TENSA

TENSA REFERENCES

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STAY CABLES

POST-TENSIONING

GROUND ANCHORS

STRUCTURAL BEARINGS

EXPANSION JOINTS

ANTI-SEISMIC DEVICES

REPAIR WORKS

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HISTORY

1951	Tensacciai, now Tensa, was founded in 1951 with headquarters in Milan, Italy.
1964	In the sixties Tensacciai underwent a phase of remarkable growth in Italy. Post-tensioning was just at the beginning of its history and its application was still experimental.
1970	A programme of technological renewal began with the adoption of steel strand.
1980	Tensacciai developed new tensioning systems and equipment in the field of ground anchors, combining innovation with versatility and ease use.
1990	New subsidiaries were established in Brazil, India and Australia and in Europe sister companies in Portugal, Greece and the Netherlands.
2000	Tensacciai's internationalization process continued unabated
2010	The company became directly involved in projects in all five continents.
2011	Tensacciai was acquired by Deal – world leading solutions provider in the field of bridge construction - and became part of Gruppo de Eccher. Tensacciai is now member of an organisation capable of designing, manufacture and install systems everywhere in the world, through specialised technicians, engineers in the technical department and quality control. Working procedures are attested by ISO9001 certification.

2012	Tensacciai merged with Tesit, another successful concrete specialist contractor with international experience in post-tensioning, steel bars, structural bearings and expansion joints becoming a prominent player in the field of specialised subcontracting. Tensacciai entered into a Worldwide Exclusive License Agreement with Rome-based Tecniche Idraulico-Stradali S.r.l. (TIS) - a leading company with experience in designing and producing structural bearings, expansion joints and anti-seismic devices since 1973.
2014	Tensacciai acquires TIS
2015	Tensa rises from the merging and development of the three important companies mentioned above: Tensacciai, TIS and Tesit.

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TECHNOLOGIES

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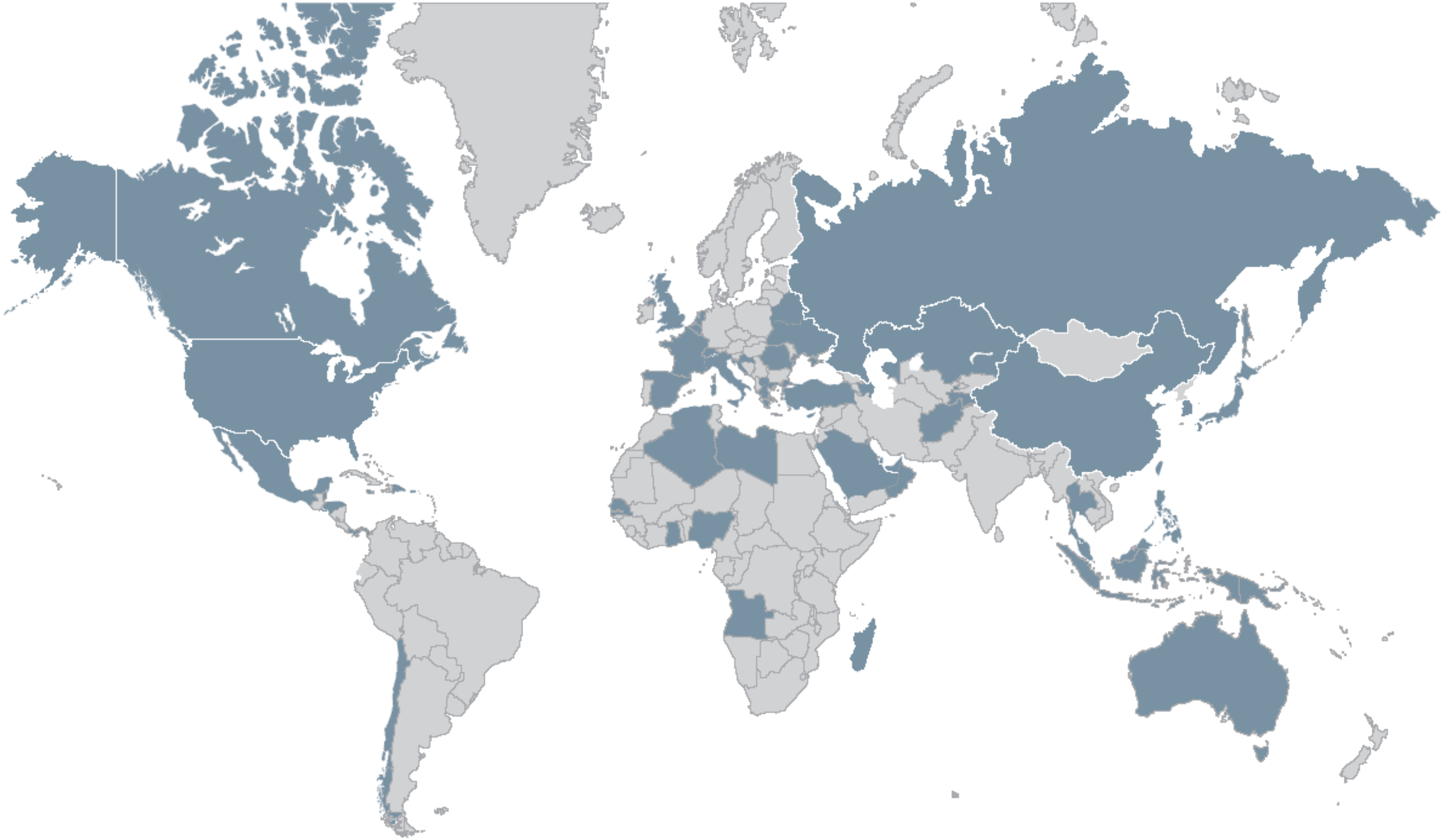
PROJECTS

TENSA

AFGHANISTAN
ALGERIA
ANGOLA
AUSTRALIA
AZERBAIJAN
BAHRAIN
CAMERUN
CHILE
CHINA
CROATIA
CYPRUS
EL SALVADOR
FRANCE
GREECE
GHANA
HONDURAS
HONG KONG
INDONESIA
ITALY
JAMAICA
JAPAN
KAZAKHSTAN
KUWAIT
LEBANON
LYBIA
MACEDONIA
MADAGASCAR
MALAYSIA
MEXICO



NETHERLANDS
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SAUDI ARABIA
SENEGAL
SINGAPORE
SPAIN
SOUTH KOREA
SWITZERLAND
TAIWAN
TAJIKISTAN
THAILAND
TURKEY
UAE
UKRAINE
UNITED KINGDOM
USA

Gruppo de Eccher presence

HISTORY

WORLDWIDE PRESENCE

PRODUCT LINE

STAY CABLES

POST-TENSIONING

GROUND ANCHORS

STRUCTURAL BEARINGS

EXPANSION JOINTS

ANTI-SEISMIC DEVICES

REPAIR WORKS

PROJECTS

Tensacciai, now Tensa, started to develop its technology for cable stayed bridges in the 1980s. The first small cable stayed bridge was built in 1988, paving the way to the development of the resin-coated wedge anchorage system that found its mature application in the bridge over Garigliano river in Formia. Further on the technical solution with waxed,polyethylene coated strands was adopted, finding its most famous application in the Erasmus Bridge in Rotterdam, with huge stays of 127 strands and lengths reaching more than 300 m.

Through the years, continuous developments and improvements have allowed Tensacciai to stay at the forefront of this technology, resulting in the construction of more than 50 cable stayed bridges, using its TSR stay cable system. One of the most prestigious is the cable stayed bridge over the river Po, designed for the high speed railway line Milano – Bologna,the first known example of this kind of structure. Later on Tensacciai completed the erection of a cable stayed bridge over the river Adige, in Italy, employing a daring design of 169 strands stays, giving a maximum breaking load of more than 47.000 kN.

STAY CABLES

Several kind of cable stayed bridges were built in different places, with the TSR system adopted also in the USA, India, Middle East, along with the usual market place of Europe. At the moment Tensacciai is directly involved in cable stayed bridge projects in all five continents. As a specialized contractor with decades of experience in the field, Tensa's Engineering Department is able to provide all services related to the design, manufacture and installation, as well as monitoring, of stay cables. Starting from the analysis of the whole structure, the design of stays is carried out with shop drawings and specifications for manufacturing, issue of installation procedures with loads and elongation checks, together with further engineering services. New and customized solutions are continuously released in order to commodate different projects. Tensacciai follows directly all installation operations, with its own specialized team and equipment, being fully accountable throughout and operating under ISO 9001 quality assurance system. The Tensa stay cable system can be used for several different construcion applications such as:

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Cable stayed bridges

stays are used to connect pylons to deck and thus allow a considerable increase of span length

Arch bridges

stays act as vertical or inclined hangers connecting arch to deck

Suspended structures

roofs, walkways coverages, lightweight domes can be easily suspended with stay cables

Buildings and Structures for technological services

TLC Towers, wind power stations, exhibition columns can be erected and stabilized with stay cables

STAY CABLES

Tensa's stay cable system has been designed and tested in order to guarantee the highest levels of performance meeting the most stringent market requirements. Key advantages can be summarized as:

- **Higher protection against corrosion both in the anchorage area and in the free length of stays** corrosion protection has been dealt with through different layers of protection surrounding the main tension element (i.e. steel strand). Anchorages and transition zones are provided with high performance anti-corrosion protection;seals and water tight connections along the stays' length guarantee complete protection and enhanced durability.

- **Resistance to axial and bending fatigue loads** the use of high performance wedges and bending filtering devices placed in the stay cables transition zone provides an outstandingly safe solution towards the long-term performance of stay cables.

- **Easy replaceability and maintenance** a modular designed multi-strand system allows single strands substitution and easy inspection for all components. The system meets the demand for

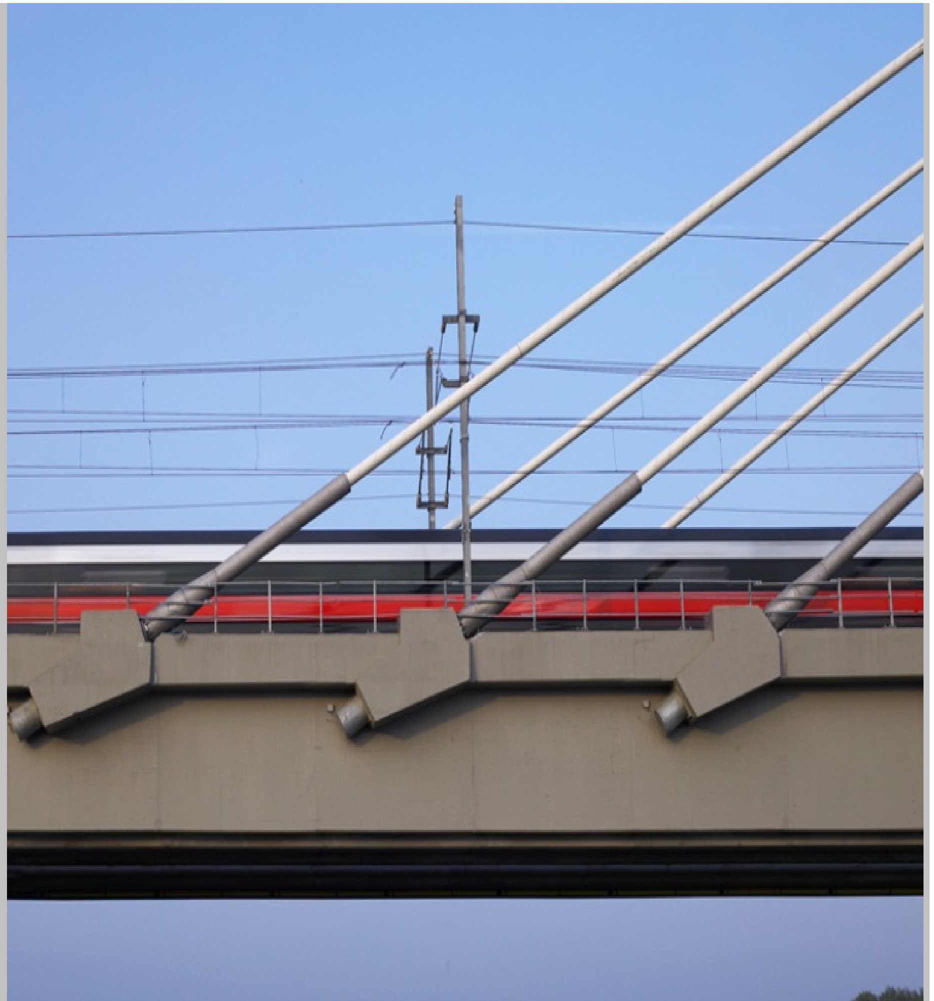
STAY CABLES

a sustainable technology that minimizes costs for maintenance and reduces wastes during the entire life cycle of the product.

- **Stays vibration control** the joint combination of compacted size ducts provided with ribs over the external surface and different types of dampers, both internal and external, provide an adequate solution to minimize wind drag and reduce stay vibrations

- **Easy and efficient installation** special lightweight dedicated equipment and installation procedures, which improve continuously, allow flexible erection schedules to meet the Contractor`s demand for a reduced number of stays' installation activities on the critical path

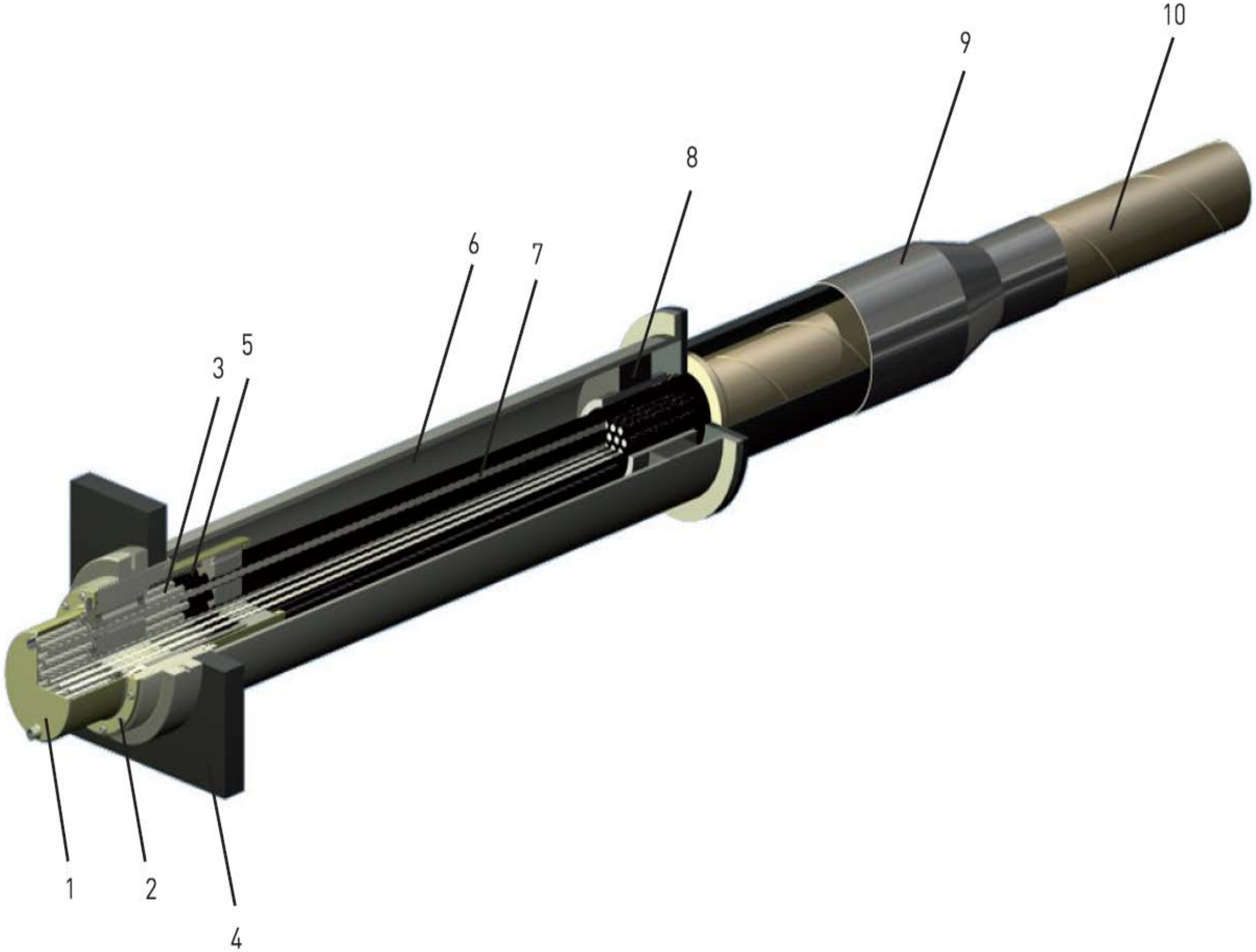
- **Improved aesthetics** the use of compact size coloured ducts, special pin shape anchorages and a variety of technical solution for different applications allow Owners and Designers to create stylish solutions appealing to all users.



STAY CABLES – SYSTEMS AVAILABLE

TSR stay cable system

1. Protection cap
2. Adjustable anchorage with nut (type TSRA)
3. Anticorrosive compound
4. Bearing plate
5. Wax box system
6. Form tube
7. High fatigue performance protected strands
8. Deviation/Internal Damper system
9. Anti-vandalism tube
10. External hdpe pipe



The TSR stay cable system consists of a compact bundle of parallel seven-wire steel strands enclosed in a co-extruded (black and coloured layers) high density polyethylene circular duct. The product offering is entirely based on modularity and stays with different dimensions can be designed, starting from the smallest one, 3TSR15, up to the biggest and complex one, 169TSR15.
Currently the most utilised type of strand is 15.7 mm [0.62''] diameter, grade 1860 Mpa, low relaxation but the use of 15.2 mm [0.6''] diameter is also considered.
Different corrosion protection treatments, such as galvanization of single wires, layers of corrosion inhibitor (wax or grease) and continuous UV stabilized extruded hdpe coating, are available.
Three nested barriers on the tensile element are always provided.

Tensacciai, now Tensa, started to develop its own post-tensioning technology in the early 1970s. Tensa's own post-tensioning tendons have been employed in several projects in all five continents, in a wide range of applications from viaducts and bridges to tanks, buildings, foundations and special reinforced slabs. Multi-strands tendons foresee a wide range of anchorages and systems for different applications: Tensa's post-tensioning system is compliant with both the European Technical Approval (ETA) and CE markings. Tensa's latest technological development is the electrically insulated tendon system, which was widely used in the 5 km high- speed train line viaduct "Piacenza" (Italy), currently the largest application of this kind globally.

Internal MTAIM dead anchorage

it is a not-accessible (dead) anchorage which is used in case accessibility during the stressing phases is not allowed. In such cases strands are placed before pouring the concrete of the structure.

External MTAIE anchorage

This anchorage can be used in external tendons and comes in different versions, such as:

- Full dismountable (MTAIE), through the presence of an inner steel cone that separates strands and inner protective injection from the surrounding elements in the anchorage zone
- Restressable (MTAIER) by means of special long protection cap and use of greased and coated strands
- Not exchangeable (MTAIEX)

Internal PTS flat anchorage

bonded post-tensioning of slabs or thin walls can be performed with the use of flat anchorages PTS whose range is from 2 up to 5 strands, whose special shape requires reduced space for installation. It can be used both with corrugated metal sheath and plastic ducts.

Internal MTAI live anchorage

the live anchorage MTAI is the most used and widely spread type of anchorage, whose compact geometry and reduced deviation angle provide a competitive advantage in all projects applications, combined with high performance standards and ease of installation. It can be also used in the unbounded MTAIU version, where single sheathed strands are used.

MTG coupler anchorage

MTG system is the type of anchorage suitable for the coupling of tendons. It is fully integrated with the MTAI system and allows installation of secondary tendon after the primary one has been completely installed.

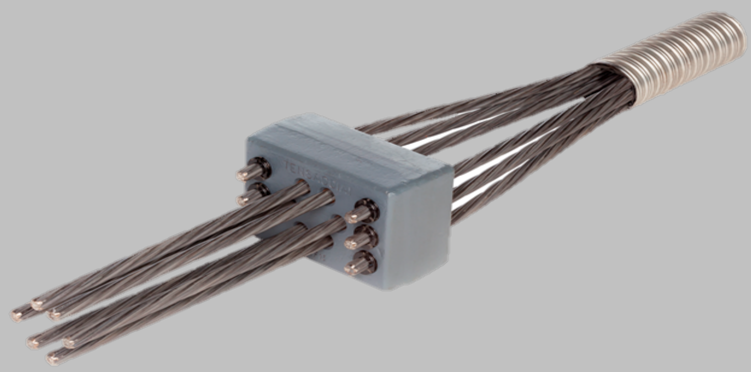
MTAID electrically insulated anchorage

MTAID anchorage for electrically insulated post-tensioning is desinged to meet the demand for a total and permanent protection for post-tensioning tendons from corrosive agents. This protection is granted by the tendon’s complete envelopment, made with:

- MTAID anchorage with anchor plate separated from the cast-iron block by mean of rigid dielectric disks, plastic connectors positioned inside the cast-iron block and connected to the corrugated ducts by mean of tight joint seals : full covering plastic protection cap, plastic ducts in the free length

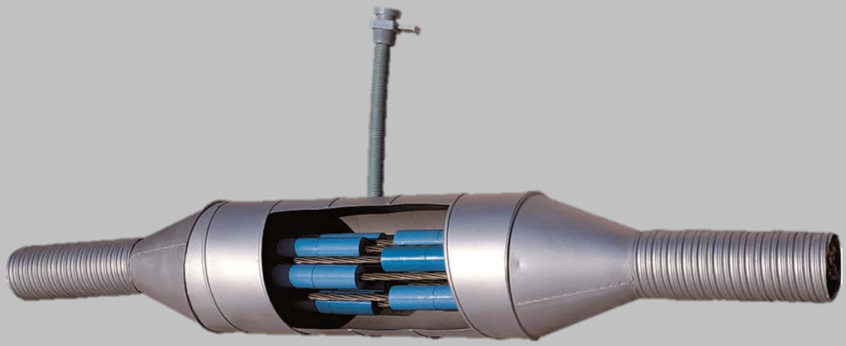
Electrically insulated post-tensioning system offers measurable advantages:

- electrical insulation of the cable from the surrounding environment and consequent protection against corrosion caused by electrochemical phenomena, oxidation and chlorides attack;
- possibility of control during structure lifetime of the integrity of protection with electrical resistance measures;
- reduction of friction losses due to the use of special corrugated plastic ducts.



DF anular anchorage

Special rectangular anchorages are used for ring and intermediate post-tensioning: these anchorages also use a special deviator for tensioning with mono-strand jacks.



CU coupling system

Couplers are used to connect tendons built in different stages. CU system makes such connection with individual strand couplers to be placed in different layers enabling a compact configuration.

ST anchorage

It is used as a dead end anchorage, devised by creating a bulb end on each of the strands composing the tendon.

BARS AND SLAB POST -TENSIONING

Thanks to the merger with Tesit Srl, Tensa has acquired the know how and the proven track record in bars and slab post-tensioning, having been involved in landmark projects.

Post-tensioning slab tendons have been adopted in many important projects all over the world finding a wide range of practical applications in buildings and special structures.

Also the Tensa slab post-tensioning system is compliant with European Technical Approval (ETA) and bears the CE marking.

The ground anchors technology is the oldest one in the range of Tensa products.
Several projects have been carried out in all continents, paving the way to important improvements and developments in this field. Tensa has recently developed a new ground anchor system fully compliant with European standard EN1537.
Special care is given to protection of the anchor-head, to anchor body protection and installation.
Stressing is always carried out with use of multi-strand jacks with possibility of re-tensioning and load check during the lifetime of ground anchors.

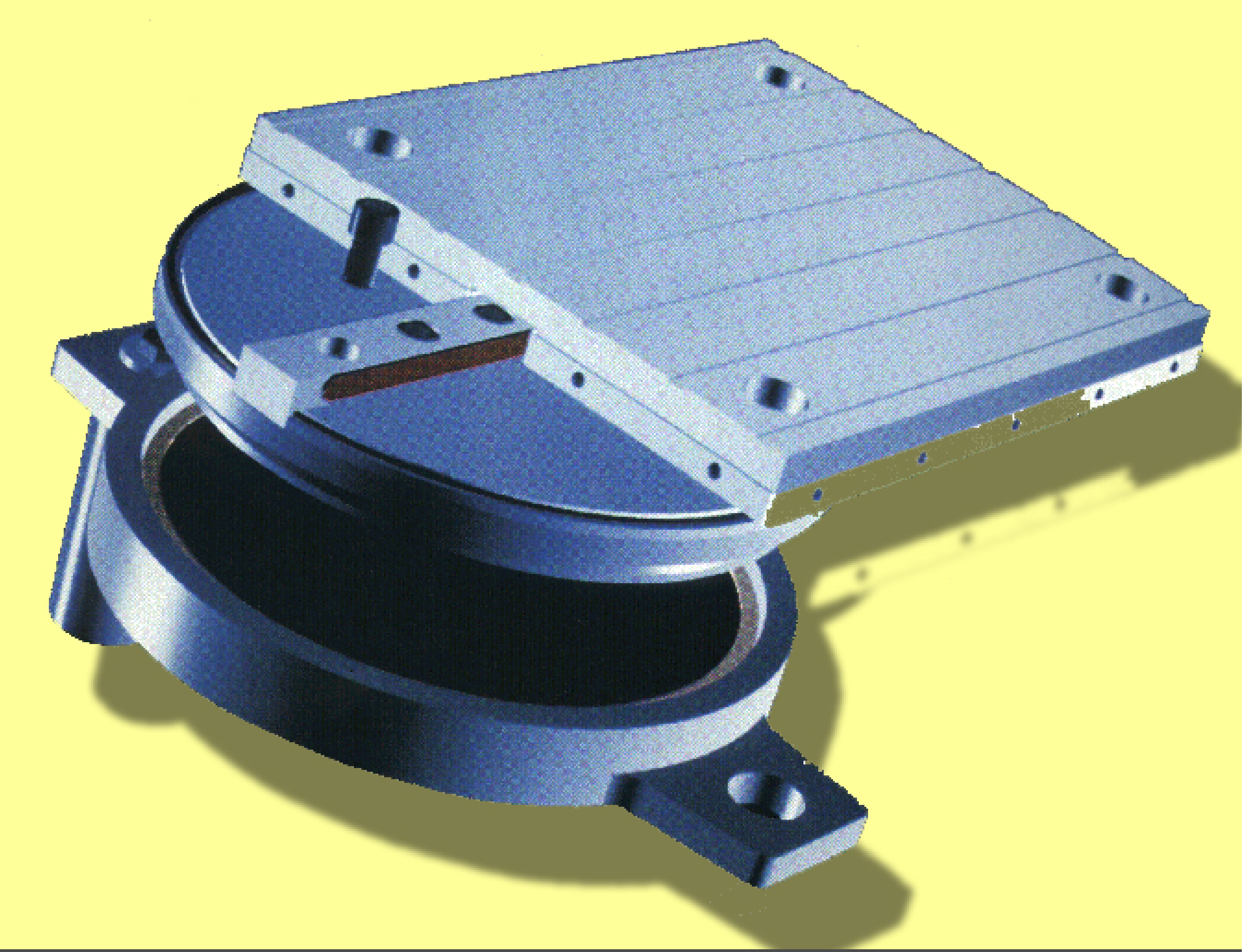
Since many years, Tensa has been actively engaged in the study of the application of post-tensioning technology in the geotechnical field.
The deep experience developed through the years has led the way to the desining and producing of systems used in important civil engineering works.

POT BEARINGS 'TENS POT ' (TP)

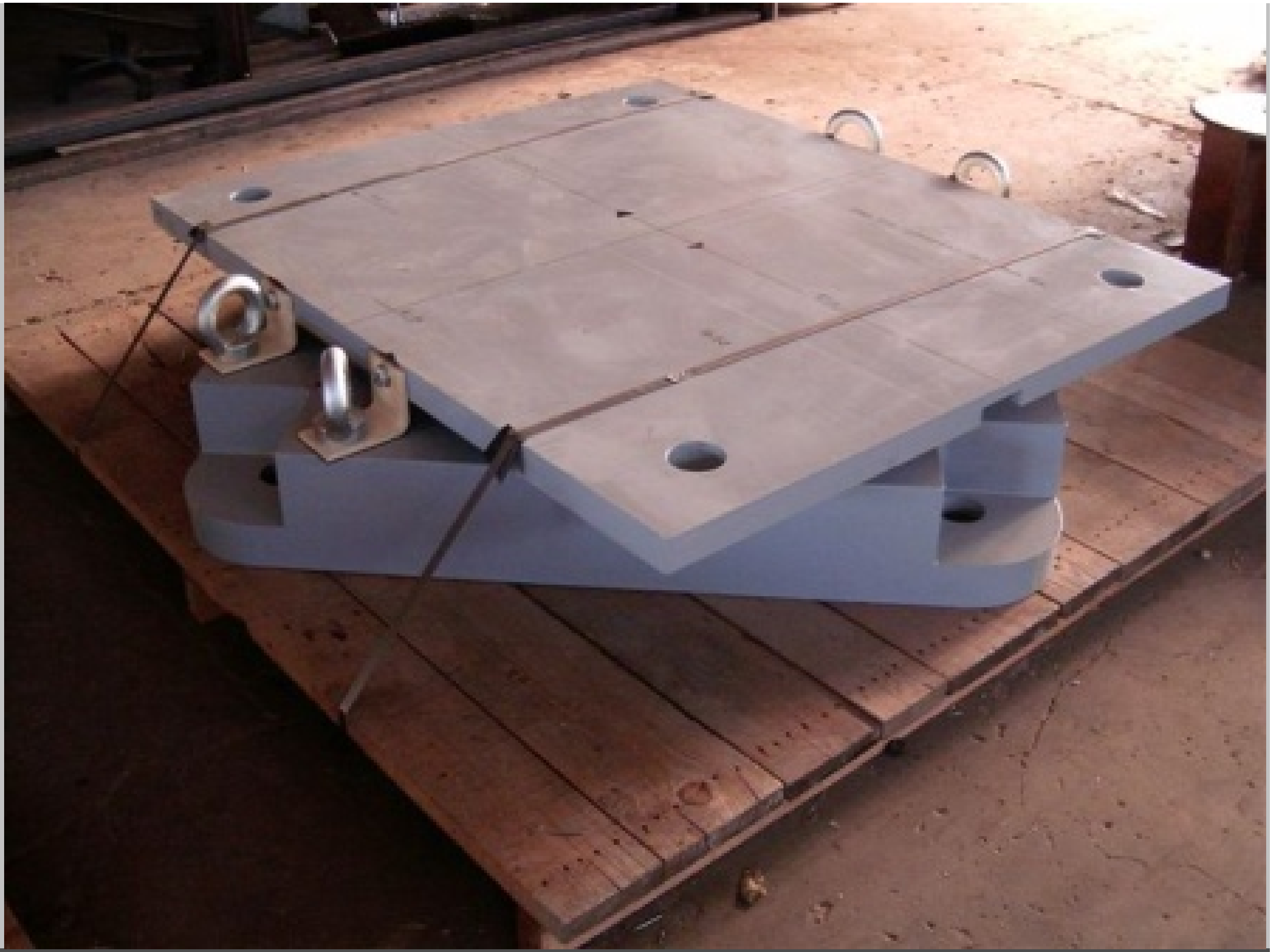
FIXED 'TPF'

GUIDED 'TPL/T'

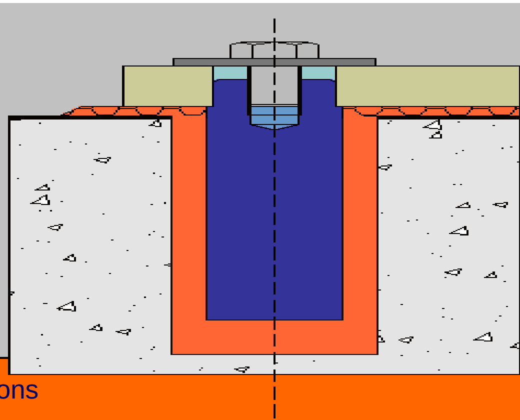
FREE 'TPM'



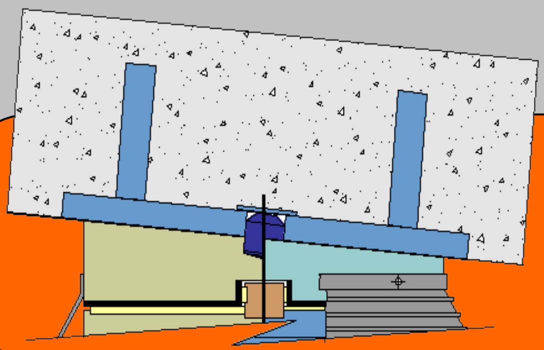
POT BEARINGS ‘TENS POT ‘ (TP)

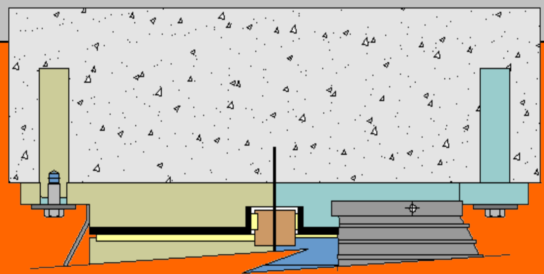


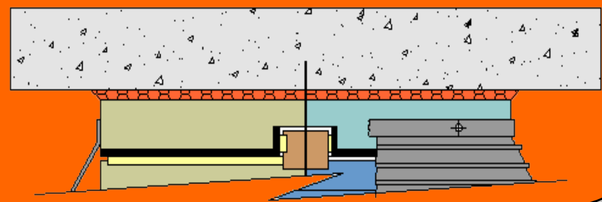
POT BEARINGS ‘TENS POT ‘ (TP)



Mechanical bottom anchorages depend on the entity of the horizontal load and on the standard or design specifications

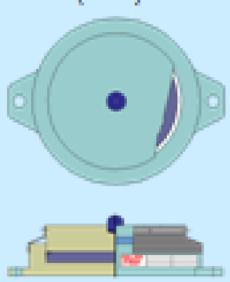






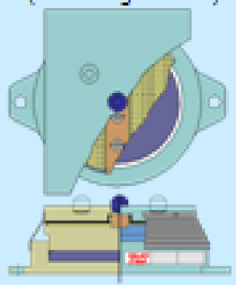
DIMENSIONS FOR BASIC PERFORMANCES
Conforming to EN 1337

(Fixed)



VL (kN)	H (kN)	Φinf. (mm)	Φsup (mm)	h (mm)	I (mm)
1000	100	260	216	60	330
2000	200	360	301	65	430
3000	300	440	366	75	530
4000	400	510	421	90	660
5000	500	570	471	90	655
6000	600	620	516	110	710
7000	700	675	561	114	775
8000	800	725	601	119	825
9000	900	780	651	123	880
10000	1000	800	660	123	920
20000	2000	1165	970	172	1325
30000	3000	1390	1150	209	1550
40000	4000	1610	1330	236	1770
50000	5000	1925	1610	281	2085

(Unid. Long. / Trans.)



VL (kN)	H (kN)	Φinf. (mm)	B (mm)	L (mm)	h (mm)	I (mm)
1000	100	260	260	305	89	330
2000	200	360	360	400	99	430
3000	300	440	420	470	114	530
4000	400	510	475	525	129	600
5000	500	570	530	580	134	660
6000	600	620	575	625	139	710
7000	700	675	620	670	144	775
8000	800	725	665	715	148	825
9000	900	780	705	755	153	880
10000	1000	800	735	785	163	920
20000	2000	1165	1035	1085	221	1325
30000	3000	1390	1245	1295	243	1550
40000	4000	1600	1430	1480	260	1760
50000	5000	1875	1685	1735	295	2035

(Multidirectional)

VL (kN)	H (kN)	Φinf. (mm)	B (mm)	L (mm)	h (mm)
1000	100	255	255	275	74
2000	200	360	335	365	74
3000	300	440	400	430	79
4000	400	505	460	490	94
5000	500	565	510	540	99
6000	600	620	555	585	103
7000	700	670	595	625	108
8000	800	715	635	665	119
9000	900	760	675	705	123
10000	1000	800	705	735	128
20000	2000	1130	990	1020	165
30000	3000	1490	1345	1375	211
40000	4000	1600	1385	1415	231
50000	5000	1815	1625	1655	259

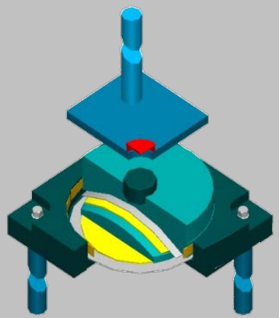
Slong= ±25 mm
Strasv=±10 mm

H=0.1*VL
α=0.01 rad

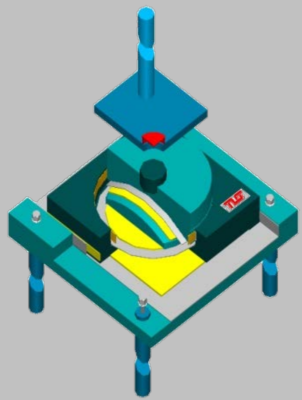
Φinf. = Lower diameter ; h = Height; B = Sliding plate's width;
Φsup. = Upper diameter; I = Anchor Interaxis; L = Sliding plate's length;

bearings, on request, can be produced conforming to any standard and for any loads combination

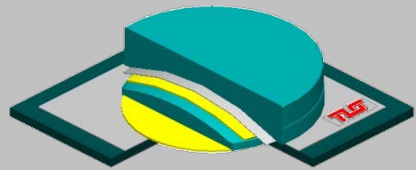
SPHERICAL AND CYLINDRICAL BEARINGS



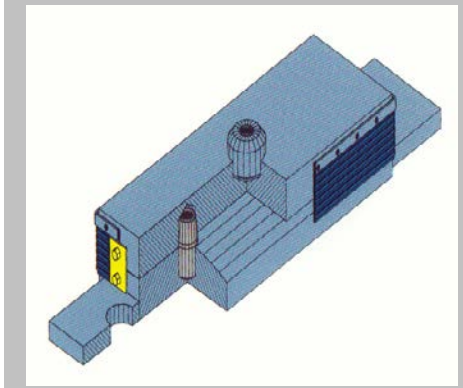
TENS
SPHERICAL
FIXED (TSF)



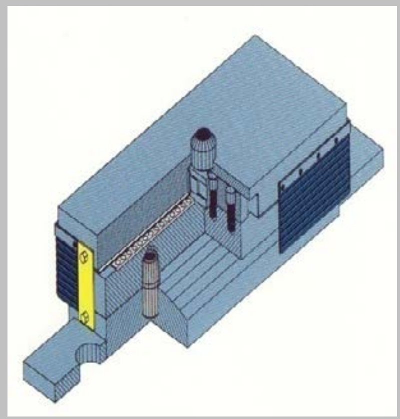
TENS
SPHERICAL
GUIDED (TSL/F)



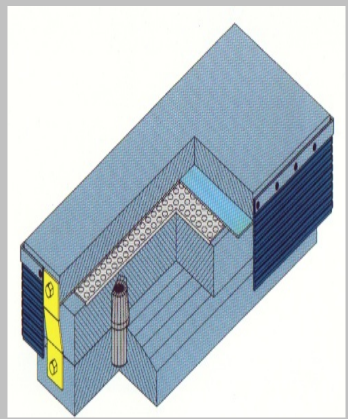
TENS
SPHERICAL
FREE (TSM)



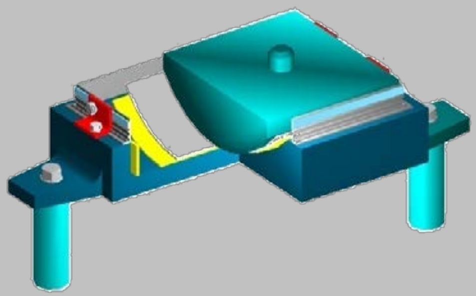
TENS
CYLINDRICAL
FIXED (TCF)



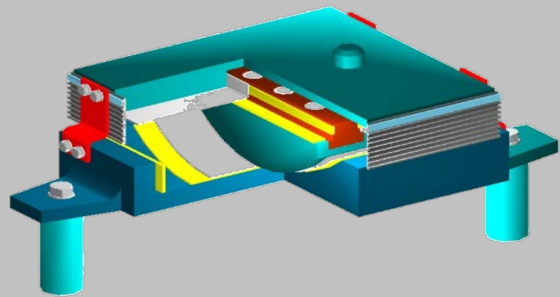
TENS
CYLINDRICAL
GUIDED
(TCL/T)



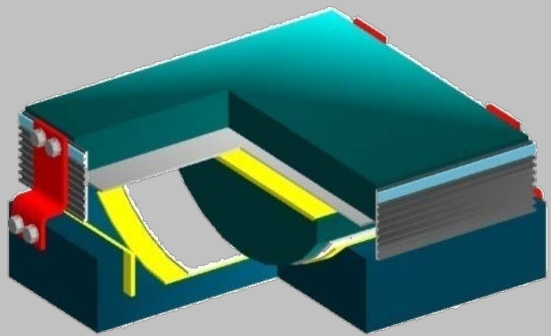
TENS
CYLINDRICA
L FREE
(TCM)



TENS DOUBLE
CYLINDRICAL
FIXED (TDCF)



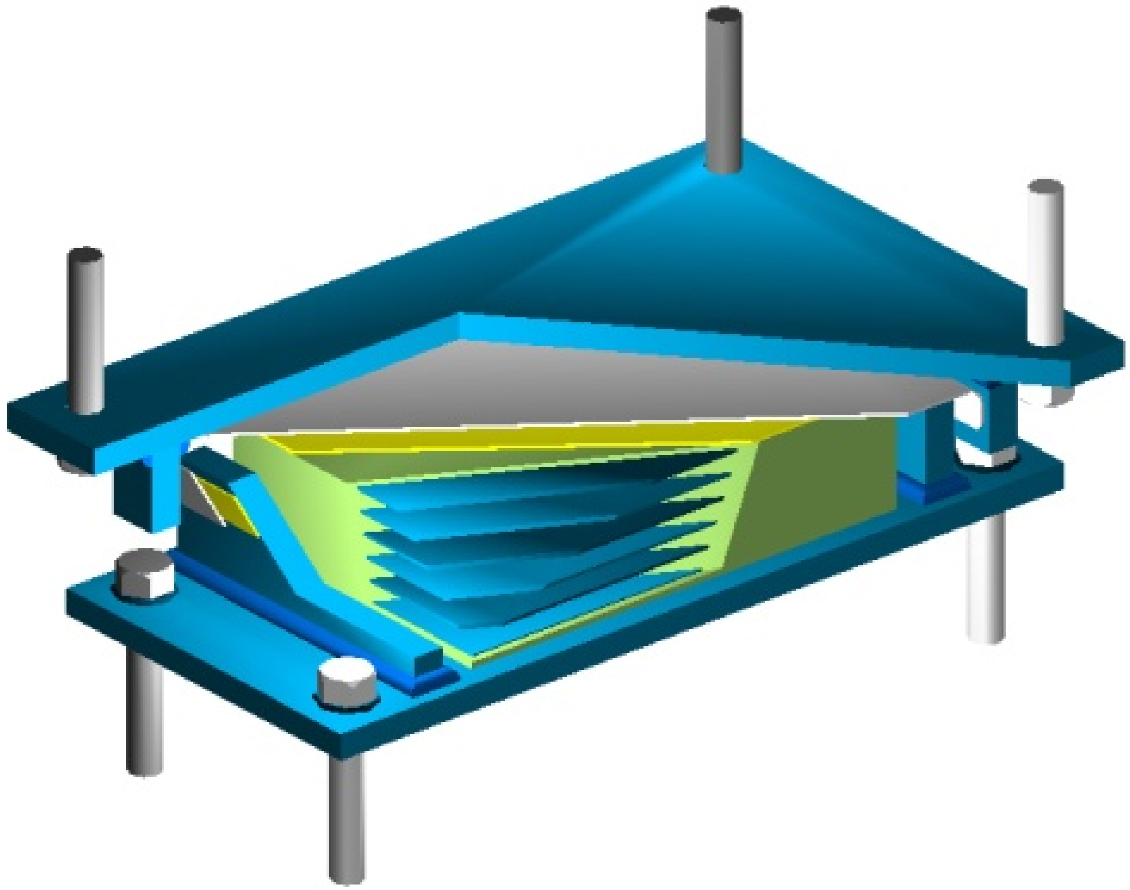
TENS DOUBLE
CYLINDRICAL FREE
(TDCL/T)



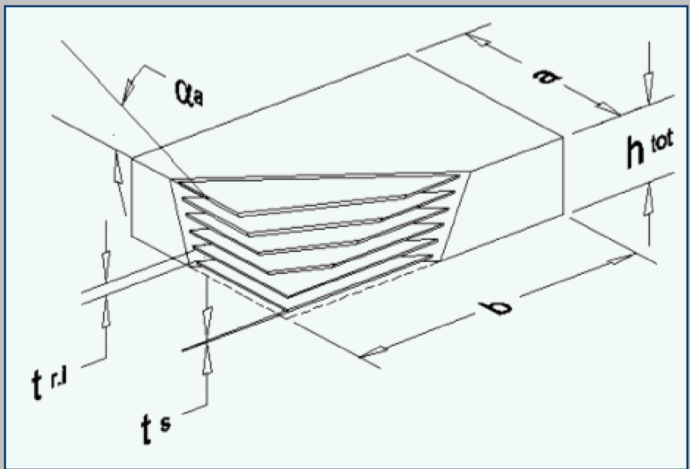
TENS DOUBLE
CYLINDRICAL
FREE (TDCM)

ELASTOMERIC BEARINGS

'TENS RUBBER' (TR)



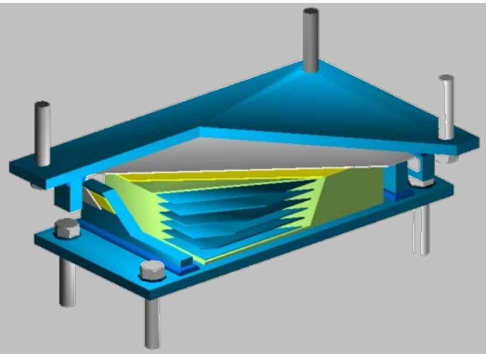
Laminated elastomeric bearings TR are composed of individual rubber layers interposed with steel plates. They are conventionally rectangular but can be realised also circular.
Each elastomeric bearing is obtained by vulcanisation. Rubber compound is based on synthetic rubber which assure a very high ageing performances and a very good oils and solvents resistance.
For special application others rubber compounds may be used also special restraining or guided arrangements can be provided. Also simple plain rubber pads or strip bearings are available on request.
Bearings may be manufactured according with the international standards as SETRA, BSI, DIN, AASHTO.

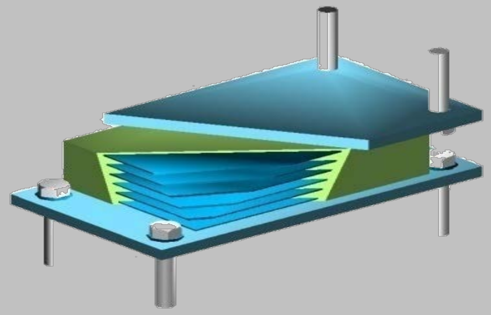


a = longitudinal dimension
b = trans versal dimension
$h_{r.tot}$ = total rubber height
h_{tot} = total bearing height
a_a = rotation on the 'a' vertical plane
$t_{r.l}$ = thickness of one inner rubber layer
t_s = thickness of steel layer
n_r = number of internal rubber layers
n_s = number of internal steel layers

According to EN 1337 part .3

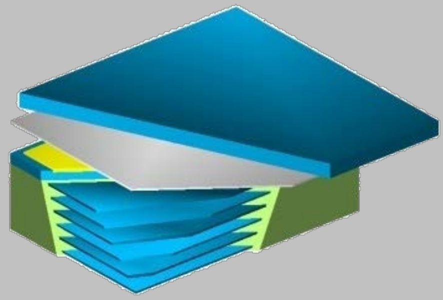
Mod. TR-U, special uni-directional bearing arranged with stainless steel surface matching with PTFE sheet and directional guides.





Mod. TR-F, special fixed bearing arranged with anchoring rods.

Mod. TR-M, special multi-directional bearing arranged with stainless steel surface matching with recessed PTFE sheet.



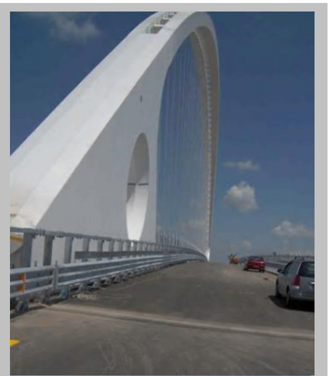
DISPLACEMENT OF 50 MM UP TO 350 MM 'TUBJ'

EXPANSION JOINTS

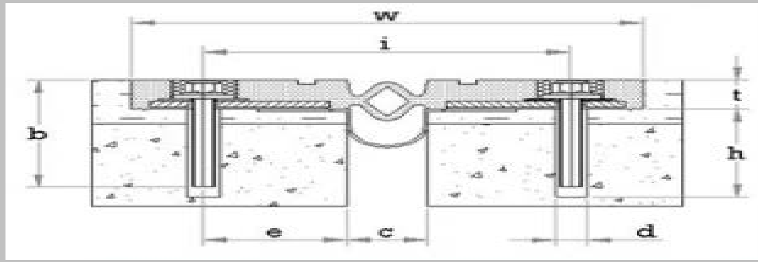
TUBJ type is a waterproofing expansion joint that allows deck movements from 50 until 350 mm longitudinally until 300 mm transversally and 40 mm vertically, due to shear deformation of the rubber elements.

The joint assures no shocks while driving it is noiseless and performs a good adherence wheels. All the steel reinforcing plates are vulcanised into the rubber completely wrapped by it so that corrosion is impossible. The long lasting life is assures by the rubber compound, resistant to oil, fuel, salt, sun and abrasion. The installation is easy and quick because no interference occurs with the concrete structures. Each single element can be easily replaced.

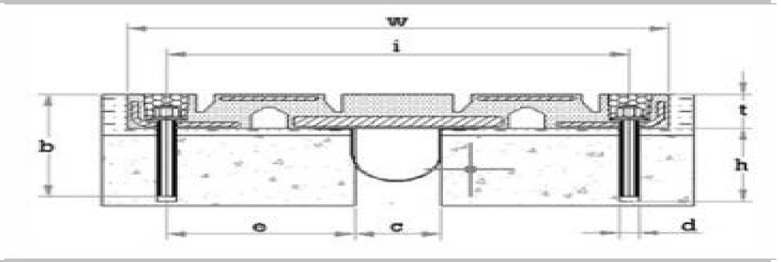
D.	s.l. (mm)	s.t. (1) (mm)	L (mm)	W (mm)	t (mm)	P (kg)	c (mm)	b (mm)	M	i (trasv) (mm)	i (long) (mm)	d (mm)	h (mm)	n
50	±25	±20	1750	240	35	28	20÷70	160	M12	190	250	15	130	14
65	±33	±25	1830	274	40	45	20÷85	160	M14	220	305	16	130	12
80	±40	±30	1830	356	46	62	20÷100	160	M14	279	305	16	125	12
100	±50	±35	1830	432	54	88	20÷120	160	M16	342	305	18	120	12
120	±60	±50	1000	400	82	65	20÷140	160	M16	280	200	18	115	10
160	±80	±70	1000	495	82	91	20÷180	160	M16	395	200	18	115	10
200	±100	±90	1830	724	75	260	20÷220	200	M20	618	305	22	150	12
250	±125	±110	1830	890	93	375	20÷270	200	M24	787	305	30	140	12
350	±175	±175	1220	1207	127	438	20÷370	250	M27	1080	305	32	180	8



TUBJ/R

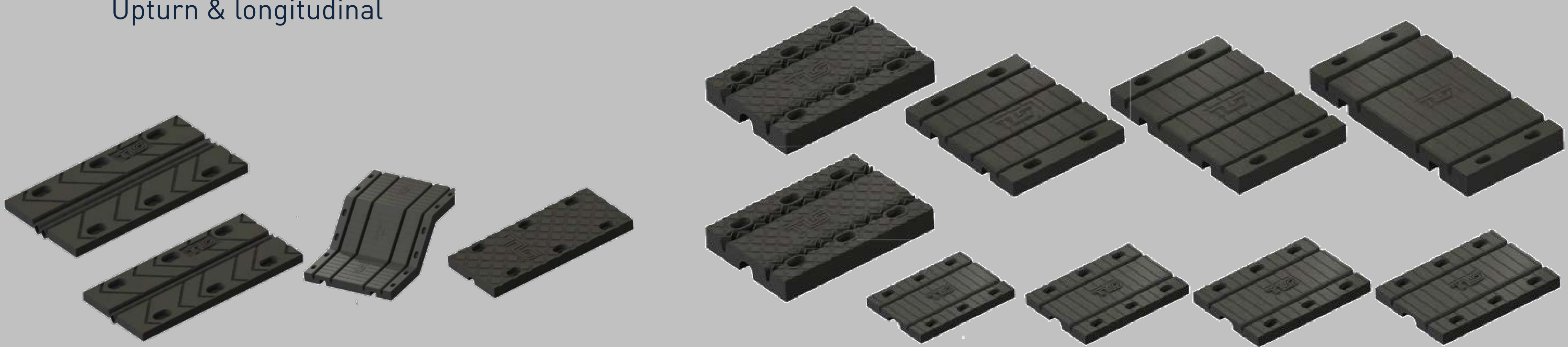


TUBJ



Special Parts

Upturn & longitudinal



DISPLACEMENT OF 400 MM
UP TO 1600 MM 'TMBJ'

TMBJ is a new modular expansion joint achieved by connecting one or two rubber deforming elements to a steel bridge plate. It allows deck movements from 400 to 1600 mm obtained by shear deformation of the rubber elements. The steel bridge plate has the upper face machined to assure the grip and to avoid the aquaplaning effect. Each hot rolled steel part is galvanised to avoid corrosion, while the antilifting elements are made in stainless steel. The long lasting life is assured by the rubber compound, resistant to oli, fuel, salt, sun and abrasion. The installation is easy and quick because there is not any interference with the structures. Each single element can be rapidly replaced.

Material properties

Synthetic or natural compound

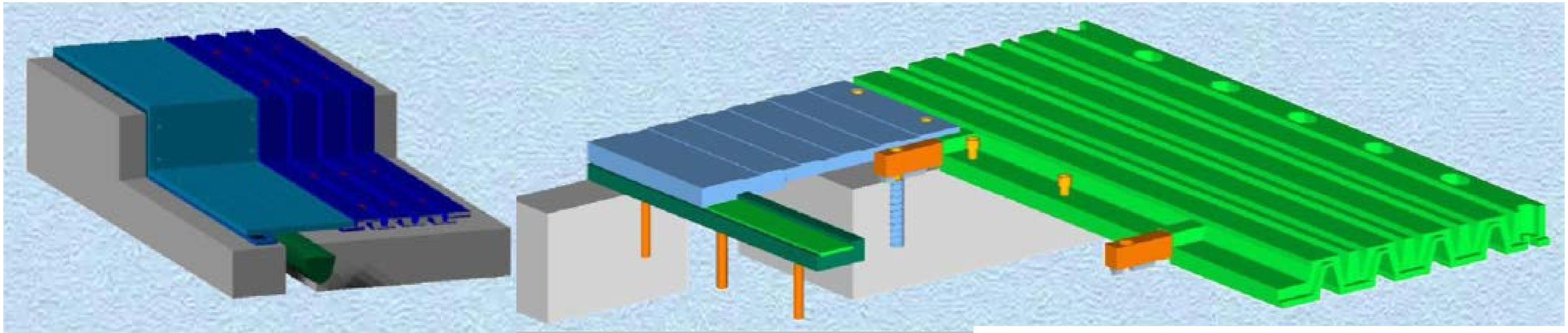
Hot rolled steel

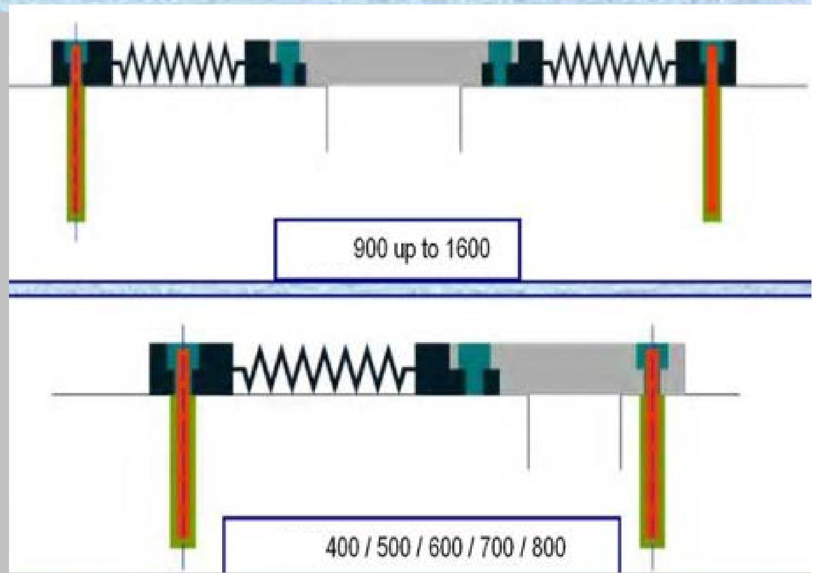
High resistance galvanised bolt

Joints can be produced for specific climatic conditions and/or standards

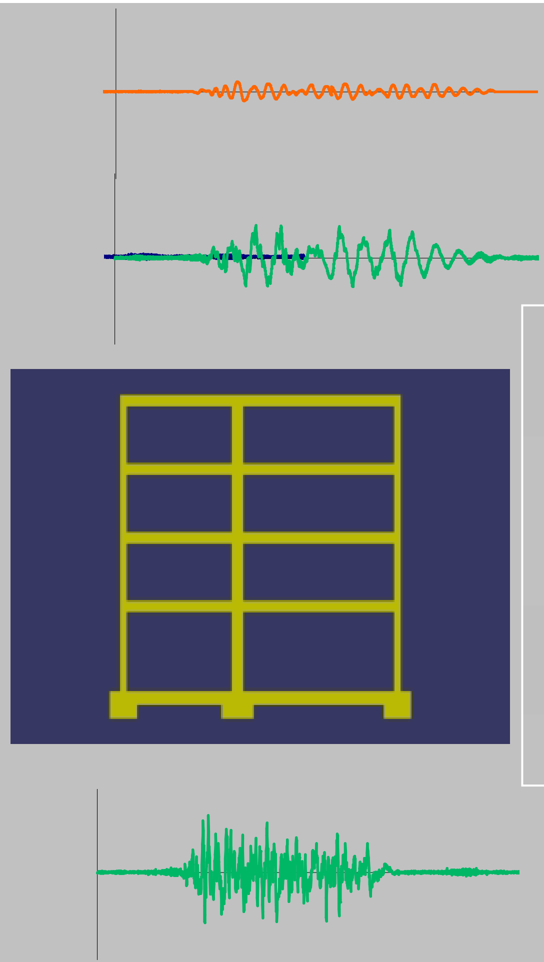
UELLU	s. l. (mm)	L (mm)	W (mm)	t (mm)	c (mm)	b (mm)	M	i (trasnv.) (mm)	d (mm)	h (mm)	n
400	±200	1600	1280	85	20÷420	250	M20	200	25	200	15
500	±250	1600	1520	85	20÷520	250	M20	200	25	200	15
600	±300	1600	1760	85	20÷620	250	M20	200	25	200	15
700	±350	1600	2000	85	20÷720	250	M20	200	25	200	15
800	±400	1600	2240	85	20÷820	250	M20	200	25	200	15
900	±450	1600	2460	85	20÷920	250	M20	200	25	200	16
1000	±500	1600	2700	85	20÷1020	250	M20	200	25	200	16
1100	±550	1600	2940	85	20÷1120	250	M20	200	25	200	16
1200	±600	1600	3180	85	20÷1220	250	M20	200	25	200	16
1300	±650	1600	3420	85	20÷1320	250	M20	200	25	200	16
1400	±700	1600	3660	85	20÷1420	250	M20	200	25	200	16
1500	±750	1600	3900	85	20÷1520	250	M20	200	25	200	16
1600	±800	1600	4140	85	20÷1620	250	M20	200	25	200	16

CHART'S KEY	
Longitudinal movement	s.l.
Panel's length	L
Panel's width	W
Panel's thickness	t
Gap	c
Anchor length	b
Anchor diameter	M
Transversal Anchor interaxis	i (transv.)
Anchor hole diameter	d
Anchor hole depth	h
Number os Anchors/Panels	n




900 up to 1600
400 / 500 / 600 / 700 / 800

ANTI-SEISMIC DEVICES



Interstory displacements time history

OUTPUT

Storey Acceleration time history

STRUCTURE IS DISCONNECTED
FROM GROUND

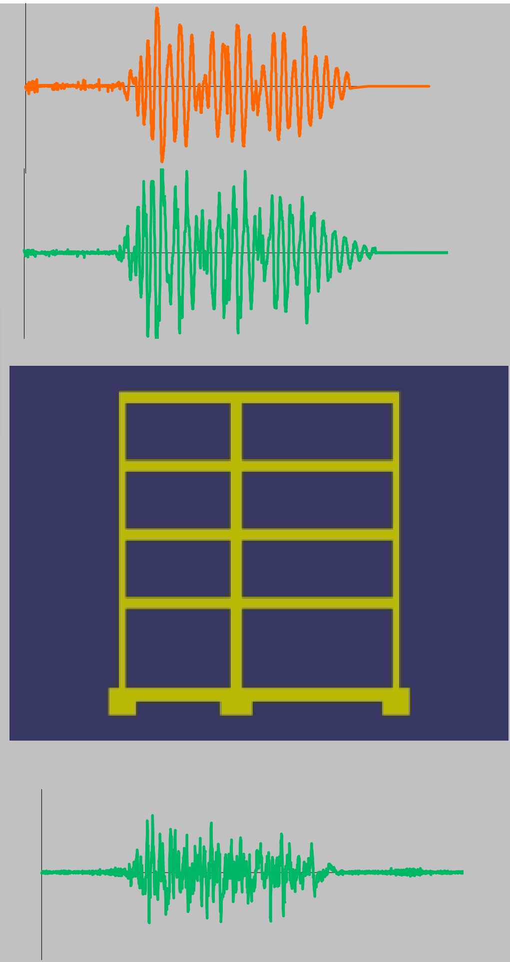
Movements of structure is
DIFFERENT
from movement of ground

RELATIVE DISPLACEMENTS ARISE
BETWEEN STRUCTURE AND GROUND

INSERTION OF FILTERING DEVICES

INPUT

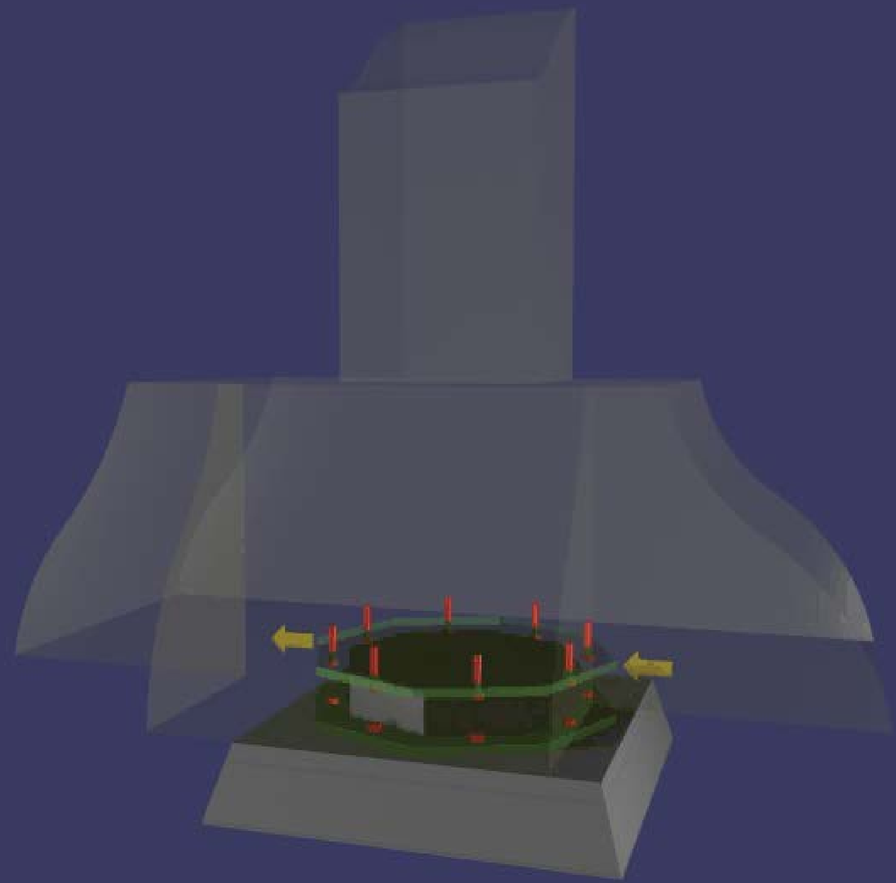
Base acceleration

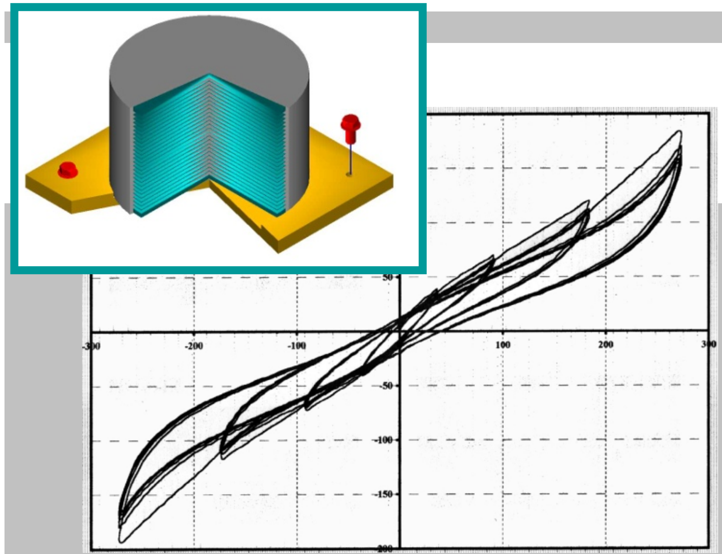


TENS DAMPING RUBBER ISOLATOR
TDRI

TENS VISCOUS RUBBER ISOLATOR
TVRI

TENS LEAD RUBBER ISOLATOR
TLRI





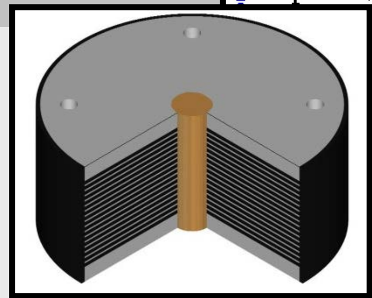
Rubber **TDRI**

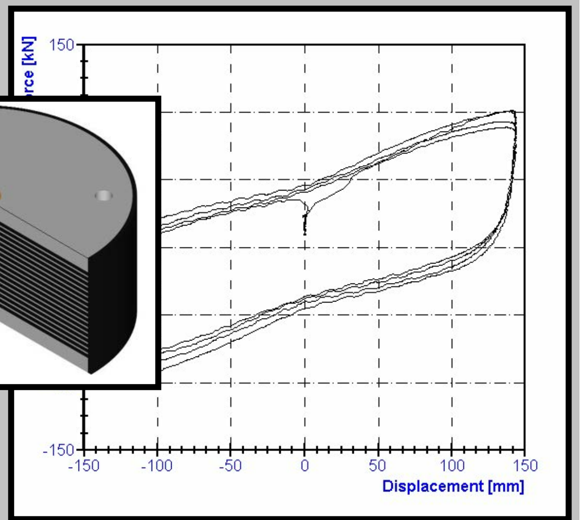
$\xi \leq 16\ \%$

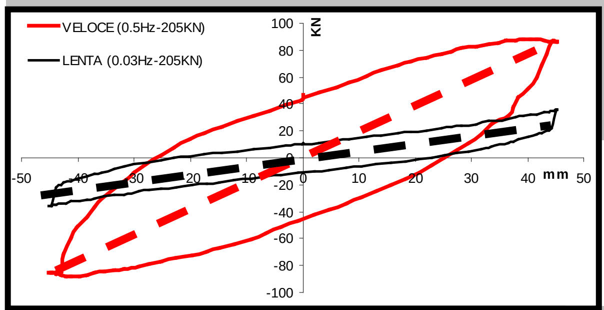
With lead core

TLRI

$\xi \leq 30\ \%$





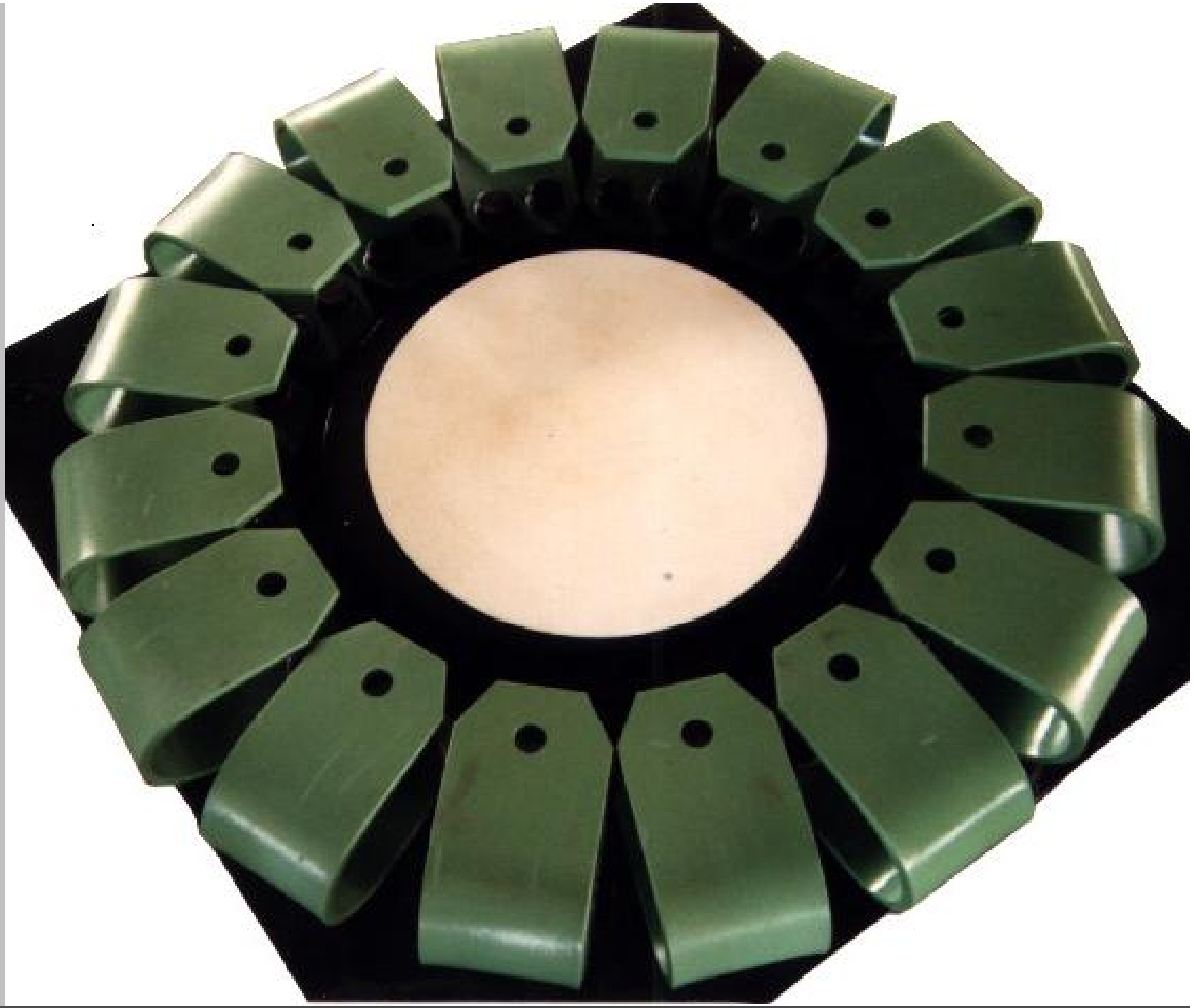


Viscoelastic **TVRI**

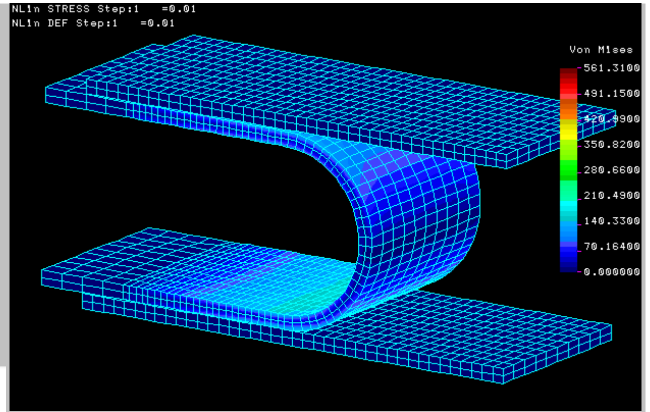
Kd≥1.8Ks ; $\xi \leq 30\ \%$

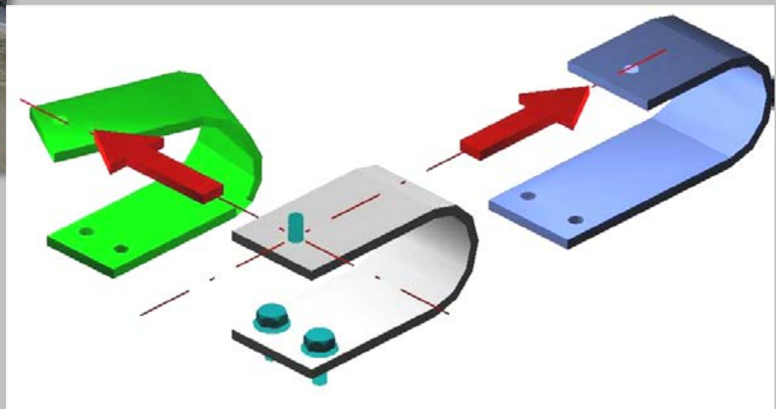
ANTISEISMIC DEVICE 'TENS ELASTO-PLASTIC DEVICE' (**TEPD**)

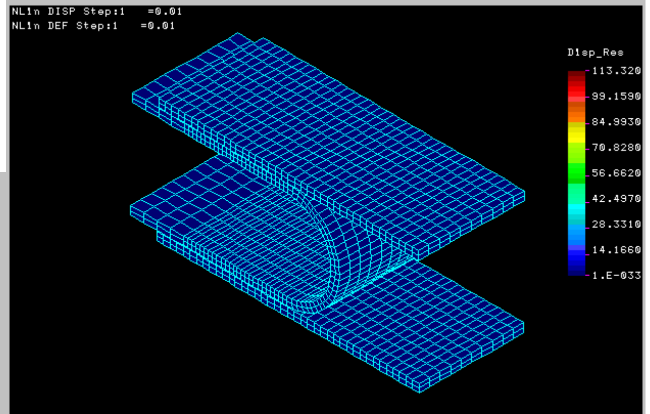
POT BEARING WITH ANTISEISMIC DEVICE 'TENS ELASTO-PLASTIC DEVICE' (**TP-EPD**)



ANTI-SEISMIC DEVICES

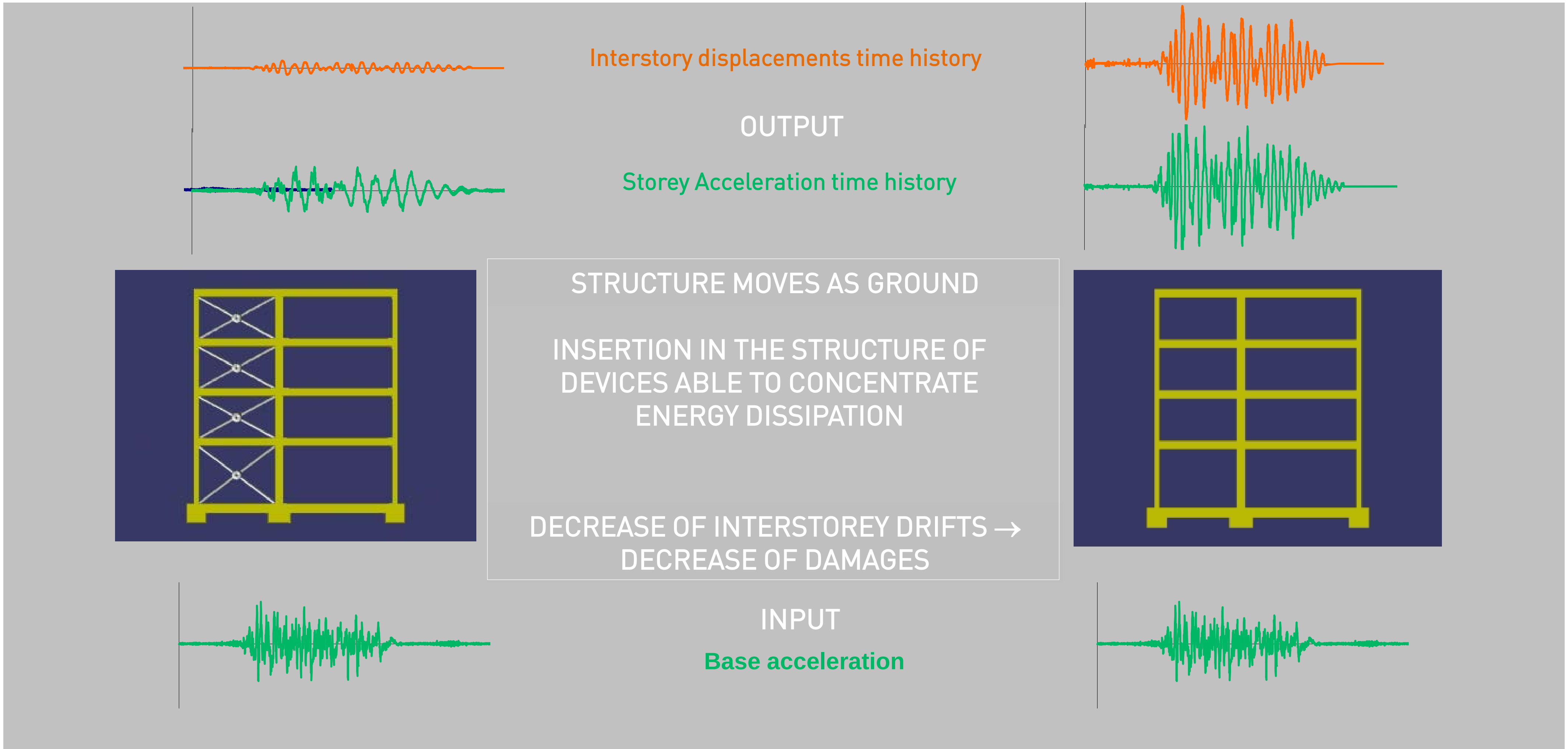




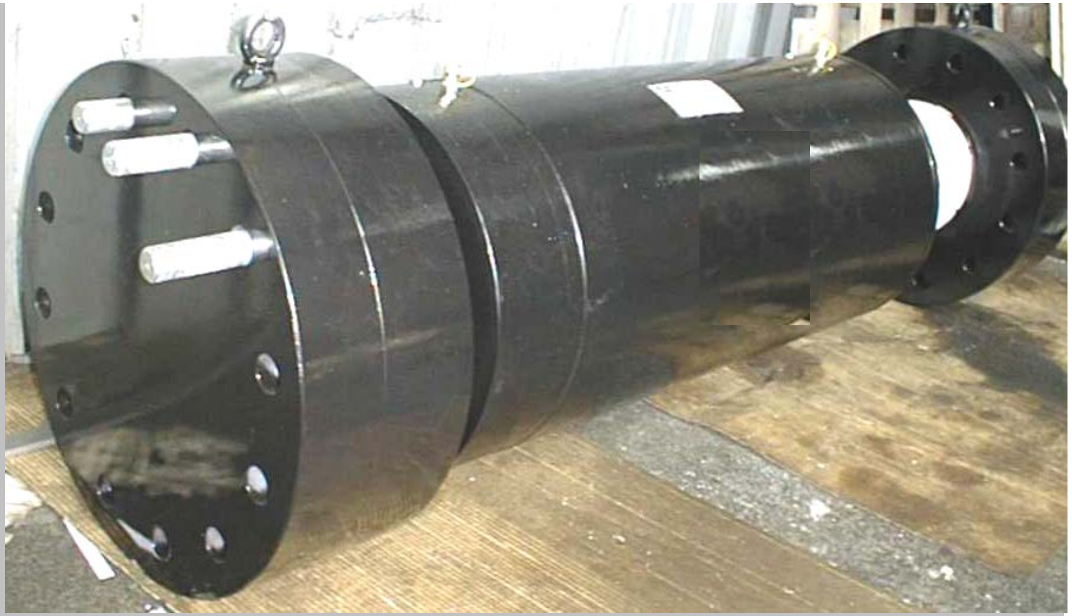


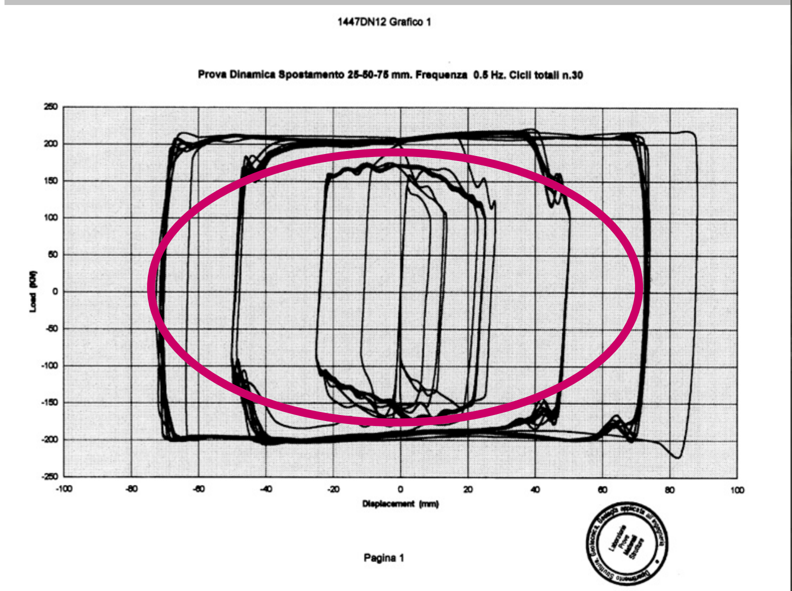
NON RE-CENTERING_ MULTI DIRECTIONAL _ STEEL BASED

ANTI-SEISMIC DEVICES

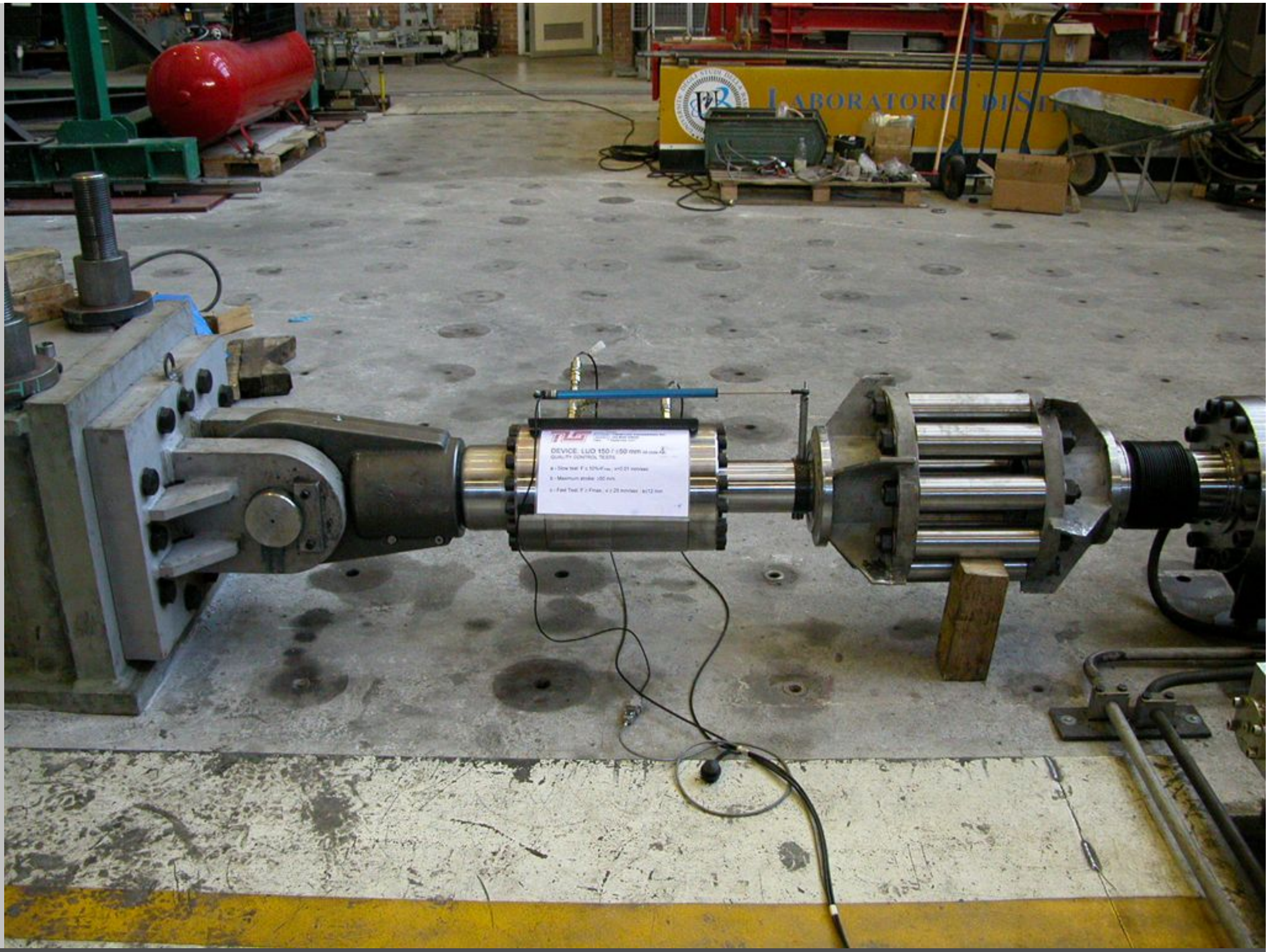


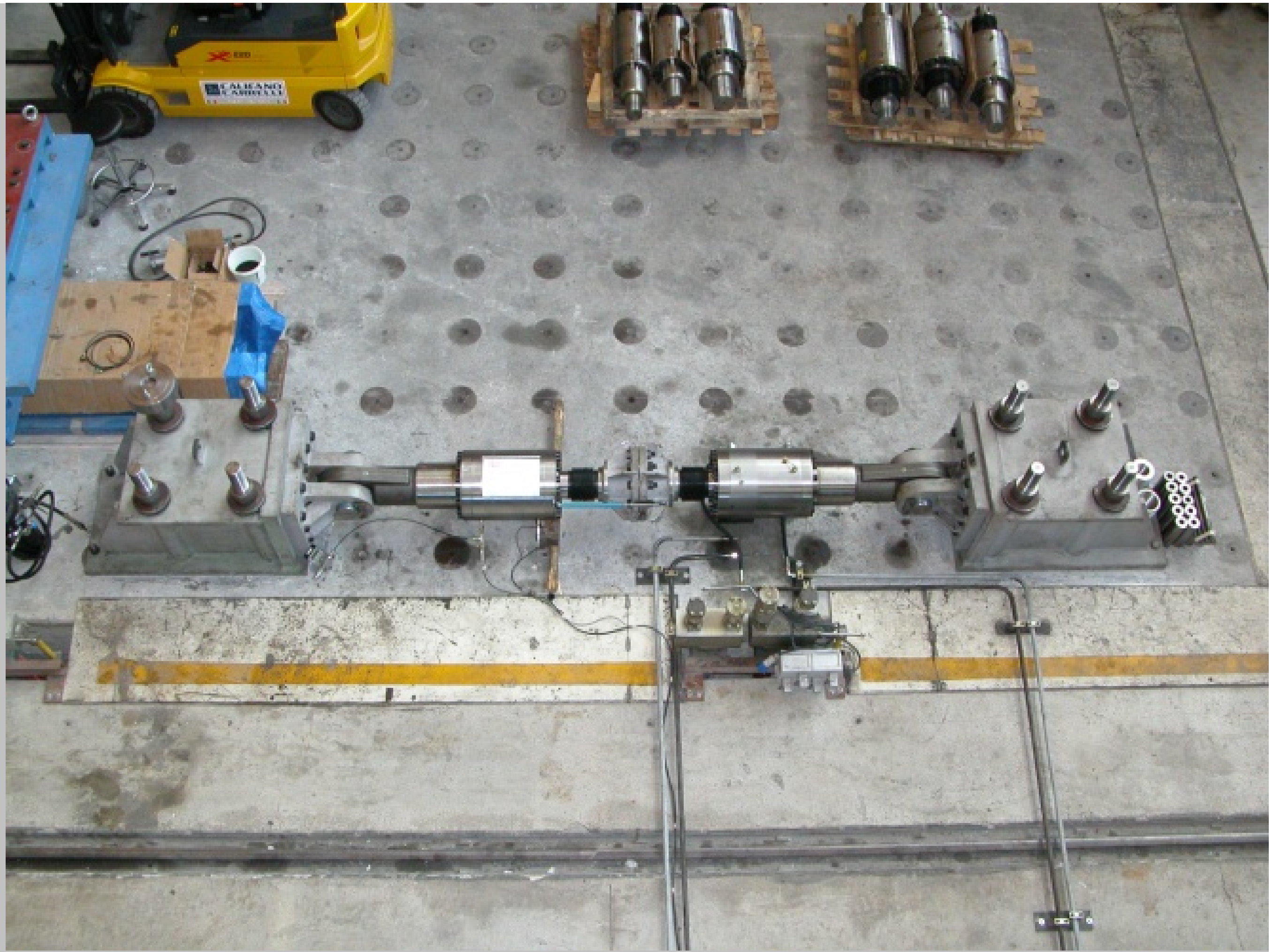
ANTI-SEISMIC DEVICE 'TENS FLUID VISCOUS DEVICE' (**TFVD**)

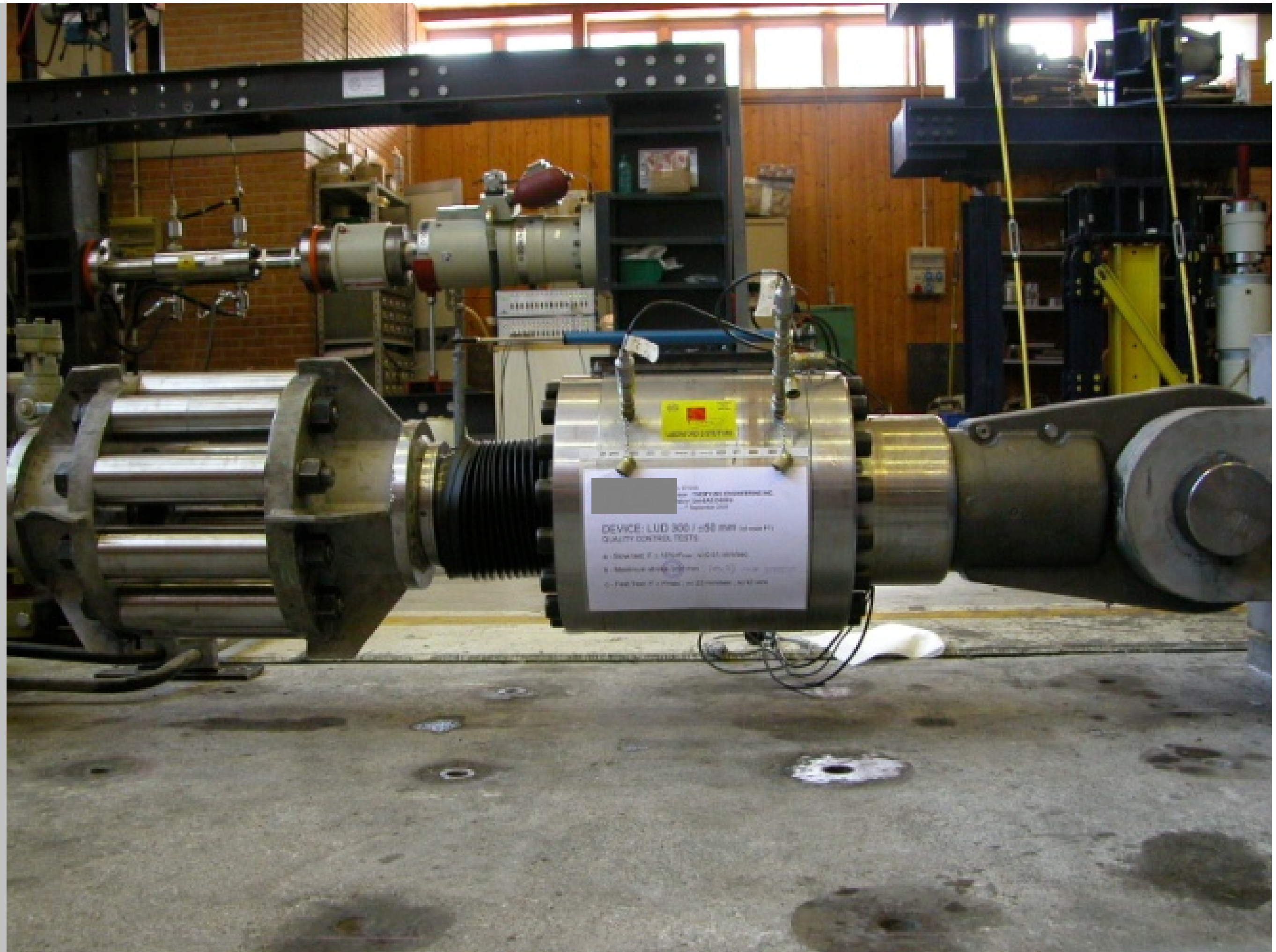



1447DN12 Grafico 1
Prova Dinamica Spostamento 25-50-75 mm. Frequenza 0.5 Hz. Cicli totali n.30
Load (KN)
Displacement (mm)
Pagina 1

ANTI-SEISMIC DEVICE 'SHOCK TRANSMITTER DEVICE' (**TSTD**)





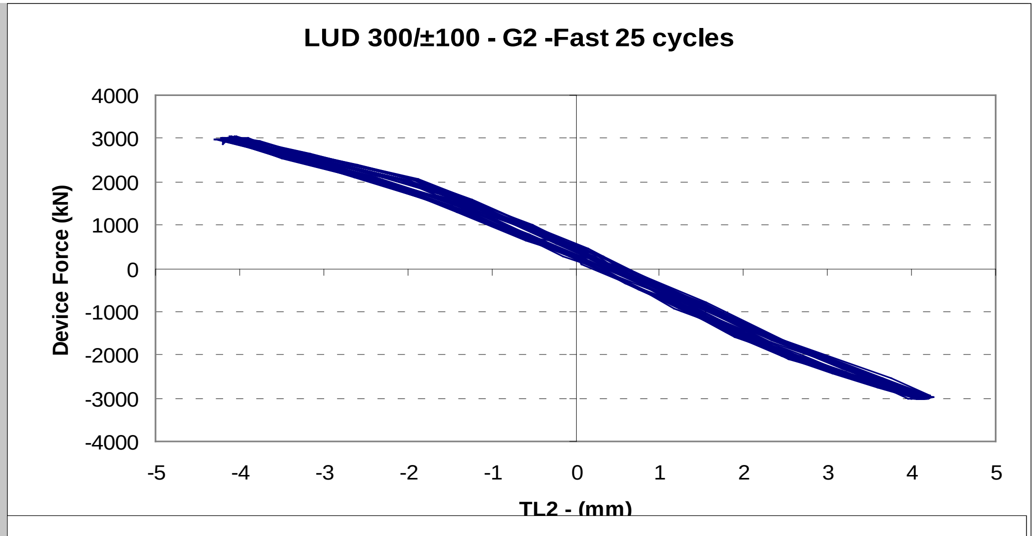

DEVICE: LUD 300 / ±50 mm
QUALITY CONTROL TESTS

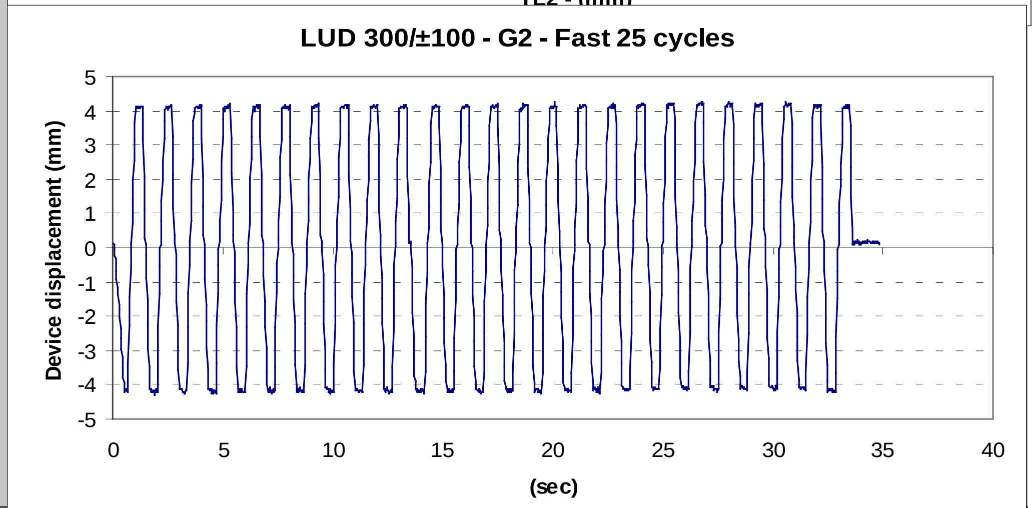

DEVICE: LUD 300 / ±100 mm (id code G1)
QUALITY CONTROL TESTS:
a - Slow test: F ≤ 10%•Fmax ; v≥0.01 mm/sec
b - Maximum stroke: ±100 mm
c - Fast Test: F ≥ Fmax ; v≤ 25 mm/sec ; s≤12 mm

ANTI-SEISMIC DEVICES

TENSA

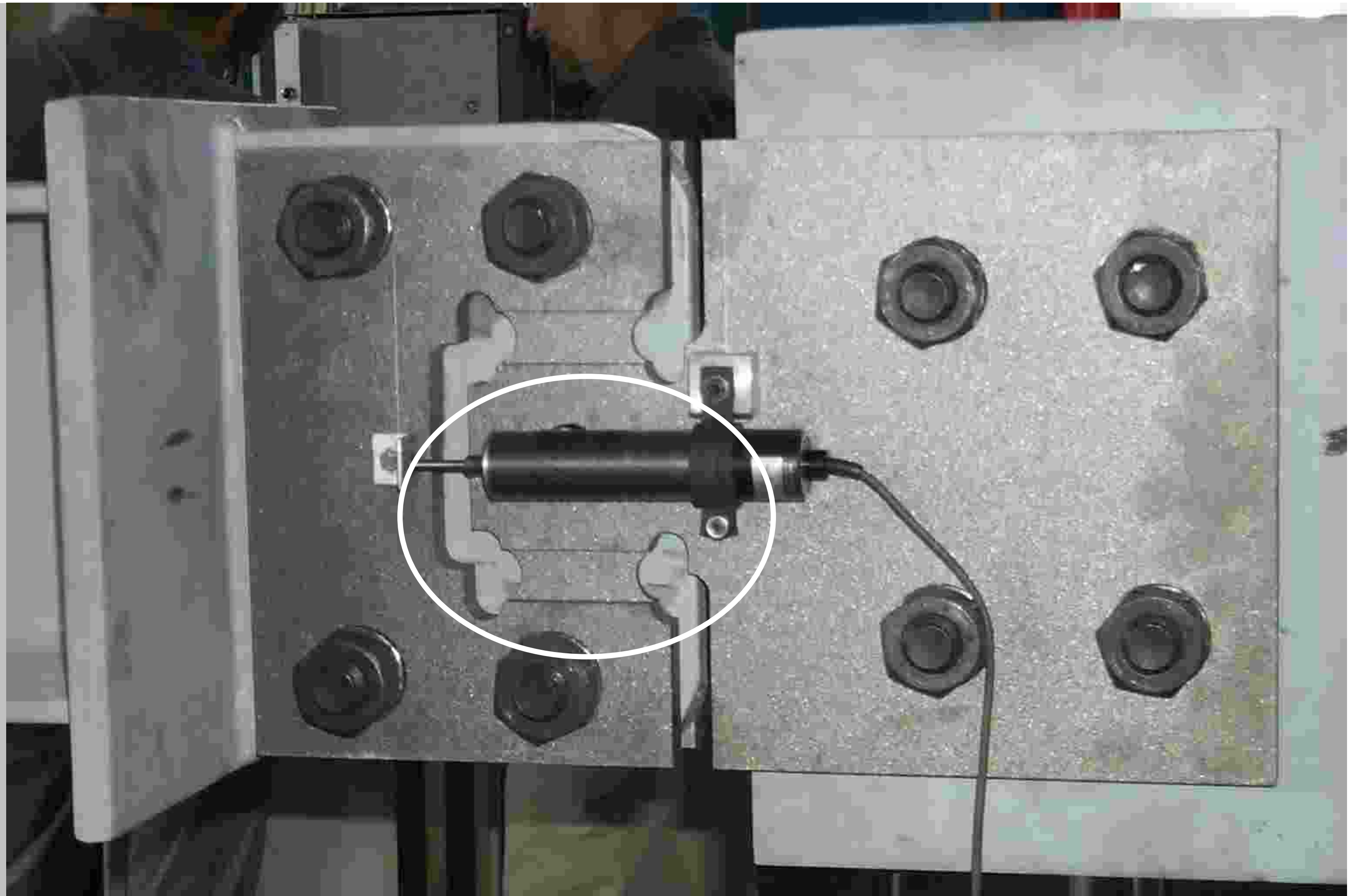
SHOCK TRANSMITTER DEVICES

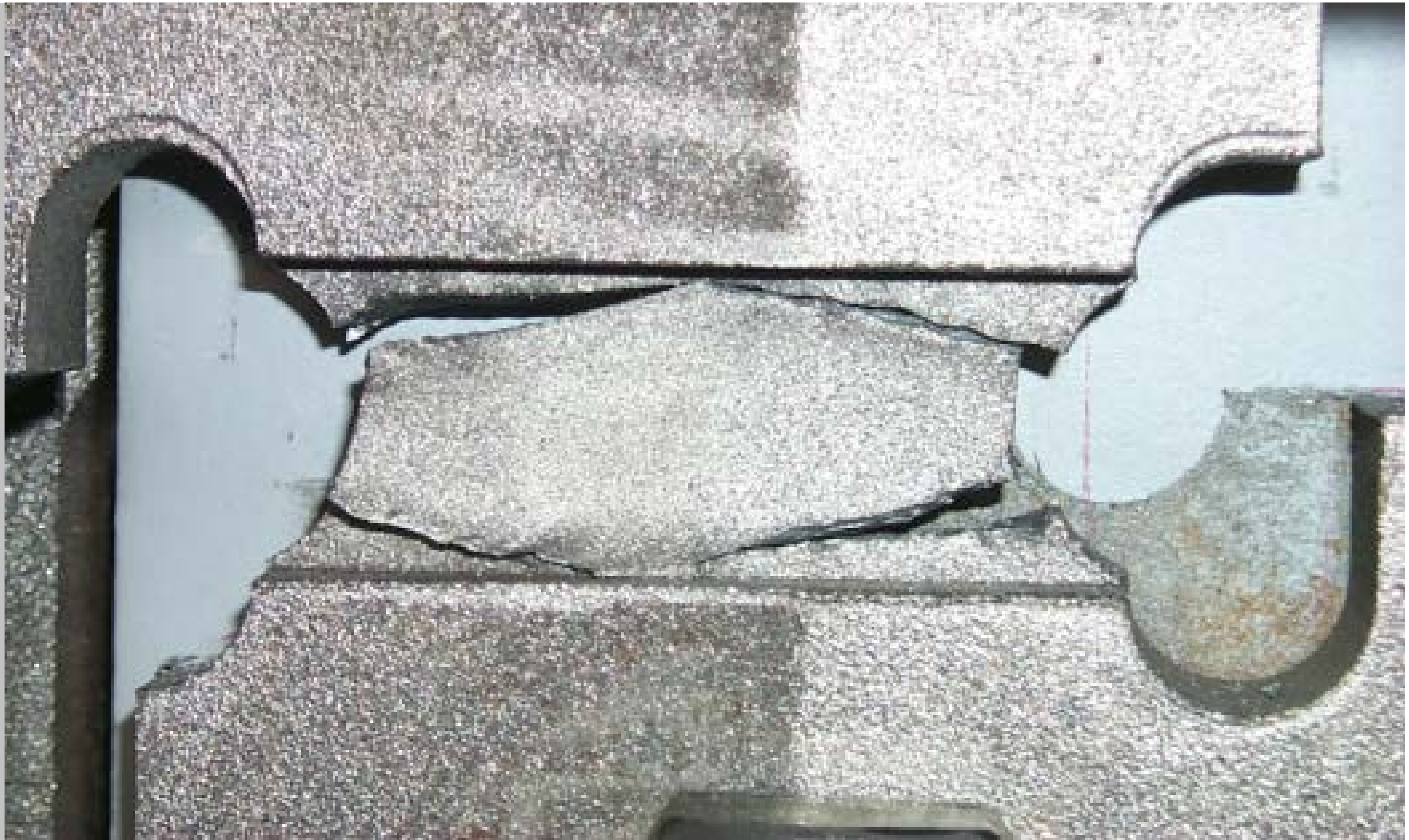

LUD 300/±100 - G2 -Fast 25 cycles
Device Force (kN)
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5
-4
-3
-2
-1
0
1
2
3
4
5
TL2 - (mm)

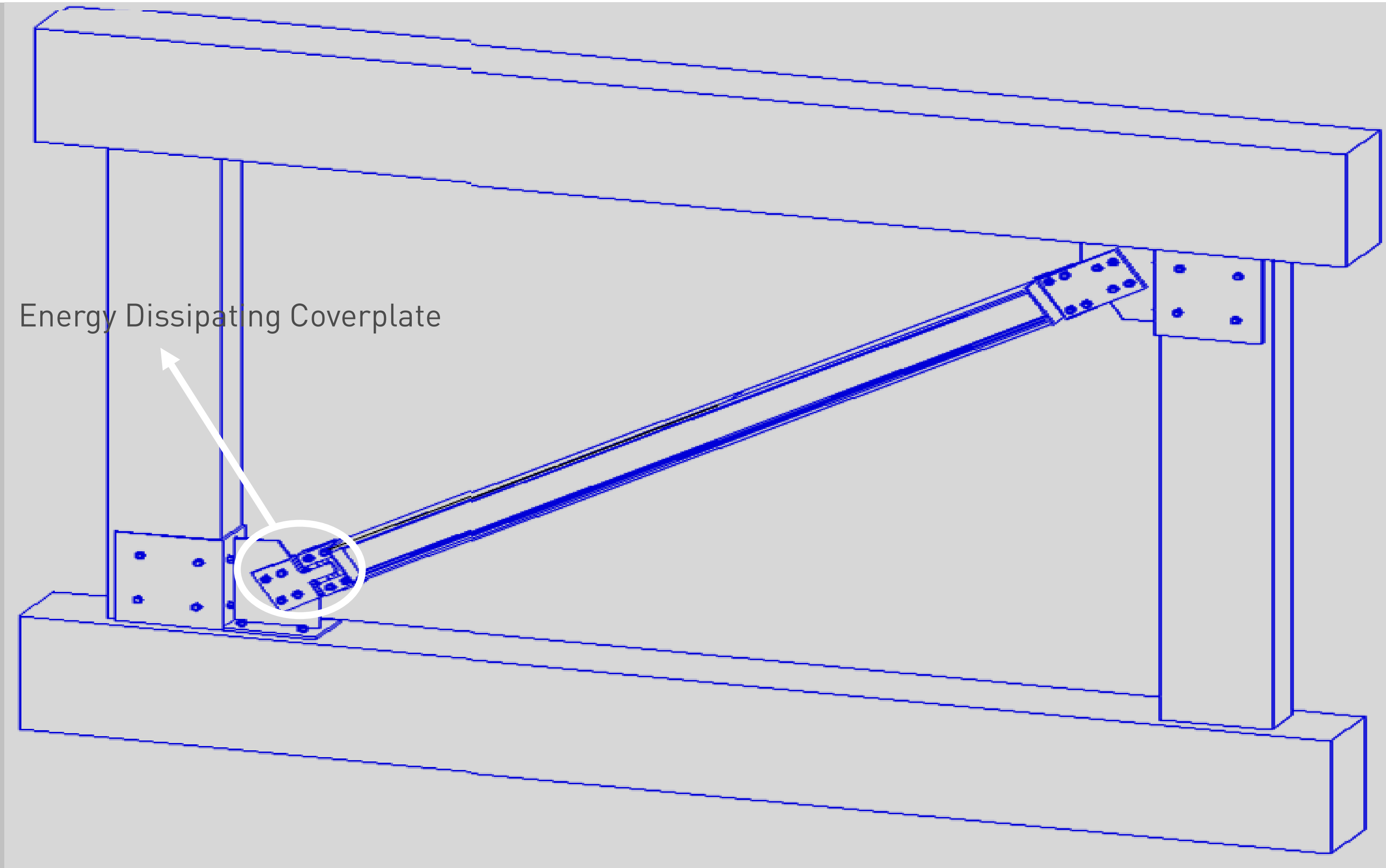

LUD 300/±100 - G2 - Fast 25 cycles
Device displacement (mm)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
5
10
15
20
25
30
35
40
(sec)

ANTI-SEISMIC DEVICES

'TENS FRAME
BENDING or SHEAR'
(TFB or TFS)






Energy Dissipating Coverplate


GIOTTO
film

REPAIR WORKS

Tensa has the capabilities and the knowledge to carry out repair works with particular reference to retrofitting of stay cable systems and cables replacement.

HISTORY

WORLDWIDE PRESENCE

ACTIVITY AREAS

STAY CABLES

POST-TENSIONING

GROUND ANCHORS

STRUCTURAL BEARINGS

EXPANSION JOINTS

ANTI-SEISMIC DEVICES

REPAIR WORKS

PROJECTS

HIGH-SPEED RAILWAY LINE (TAV) MILANO - BOLOGNA, ITALY

- **SITE LOCATION:** Po river, Piacenza (Italy)
- **TOTAL LENGTH OF THE BRIDGE:** 400 m
- **MAIN SPAN:** 192 m
- **STAY CABLES:** 530 tons
- **NO. OF STAYS:** 72
- **LONGEST STAY CABLE:** 105m
- **MAX NO. OF STRANDS PER ANCHORAGE:** 91 – 15,7 mm diam.
- **DECK TYPE:** P.C. continuous box girder cable stayed deck
- **DECK WIDTH:** 15m
- **HEIGHT OF TOWERS FROM DECK LEVEL:**60m
- **MAIN CLIENT:** TAV-High Speed Train Authority – (Italy)
- **CONTRACTOR:** Grandi lavori Fincosit (Italy)
- **DESIGNER**: MPA Mario Petrangeli & Associati
- **PERIOD:** 08/2005-03/2007

CABLE STAYED BRIDGE OVER ADIGE RIVER, ITALY

- **SITE LOCATION**: A31 Valdastico Highway – Rovingo- Piacenza d'Adige (VI) - Italy
- **MAIN SPAN**: 310 m
- **STAY CABLES**: 650 tons
- **NO. OF STAYS**: 32
- **MAX NO. OF STRANDS PER ANCHORAGE**: 166 – 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**: Steel
- **STRUCTURE TYPE**: Cable-stayed bridge
- **MAIN CLIENT**: A.N.A.S. (Italy)
- **CONTRACTOR**: Cimolai (Italy)
- **DESIGNER**: STUDIO SETECO (Genova)
- **PERIOD**: 4/2009-10/2010

ERASMUS BRIDGE, THE NETHERLANDS

- **SITE LOCATION**: Rotterdam (The Netherlands)
- **MAIN SPAN**: 284 m
- **STAY CABLES**: 600 tons
- **NO. OF STAYS**: 40
- **MAX NO. OF STRANDS PER ANCHORAGE**: 127 – 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**:Orthotropic steel deck, 8 mm epoxy wearing course
- **STRUCTURE TYPE**: Cable stayed bridge
- **MAIN CLIENT**: MUNICIPALITY OF ROTTERDAM (The Netherlands)
- **CONTRACTOR**: J.V.GROOTINT B.V. –CFE – MBG (The Netherlands)
- **DESIGNER**: Arch. Ben Van Berkel – Geemente Werken Rotterdam (The Netherlands)
- **PERIOD**: 04/1995-07/1996

BRIDGE OVER THE GARIGLIANO RIVER, ITALY

- **SITE LOCATION:** Formia-Latina (Italy)
- **MAIN SPAN:** 2x90m
- **STAY CABLES:** 125 tons
- **NO. OF STAYS:** 36
- **MAX NO. OF STRANDS PER ANCHORAGE:** 55-15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE:** Precast segments – concrete multi light box section
- **STRUCTURE TYPE:** Cable-stayed bridge
- **MAIN CLIENT:** ANAS – Department for the Sarno Roadway System (Italy)
- **CONTRACTOR:** Giustino Costruzioni (Italy)
- **DESIGNER:** Prof. Ing. M. Mele – Ing. S. Masciocchi
- **PERIOD:** 11/1992 – 07/1994

BRIDGE OVER THE LOING RIVER, FRANCE

- **SITE LOCATION**: Nemours (France)
- **MAIN SPAN**: 165,42 m
- **STAY CABLES**: 37 tons
- **NO OF STAYS**: 36
- **MAX NO OF STRANDS PER ANCHORAGE**: 28 – 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**: concrete
- **STRUCTURE TYPE**: Cable-stayed bridge
- **MAIN CLIENT**: Seine et Marne General Council DDE (France)
- **CONTRACTOR**: Demathieu&Bard (France)
- **DESIGNER**: Jean Muller International (France)
- **PERIOD**: 6/1996-12/1996

SHAIKH KHALIFA BIN SALMAN BRIDGE, BAHREIN

- **SITE LOCATION:** Hidd (Bahrain)
- **MAIN SPAN:** 121m
- **STAY CABLES:** 28 tons
- **NO OF STAYS:** 108
- **MAX NO STRANDS PER ANCHORAGE:** 16-15,7 mm diam
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE:** steel-concrete
- **STRUCTURE TYPE**: arch bridge
- **MAIN CLIENT:** State of Bahrain – Ministry of Works and Agriculture Roads Directorate (Bahrain)
- **CONTRACTOR :** Cleveland Bridge U.K.
- **DESIGNER:** Hyder Consulting (U.K.)
- **PERIOD:** 08/2002 – 04/2003

JURA OVERPASS, FRANCE

- **SITE LOCATION:** Desnes A39 – Expressway (France)
- **MAIN SPAN:** 80m
- **STAY CABLES:** 28 tons
- **NO. OF STAYS:** 17
- **MAX NO. OF STRANDS PER ANCHORAGE:** 61 – 15,7 mm diam.
- **SYSTEMS SUPPLIED:** TSR
- **DECK TYPE:** Concrete
- **STRUCTURE TYPE:** Cable-stayed bridge
- **MAIN CLIENT:** SAPPR Société des Autoroutes Paris-Rhin-Rhone (France)
- **CONTRACTOR:** DEMATHIEU & BARD (France)
- **DESIGNER:** Jean Muller International (France)
- **PERIOD:** 9/1997-4/1998

SANTA APOLONIA RAILWAY BRIDGE, PORTUGAL

- **SITE LOCATION**: Lisbon (Portugal)
- **MAIN SPAN**: 80m
- **STAY CABLES**: 42 tons
- **NO OF STAYS**: 16
- **MAX NO OF STRANDS PER ANCHORAGE**: 55 – 15,2 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**: concrete
- **STRUCTURE TYPE**:Cable-stayed bridge
- **MAIN CLIENT**: Caminhos de Ferro Portuguese, E.P. (Portugal)
- **CONTRACTOR**: J.V. Soares Da Costa/Teixeira Duarte (Portugal)
- **DESIGNER**: Eng. J.L. Cancio Martins (Portugal)
- PERIOD: 11/1997-8/1998

DINTELHAVEN RAILWAY BRIDGE, THE NETHERLANDS

- **SITE LOCATION:** Rotterdam (The Netherlands)
- **MAIN SPAN:** 170m
- **STAY CABLES:** 25 tons
- **NO. OF STAYS:** 30
- **MAX NO. OF STRANDS PER ANCHORAGE:** 1
- 3- 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE:** Steel
- **STRUCTURE TYPE**: Arch bridge
- **MAIN CLIENT:** NS Railinfra-Beheer-Management Groep Betuwe-Route
- (The Netherlands)
- **CONTRACTOR:** HOLLANDIA B.V.
- **DESIGNER:** HOLLAND RAINCONSULT
- (The Netherlands)
- **PERIOD:** 12/1997-07/1998

BRIDGE OVER THE SANGONE CREEK, ITALY

- **SITE LOCATION**: Giaveno (Turin), Italy
- **MAIN SPAN**: 80m
- **STAY CABLES**: 66 tons
- **NO OF STAYS**: 32
- **MAX NO of STRANDS PER ANCHORAGE**: 37-15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**: concrete
- **DECK WIDTH**:15,10 m
- **DECK DEPTH**:1,20 m
- **PYLON HEIGHT**: 37 m
- **MAIN CLIENT**: Province of Turin
- **CONTRACTOR**:SISEA (Turin)
- **DESIGNER**: Mario Petrangeli & Associati (Italy)
- **PERIOD**:01/2005-06/2005

CHIHANI SUSPENDED BRIDGE, ALGERIA

- SITE LOCATION: Chihani (Wilaya El Tarf), Algeria
- MAIN SPAN : 100 m
- STAY CABLES: 28 tons
- NO OF CABLES: 6 suspension cables, 24 stays + 114 hangers
- MAX NO OF STRAND PER ANCHORAGE: 13 – 15,7 mm diam. epoxy coated strands
- SYSTEMS SUPPLIED: TSR
- DECK TYPE: steel + concrete
- DECK WIDTH: 7m
- PYLON HEIGHT: 12m
- MAIN CLIENT: Republique Algerienne Democratique et Populaire
- CONTRACTOR: SAPTA Enterprise Publique Economique (Algeria)
- DESIGNER: INTEGRA (Italy)
- PERIOD: 07/2007-03/2008

CABLE-STAYED BRIDGE OVER FAVAZZINA VIADUCT

- **SITE LOCATION:** Sicily (Italy) – Highway Salerno-Reggio Calabria
- **MAIN SPAN:** 310 m
- **STAY CABLES:** 440 tons
- **NO. OF STAYS:** 128
- **MAX NO. OF STRANDS PER ANCHORAGE:** 55 – 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE:** steel
- **STRUCTURE TYPE**: Cable-stayed bridge
- **MAIN CLIENT:** A.N.A.S. (Italy)
- **CONTRACTOR:** Cimolai (Italy)
- **DESIGNER:** Studio Seteco (Genova)
- **PERIOD:** 10/2010 – 01/2013

BASARAB FLYOVER BYPASS CABLE-STAYED BRIDGE

- **SITE LOCATION**: Bucharest (Romania)
- **MAIN SPAN**: 170 m
- **STAY CABLES**: 430 tons
- **NO OF STAYS**: 60
- **MAX NO OF STRANDS PER ANCHORAGE**: 109 – 15,7 mm diam.
- **SYSTEMS SUPPLIED**: TSR
- **DECK TYPE**: Steel
- **STRUCTURE TYPE**: Cable-stayed bridge
- **MAIN CLIENT**: Bucharest Municipality (Romania)
- **CONTRACTOR**: J.V. Astaldi - FCC
- **DESIGNER**: Carlos Fernandez Casado (Spain)
- **PERIOD**: 3/2010 – 2/2011

PEARL HARBOR MEMORIAL BRIDGE, USA

- SITE LOCATION: New Haven (Connecticut) – U.S.A.
- MAIN SPAN: 157 m
- STAY CABLES: 340 tons
- NO. OF STAYS: 128
- MAX NO OF STRANDS PER ANCHORAGE: 48 – 15,2 mm diam.
- SYSTEMS SUPPLIED: TSR
- DECK TYPE: cast on site concrete segments – concrete multi cellular deck
- STRUCTURE TYPE: extradosed bridge
- MAIN CLIENT: Department of Transportation Connecticut
- CONTRACTOR: SDI – J.V. PCL/Walsh
- DESIGNER: URS Corporation
- PERIOD: 10/2011 – 10/2013

STEEL ARCH BRIDGE – RAILWAY STATION SOUK AHRAS, ALGERIA

- **SITE LOCATION**: Souk Ahras (Algeria)
- **MAIN SPAN**: 130 m
- **STAY CABLES**: 22 tons of steel bars
- **NO OF STAYS**: 118
- **TYPE OF BAR**: 40 mm diam. – Type SAH Y1050
- **DECK TYPE**: Steel deck
- **STRUCTURE TYPE**: Arch bridge
- **MAIN CLIENT**: Ministere Travaux Publiques Dtp Wylaya de Souk Ahras
- **CONTRACTOR**: Sapta Epe/Spa (Algeria)
- **DESIGNER**: Studio de Miranda Associati(Italy)
- **PERIOD**: 2/2009-9/2010

LOUREIRO VIADUCT HIGHWAY BUCELAS/CARREGADO CALHANDRIZ, PORTUGAL

- **SITE LOCATION:** Calhandriz, Portugal
- **POST-TENSIONING TYPE:** Continuous bridge
- **DECK TYPE:** Double deck concrete box girders
- **LAUNCHING METHOD:** cast in-situ launching girder
- **STRAND(t):** 850
- **SYSTEMS SUPPLIED:** 12,19,22 MTAI 15 cables, 22MTG15 couplers
- **END CLIENT:** BRISA – Auto Estradas de Portugal
- **CONTRACTOR:** Teixeira duarte /Construtora Abrantina (Portugal)
- **CONSULTANT:** J.L. Cancio Martins Structural Engineers (Portugal)
- **DESIGNER:**
- **PERIOD:** 01/2002-04/2004

JAMAL ABDUL NASSER STREET, KUWAIT

- **SITE LOCATION**: Kuwait City (Western Region, Kuwait)
- **POST-TENSIONING TYPE**: box girder (segment)
- **DECK TYPE**: concrete
- **LAUNCHING METHOD**: precast span by span
- **STRAND(t)**: 2000
- **SYSTEMS SUPPLIED**: MTAI, MTAIE
- **END CLIENT**: The Ministry of Public Works (MPW) – Roads Engineering Department
- **CONTRACTOR**: Rizzani de Eccher – OHL- Trevi JV
- **CONSULTANT**: Luis Berger (USA) – Pan Arab Consulting Engineer
- **DESIGNER**:
- **PERIOD**: 01/2011-10/2016

MALAMPAYA OFF SHORE CONCRETE GRAVITY STRUCTURE PLATFORM
GREEN BEACH, SUBIC BAY, PHILIPPINES

- **SITE LOCATION:** Olongapo(Philippines)
- **POST-TENSIONING TYPE:** Platform
- **DECK TYPE:**
- **LAUNCHING METHOD:** prestressed concrete
- **STRAND(t):**
- **SYSTEMS SUPPLIED:** MTAI
- **END CLIENT:** SHELL (Philippines)
- **CONTRACTOR:** Malampaya CGS Alliance –John Holland (Australia) – Arup Energy (UK) – Van Oord ACZ (The Netherlands)
- **CONSULTANT:** Arup Energy (UK)
- **DESIGNER:**
- **PERIOD:** 05/1999-04/2000

HIGH-SPEED RAILWAY LINE (TAV) MILANO - BOLOGNA ,PIACENZA VIADUCT, ITALY

- **SITE LOCATION**: Piacenza (Italy)
- **POST TENSIONING TYPE**: Viaduct
- **DECK TYPE**: double box girder
- **LAUNCHING METHOD**: precast span
- **STRAND(t)**: 2300
- **SYSTEMS SUPPLIED**: MTAID
- **END CLIENT**: TAV (High Speed Train Authority), Italy
- **CONTRACTOR**: Consortium ASG (Aquarte,Snamprogetti, Grandi Lavori Fincosit)
- **CONSULTANT**: Mario Petrangeli & Associati (Italy)
- **DESIGNER**: Mario Petrangeli & Associati (Italy)
- **PERIOD**: 02/2003-07/2005

MANHATTAN WEST DEVELOPMENT PLATFORM,USA

- **SITE LOCATION**: Manhattan, New York (NY)
- **POST TENSIONING TYPE**: Box girder (segment)
- **DECK TYPE**: Concrete
- **LAUNCHING METHOD**: Precast span by span
- **STRAND (t)**: 1400
- **SYSTEMS SUPPLIED**: MTAI
- **END CLIENT**: Brookfield Properties
- **CONTRACTOR**: Rizzani de Eccher USA
- **CONSULTANT**: Entuitive Turner
- **DESIGNER**: McNary Bergeron & Associates
- **PERIOD**: 12/2013 – 12/2014

ISOZAKI TOWER, ITALY

- **SITE LOCATION**: Milan, Italy
- **POST TENSIONING TYPE**: Bonded hdpe cables
- **DECK TYPE**: Concrete
- **STRAND (t)**: 480
- **SYSTEMS SUPPLIED**: MTAI, 1C15
- **END CLIENT**: City Life SpA
- **CONTRACTOR**: Colombo Costruzioni SpA
- **CONSULTANT**: CityLife
- **DESIGNER**: Arata Isozaki
- **PERIOD**: 12/2012-04/2015

REGIONE PIEMONTE TOWER, ITALY

- **SITE LOCATION**: Turin, Italy
- **POST TENSIONING TYPE**: Bonded hdpe cables
- **DECK TYPE**: Concrete
- **STRAND (t)**: 400
- **SYSTEMS SUPPLIED**: MTAI, 1C15
- **END CLIENT**: Regione Piemonte
- **CONTRACTOR**: Torre Regione Piemonte Scarl
- **CONSULTANT**: Regione Piemonte
- **DESIGNER**: Massimiliano Fuksas
- **PERIOD**: 07/2013-12/2014

DERINER DAM ON THE CORUH RIVER, TURKEY

BELLE BAY PLAZA HOTEL MANILA, PHILIPPINES

TENSA

GROUND ANCHORS

FONTE DE SAINT DENIS, MARTINICA

TOUMAI CAP D'AIL, FRANCE

CONSOLIDATION WORKS IN ABRUZZO REGION, ITALY

TENSA

GROUND ANCHORS

UNDERGROUND PARKING IN MILAN, ITALY