Internal Radial Damper

- Active from low amplitude movements
- Track record on more than 900 units
- Long endurance
- Easy maintenance

Stay cable dampers

Technical Sheet Reference: FT En C I 1 18

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,
- 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 IRD, Internal Radial Damper, is the most powerful internal damper of the FREYSSINET range.

Description

The Internal Radial Damper is composed of three hydraulic pistons placed at 120° angles around the cable. The inner end of the pistons is fixed with a pin joint on a collar compacting the strand bundle. Their outer end is fixed with pin joints to a metallic tube called the guide tube. The latter is fixed rigidly to the structure (formwork tube) through a bolted flange.

Applications

The IRD technology is equally applicable to new or 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.)

Advantages

IRD dampers have many advantages:

- High durability using well proven hydraulic piston technology
- Efficiency which increases with the amplitude
- Low aesthetical impact as they are housed in a guide tube
- Low dependence on temperature effect
- Easily accessible for monitoring and maintenance
- Removable and replaceable
- Protected against climatic aggressions and vandalism
- Low maintenance cost

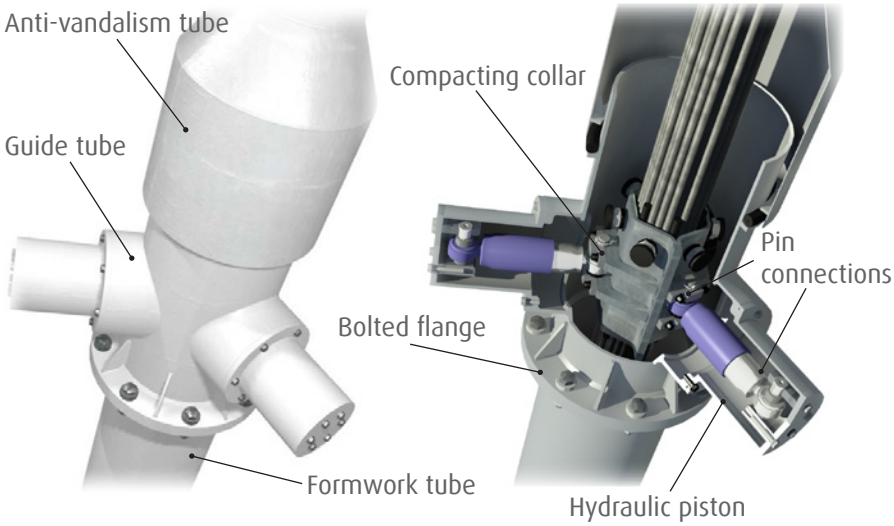
Materials & Corrosion Protection

Materials

Tubes & steel components:	S355 (EN 10025)
Screws:	Class 8.8 (NF E 25-112)
Bolts:	Class 10.9 (NF E 27-701)

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 $(n + 1)^{th}$ 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: 100 km of cumulative stroke

Internal Radial Damper

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Installation

The IRD 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.
On site, collars, pistons, pins, washers, shims and stroke limiters are prepared and placed closely to the stay cable.
The damper is installed through an access window according to the following sequence:

- Place the two half hexagonal collars
- Adjust the stroke limiters
- Lower the guide tube
- Install the pistons with their connection devices
- Install the caps
- Lower the duct and the anti-vandalism tube

The IRD installation requires mechanical means only.
Many check points ensure an accurate positioning of each element.

Maintenance

The IRD maintenance operations consist mainly in:

- checking the greasing of pin connections,
- tightening loosened bolts,
- replacing the hydraulic pistons when endurance has been reached.

This task is carried out simply by opening the caps and removing two pin connectors.

IRD dampers on ANZAC bridge (Australia)

Tests

FREYSSINET has carried out laboratory tests to demonstrate the efficiency of IRD, including:

- Production test on each piston (rating)
- Dynamic characteristics of IRD pistons
- Fatigue resistance of IRD

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

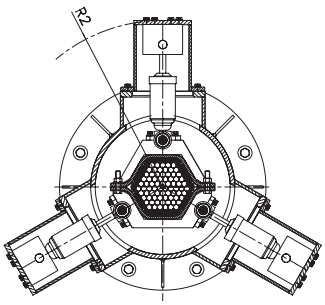
The IRD is usually proposed for 'middle class' stay cable length (150 to 300 m)

- Stay eccentric adjustment: +/- 20 mm
- Effective damper stroke: from +/- 40 mm
- Recommended position: x = 0.02 L (L = Stay cabe length / x = distance from anchorage)

Guide tube typical dimensions (in mm):

Unit	Outer diameter	Radial Clearance (R2)	Length
19	406.4	538	800
27/31/37	406.4	552	800
48/55/61	470	570	800
75	508	587	800
91	558.8	587	800
109/127	558.8	606	800

IRD dampers on Russky Island bridge (Russia)



Some references

- Golden Horn (Vladivostok) bridge (Russia) - 2012 - 192 units
- Jukseong Jeongok bridge (South Korea) - 2012 - 64 units
- Second Gaukeum bridge (Korea) - 2010 - 28 units
- Geoga bridge (Korea) - 2009 - 132 units
- Serebriany Bor bridge (Moscou) - 2007 - 52 units
- Bai Chay bridge (Vietnam) - 2006 - 40 units
- Oresund bridge (Sweden) - 2000 - 80 units
- Russky bridge (Russia) - 2012 - 56 units
- Portmann bridge (Canada) - 2011 - 208 units
- Wroclaw bridge (Poland) - 2010 - 32 units
- Phu My bridge (Vietnam) - 2008 - 24 units
- Southern Outer Bangkok Ring Road bridge (Thailand) - 2007 - 24 units
- Shenzhen Western Corridor bridge (Hong Kong) - 2005 - 6 units

Golden Horn bridge (Russia)

Local sales contact