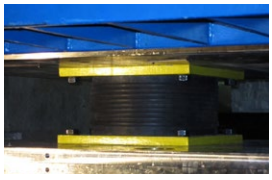
Seismic devices

Infrastructure | Buildings | Industrial structures

mageba seismic protection devices – for reliable preservation of structures

LASTO®LRB Lead Rubber Bearing

proven, safe, versatile



mageba

Product features

Principle

mageba LASTO®LRB lead rubber bearings work on the principle of base isolation and limits the energy transferred from the ground to the structure in the event of an earthquake. The rubber and steel laminated bearing is designed to support the weight of the structure and to provide post-yield elasticity. The rubber provides the isolation and re-centring of the bearing after a seismic event. The lead core deforms plastically under shear deformations, while dissipating energy through heat.

Properties

LASTO®LRB lead rubber bearings consist of alternate layers of elastomeric material and vulcanized reinforcement steel plates with a central lead core. They provide a high level of damping of up to 30% due to high absorption capacity of the lead core.

As the reinforcement steel plates are fully embedded in the elastomeric material, they are sealed, and therefore protected against corrosion. The devices are manufactured with the rubber vulcanised to the top and bottom connection plates. The bearings can also be supplied with additional anchor plates, allowing easier replacement of the device in case of maintenance needs.

Application

LASTO®LRB devices are made from natural rubber (NR) providing a high resistance against mechanical wear.

Lead rubber bearings find wide applications in structures. This is due to their simplicity and the combined isolation and energy dissipation functions in a single, compact unit. In terms of seismic protection, it is a crucial aspect to minimise the seismic energy transfer to the superstructure and to limit the horizontal displacements of the device.

Under normal conditions LASTO®LRB lead rubber bearings act as regular elastomeric bearings. Therefore, in case of structures with limited space for bearings and seismic protection means all these functions can be combined in a single device.

The fitting of structures with lead rubber bearings is one of the most used seismic isolation means and has proven its effectiveness in numerous earthquakes. The system has been researched over the past decades and allows the structural engineer a straight-forward simulation of the device response due to simple bi-linear modelling.

Seismic isolation

Seismic isolation is the decoupling of structures from ground motions induced by earthquake motions which could cause damage to the structures. To achieve such decoupling, different seismic devices – so called isolators – are strategically installed in specific locations of structures, allowing them to perform properly during an earthquake.

Seismic isolators provide sufficient flexibility to the structure, so that the natural period of the structure differentiates as much as possible from the natural period of the earthquake. This prevents the occurrence of resonance, which could lead to severe damage or even collapse of a structure.

An effective seismic isolation system shall provide the following main functions:

- Performance under all service loads, vertical and horizontal; shall be as effective as conventional structural bearings
- Provide enough horizontal flexibility in order to reach the target natural period for the isolated structure
- Re-centring capabilities after the occurrence of a severe earthquake so that no residual displacements can disrupt the serviceability of the structure
- Provide an adequate level of energy dissipation in order to control the displacements that could otherwise damage other structural members

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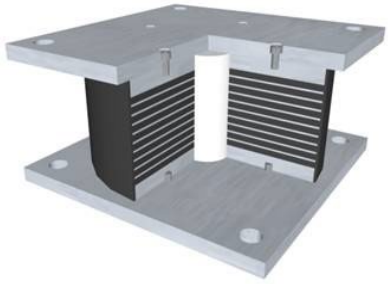

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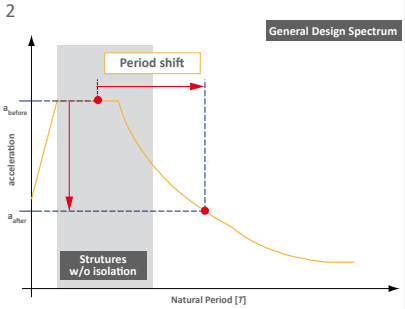

Reduction of acceleration by seismic isolation

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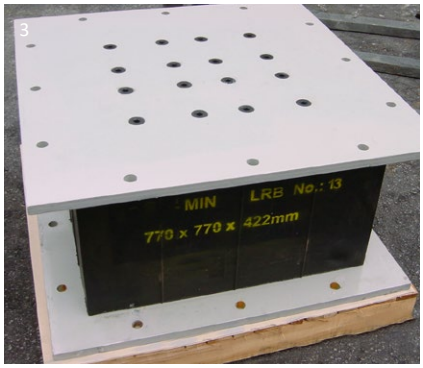

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1 Schematic view of a LASTO®LRB device
2 Principle of seismic isolation – reduction of acceleration by means of period shifting
3 LASTO®LRB device ready for installation
4 Viaduct de Chillon, Switzerland, retrofitted with LASTO®LRB bearings

Properties & benefits

Materials

The following materials are used for the production of mageba LASTO®LRB lead rubber bearings:

- Reinforcing plates, the top and bottom plates are made from rolled carbon steel conforming to ASTM A36 or A570
- Natural rubber, type NR, grade 3 per ASTM D4014-81
- Lead with a minimum purity of 99.9%

Anchoring system

LASTO®LRB devices are equipped with anchor plates to facilitate the connection to the lower and upper concrete structures. Alternatively, the bearings can be prepared for connection to steel structures.

Corrosion protection

mageba proposes standard corrosion protection systems according to EN ISO 12944, with corrosivity category depending on location, environmental conditions and the required degree of protection.

Corrosion protection systems according to other standards can be provided upon request.

Main dimensions

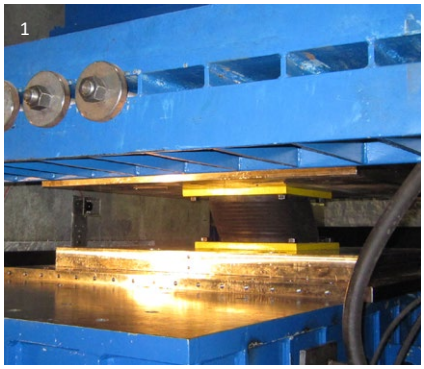
The table below summarizes the main dimensions for one given seismic design displacement. Values for other sets of input parameters can be provided upon request.

Benefits

- Significant dissipation of energy during earthquakes leading to an optimized structure size and reduced structure cost
- Combined transfer of service and seismic loads leading to minimal space requirement for the devices
- Effective solution for a wide range of types of structures
- Effective solution for the retrofitting or upgrade of existing structures
- Re-centring capabilities of bearings after a seismic event allows to maintain the serviceability of the structure
- Well researched technology with several decades of track record for many applications worldwide

Inspection and maintenance

LASTO®LRB lead rubber bearings are maintenance free. The condition and position of the bearings should be inspected at regular intervals. Upon request, mageba specialists can carry out such inspections and summarize the results in a detailed report.



1 Testing of LASTO®LRB bearings
2 Manufacturing of LASTO®LRB bearings

LASTO®LRB – d_{bd} = 400mm										
D (mm)	t_e (mm)	H_B (mm)	N_{Sd} (kN)	N_{Ed} (kN)	F_1 (kN)	F_2 (kN)	K_r (kN/mm)	K_{eff} (kN/mm)	K_v (kN/mm)	ξ (%)
500	160	326	3,600	1,250	315	755	1.1	1.89	814	29
600	176	350	5,950	2,150	420	990	1.45	2.49	1,346	28
700	192	374	8,750	3,450	515	1230	1.8	3.09	1,991	28
800	208	398	10,950	5,100	620	1500	2.17	3.73	2,725	26
900	216	410	16,250	6,750	690	1750	2.65	4.38	3,658	26
1000	224	422	18,750	10,100	760	2030	3.16	5.07	4,693	25

Important Note: This table is intended only as a preliminary reference for the design of the isolator. The final design and technical details will be fully defined once all the parameters of the project are considered in the final design.

Legend

d_{bd}	*Design seismic displacement*	F_1	*Yield force*
D	*Rubber block diameter*	F_2	*Maximum horizontal force (at d_{bd})*
t_e	*Total rubber height*	K_r	*Horizontal stiffness*
H_B	*Total isolator's height*	K_{eff}	*Effective stiffness*
N_{Sd}	*Maximum vertical service load*	K_v	*Vertical stiffness*
N_{Ed}	*Maximum vertical seismic load*	ξ	*Damping ratio*

Quality & support

Quality

For five decades, mageba bearings have proven their worth in thousands of structures under most demanding conditions. In addition to the product properties, the extensive experience of mageba's well-qualified manufacturing and installation staff also contributes to the high quality and durability of the products.

mageba has a process-orientated quality system that is certified in accordance with ISO 9001:2008. Quality is also regularly inspected by independent institutes, such as the materials testing body (MPA) of the University of Stuttgart. mageba factories are certified for welding in accordance with ISO 3834-2, and according to the current steel construction standard EN 1090.

CE Certification

LASTO®LRB lead rubber bearings are designed and manufactured in accordance with European Standard EN 15129:2009 and with EN 1337. Bearings are marked with the CE mark of conformity, which confirms that they satisfy all requirements of this standard, without exception. All necessary type testing performed on LASTO®LRB devices was carried out at an independent testing facility and fully supervised by a certified body.

mageba LASTO®LRB lead rubber bearings can also be designed and manufactured in accordance with other international specifications, such as the "AASHTO Guide Specification for Seismic Isolation Design", Japanese Specifications, National Norms, etc.

Testing

If required by the client, full-scale factory production testing can be carried out. mageba performs the tests in-house as well as with independent 3rd party test institutes. Commonly performed tests are based on European Standard EN 15129:2009 or AASHTO "Guide Specifications for Seismic Isolation Design". For special projects, customised testing can also be performed if requested by the client.

Customer support

Our product specialists will be glad to advise you in selection of the optimal solution for your project, and to provide you with a quotation.

On our website, **mageba-group.com**, you can find further product information, including reference lists and tender documentation.

Reference projects for mageba seismic devices


Awaza Bridge (TM)


Flendruz (CH)


Langenargen (DE)


Ramstore Bridge (KZ)


Agin Bridge (TR)


Vasco da Gama Bridge (PT)

mageba seismic devices


RESTON®SA & STU


RESTON®PSD


RESTON®PENDULUM


LASTO®LRB & HDRB

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