

INTERNAL HYDRAULIC DAMPER

- Invisible
- Damping from low amplitude
- Track record of more than 1000 units
- Easy maintenance

STAY CABLE DAMPERS

Technical Sheet Reference: FT En C I 1 17



FREYSSINET
SUSTAINABLE TECHNOLOGY

INTRODUCTION

Stay cables are key elements of cable stayed structures. Under some conditions, stay cables can accumulate energy and oscillate with high amplitudes, particularly when they are subject to periodic excitations. There are two main causes of these vibrations:

- displacement of the anchors under the effect of traffic or wind loads,
- the effect of wind acting on the cables directly

These oscillations rarely endanger the structure, but they can make users feel uncomfortable and they can damage the stay cables if they are not controlled.

Since stay cables have a fairly low intrinsic damping, FREYSSINET has developed a range of dampers to increase the damping of stay cables and thus limit or eliminate vibrations.

For aesthetics and practical considerations, when possible, the dampers are located inside a guide tube which is linked to the formwork tube to be invisible from the outside. Such dampers are called internal. Their efficiency is optimized according to the configuration of each project.

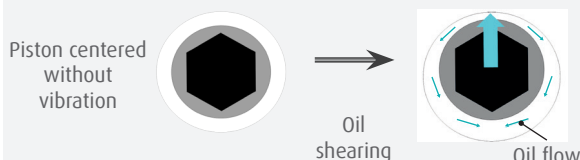
The IHD, Internal Hydraulic Damper, is the middle range of the FREYSSINET internal dampers.

DESCRIPTION

The Internal Hydraulic Damper has an annular shape and operates by viscous flow to absorb the stay energy. It works as a "jack" fixed onto the strands by the means of a metallic compacting collar and connected to the structure through a metallic piston.

The damper is placed inside a metallic tube called the guide tube. The latter is bolted to the formwork tube, to enable correction of cable eccentricity.

Inside the annular jack, a silicon oil with optimized viscosity achieves the required damping, depending on the stay characteristics (length, mass, force, temperature, damper position, etc.)



APPLICATIONS

The IHD technology is equally applicable to new and existing structures. It can be adapted to all types of stay cable systems (stay cables with parallel wires, stay cables with parallel strands, locked coil cables, etc.) and all types of cable stayed structures (bridges, roofs, etc.)

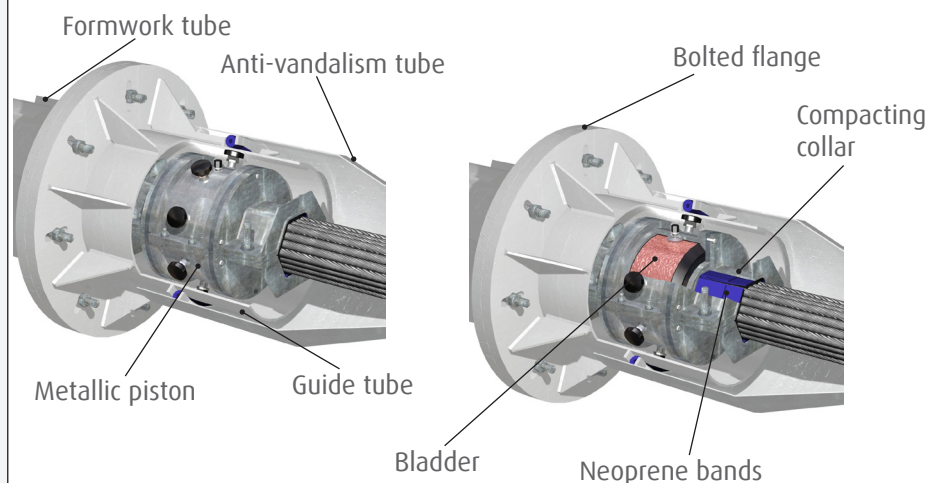
MATERIALS & CORROSION PROTECTION

Materials

Tubes & steel components:	S355 (EN 10025)
Screws:	Class 8.8 (NF E 25-112)
Bolts:	Class 10.9 (NF E 27-701)
Bladder:	PVC-NBR Black
Oil:	High viscosity silicone oil

Corrosion protection

Tubes & collars:	Hot dip galvanised (ISO 1461) or Thermally sprayed zinc
Threaded parts:	Zinc + Bichromate (EN 12339)
Bolts & screws:	Galvanised or zinc bichromated



PERFORMANCES

Damping

The damping of a cable is characterised by its damping ratio to critical ξ or its logarithmic decrement δ . The latter is preferred here as it is linked to the physical behaviour of the cable:

$$\delta = \ln\left(\frac{a_n}{a_{n+1}}\right),$$

where a_{n+1} and a_n are the vibration amplitudes of the free length of the stay cable in the $(n+1)^{\text{th}}$ and n^{th} cycles respectively, for any two consecutive cycles.

Note that: $\delta = 2\pi\xi$

Damping performance depends on the cable length L , the distance x from the cable anchorage to the damper, and the stiffness of the damper support. Freyssinet Technical Department has developed proprietary software to design the damping solution that is optimal for each given project.

- Maximum theoretical efficiency: $\delta_{\max} = \pi \frac{x}{L}$,
- Endurance: 30 km of pulsation

INTERNAL HYDRAULIC DAMPER



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ADVANTAGES

IHD dampers have many advantages:

- damping efficiency even for very small oscillations,
- unseen since the damper is inside a guide tube,
- no elastic stiffness
- easily accessible for monitoring and maintenance,
- removable and replaceable,
- protected against climatic aggressions.

INSTALLATION

The IHD damper is assembled in our factory so that all alignments are checked before installation.

The dampers can be installed after erection and final stressing of the stay cables. The installation requires access to the bottom of the cable at the guide tube location. The damper is installed through an access window according to the required sequence:

- Place the two half hexagonal collars and tighten them
- Install the bladder
- Install the annular pistons
- Inject oil inside the bladder
- Lower the guide tube, adjust it and tighten bolts
- Lower the duct and the anti-vandalism tube

The IHD installation requires mechanical means only. Several control points ensure an accurate positioning of each element. The oil injection inside the bladder is carried out using a special automatic pump that fastens the operation.

MAINTENANCE

The IHD maintenance operations consist in checking periodically the oil pressure and replacing the bladder when endurance has been reached. This task is carried out simply by lifting the guide tube and removing the two half pistons.



IHD dampers' installation

TESTS

Freyssinet has carried out laboratory tests to demonstrate the efficiency of IHD, including:

- test of resistance on bladders,
- dynamic characteristics of IHD,
- fatigue resistance of IHD.

Numerous in situ damping measurements were also made on different bridges throughout the world in order to confirm the theoretical efficiency of these devices.

GEOMETRICAL DIMENSIONS

The IHD is usually proposed for short to medium cable lengths (80 to 150 m)

- Stay eccentric adjustment: ± 20 mm
- Effective damper stroke: ± 20 mm
- Recommended position: $x = 0.015 L$ (L = Stay cable length / x = distance from anchorage)

Guide tube typical dimensions (in mm):

Unit	Outer diameter	Length
19/27/31/37	380	500
48/55/61	440	500
75/91	515	500
109/127	558	500



IHD damper on Panama Canal Bridge

SOME REFERENCES

- La Poya (Suisse) 16 units (on going)
- Indian River (USA), 2010, 152 units
- Second Geogum (Korea), 2010, 56 units
- Song Do 3 (Korea) – 2009 – 8 units
- Terenez (France) – 40 units
- MO (Hungary) – 2008 – 64 units
- Cheong Pong (Korea) – 2008 – 24 units
- Penang bridge (Malaysia) – 2008 – 96 units
- Orinoco bridge (Venezuela) – 2006 – 160 units
- Bai Chay bridge (Vietnam) – 2006 – 40 units
- Shenzhen Western Corridor bridge (Hong Kong) – 2005 – 20 units
- New Cooper river bridge (USA) – 2005 – 140 units
- Panama bridge (Panama) – 2004 – 108 units
- Millau viaduct (France) – 2004 – 112 units
- Seo Hae bridge (Korea) – 2002 – 104 units
- My Thuan bridge (Vietnam) – 2000 – 128 units
- Oresund bridge (Denmark) – 2000 – 32 units
- Second Tagus crossing (Portugal) – 1998 – 72 units
- Ting Kau bridge (Hong Kong) – 1998 – 40 units
- Dee crossing bridge (UK) – 1997 – 56 units

- Portmann (Canada), 80 units
- La Madeleine (France), 2010, 18 units
- Wroclaw (Poland), 2010, 128 units
- Kuhmo (Korea) – 2010 – 8 units
- Wando (Korea) – 2009 – 20 units
- Ada Tisa (Serbe) – 2008 – 24 units
- Golden Ears (Canada) – 2008 – 48 units
- Phu My (Vietnam) – 2008 – 103 units



New Cooper river bridge in South Carolina (USA)

FABRICATION AND DISTRIBUTION

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