HIRUN
HI TECH CIVIL ENGINEERING

HISLIDE

SLIDING PENDULUM ISOLATORS

CE MARKED

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Distributore esclusivo

◎COMPANY INTRODUCTION

Founded in 1998, Wuhan Hirun Engineering Equipment Co., Ltd. (HIRUN) is a wholly owned subsidiary of Wuhan Marine Machinery Plant Co., Ltd. (WMMP), which is a subsidiary of China Shipbuilding Industry Corporation (CSIC), one of the world's top 500 enterprises, and it is a professional manufacturing enterprise of research, development, production and sales in bridge and anti-seismic products.

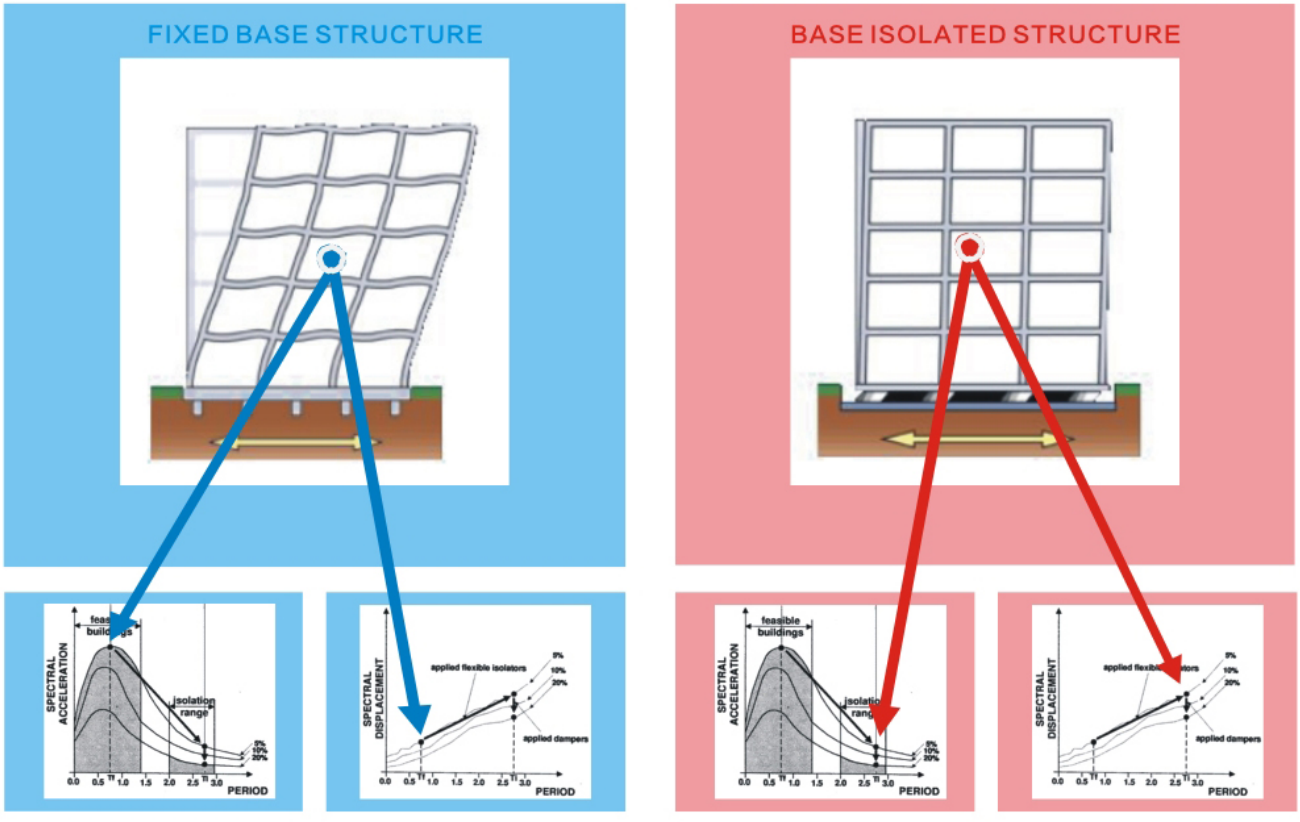
◎BASIC PRINCIPLES AND REQUIREMENTS OF THE BASE ISOLATION

The reduction of the seismic response of a structure may be achieved by one of the following strategies or by a combination of them:

◆Shifting the natural period of the structures to a field of lesser acceleration response

◆Dissipating energy (damping)

It is easy to understand the effects of anti-seismic devices based on the above mentioned strategies examining a typical acceleration response spectrum diagram. This diagram represents the behaviour of a structure under the effect of an earthquake and clearly shows that rigid structures amplify the ground acceleration whilst soft ones reduce it. The diagram also clearly shows the influence of the energy dissipation in reducing the acceleration of the structure.



Quite often there is a price to be paid for any advantage got. In this case, the price to be paid is the relative displacement that the anti-seismic devices induce between the parts of the structure. The relative displacements are shown in the following graph in function of the natural period of the structure.

The diagram clearly shows the great advantage given by the energy dissipation in terms of reduction of the displacements. Especially for bridges, a high value of the damping has no undesirable effects and therefore shall be adopted in order to reduce all necessary clearances in correspondence of the bearings and the joints.

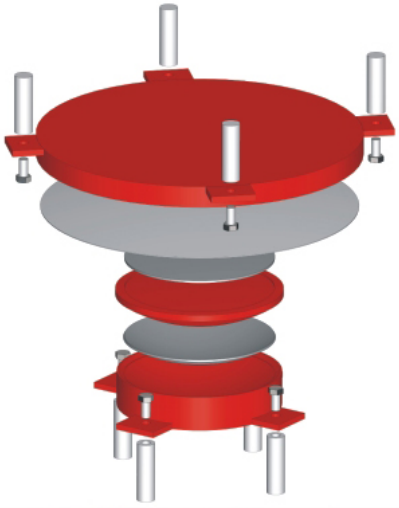
HISLIDE
SLIDING PENDULUM ISOLATORS

◎FEATURES

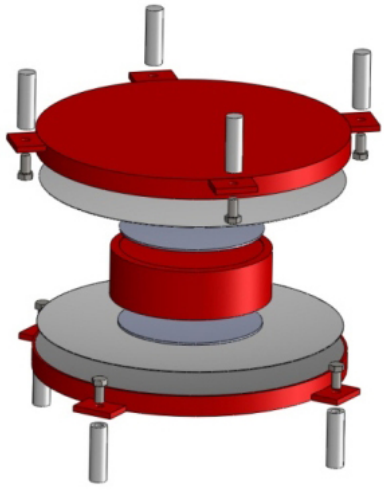
Sliding Pendulum Isolators basically consist of one or two main spherical sliding surfaces and one articulation allowing relative rotation.

The main sliding surface shall provide displacement capability and energy dissipation through friction. The friction value shall be in accordance with the design requirements.

The secondary sliding surface shall provide relative rotation capability between the lower and the upper part of the isolator. The sliding material of the secondary sliding surface shall have as low as possible friction coefficient. Normally it is dimpled, lubricated and may be PTFE according to EN 1337-2 or other approved material.



HISLIDE HP 1: single sliding surface



HISLIDE HP 2: double sliding surface

◎STANDARD & QUALITY ASSURANCE

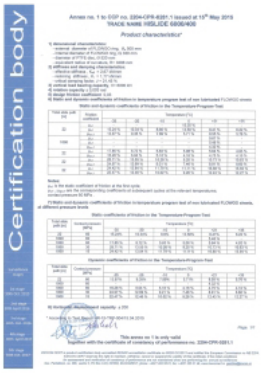
The whole production of HIRUN is subjected to a quality assurance program in accordance with ISO 9000 certified by CQC, member of the International Mutual Acknowledgment Body IQNET.

The production of the Sliding Pendulum Isolators is subjected to a specific quality assurance program in accordance with EN 15129 Annex ZA for the CE marking with the supervision of the Notified Body ICECON.

Hirun can design, manufacture and test pendulum isolators in accordance with EN15129 (CE markded with supervision of the notified body ICECON) or with other worldwide standard as: ISO-AASHTO-TT/T.

Hirun is also certified for the execution of steel and aluminum structures with CE certificate according to EN 1090.

The relevant certificates are shown here below:



HISLIDE Sliding Pendulum CE certificate

ISO 9001 certificates

EN 1090 certificate

◎TESTS

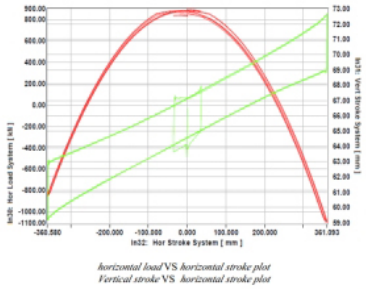
All relevant tests can be performed in the HIRUN testing facility having the following performances:

- Vertical load capacity 75 MN
- Horizontal load capacity 20 MN
- Dynamic Vertical load 50 MN
- Dynamic Horizontal load 6 MN
- Dynamic Horizontal stroke 1200 mm
- Peak horizontal velocity 1000 mm/s

The Hirun testing laboratory

The tests are performed in accordance to the specific requirement of the Standard EN 15129 or other applicable Standard for the specific project and normally include the following tests.

- Vertical load tests at zero displacement
- Friction test in service conditions
- Static friction coefficient test
- Dynamic test at design displacement and design velocity
- Aging test



horizontal load VS horizontal stroke plot
Vertical stroke VS horizontal stroke plot

Dynamic tests for the Sliding Pendulum Isolators for the Bursa Hospital, Turkey, executed in our laboratory

◎GENERAL CHARACTERISTICS

The **corrosion protection** of structural steel is normally performed in accordance with EN ISO 12944.
The working life of the protective coating system on the bearing can be assumed to be fulfilled with a protective system designed for the durability "high" of more than 15 years in accordance with EN ISO 12944-5:2007, 5.5 for corrosivity category C5-I (I=industrial) for inland locations and C5-M (M=marine) for sea side locations.
Surfaces in contact with concrete need no corrosion protection, however a layer of 50 μm of the first pack is applied in order to prevent oxidation during the storage before the installation. A return of at least 50 mm is applied.
In alternative paint will conform to the Project specifications, as specified by the purchaser.

HISLIDE Isolators are **fire resistant** and don't require special precautions to protect them from the fire. After a fire event an inspection is recommended and, depending on the fire intensity, the sliding material may need to be replaced.

The HISLIDE Sliding Pendulum isolators are provided with **fixings** made with bolts or dowels according to the type of structure. The fixing are connected to the Isolator in such a way to allow the easy replacement if necessary.

In case of use of the HISLIDE Isolators in railway bridges it is recommended the use of **mechanical fuses** in order to grant the fixity of the bridge under service condition. In case of a strong earthquake the fuses will be sheared off and the isolators can start their antiseismic function.

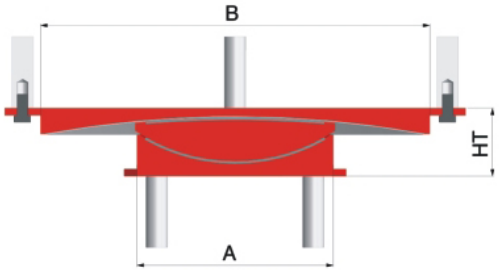
◎DIMENSIONS TABLES: HISLIDE HP1

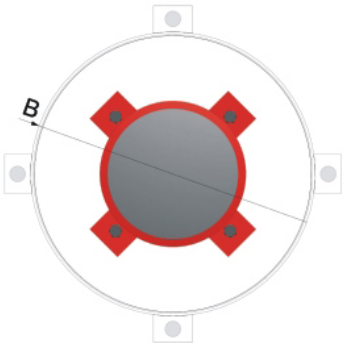
They are identified by the following Mark:

HP1 Vk(kN)/D(mm)

EXAMPLE:

Hp1 4000/500: Friction Pendulum isolator with single sliding surface with 4000 kN characteristic vertical load and 500 mm horizontal displacement (± 250)





V_k	V_d	D	A	B	HT
kN	kN	± mm	mm	mm	mm
1000	1400	± 250	190	690	88
2000	2800	± 250	270	770	102
3000	4200	± 250	330	830	112
4000	5600	± 250	380	880	119
5000	7000	± 250	430	930	127
6000	8400	± 250	470	970	134
7000	9800	± 250	500	1000	140
8000	11299	± 250	540	1040	147
9000	12600	± 250	570	1070	150
10000	14000	± 250	600	1100	169
11000	15400	± 250	630	1130	174
12000	16800	± 250	660	1160	179
13000	18200	± 250	680	1180	183
15000	21000	± 250	730	1230	192
17500	24500	± 250	790	1290	200
20000	28000	± 250	850	1350	210
25000	35000	± 250	950	1450	227
30000	42000	± 250	1040	1540	243
40000	56000	± 250	1190	1690	269
50000	70000	± 250	1340	1840	292
60000	84000	± 250	1460	1960	314

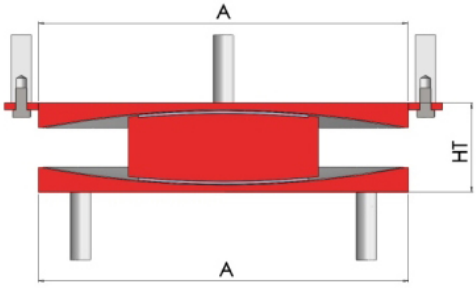
V_K: CHARACTERISTIC LOAD (SLS)
V_d: DESIGN LOAD (ULS)
D: HORIZONTAL DISPLACEMENT (± D/2)
A: BOTTOM PLATE DIMENSION
B: UPPER PLATE DIMENSION
HT: TOTAL HEIGHT
R: equivalent radius (from 1500mm to 7000mm)
μ: dynamic friction coefficient (from 2% to 10%)

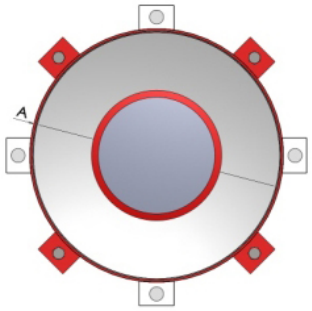
◎DIMENSIONS TABLES:HISLIDE HP2

They are identified by the following Mark:
HP2 Vk(kN)/D(mm)

EXAMPLE:

HP2 3000/500: Friction Pendulum with single sliding surface with 3000 kN characteristic vertical load and 500 mm horizontal displacement (±250)





V_k	V_d	D	A	HT
kN	kN	± mm	mm	mm
1000	1400	± 250	440	108
2000	2800	± 250	520	122
3000	4200	± 250	580	132
4000	5600	± 250	630	139
5000	7000	± 250	680	147
6000	8400	± 250	720	154
7000	9800	± 250	750	160
8000	11299	± 250	790	167
9000	12600	± 250	820	170
10000	14000	± 250	850	189
11000	15400	± 250	880	194
12000	16800	± 250	910	199
13000	18200	± 250	930	203
15000	21000	± 250	980	212
17500	24500	± 250	1040	220
20000	28000	± 250	1100	230
25000	35000	± 250	1200	247
30000	42000	± 250	1290	263
40000	56000	± 250	1440	289
50000	70000	± 250	1590	312
60000	84000	± 250	1710	334

V_K: CHARACTERISTIC LOAD (SLS)
V_d: DESIGN LOAD (ULS)
D: HORIZONTAL DISPLACEMENT (±D/2)
A: PLATE DIMENSIONS
HT: TOTAL HEIGHT
R: equivalent radius (from 1500mm to 7000mm)
μ: dynamic friction coefficient (from 2% to 10%)

◎STANDARD DEFINITION AND THEORETICAL FORMULA

Base isolators, as defined in EN 15129 are the devices or the combination of devices providing the following four functions:

◆Support the weight of the structures

◆Provide lateral displacement capability

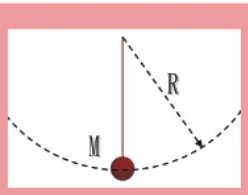
◆Provide re-centring capability

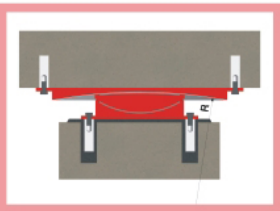
◆Dissipate energy

Sliding Pendulum Isolators indeed are one of the most efficient systems of base isolators.

They are based on the principle of the physical pendulum and therefore they force the structure to oscillate in accordance to their own period.

$$T = 2\pi\sqrt{\frac{R}{g}}$$





$$\xi = \frac{2}{\pi}\left[\frac{\mu}{\mu + \frac{D}{R}}\right]$$

$$T = 2\pi\sqrt{\frac{DR}{(D + \mu R)g}}$$

The principle and mathematical model of the Sliding Pendulum Isolator

Their period is determined by the length l or the radius R of the pendulum and the gravity g only.

The period of the pendulum is not influenced by the mass.

In the reality the sliding pendulum isolators are based on sliding materials mated with spherical sliding surfaces as shown in the picture. The friction of the sliding material can provide the energy dissipation.

So the Sliding Pendulum Isolators will shift the period of the structures forcing them to swing according to their own period.

In addition the Sliding Pendulum Isolators fulfil the 4 requirements given by the EN 15129 as follows:

◆It supports the weight of the structure acting like a spherical bearing.

◆It provides lateral displacement capability through the curved sliding surface.

◆It provides re-centring capability storing potential energy when is pushed off its neutral position and giving it back to return to the initial position.

◆It provides energy dissipation through the friction of the sliding surface.

The mathematical model of the Sliding Pendulum Isolator, independently of the type with one or two sliding surfaces, is very simple and can be expressed in function of two parameters only:

◆R is the equivalent radius. The equivalent radius defines the cinematic of the isolator or, in other terms the circle along which the top and the bottom part can move relatively. It is a function of the radii of the main and secondary sliding surfaces and their distance.

◆μ is the friction coefficient of the main sliding surface.

With the following definition of the symbols:

◆T: Period

◆g: Gravity acceleration

◆μ : Dynamic friction coefficient

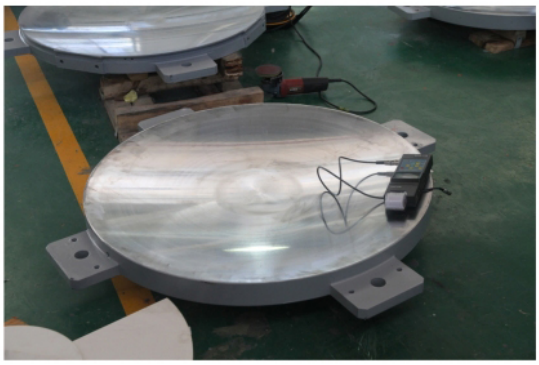
◆R: Equivalent radius

◆D: Design displacement

◆ξ : Equivalent viscous damping

SUPPLY OF HISLIDE PENDULUM DEVICES (VERTICAL LOAD UP TO 14000KN) FOR BURSA HOSPITAL, TURKEY

SUPPLY OF HISLIDE PENDULUM DEVICES (VERTICAL LOAD UP TO 35000KN) DAYUE HIGHWAY, HUNAN, CHINA



SUPPLY AND INSTALLATION OF 600 HISLIDE PENDULUM DEVICES (VERTICAL LOAD 1000KN) FOR SEBES – TURDA MOTORWAY, ROMANIA

Divisione
HIRUN® ENGINEERING

G&P intech s.r.l
via Retrone 39 - 36077 Altavilla Vic. (VI) - ITALY
Tel. +39 0444 522797 - Fax +39 0444 348692
E mail: info@gpintech.com

www.gpintech.com