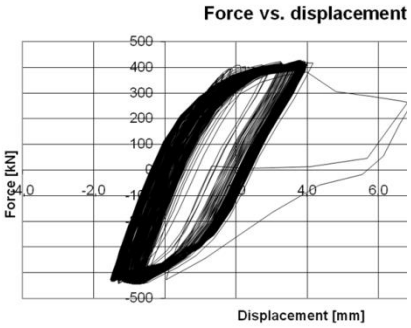
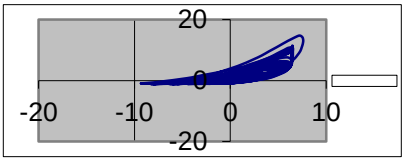
MASS RETROFIT OF MASSIVE MASONRY SYSTEM
Riparazioni massicce del sistema di pareti massiva

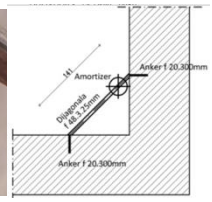
1.Position of Dampers on the site of the crack - Vertical bracing width the Damper in the walls, (forces from 50 to 500 kN and displacement of 4-5 mm)

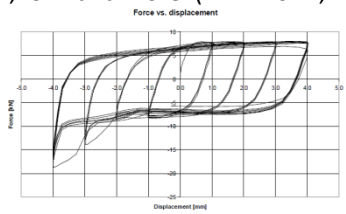


2. Position the expansion joint on the corner of the walls - Horizontal prestressing Compensation shrinkage (Force in tie plus 10-20kN, displacement X = Xe + 6mm)

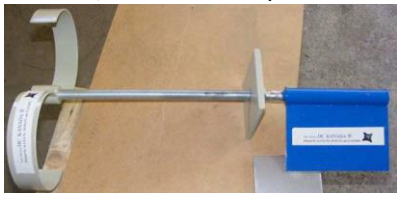


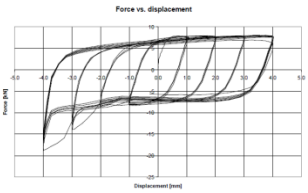
3. Damper for connecting the massive stone walls in the corner of the thickness 1,2o m and more. (F = 4-20kN, x = + - 4 mm.)

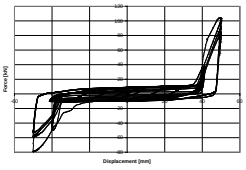




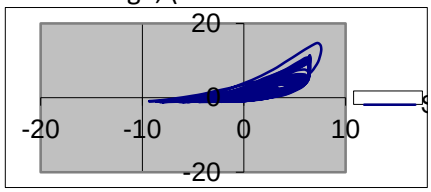
4. Damper connector for connecting the ceiling to walls or walls to walls to control the forces perpendicular to the wall (F = 4-80 kN, x = 4-100mm)

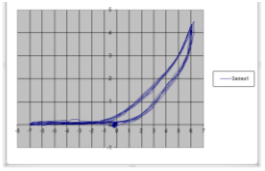




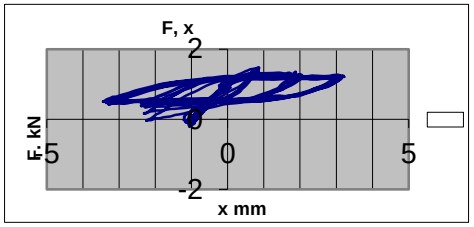


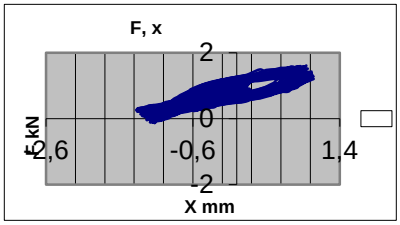
5. Anker with a compensator of shrinkage, (force in tie + 10-20kN, X = Xe + 6mm)





6. Hysteresis diagram of plaster in the field of elastic response after fracture and fatigue





DESIGNING DEVICE CUSTOM AND NEEDS. Nonlinear dynamic analysis FEM FOR AT LEAST THREE EARTHQUAKE RECORD

Sistema DC90 -Trasferimento di tecnologia SYSTEM DC90-TECHNOLOGY TRANSFER

ASSUMPTIONS ON WHICH ASSESSMENT IS BASED ARE:

1. Technology DC90 is twice cheaper in the performance over traditional classical known methods.
2. Top speed is also significantly higher, twice as fast.
3. Security is guaranteed and is exercised and controlled by special devices to control the dynamic behavior of structures.
4. Previous experience, dynamic tests on models in laboratories on objects and references on four continents.
5 of top specialists and collaborators Team System DC90 (Belgrade, Montreal, Skopje).
6. Support provided by RAS Development Agency of Serbia, Serbian Chamber of Italian businessmen and other institutions of Serbia and Italy.

(**Presupposti su cui la valutazione è basata sono**:
1. La tecnologia DC90 è due volte più economica nelle prestazioni rispetto ai metodi noti classici tradizionali.
2. La velocità massima è anche significativamente più alta, due volte più veloce.
3. La sicurezza è garantita ed esercita e controllata da appositi dispositivi per controllare il comportamento dinamico delle strutture.
4. L'esperienza precedente, prove dinamiche su modelli in laboratorio su oggetti e riferimenti in quattro continenti.
5. Dei migliori specialisti e collaboratori del Team System DC90 (Belgrado, Montreal, Skopje).
6. Il sostegno fornito da RAS Agenzia di Sviluppo della Serbia, Camera di imprenditori italiani di Serbia e di altre istituzioni della Serbia e Italia.)

CONTENTS PROCESS TECHNOLOGY TRANSFER:
1. THE CONCEPT OF TECHNOLOGY based on special devices to control the dynamic behavior. Devices and system provides a global integrity and stability of the structural elements of the walls of forces in the plane and perpendicular to the plane of the walls.
2. CATALOGUE Damper and devices with histetezis characteristics.
3. TECHNOLOGY INSTALLATION element of steel, cutting slits and application of fine-grained concrete, high strength and good workability.
4. DESIGN OF ADVANCED nonlinear dynamical methods MKE anisotropic nature of finite elements taking into account the real rheological characteristics and routine engineering methods that allow you to quickly and efficiently design by routine licensed Italian engineers. Phase system of quality control of all active times of research and design.
Special control structure and disposition of the device in terms of the philosophy of control in the System DC90 for each object that is to be realized.
5. TRAINING designers skills and essences DC90 system construction.
6. TRAINING CONTRACTOR skills, technological and system construction
7. DYNAMIC TESTING equipment and facilities at ambient and forced vibration, as well as the device to the desired hysteresis and fatigue in relation to the number of stress cycles.
8. Monoritong on several important facilities for online observation and monitoring of structures in real time
9. COPYRIGHT DC90 and methods of protection in relation to the limited right technology was used only for the needs of enterprise .

(**Indice di processo trasferimento tecnologico:**
1.Il concetto di tecnologia sulla base di apposite dispositive per il controllo del comportamento dinamico. Dispositivi e sistema forniscono integrità globale e stabilità degli elementi strutturali delle pareti delle forze nel piano e perpendicolare al piano delle pareti.
2.CATALOGO Damper e dispositive con caratteristiche hysterezis.
3.TECNOLOGIA DI INSTALLAZIONE degli elementi di acciaio, taglio delle feritoie e l'applicazione di grana fine di cemento, alta resistenza e buona lavorabilità.

4.PROGETTAZIONE DI AVANZATE metodi dinamici non lineari MKE della natura anisotropa di elementi finite, tenendo conto delle caratteristiche reologiche reali e metodi di ingeneria di routine che consentono di rapida ed efficiente progettazione della routine ingegneri italiani autorizzati. Sistema di fase di controllo della qualità di tutti i tempi attivi di ricerca e progettazione.
5.FORMAZIONE dei designer professionisti- ad essenze di costruzione del sistema DC90.
6.FORMAZIONE dei contraenti professionisti- tecnologia e costruzione del sistema.
7.CONTROLLO DINAMICO dell'attrezzatura delle vibrazioni ambientali e costretti, nonché il dispositivo per l'isteresi desiderata e la fatica in relazione al numero di cicli di sollecitazione.
8.Monitoraggio delle diverse strutture importanti per l'osservazione e il monitoraggio on-line delle strutture in tempo reale.
9.COPYRIGHT DC90 e metodi di protezione in relazione alla giusta tecnologia limitata è stato utilizzato solo per le esigenze di impresa Amatrice 2016.)

MASSIVE MASONRY CONSTRUCTION AND SYSTEM DC90

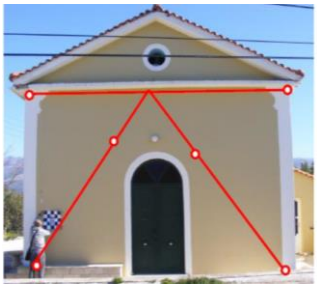
PHILOSOPHY OF THE TECHNOLOGY

for raising the safety, stability and durability of the massive masonry constructions named SISTEM DC90 is based on specially designed additional steel structures and devices. It enables, firstly, integrity of the construction as a whole, (hysteresis steel compensator with vertical and horizontal pre-stressing), secondly, stability of the vertical (walls) and horizontal (floor structure), in-plane structural elements, for loads in the plane (braces with hysteresis dampers) as well as for orthogonal loads (connectors with hysteresis dampers). Structure SISTEM DC90 integrates and hysteretic controls construction as a whole. When earthquake happens, fissures and minor cracks may occur, but object shall keep its integrity for allowed (calculated) ground movements. Fatigue in the field of small cycles, in materials, devices and joint connections, as well as ageing and durability are special part of the theoretical science researching for SISTEM DC 90 technology development. Acquired results and methodologies of numeric modelling and application of the SISTEM DC90 are encouraging and commits to further interactive development and technology transfer.

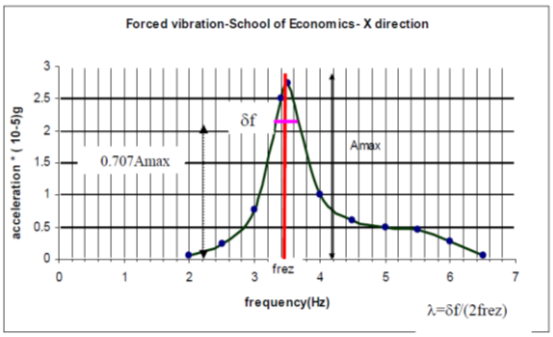
MASS RETROFIT OF MASSIVE MASONRY SYSTEM
Riparazioni massicce del sistema di pareti massiva
Technology Transfer

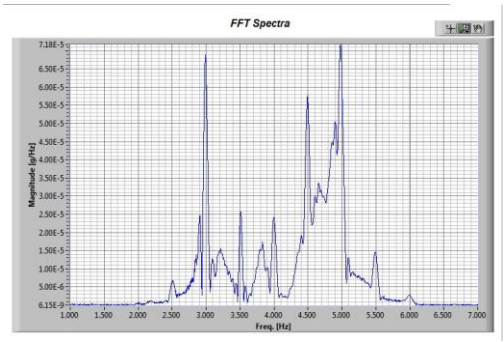
DESIGN CONSTRUCTION AND ARCHITECTURE

1. RECORDING STRUCTURE and damage
2. Record geometry, damage and photo Recording.

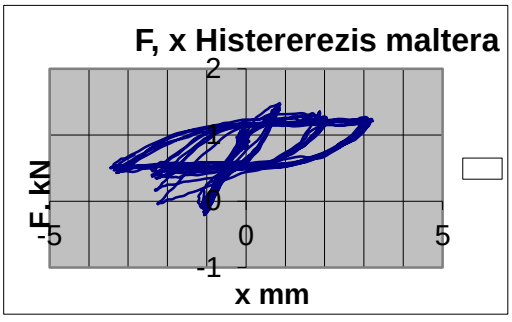



3. Tests ambient vibrations .





4. Tests mortar, stone and brick on the cyclical dynamic forces.

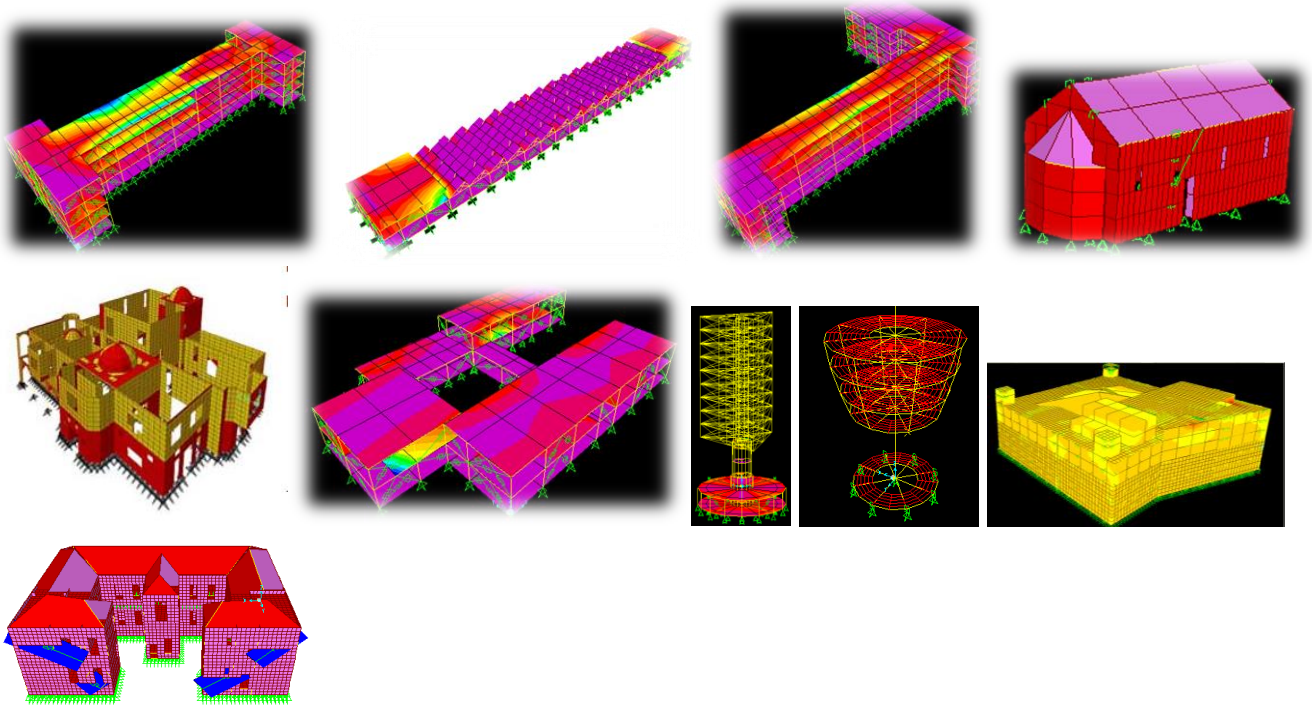


Investigation of the State of the walls and Studies of soil, groundwater and liquefaction. . Universal detector DUD 15

5. Project state of objects with a drawn damage

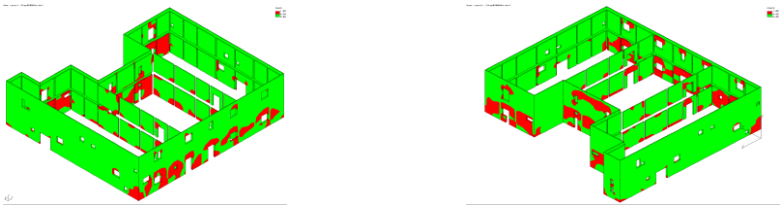
DESIGN STRUCTURE AND STRENGTHENING OF RAISING THE LEVEL OF SECURITY

1. Geometry and 3D model construction in "3D numerical model".

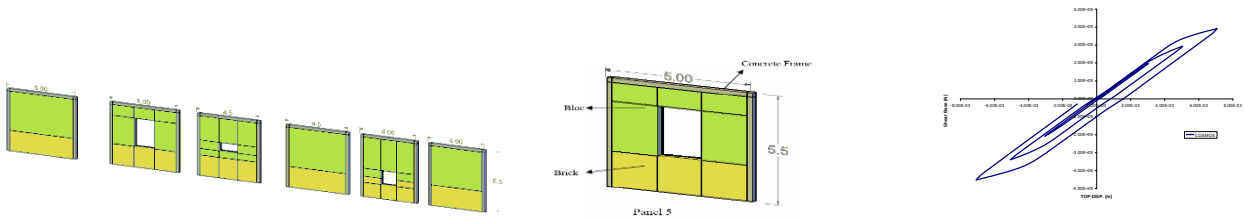


2. The layout of elements DC 90 to raise construction safety

3. Analysis of typical walls advanced numerical methods COSMOS of FEM (Hydro-Quebec Gocevski).
wall (b,h),
wall (b, h) with a window (b1, h1),
wall (b, h) with the door (b2 h2) and
wall (b, h) with two openings (b1, h1) and (b2, e2).

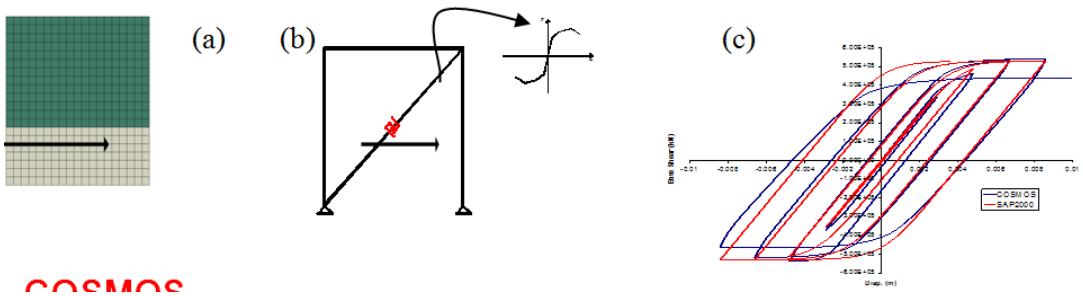


The geometry of the building, and the results of the elaborate FE dynamic analysis. The red areas indicate distribution of cracks in the masonry walls.



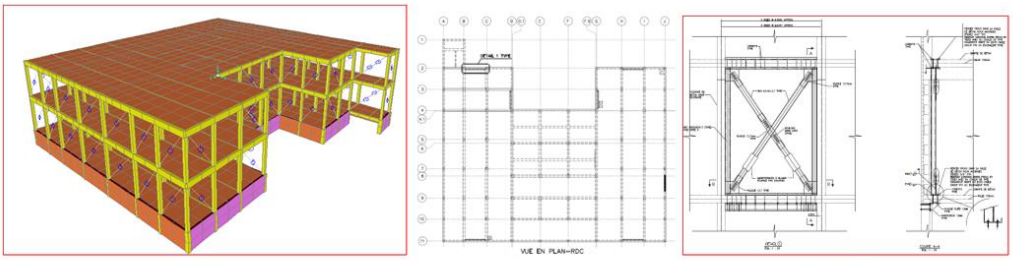
(a) (b) (c)

Typical masonry panels (a); panel #5 (b) and its shear force-deformation hysteresis (c)

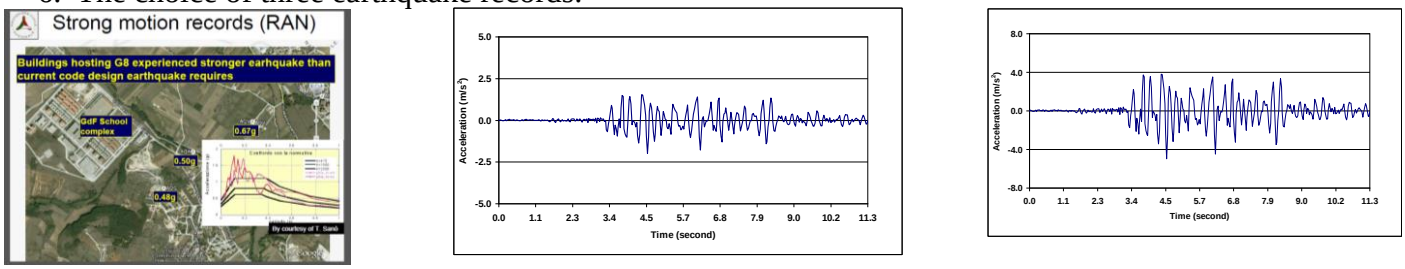


Typical masonry panel (a); replaced by "Link" element (b); having equivalent hysteresis (c)

4. The formation of 3D models to "3D numerical model".



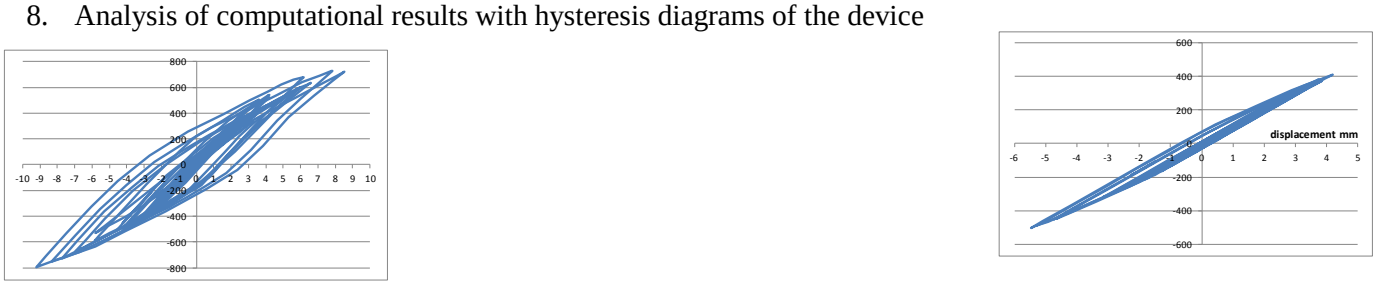
5. Numerical model including the "Link" elements in "3D numerical model". (a); location of the bracings with dampers on the ground floor of the building (b); and unit of bracing with dampers (c)
6. The choice of three earthquake records.



7. The iterative procedure for calculating and adjusting Dampers and disposition of elements.

(a) D-98 Damper 1.5 to 4.0 mm , F=320-400 kN (b) Damper 1.5 to 4.5 mm; 450 kN (test)
Hysteresis obtained from the analysis (a); Results from the test (b)

8. Analysis of computational results with hysteresis diagrams of the device



(a) P-16 un-reinforced structure (b) P-16 reinforced structure
Hysteresis for a typical masonry panel obtained from the analysis: (a) before and (b) after the structural reinforcement with bracings and dampers

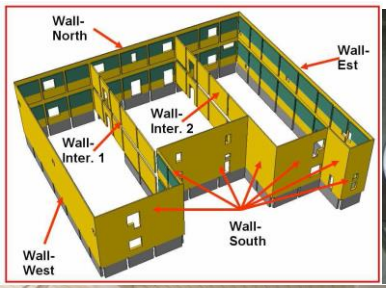
DISPOSITIONS OF ELEMENTS DC90. In the wall. Outside the Wall. Connectors and connections. Prestressing and shrinkage compensators.



















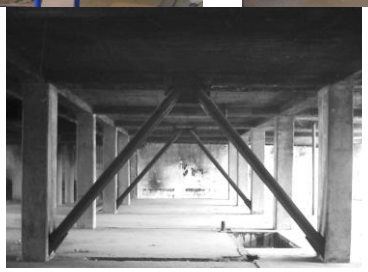



Table shows Stucture areas, number of Dampers, Stiffeners length and Stiffeners weight.

No.	Name of school (sc)	Stucture area (m²)	Wall Dampers No.	Wall-ceiling Dampers No.	Stiffeners length (m)	Stiffeners weigth (kg)	Stiffeners weight per m² (kg)	Total cost (€)	Total Cost per m² (€)
1	IVKB	2,667	16	0	150	5,050	1.89	45,536.70	17.07
2	DT	1,575	70	20	858	16,474	10.46	95,332.50	60.53
3	JK	1,375	26	0	492	6,100	4.44	41689.70	30.32
4	G	5,935	133	0	1,486	25,262	4.26	166,204.10	28.00
5	E	2,350	66	0	704	12,631	5.37	80,781.60	34.38
6	M	6,217	65	0	720	8,382	1.35	126,036.40	20.27
7	P	5,132	18	32	122	1,650	0.32	121,996.70	23.77
8	VK	1,140	23	33	324	1,285	1.13	43,012.60	37.73
9	DMA	455	8	15	107	463	1.02	15,896.30	34.94
10	DMP	289	9	16	128	552	1.91	14,809.90	51.25

Technology transfer CENTRAL ITALY 2016-2026

TECHNOLOGY TRANSFER, also called transfer of technology (**TOT**), is the process of transferring (disseminating) technology from the places and ingroups of its origination to wider distribution among more people and places. It occurs along various axes: among universities, from INNOVATION CENTER to businesses, from large businesses to smaller ones, from governments to businesses, across borders, both formally and informally, and both openly and surreptitiously. Often it occurs by concerted effort to **SHARE SKILLS, KNOWLEDGE, TECHNOLOGIES, METHODS OF MANUFACTURING**, samples of manufacturing, and facilities among governments or INNOVATION CENTER and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services. It is closely related to (and may arguably be considered a subset of) knowledge transfer.

Horizontal transfer is the movement of technologies from one area to another. At present[when?] transfer of technology (TOT) is primarily horizontal.

Vertical transfer occurs when technologies are moved from applied research centers to research and development departments.[1]

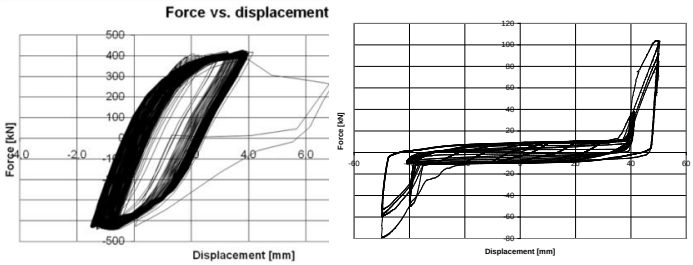
TECHNOLOGY BROKERS are people who discovered how to bridge the emergent worlds and apply scientific concepts or processes to new situations or circumstances.[2] A related term, used almost synonymously, is "technology valorisation". While conceptually the practice has been utilized for many years (in ancient times, Archimedes was notable for applying science to practical problems), the present-day volume of research, combined with high-profile failures at Xerox PARC and elsewhere[citation needed], has led to a focus on the process itself.

Whereas technology transfer can involve the dissemination of highly complex technology from capital-intensive origins to low-capital recipients (and can involve aspects of dependency and fragility of systems), it also can involve appropriate technology, not necessarily high-tech or expensive, that is better disseminated, yielding robustness and independence of systems.

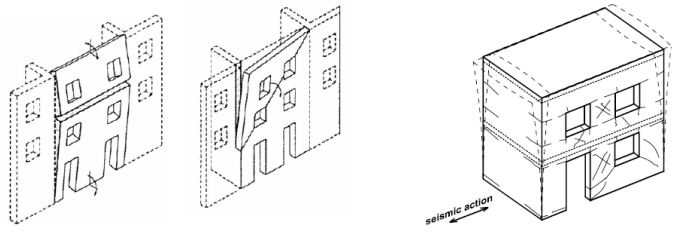
FIVE BASIC ELEMENTS of SYSTEM DC90

Hysteresis control of massive masonry structures (force and displacement control)

1. **VERTICAL STIFFENING** WITH THE DAMPERS IN THE PLANE OF THE WALL. Hysteresis wall control of forces in the plane of the wall after the first cracks.
2. **HORIZONTAL OR VERTICAL PRESTRESSING** WITH COMPENSATED SHRINKAGE. Even after shortening of elements due to shrinkage or cracking, compensator retains the force and hysteresis behavior.
3. **THE DIAGONAL CONNECTOR** WITH DAMPER. It connects the wall to the wall, walls to arched construction or horizontal surface elements and controls their hysteresis behavior before and after the formation of cracks.
4. **ANCHOR CONNECTOR** WITH DAMPER. Connects wall to column for forces perpendicular to the plane of the wall or conetcts floor slabs to the wall and controls their hysteresis behavior.
5. **"S" ANCHOR ELEMENT** WITH COMPENSATED SHRINKAGE. After the force decrease in tie/anchor retains the force and hysteresis control.



Two basic forms of hysteresis for dumpers and devices DC90.



Examples of first-mode "local" damage mechanisms (a, from D'Ayala & Speranza, 2003) and global response mechanism (b).