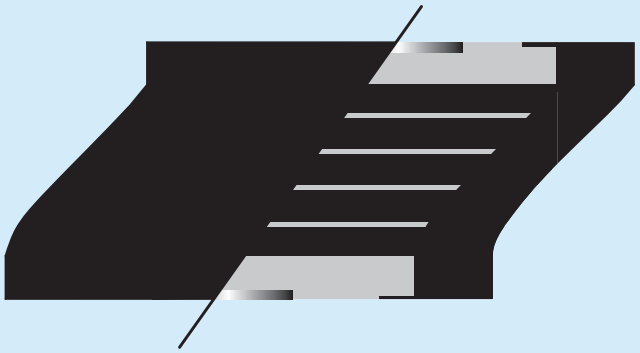
HDR-S *Super High Damping Rubber Bearing*

Application range

Suitable for a variety of bridges including highway bridges and railway bridges

Function

- Supports vertical loads
- Superior damping effect



Sheared HDR-S Bearing Section

High Performance

- Super high damping performance
- Stable performance against repeated deformation by large scale earthquakes

High Quality

Accurate quality control by rigorous performance

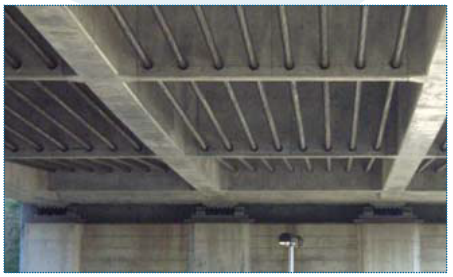
Size Line-up

- A broad line-up of HDR-S bearings to support small to large vertical loads
- High vertical load capacity up to 20,000 kN

The Super High Damping Rubber Bearing (HDR-S) is an improved version of High Damping Rubber Bearings (HDR). Its damping performance is 20% higher than HDR. It consists of the same laminated structure of rubber and steel plates. The steel plates are installed to prevent rubber bulging and provide high vertical stiffness, while horizontal stiffness is controlled by the low elastic shear modulus of the rubber.

Application Examples

Product Detail



Installation Example-1

Installation Example-2

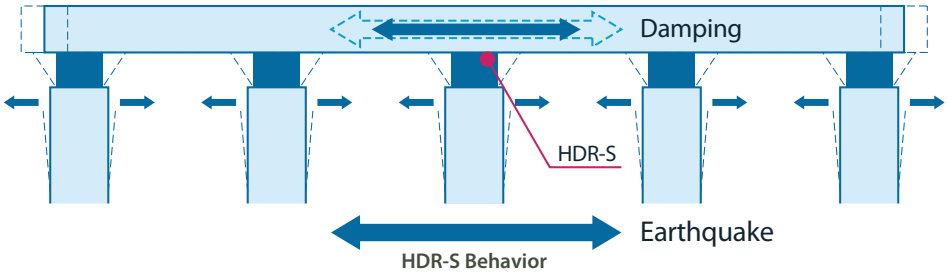
Imokawa Bridge

Tenpaku Bridge

Sakaigawa Bridge

Performance

The HDR-S has large deformation capability. Its long-term serviceability and high reliability are verified by various performance tests.



HDR-S Behavior

The HDR-S is an ideal seismic device due to its restoring capability, high damping effect and high durability as well as its environmentally friendliness. The characteristics of HDR-S bearings are shown in the following figures (Table-1,2 and 3).

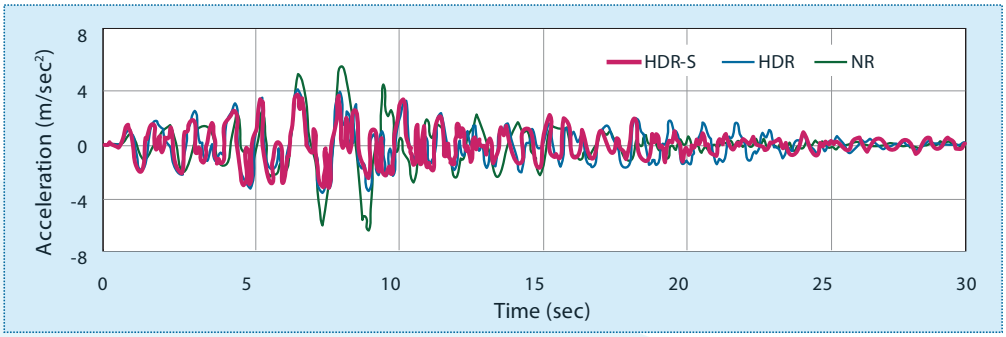


Figure-1. Superstructure acceleration

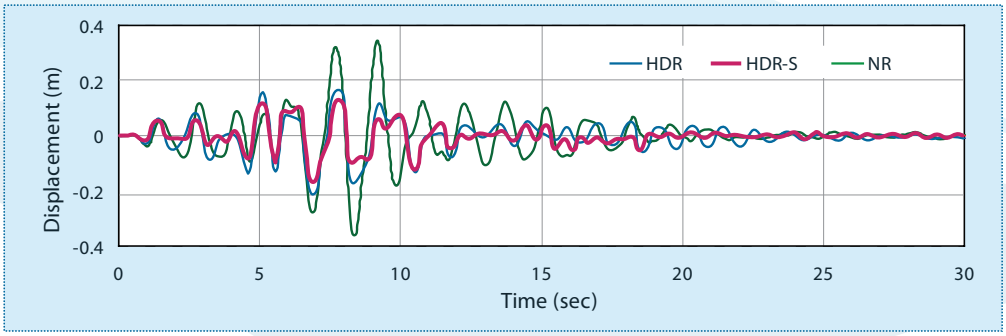


Figure-2. Superstructure Displacement

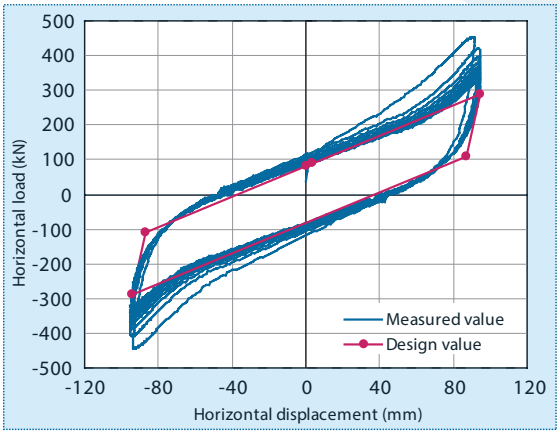


Figure-3. Hysteretic Curve

Fracture Test

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Tomorrow's Technology, Today.
Kawakin Holdings Group

Issued 07/2022

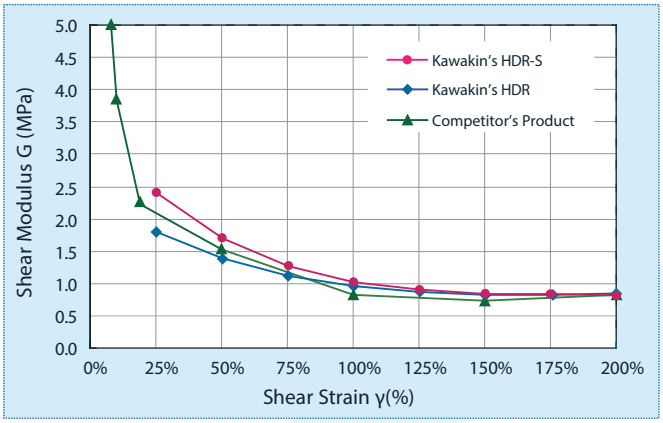
HDR-S Super High Damping Rubber Bearing

Issued 02/2017

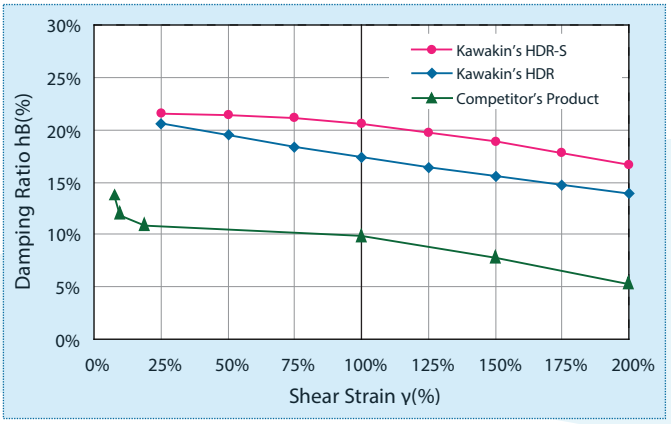
COMPARISON - Shear Property

Kawakin' s HDR-S has outstanding damping performance compared to other competitive products, although their stiffnesses are all quite similar as shown in the following figures. The damping ratio is 20% as to Kawakin' s HDR-S when the shear deformation is 100%, whereas the ratio of the competitors' product is approximately 10%.

Shear Stiffness



Damping Performance



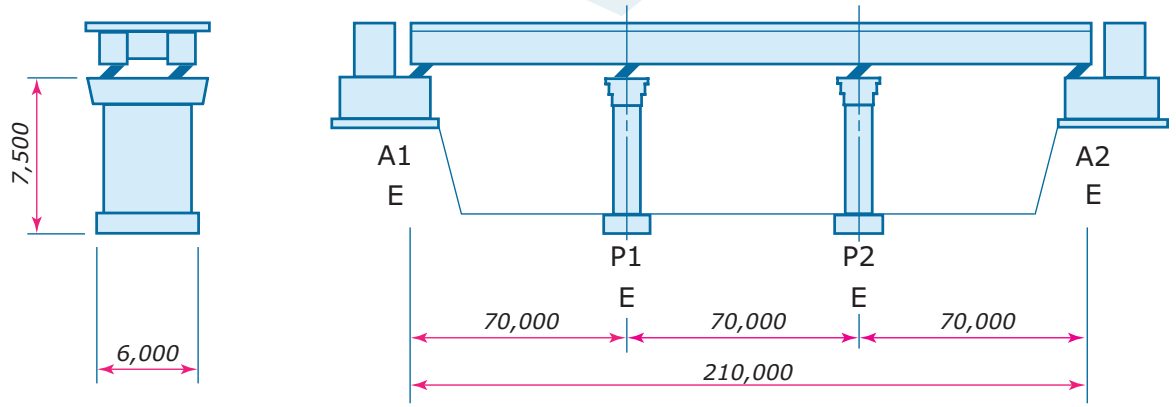
TRIAL DESIGN - Dynamic Analysis

A trial design is provided for bearings with a three-span continuous steel box girder bridge based on the results of dynamic analysis.

» Design Condition

Bridge Type : Three-span continuous non-composite box girder bridge
Area Type : A
Span : 70m-span each (Total Lenght: 210m)

Soil Type : Class 2
Effective Width : 10m



*The other conditions are on the next page

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HDR-S Super High Damping Rubber Bearing

TRIAL DESIGN - Dynamic Analysis Results

» Design Conditions

Reactions and Substructure Stiffness

			A1	P1	P2	A2	Remarks
Maximum Reaction	Rmax	kN	3101.8	7415.9	7415.9	3101.8	
Dead Load Reaction per support	Rd	kN	1910.9	5272.3	5272.3	1910.9	
Total Dead Load Reaction	∑Rd	kN	3821.7	10544.6	10544.6	3821.7	∑Rd=28732.6kN
Dead Load on Bridge Pier	∑N	Qty	2	2	2	2	
Substructure Stiffness	kp1(axial)	kN/m	1.00E+09	3.00E+05	3.00E+05	1.00E+09	For Level 1 Earthquake
	kp2(axial)	kN/m	1.00E+09	8.24E+04	8.24E+04	1.00E+09	For Level 2 Earthquake

» Analysis Results

			A1	P1	P2	A2
Super High Damping Rubber Bearing **HDR-S**	G value	N/mm²	0.8	1.2	1.2	0.8
	Side Length	mm	900	1150	1150	900
	Rubber Thickness	mm	37	43	43	37
	Number of Layers	n	5	3	3	5
	Total Volume	cm³	**1281810(1.000)**			
	Shear Strain	%	229.7%	249.6%	249.6%	229.7%
High Damping Rubber Bearing **HDR**	G value	N/mm²	0.8	1.2	1.2	0.8
	Side Length	mm	950	1250	1250	950
	Rubber Thickness	mm	39	41	41	39
	Number of Layers	n	6	4	4	6
	Total Volume	cm³	**1869740(1.459)**			
	Shear Strain	%	234.2%	228.7%	228.7%	234.2%
Lead Rubber Bearing **LRB**	G value	N/mm²	0.8	1.2	1.2	0.8
	Side Length	mm	950	1250	1250	950
	Rubber Thickness	mm	35	42	42	35
	Number of Layers	n	6	3	3	6
	Diameter of Lead Plug	mm	140	170	170	140
	Number of Lead Plugs	n	4	4	4	4
	Total Volume	cm³	**1483860(1.158)**			
	Shear Strain	%	209.0%	249.2%	249.2%	209.0%

HDR-S bearings achieve a reduction of the entire volume of a bearing of 15 % compared to other types of seismic isolation bearings. Therefore, it leads to remarkable cost savings.

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