Transactions of the 17th International Conference on Structural Mechanics in Reactor Technology (SMiRT 17)
Prague, Czech Republic, August 17 –22, 2003

Paper # K13-5

"Advanced Tested Technology for Earthquakes" and "The Shapes of Memory": a Short Film and a Motion-Picture Developed in the Framework of the MUSICA Project

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KEY WORDS: information, training, films, seismic vibrations, passive control, seismic isolation, passive energy dissipation, shock transmitters, shape memory alloys, research, manufacturing, application, bridges, viaducts, buildings, industrial plants, cultural heritage.

ABSTRACT

This paper summarizes the main features of the Project MUSICA ("MUltimediale per lo sviluppo di Sistemi Innovativi per Costruzioni Antisismiche", namely "Multimedia for the Development of Innovative Systems for Anti-Seismic Constructions") which was jointly undertaken by the Italian Agency for New Technology, Energy and the Environment (ENEA) and other partners associated in the Italian Working Group on Seismic Isolation (GLIS) in May 2000, to contribute to information and training on the modern passive control techniques of seismic vibrations through a better, modern use of media. The Project consists in the development of a series of films of various durations on manufacturing, R&D and applications of the aforesaid techniques, namely seismic isolation, passive energy dissipation, hydraulic coupling by means of shock transmitters, systems formed by shape memory alloy devices, "active sewing" method for masonry buildings, etc. These films are addressed to designers, representatives of the Institutions and the ordinary public, as well. The short film "Advanced Tested Technology for Earthquakes", that developed for ENEA, and the film "The Shapes of Memory" will be shown at the Conference.

INTRODUCTION

Since 1988, large efforts have been devoted by the Italian Agency for New Technology, Energy and the Environment (ENEA – "Ente per le Nuove tecnologie, l'Energia e l'Ambiente") to the development, validation and application of innovative (or, better, modern) anti-seismic (IAS) techniques, namely [1]:

- seismic isolation (SI),
- passive energy dissipation (ED),
- provisional hydraulic coupling (HC) by means of shock transmitters,
- coupling of structures using shape memory alloy (SMA) devices,
- and more recently, semi-active control (SAC) of vibrations.

The work of ENEA has been performed taking advantage of both international and national collaborations. Among the latter to be stressed are those in progress in the framework of the activities of the Italian Working Group on Seismic Isolation (GLIS – "Gruppo di Lavoro Isolamento Sismico") of the Italian National Association for Earthquake Engineering. GLIS was founded in 1989 and has now more than 250 members representing all the parties interested in the development, application and promotion of the IAS techniques (research centers, universities, manufacturing companies, design offices, building companies, national, regional and local Institutions, media); since its foundation, the coordination, technical secretariat and responsibility for external relations of GLIS have been entrusted to ENEA.

With regard to the international collaborations, it is worthwhile citing that the coordination of Task Group 5 on Seismic Isolation of Structures (TG5) of the European Association for Earthquake Engineering (EAEE) was also entrusted to ENEA at the beginning of 2001. In addition, in October of the same year, based on a proposal of GLIS and ENEA, the decision of founding the *A*nti-*S*eismic *S*ystems *I*nternational *Soci*ety (*ASSISi*) was taken during the Closing Panel of the 7th International Seminar on Seismic Isolation, Passive Energy Dissipation and Active Control of Vibrations of Structures, which had been organized by GLIS and EAEE-TG5 at Assisi (Italy). There, the chairmanship of the *ASSISi* Foundation Committee was entrusted to ENEA, together with the task to formally found the Society [2]: this foundation occurred at Budrio, near Bologna, on November 21, 2002. It is noted that the ASSISi Foundation Committee is formed by 65 from 28 countries.

In addition to performing the aforesaid R&D and coordination work, ENEA, together with other GLIS members, is devoting particular attention to information and training. Information is being addressed not only to specialists, but also to designers, representatives of the national, regional and local Institutions and the ordinary public. Thus, the used information / training tools are not only publications and organization of meetings for experts, but also organization of conferences addressed to non-experts, students and the ordinary public, as well as publication of articles in magazines and newspapers and talks at radios and TVs.

In May 2000, to further contribute to information and training on the IAS techniques towards all the above-mentioned parties through a better use of media (so as to also more incisively contribute to the promotion of a wider application of the modern anti-seismic techniques), ENEA and other GLIS Partners undertook the Project MUSICA ("MUltimediale per lo sviluppo di Sistemi Innovativi per Costruzioni Antisismiche", namely "Multimedia for the Development of Innovative Systems for Anti-Seismic Constructions"). This consists in the development of a series of films of various durations on manufacturing, R&D and application of the IAS techniques [3].

THE FILM DIRECTOR AND PRODUCTION COMPANY

MUSICA has been jointly developed by ENEA and GLIS in cooperation with the Film Company Giotto Film of Borgo Trevi (Perugia, Italy). It takes advantage of the skill of the Film Director Enrico Bellani, who had already directed the motion-picture "Assisi. Il Cantiere dell'Utopia" (Assisi. The Yard of Utopia) on the restoration of the Upper Basilica of St. Francis at Assisi, by also filming the installation of SMA devices and innovative shock transmitters [1]: this film was shown by the Italian national TV "RAI UNO" on the day of the re-consecration of the Basilica (November 28, 1999).

GLIS PARTNERS

In addition to ENEA, the major Partners of MUSICA (namely those contributing with the largest funding) are the following Institutions and companies, which are all represented in GLIS:

- ALGA, a manufacturing company of IAS devices at Milan;
- ENEL.HYDRO-ISMES, a company which owns and operates very well known laboratories for dynamic tests at Seriate (Bergamo);
- FIP Industriale, a manufacturing company of IAS devices at Selvazzano (Padova);
- "Impresa Generale di Restauro Pouchain", a company specialized in the restoration of cultural heritage, located at Rome;
- INSO, a building company specialized in the design and construction of large public buildings, located at Florence;
- the Italian National Seismic Survey (SSN – "Servizio Sismico Nazionale"), Rome, which now belongs to the National Civil Protection Department;
- the Joint Research Center (JRC) of the European Commission (EC) at Ispra (Varese);
- TIS, a manufacturing company of IAS devices at Rome;
- the University of Basilicata at Potenza, which owns a very advanced laboratory for seismic tests.

In addition to these main Partners, the Project has also been funded (with lower contributions) by the following Institutions and companies, some of which are already represented in GLIS:

- IERP ("Istituto per l'Edilizia Residenziale Pubblica") of Perugia Province, namely the Public Building Institute for ordinary apartment houses in this Province, which is now completing the erection of three adjacent isolated apartment houses at Città di Castello (Perugia) (see below);
- "Impresa Lunghi", a building company located at Santa Maria degli Angeli (Perugia), which has worked at the aforesaid application and was also involved in the restoration of the Upper Basilica of St. Francis at Assisi;
- "Studio Mancinelli", a design office at Fabriano (Ancona), which is performing the first retrofit of an European building by means of construction of a subfoundation to insert SI (see below);
- "Tekno In", an engineering company at Rome;
- the University of Ancona;
- the University of Catania;
- the Third University of Rome;
- the US Company Forell Elsessers Engineers of San Francisco.

The activities of the MUSICA Project are coordinated by a Coordination Committee, formed by one representative for each of the major Partners and chaired by the first author of this paper.

FILMING ACTIVITIES

Several structures provided with IAS systems (bridges, viaducts, strategic, public and regular apartment

buildings and industrial plants), including the most important in Italy and some also in the San Francisco area and Turkey, were filmed, together with production processes of the devices and their testing in the Italian Laboratories. In addition, some conventionally founded structures of interest of SSN, provided with seismic monitoring systems, were filmed.

Filming activities started in May 2000; those of the present phase were completed in June 2001 (with the exception of shots concerning the Rione Traiano Civic Center at Soccavo, which were recently performed – see below). Filmed documentation lasts approximately 55 hours and contains comments of concerned experts, owners, or inhabitants, recorded on site while filming laboratories, factories or structures. During montage, use was also made of pictures taken from previous films, such as "Il Cantiere dell'Utopia" and films shot during important tests in the past.

The filmed test laboratories, engineering and research centers, manufacturing companies and structures provided with IAS systems are outlined below. To provide some examples, a few filmed viaduct and building applications of the various systems are shown by Figures 1-7.

From conceiving to applying the IAS systems

(1) Test laboratories and engineering and research centers working at IAS systems. Filmed were the following test laboratories and engineering and research centers, where IAS systems and structure mock-ups provided with them have been tested using specific equipment (SE), shaking tables (ST) and the pseudo-dynamic method (PsDM):

- ALGA (Montebello, Pavia) (SE);
- ENEA (Casaccia Center, Rome) (ST);
- ENEL.HYDRO-ISMES (Seriate, Bergamo) (SE and ST);
- FIP Industriale (Selvazzano, Padova) (SE);
- JRC Ispra (ELSA Laboratories, Varese) (SE and PsDM);
- TIS (Civita Castellana, Viterbo) (SE);
- University of Basilicata (Potenza) (SE, ST and PsDM);
- University of Bologna and ENEA at Montecuccolino (Bologna) (SE).

Pictures taken from films shot during tests performed in past years have been combined to those concerning the aforesaid filming activities, in particular as far as ENEL.HYDRO-ISMES and the University of Basilicata are concerned.

(2) Italian manufacturing companies of IAS systems. Filmed were the factories of the following manufacturers of IAS devices of the aforesaid various kinds (SI, ED, HC and SMA devices), by focusing on production and qualification:

- ALGA (Montebello) (SI, ED and HC devices);
- FIP Industriale (Selvazzano) (SI, ED, HC and SMA devices);
- Metalgomma (Monzambano, Mantova Province) (SI rubber devices);
- TIS (Civita Castellana) (SI, ED, HC and SMA devices).

Applications of the IAS systems, already been completed or susceptible of wide-ranging extension in Italy

(1) Italian bridges and viaducts. Filmed were the following Italian bridges and viaducts, provided with elastic-plastic ED devices (EPDs), other ED device types and HC devices:

- The "Somplago" Viaduct (Carnia, Udine Province, Friuli Region), provided with EPDs of FIP Industriale (conceived by Dr. R. Medeot), which was the first Italian application of IAS devices (1975) and survived the Friuli earthquake in 1976 (while all other bridges and structures in the same area were severely damaged or collapsed);
- The "Ponte nelle Alpi" bridge (Belluno Province, Veneto Region) and "Ponte Giulio" bridge (Maniago, Udine Province, Friuli Region), which are again relatively old applications, equipped again with ED and HC devices manufactured by FIP Industriale;
- A more recent viaduct equipped by TIS with ED and HC devices near Urbino (Pesaro Province, Marche Region);
- The "Coltano" Viaduct, on the Cecina - Livorno freeway (Tuscany Region), which is probably the longest viaduct in the world (more than 9 km) being provided with IAS devices (EPDs and HC devices of ALGA and FIP Industriale);
- The Agrifoglio Viaducts of the Napoli-Bari freeway near Vallata (Avellino, Campania Region), which were retrofitted some year ago with ED and HC devices manufactured by TIS and ALGA;
- A new viaduct under construction of the Florence-Livorno Highway near Livorno (Tuscany Region), during installation of ED and HC devices manufactured by TIS.

(2) New Italian strategic or industrial large buildings. Filmed were the following new strategic or industrial large Italian buildings provided with IAS systems:

- Two buildings of the New Fire Management Center at Naples (Campania Region), which were the first Italian application (at the beginning of the years '80s) of the IAS techniques and were provided with HC devices, sliding devices and rubber bearings, the latter manufactured by TIS (these buildings had been designed prior the 1980 Campano-Lucano earthquake and the use of the aforesaid IAS techniques, thanks to

Prof. F.M. Mazzolani, allowed for avoiding large design modification in spite of the seismic reclassification of the Naples area after such an earthquake);

- The five isolated buildings of the TELECOM Italia (former SIP) Telephone Company at Ancona (Marche Region), owned by SEAT and designed by Dr. G.C. Giuliani, the first Italian application of base SI (beginning of years '90s), which were equipped with High Damping Rubber Bearings (HDRBs) manufactured by ALGA and were provided by ENEL with a seismic monitoring system that recorded the March 1998 aftershock of Marche and Umbria earthquake (in the films use has also been made of some pictures shot in 1990 during impressive forced- and free-vibration tests, the latter to 110 mm base displacement [4]);
- A base isolated building of the Italian Navy at Ancona, to be used for emergency management during natural disasters, including earthquakes, which was equipped again with HDRBs of ALGA;
- The twin towers of the Administration Center of ENEL (National Electricity Board) at Naples, each of which consists of a central core suspended at the top from the two external towers and was provided with EDPs of FIP Industriale to limit its rotation;
- An isolated medical center in the Navy Base of Augusta (Siracusa Province, Sicily Region), which is the first example (beginning of years '90s) of application of SI to an Italian medical structure, being provided with HDRBs of ALGA;
- Two non-isolated hospitals, at Cecina (Livorno Province, Tuscany Region) and Pisa (Tuscany Region), erected by INSO, having a modular structure which may be easily provided with base or floor SI, as demonstrated by specific numerical and experimental studies carried out by INSO in cooperation with Prof. R. Antonucci (Ancona) and ENEA.

(3) Other important Italian new and retrofitted public buildings. Filmed were also the following further important public buildings, which were provided, during construction or rehabilitation, with IAS systems in Italy:

- Five new buildings of University of Basilicata, erected in the middle of the years '90s, which were provided by with HDRBs manufactured by TIS, were subjected to on site-tests and equipped with a seismic monitoring system;
- The "La Vista" and "Domiziano Viola" schools at Potenza (Basilicata Region), which were just retrofitted by means of dissipative braces manufactured by TIS (Figure 4);
- The "Gentile Fermi" school at Fabriano (Ancona Province, Marche Region), an historic monument damaged by the 1999 Marche and Umbria quake, which was being seismically improved by means of viscoelastic ED devices of FIP Industriale (Figure 3);
- The "Rione Traiano" Civic Center at Soccavo, near Naples, a huge construction that had been completed just before the 1980 Campano-Lucano earthquake, but did not satisfy the seismic requirements imposed by the reclassification of the site after such an earthquake, the retrofit of which by cutting the supporting columns and inserting 500 HDBRs was approved by the Ministry of Constructions some months ago (filming of this important application, which concerns the first retrofit in Europe with SI, was recently performed by ALGA).

Applications of the IAS systems in other countries

The following structures of different kinds applying the IAS techniques, both new and retrofitted, were filmed in the San Francisco area (California), USA, in order to provide a few examples of what has been and is being done in countries other than Italy:

- The new Emergency Management Center of San Francisco (Figure 1), a very strategic reinforced concrete construction which was base isolated by means of rubber bearings to ensure its protection to extremely violent earthquakes;
- The Berkeley Civic Center, an important public and historic reinforced concrete structure, which was being retrofitted during filming by cutting the existing foundations and installing rubber bearings;
- The San Francisco City Hall, an important public and historic masonry structure damaged by the 1989 Loma Prieta earthquake, the retrofit of which by cutting the structure foundations and inserting rubber bearings had been recently completed;
- The San Francisco Asian Art Museum, a mixed masonry and steel structure which was being retrofitted during filming, again by cutting the foundations and inserting rubber bearings;
- The Market Street branch of Wells Fargo Bank, which was seismically rehabilitated using dissipative braces similar to those used in the Potenza schools;
- A three story apartment house at Marina, San Francisco, which was seismically retrofitted by means Friction Pendulum IAS system after the 1989 Loma Prieta earthquake that had broken its foundations.

The presence of Italian manufacturing industry abroad

(1) Applications in the USA. Filming concerned:

- The main bridges and viaducts of the San Francisco Bay Area (Bay Bridge, Golden Gate Bridge, San Rafael Bridge and Carquinez Bridge), which were being seismically retrofitted or might be retrofitted partly using

SI, or ED or HC devices manufactured in Italy (the Carquinez Bridge was filmed during installation of HC devices manufactured by ALGA);
- The Marin County Civic Center – Hall of Justice of San Rafael, which had to be seismically retrofitted by means of HC devices manufactured by FIP Industriale.

(2) Applications in Turkey. Filming concerned the Bolu viaducts of the Istanbul-Ankara freeway (Figure 2), equipped with EPDs manufactured by ALGA and other IAS devices manufactured by FIP Industriale, which had been struck by the August and November 1999 earthquakes, being the first structure in the world which did not collapse in spite of being located in the epicentral zone of a very violent earthquake and in spite of the fact that the earthquakes largely exceeded the design values [4].

The new bounds of research and application of the IAS systems

Filming concerned three key application fields for ensuring the success of the IAS techniques in Italy, namely cultural heritage, ordinary apartment buildings and industrial plants.

(1) Cultural heritage. Filmed were:
- "Il Cenacolo", a foundation of "Impresa Pouchain" for restoring activities, located at La Giustiniana, near Rome;
- The Upper Basilica of St. Francis at Assisi (Perugia Province, Umbria Region), which is the first cultural heritage construction that was seismically retrofitted with SMA devices (manufactured by FIP Industriale), in 1999, and as mentioned, had also been filmed by the Film Director E. Bellani in that year, during the installation of such devices and innovative shock transmitters (the latter had been developed in the framework of the EC-funded REEDS Project);
- The bell tower of the St. Giorgio in Trignano Church (San Martino in Rio, Reggio Emilia Province, Emilia-Romagna Region), severely damaged by the 1996 Reggio Emilia and Modena earthquake (it was cut into two pieces), which was also retrofitted using SMA devices of FIP Industriale in 1999 (it was the pilot application of the EC-funded ISTECH Project, aimed at developing SMA devices for the protection of cultural heritage [4]);
- The St. Feliciano Cathedral at Foligno (Perugia Province, Umbria Region), severely damaged by the 1997 Marche and Umbria earthquake (similar to the Upper Basilica of St. Francis), again an application of SMA devices of FIP Industriale, which was filmed in 2000 during their installation;
- The Church of St. Giovanni Battista at Apagni and that of Santa Lucia at Aggi (Perugia Province, Umbria Region), which will be rehabilitated by sub-founding them and using SI in the framework of the PROSEESM Project [1,2,5];
- The Basilica of Santa Maria di Collemaggio at L'Aquila, which is the most important example of romanesque style in the Abruzzo Region and was seismically improved using special non-invasive EPDs manufactured by ALGA;
- The worldwide famous Bronzes of Riace, which were seismically isolated using ALGA multistage HDRBs in the Museum of Reggio Calabria (Calabria Region);
- The Temple of Vesta at Rome, which was seismically improved using an IAS system conceived and manufactured by TIS;
- The "Fori Imperiali" at Rome, which were filmed to also cite the issue of protection of cultural heritage from traffic-induced vibrations;
- The village of Mevale di Visso (Macerata Province, Marche Region – see Figure 7), which was destroyed by the 1997 Marche and Umbria earthquake (similar to previous events) and is now being considered for reconstruction using the original masonry materials and SI based on the results of a feasibility study of ENEA, funded by the Technical and Scientific Committee of Marche Region [1,5].

(2) Ordinary apartment buildings. Filming concerned the still very few Italian apartment buildings which have been provided with IAS techniques, with the purpose of stimulating a wide extension of the number of applications in this field, following the example of Japanese and now, especially, Chinese, namely:
- A reinforced concrete apartment house at Squillace (Catanzaro, Calabria Region), base-isolated by means of ALGA HDRBs, which had also been subjected to forced vibration tests and provided with a seismic monitoring system (this house withstood a moderate earthquake shortly after its construction, without suffering any damage, contrary to a twin non-isolated house, which was slightly damaged) [4];
- Three reinforced concrete isolated apartment buildings at the Navy Base of Augusta (Siracusa Province, Sicily Region), isolated by means of ALGA HDRBs, which were erected, together with the already mentioned medical center, just after an earthquake that had caused significant damage to Augusta;
- A reinforced concrete isolated apartment building at Rapolla (Potenza Province) which was also subjected to on-site tests, together with a twin fixed-base building, with different SI systems (pictures of a film shot during these tests have been combined to our shots);
- The already mentioned three adjacent reinforced concrete apartment houses at Città di Castello (Perugia Province, Umbria Region), owned by IERP Perugia, which were filmed during installation of HDRBs

manufactured by ALGA (Figure 5);

- A reinforced concrete building at Fabriano (Ancona, Marche Region), severely damaged by the Marche and Umbria earthquake of 1997-1998, which, as already mentioned, is being retrofitted by constructing subfoundation, cutting foundation piles and inserting SI devices (HDRBs), being the first application of this kind in Europe and (after that at Soccavo) the second with SI;
- A masonry apartment building at Sigillo (Perugia Province, Umbria Region) and two similar buildings at Rome, provided with an innovative strengthening system, the so-called "Active Sewing Method for Masonry" (CAM – "Cucitura Attiva delle Murature" [6]), which were filmed during and after the seismic / static improvement works (Figure 6).

(3) Industrial plants. Although there are no industrial plants provided with the IAS systems in Italy (there are only some industrial buildings, provided with such devices), filmed were also some industrial facilities, both in the north of Italy (Friuli) and in the south (Sicily), in particular some high risk chemical plants and components, which are susceptible of a significant improvement of seismic protection, if constructed or retrofitted using SI and / or the other IAS techniques.

Structures provided by SSN with seismic monitoring systems

The following structures, provided with seismic monitoring systems, were filmed in addition to those provided with IAS systems, mentioned above, to also stress the importance of monitoring non-conventional constructions:

- The Institute "F. Momigliano" at "Parco di Villalago" (Piediluco, Terni Province, Umbria Region), which is an historic masonry building;
- The Ponte Cesi bridge of the Terni – Perugia highway;
- The main offices of IERP Perugia at Perugia (Umbria Region), which is a reinforced concrete building;
- The Zingone reinforced concrete bridge on the Savio river of the Provincial Road N. 138 (Forlì Province, Emilia-Romagna Region).

The pictures related to these shots were included in the film which was specifically assembled for SSN.

FILMS DEVELOPMENT AND AWARDS

Ten short films, lasting from 15 to 35 minutes, were mounted for the 10 major partners of the MUSICA Project in two versions, one with comments in Italian, the other with comments in English. They consisted in:

- the so-called "institutional" version of ENEA and GLIS ("*Advanced Tested Technology for Earthquakes*", namely "Le Moderne Tecniche Antisismiche");
- two slightly different versions of this for ENEL.HYDRO-ISMES and JRC Ispra;
- specific short films (some of which having a part in common with the institutional version) for the other partners.

In addition, the motion-picture "Le Forme della Momoria" ("*The Shapes of Memory"*), approximately one hour long, was mounted.

The short film "*Advanced Tested Technology for Earthquakes*" was submitted by ENEA to the "Seismos Awards" at the 12th European Conference of Earthquake Engineering in September 2002, together with the film "*Assisi. The Yard of Utopia"*: the experts attending the conference, taking into account both the technical and artistic issues, judged the latter as the overall best documentary and our short film as the best documentary on earthquake engineering and the third overall best documentary.

It has been planned to very soon restart activities, by assessing the montage a feature film, lasting approximately one hour and twenty minutes, a first draft of which was shown at Assisi on October 3, 2001, during the 7th International Seminar on Seismic Isolation, Passive Energy Dissipation and Active Control of Vibrations of Structures [2]. This feature film will be limited to the R&D on the IAS systems and their applications and will consist of some selected episodes, on the experimental laboratories or some important structures. Contrary to the short films and the motion-picture "The Shapes of Memory", it is characterized by mainly in screen comments. If possible, this feature film will be also updated, for instance with some new shots concerning the construction completion of the Città di Castello isolated houses and the retrofit works with SI that are in progress on that at Fabriano, as well as with the inclusion of new episodes concerning important applications recently approved by the Ministry of Constructions, namely the aforesaid retrofit works in progress at Fabriano and that on the "Rione Traiano" Civic Center at Soccavo.

It is planned to show at the Conference both the short film "*Advanced Tested Technology for Earthquakes*" and the motion-picture "*The Shapes of Memory"*.

CONCLUSIONS

The main features of the MUSICA Project and its development state have been presented. It has been stressed that, as a result of this Project, at set of short film and a motion-picture are already available on the development and application of the IAS techniques, which should be easily understood not only by experts, but also by the regular public.

The authors of this paper are confident that the aforesaid documentaries will significantly contribute to a wide information on the IAS techniques, by demonstrating that these techniques are already fully reliable, easy to be used and not costly and that what is only needed now is to ***apply them***. Thus, the authors are also confident that these films will significantly contribute to a wider extension of the application of the IAS techniques not only to important public buildings and bridges and viaducts, but also, as necessary and now fully feasible, to the cultural heritage and especially, the high risk industrial plants and ordinary apartment buildings: this will contribute to largely increase the protection of human life, in addition to economy, in seismic countries like Italy.

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ACKNOWLEDMENTS

The authors warmly thank the other Partners of the MUSICA Project for their cooperation.

Figure 1: Seismic isolation system (rubber bearings) of the new Emergency Management Center of San Francisco, California, USA (filmed in July 2000).

Figure 2: Viaduct of the Istanbul – Ankara freeway, provided with elastic-plastic dampers, which survived the 1999 earthquakes (filmed in May 2000).

Figure 3: Visco-elastic dampers installed in the Gentile Fermi school at Fabriano (a rare example of rationalist architecture), during seismic improvement works (filmed in 2001).

Figure 4: Dissipative braces installed in the Domiziano Viola school at Potenza, during seismic improvement works (filmed in June 2000).

Figure 5: High damping rubber bearing just installed in the apartment houses of IERP at Città di Castello (Perugia), as filmed in May 2001.

Figure 6: Application of the CAM method to the seismic improvement of a masonry apartment building at Sigillo (Perugia) (filmed during works in December 2000).

Figure 7a: View of the village of Mevale di Visso (Macerata) after the restoration performed to repair the serious damage caused by the Valnerina earthquake in 1979.

Figure 7b: Mevale di Visso, as destroyed again by the 1997 Marche and Umbria earthquakes, for which a feasibility study is in progress for its reconstruction with seismic isolation (filmed in 2000).