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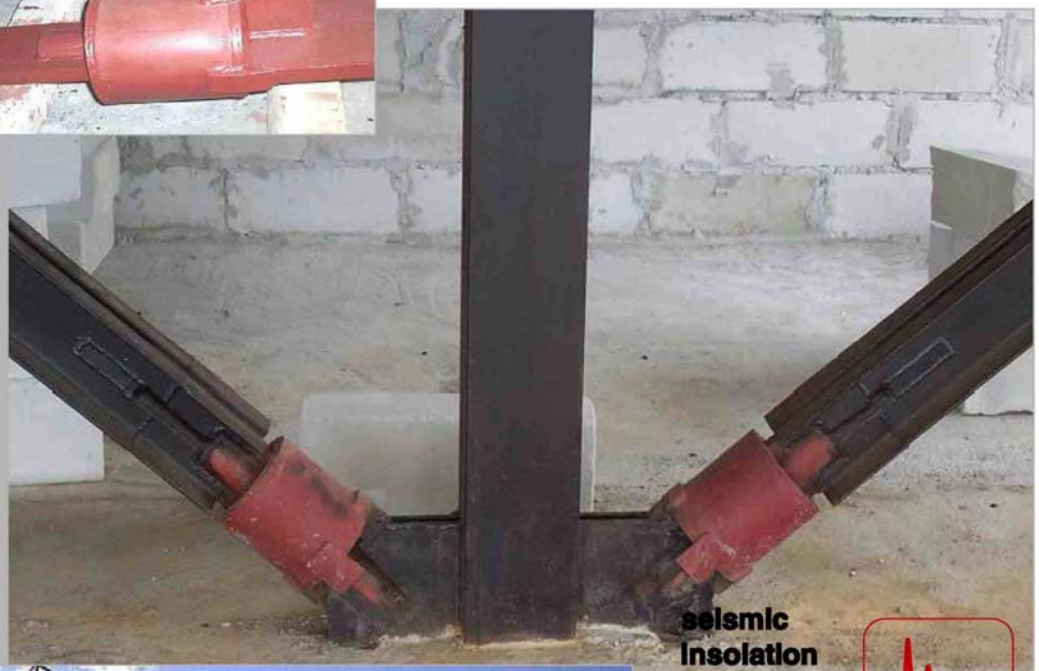

seismic insolation & passive energy damping

noise reduction

equipment isolation

pipes isolation

cost eficient

DEVICES FOR THE CONTROL, LIMITATION AND DAMPING OF NOISES, SHOCKS, VIBRATIONS AND SEISMIC MOVEMENTS FOR BUILDINGS, EQUIPMENT AND PIPES NETWORKS

APLICATIONS

The new technology developed by SITON has been applied by now in classic and nuclear objectives as follows:

- in 2003, the isolation of vibration shocks and seismic actions of a forging hammer located in IUS Brasov-Romania and having the weight of 360 kN which, as per the initial foundation solution, the shocks generated by the hammer blow were transferred to the near-by building (300 m and 800 m distance) and were resulting in the vibration of the building floors by a speed up to 52 mm/sec exceeding by 3,5 times the allowable limit of 15 mm/sec. After having installed SERB isolation devices, the value of the building floor vibration speed was reduced down to 6,75 mm/sec.
- also in 2003, the isolation against shocks, vibrations and seismic actions of pressurized air inlet and outlet pipes to the forging hammer. By the installation of the isolation devices the volume compensator on these pipes with an average service-life of 30 days were eliminated and the costs related to the maintenance and repairs were reduced.
- in 2005 a similar work with the one in 2003 for another forging hammer. The adopted solution was more performant meaning that the values of the building floor vibration speed was reduced to 0.085 mm/sec from 52mm/sec. The **isolation rate** experimentally determined is **89%.**
- Between 2005-2006 the strengthening, extension and rehabilitation of an old reinforced concrete framework building in order to withstand violent earthquakes with a 0.29 g acceleration on 2 orthogonal directions in horizontal plane. Strengthening was done by inserting a small number of panels braced by SERB type telescopic devices symmetrically arranged as to the building symmetry plane. SERB devices are controlling, limiting and damping the relative level displacements of the building. The columns (pillars) and beams of the building have not been strengthened, except those pertaining to the braced panels which have been lined with metal profiles.
- In 2006, the installation of a SERB type of support on the pipe 1056 located in Drobeta-Turnu Severin Factory-Romania. After the installation the amplitude of the pipe vibrations was reduced 6 times.
- In 2007, isolation of electric and I&C panels associated to the H2S compressors in GS3 section in ROMAG PROD against shocks, vibrations and seismic movements by the use of SERB type sliding supports. After the installation of the seismic isolation devices in the cabinets, the serial components inside the cabinet could be also installed but without verifying the behavior of the cabinet during an earthquake because the seismic acceleration transferred to the cabinet by the isolating is under 0,01g - 0,02g
- In 2008, Seismic qualification of Cold-Box columns for the radioactive tritium separation located in the Cryogenic Research Institute (ICSI) in Rimnicu Vilcea (Romania). The seismic qualification consisted of the installation of 4 SERB supports on each column for to control, limit and damp the swinging movement of the columns during an earthquake.
- In 2009, isolation of electric and I&C panels associated to the H2S compressors in GS4 section in ROMAG PROD against shocks, vibrations and seismic movements by the use of SERB type rolling supports. The acceleration transfered to the cabinetis under 0,01g.




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Based on more than 40 years of design experience and provided with modern computation equipment, C.I.T.O.N. offers a wide range of services under quality assurance programs, the control at high engineering levels using:
American (ASTM, ASME, API, IEEE), European (ISO, IEC), and Canadian codes (CSA), as well as AIEA Safety series regulatory guides in the following fields of activity:

- **SUPPORT DESIGN DOCUMENTATION**
- **SAFETY OPERATION MONITORING DOCUMENTS**
- **PRE-COMMISSIONING AND IN-SERVICE IN SPECTION**
- **CONSULTING,ENGINEERING AND TECHNICAL ASSISTANCE**
- **RADIOACTIVE WASTE MANAGEMENT**
- **ECONOMIC EVALUATION AND COST ANALYSES**
- **BID REQUESTS AND BID EVALUATIONS**
- **SITE SELECTION**
- **DECOMMISSIONING ENGINEERING ACTIVITIES**
- **SAFETY REPORTS AND ANALYSES, RISK EVALUATION**
- **PHYSICAL PROTECTION AND SAFEGUARDS**
- **ENVIRONMENTAL IMPACT ASSES**
- ***CONTROL, LIMITATION AND DAMPING OF SEISMIC MOVEMENT, SHOCKS, VIBRATIONS, AND NOISE FOR EQUIPMENT, PIPE NETWORKS AND BUILDINGS BY "SERB" DEVICES***

SERB DEVICES can be used:

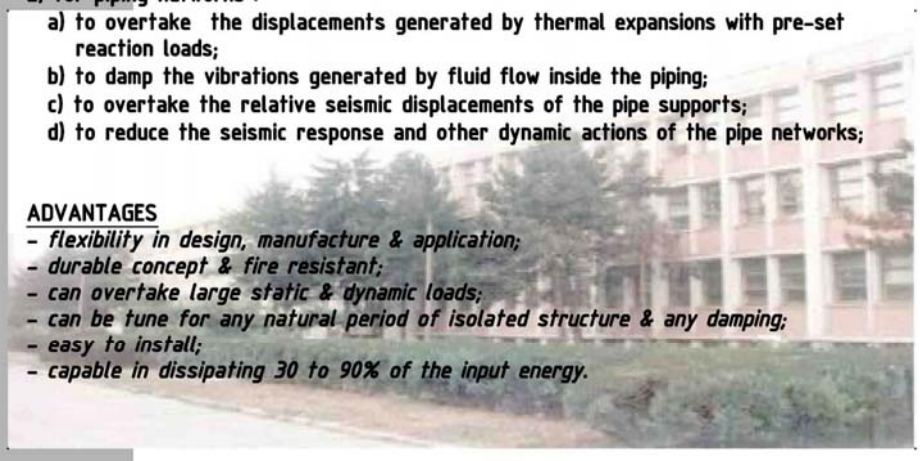
A) in building construction to reduce the seismic response in 2 ways:
  - providing seismic isolation (SERB isolator devices);
  - dissipating the seismic energy and controlling the relative interstory displacements (SERB telescopic devices);

B) in bridge building to provide the support of bridges to overtake the displacements generated by thermal expansion & to provide protection against dynamic actions (SERB isolators & SERB telescopic devices).

C) in the rehabilitation of buildings without moving away the tenants (SERB isolators & SERB telescopic devices).

D) for equipment to provide isolation related to their foundation in order to stop the vibration transfer to the environment & to get their protection against the vibrations coming from the surrounding environment (SERB isolators & SERB supports).

E) for piping networks :
  a) to overtake the displacements generated by thermal expansions with pre-set reaction loads;
  b) to damp the vibrations generated by fluid flow inside the piping;
  c) to overtake the relative seismic displacements of the pipe supports;
  d) to reduce the seismic response and other dynamic actions of the pipe networks;



ADVANTAGES
- *flexibility in design, manufacture & application;*
- *durable concept & fire resistant;*
- *can overtake large static & dynamic loads;*
- *can be tune for any natural period of isolated structure & any damping;*
- *easy to install;*
- *capable in dissipating 30 to 90% of the input energy.*

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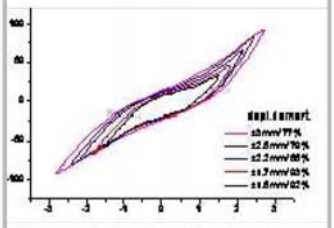
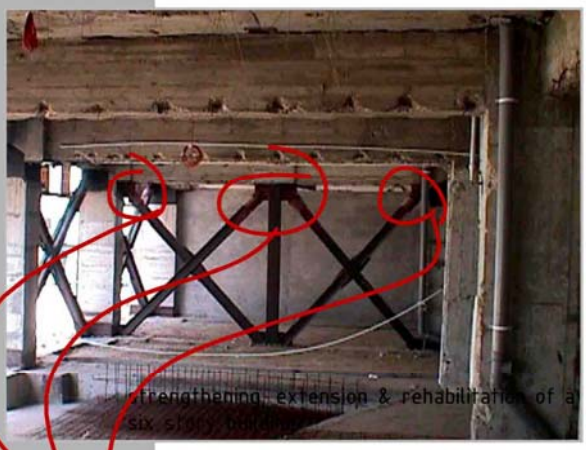
SERB TELESCOPIC DEVICES FOR PASSIVE CONTROL, LIMITATION & DAMPING OF BUILDING RELATIVE INTERSTORY DISPLACEMENTS - SOLUTION 1

detail of telescopic braces, in retrofitting structure, anchoring around a new steel column

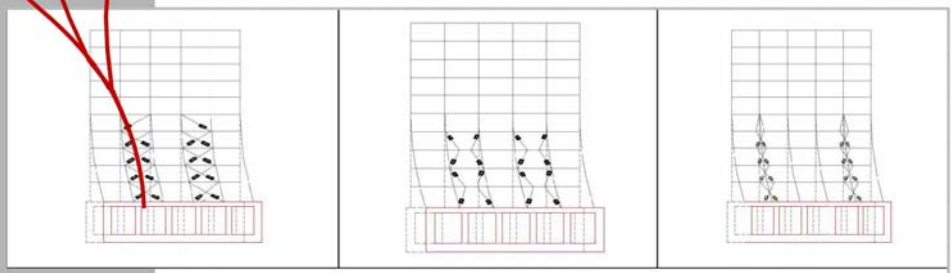
nonlinear elastic telescopic device with radial friction



force distortion Hysteresis loop Damping 77% - 92%



retrofitting, extension & rehabilitation of a six story building



passive energy dissipation and iter-story deflection control by SERB telescopic bracing (centric, eccentric and around joint)

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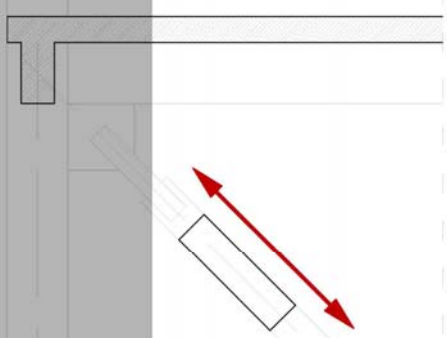
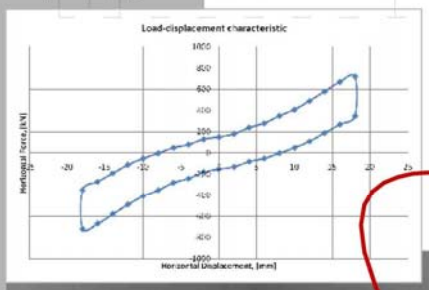
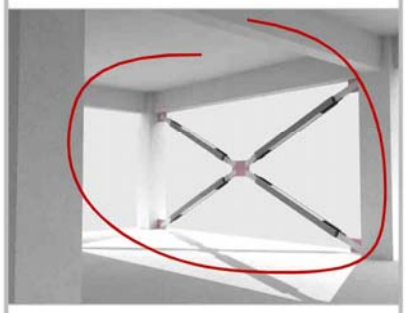
SERB TELESCOPIC DEVICES FOR PASSIVE CONTROL, LIMITATION & DAMPING OF BUILDING RELATIVE INTERSTORY DISPLACEMENTS - SOLUTION 2

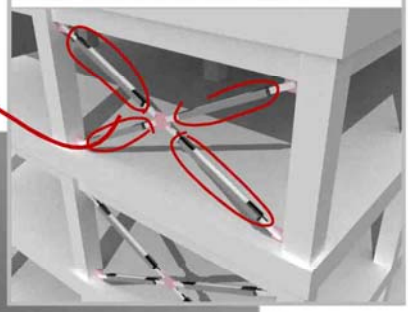


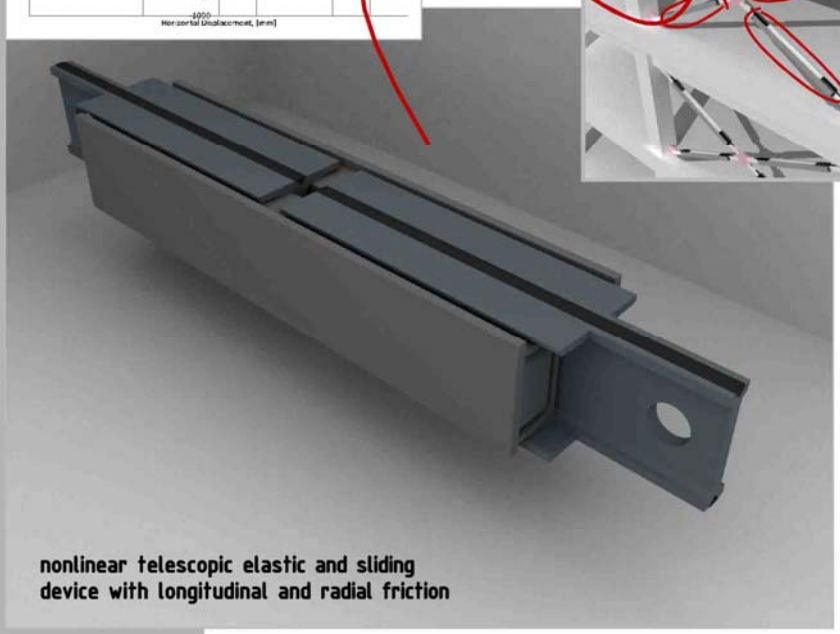
force distortion Hysteresis loop Damping 80% - 95%





devices installed in building structure





nonlinear telescopic elastic and sliding device with longitudinal and radial friction

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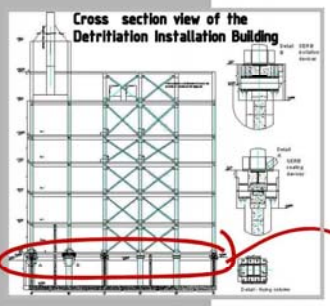
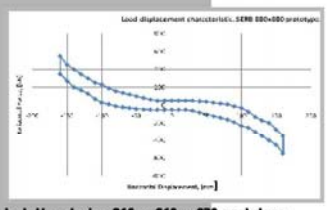
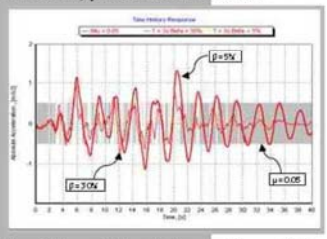
SLOW-OSCILLATING **SERB** DEVICE FOR SEISMIC ISOLATION OF BUILDINGS
▫ SOLUTION 1





Isolation device 960 x 960 x 230 prototype.
The experimental hysteresis horizontal force-displacement diagram for maximum displacement +/- 150 mm; preload 1200KN and 1800KN



Time-history relative displacement for oscillating system with T = 3s, β= 5%- 30%, and for sliding non-oscillating system with μ= 0.05

ADVANTAGES:

- robust, capsulated, small-sized, adjustable to installation errors; require no maintenance; no blocking risk; accuracy in installation; low costs.
- can be fabricated
  - to have pre-set hysteresis characteristics (stress – displacement)
  - as oscillating or non oscillating type with nonlinear limitation of lateral displacement;
  - with a pre-set stiffness and damping in the horizontal plane;

The relative movement is developing between two stiff boxes. The maximum horizontal displacement is 230mm and the acceleration transferred to the isolated supra-structure varies between 0.03g to 0.05g.

On vertical direction, the high compressive & tensile forces with actually zero distortion the devices are actually stiff; no risk of turning-up and loosing its stability;

- may not be inspected, verified or replaced after a seismic event,.

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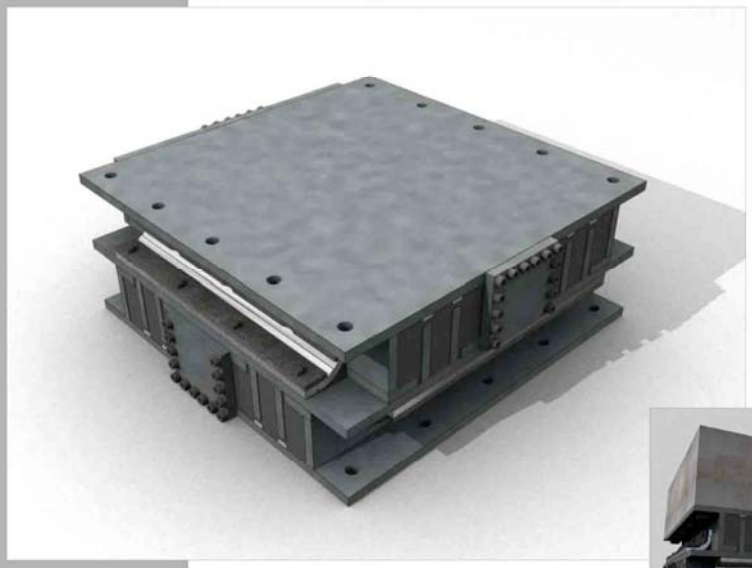
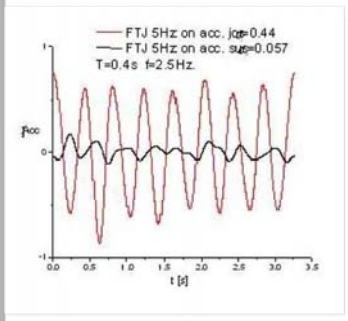
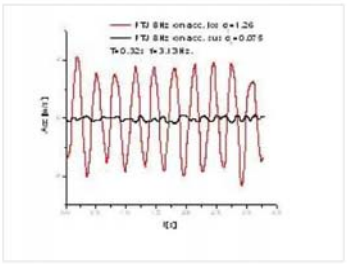
NON-OSCILLATING **SERB** DEVICE FOR SEISMIC ISOLATION AND ACUSTIC ATENUATION - SOLUTION 2





experimental results on model.acceleration recorded on the fundation and isolated structure



ADVANTAGES:

- **robust, capsulated, small-sized, adjustable to installation errors; require no maintenance; no blocking risk; accuracy in installation; low costs.**
- **can be fabricated**
  - **to have pre-set hysteresis characteristics (stress - displacement)**
  - **with adjustable rigidity in horizontal dyrection;**
  - **overtake compresion and tension, static and dynamic loads;**

The relative movement is developing between 3 stiff parts by rolling friction.
The usual horizontal displacement is between 250mm - 350mm and the acceleration transferred to the isolated supra-structure varies between 0.007g to 0.01g.
May not be inspected, verified or replaced after a seismic event.
Stiffness and damping for horizontal direction can be easy ajusted during the buiding life, if needed

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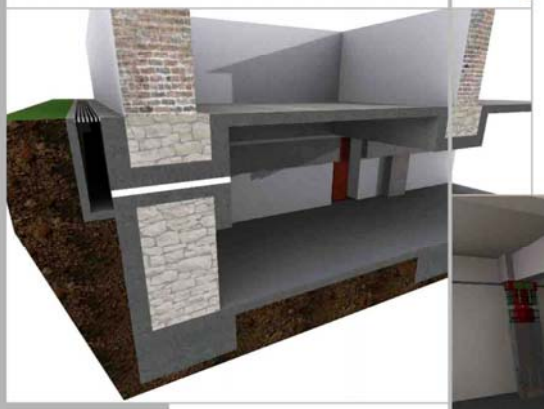
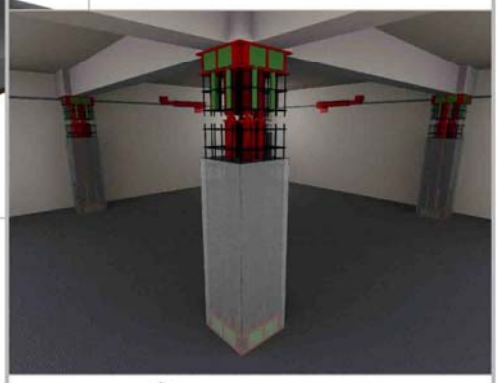
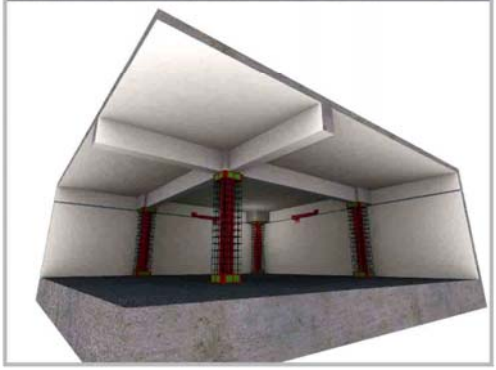
SEISMIC ISOLATION WITH **SERB** PENDULAR COLUMNS FOR BUILDINGS - SOLUTION 3

isolated old building

elastic hinge with damping







THE PENDULAR COLUMNS CAN BE INSTALLED IN SEMIBASEMENT OR GROUNDFLOOR;

CAPITELS AND CUZINETS HAVE PRESET STIFNESS AND DUMPING;

PENDULATED ANGLE IS LIMITED BY ELASTIC AND DAMPING FORCE;

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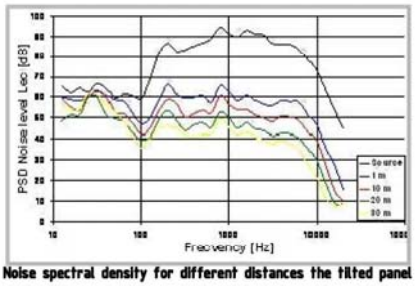
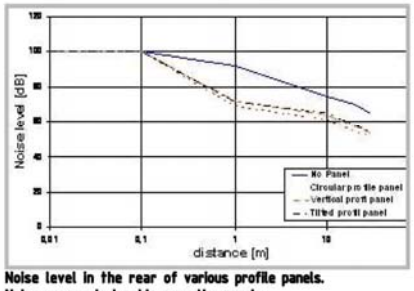
NOISE ABSORBANT **SERB** PANELS

Noise absorbant vertical panels

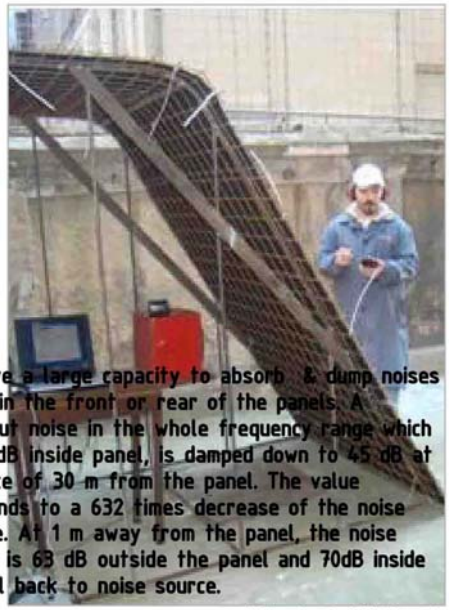


Noise spectral density for different distances the tilted panel



Noise level in the rear of various profile panels.
Noise source is insaide near the panels.

Noise absorbant curved panels



They have a large capacity to absorb & dump noises comming in the front or rear of the panels. A throughout noise in the whole frequency range which has 100 dB inside panel, is damped down to 45 dB at a distance of 30 m from the panel. The value corresponds to a 632 times decrease of the noise amplitude. At 1 m away from the panel, the noise intensity is 63 dB outside the panel and 70dB inside the panel back to noise source.

Noise absorbant tilted panels

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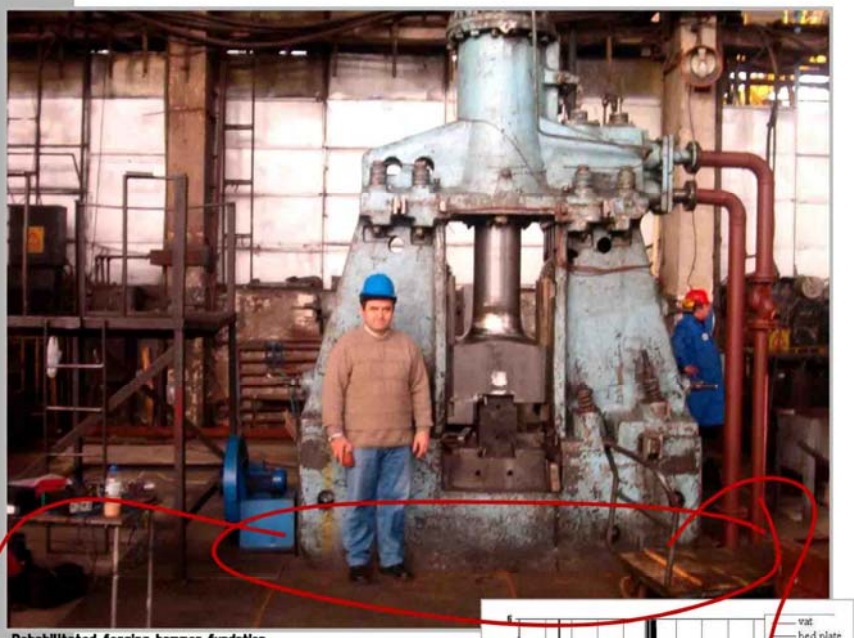
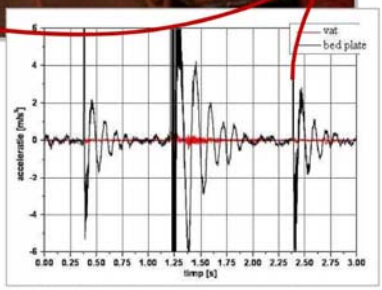
EQUIPEMENT ISOLATION WITH **SERB** DEVICES - SOLUTION 1

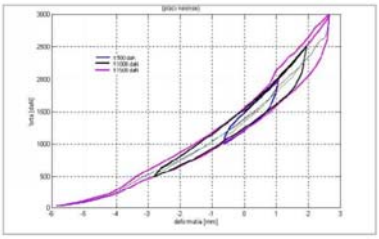


Rehabilitated forging hammer fundation

Bed plate installed on the devices



Variation in time of accelerations measured on the vat fundation & forging hammer bed plate



Force-distortion characteristic for SERB-E-194 device
Permanent load 1500 daN

The isolation rate experimentally determined is 89%.

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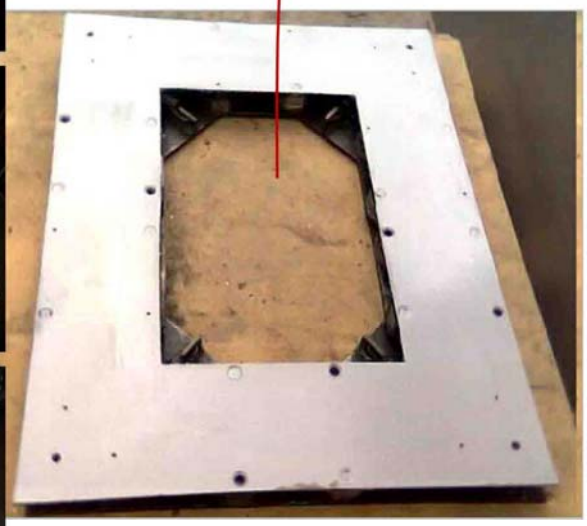
EQUIPEMENT ISOLATION WITH **SERB** DEVICES - SOLUTION 2



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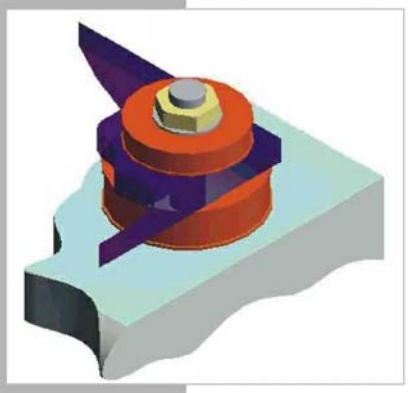
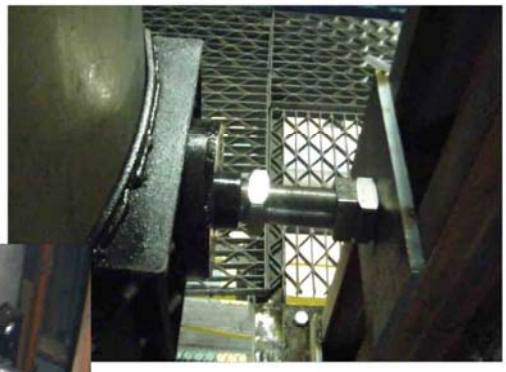
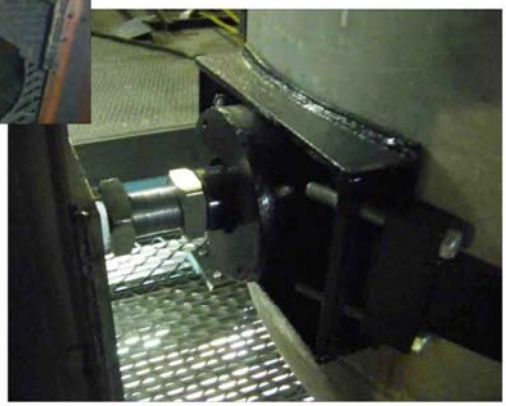
EQUIPEMENT ISOLATION WITH **SERB** DEVICES - SOLUTION 3



SERB-SE washer device for equipment

Instalation of the equipment





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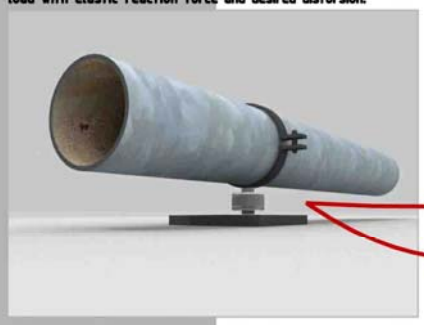
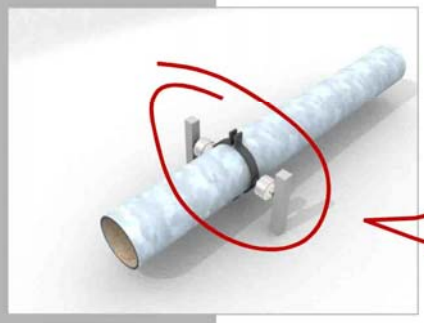
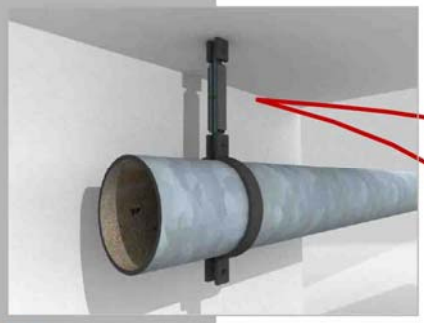
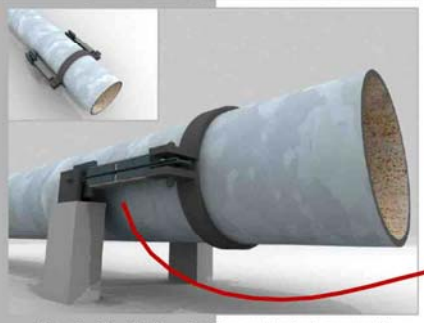
SERB SUPPORT WITH LARGE THERMAL EXPANSION FOR PIPING

Supports can allow displacements up to 200mm along the direction of load action with pre-set reaction force and can overtake permanent load with elastic reaction force and desired distorsion.









SERB-P-500x200 device

Piping SERB-P-168 device

Piping SERB-P-230-2 device

SERB-P-194x300 device

... atenuate the shocks, vibrations and seismic movements

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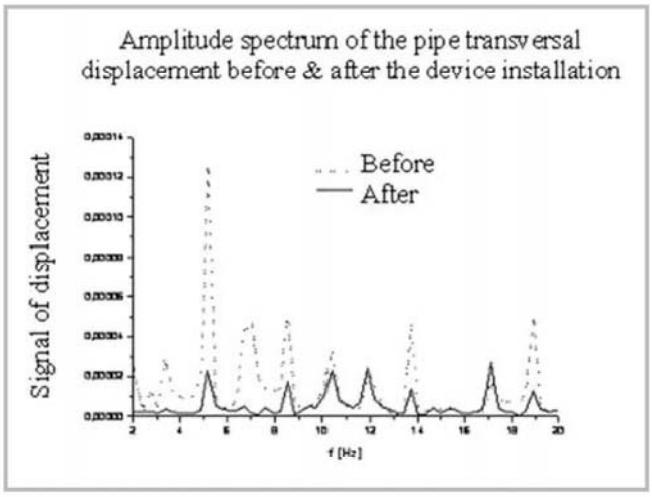
SERB DEVICE FOR VIBRATIONS DAMPING GENERATED BY FLUID FLOW INSIDE THE PIPE NETWORK



Pipe vibration reduction after SERB-HP-100 damper installation

SERB-HP-100 Damper for Hydraulic shocks isolated on pump outlet pipe PL1056

SERB-HP-160 Damper for Hydraulicshocks elastic room of SERB device

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Ⓒ omprehesion and
Ⓘ nteligence for
Ⓣ echnologies and
Ⓞ ptimum
Ⓝ etworks

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