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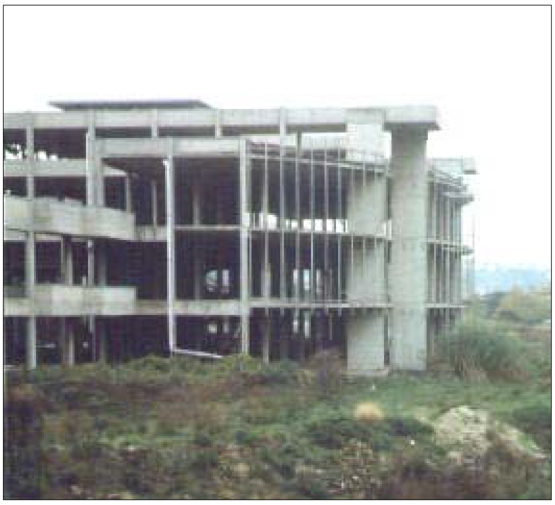
Il complesso Polifunzionale del Rione Traiano fu realizzato a Napoli prima del terremoto del 1980. A seguito della riclassificazione sismica della zona, il complesso risultò non in regola con le norme antisismiche e fu abbandonato. Ora è stato approntato un piano di adeguamento sismico che prevede l'inserimento alla base di un sistema di isolatori sismici elastomerici armati con piastre d'acciaio. Si tratta del primo '*retrofit*' effettuato in Italia e la sua importanza strategica è notevole. L'attività di recupero del complesso prevede anche l'esecuzione di prove di eccitazione forzata e caratterizzazione vibratoria in sito che saranno probabilmente eseguite dall'ISMES.



❒ **Tito Sanò** (*sanò@anpa.it*), **Giacomo Di Pasquale** (*dipasquale@ssn.dstn.pcm.it*)

Il nuovo presidio ospedaliero attualmente in fase di realizzazione a Frosinone, sarà dotato di un sistema isolamento alla base formato da isolatori sismici in gomma armata con piastre d'acciaio.

❒ **Rodolfo Antonucci** (*stalb1@reteitalia.net*)

La scuola media "Gentile Fermi" di Fabriano è un edificio costruito negli anni 50 con struttura in c.a. e rappresenta uno dei pochi espressivi esempi d'architettura razionalista a Fabriano. Nel terremoto Umbro-marchigiano del 1997 ha subito seri danni sia alle strutture sia al portato. L'Amministrazione Comunale ha deciso di impostare un progetto di recupero e d'adeguamento sismico, che è in fase di realizzazione e prevede l'utilizzo di dissipatori energetici viscoelastici .

❒ **Agostino Marioni** (*a.marioni@alga.it*)

Esperti del GLIS hanno predisposto un documento che servirà come base per la preparazione della normativa Europea dei dispositivi antisismici che è attualmente in fase di elaborazione da parte del CEN TC 167 / SC1 (comitato tecnico del CEN).

❒ **Alessandro Martelli** (*martelli@bologna.enea.it*)

Informazioni relative **all'International Post-SMiRT Conference Seminar on SEISMIC ISOLATION, PASSIVE ENERGY DISSIPATION AND ACTIVE CONTROL OF VIBRATIONS OF STRUCTURES,** ***Cheju, Korea, August 23 to 25, 1999.***

❒ **Massimo Forni** (*forni@bologna.enea.it*)

Un articolo, pubblicato sul *Monitore Tecnico* del 1912, dimostra come 'normativa antisismica' e 'ricostruzione' costituiscano mali cronici dell'Italia.

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L'ADEGUAMENTO SISMICO MEDIANTE ISOLAMENTO ALLA BASE DEL CENTRO POLIFUNZIONALE DI SOCCAVO - NAPOLI

La realizzazione del complesso Polifunzionale al rione Traiano in Napoli, intrapresa verso la metà degli anni '70 dall'Amministrazione Comunale, fu interrotta, a causa della mancanza di fondi, quando erano ultimate solo le strutture in c.a.. Oggi l'Amministrazione ne ripropone il completamento conservando quanto dell'opera finora è stato realizzato.

Trattandosi di opera non completata nei due anni successivi all'entrata in vigore dell'attuale normativa sismica, incorre nell'obbligo dell'adeguamento strutturale. Un accurato esame dello stato del manufatto e del suo progetto originario conduce alle seguenti considerazioni.

1. L'ossatura portante del fabbricato si presenta in uno stato di conservazione piuttosto disomogeneo. In particolare, mentre si mostrano buone le condizioni degli elementi verticali (pilastri, setti, muri di contenimento), desta una certa preoccupazione la conservazione delle armature dei solai e delle travi.
2. La struttura fu progettata per i soli carichi verticali, non essendo all'epoca Napoli zona sismica. Il comportamento a telaio dell'ossatura portante non fu, pertanto, preso in esame.
3. Un ulteriore elemento concorre a destare preoccupazione sulla risposta sismica : la complessità del progetto originario, che si concretizza in grosse discontinuità degli orizzontamenti, alternanza di tipologie costruttive (c.a. ordinario, c.a.p. prefabbricato ed acciaio) ed, in alcuni punti, nell'estrema vulnerabilità dei nodi trave – pilastro. Tutto ciò rende gran parte della struttura realizzata completamente priva di quella duttilità che costituisce la principale riserva di sicurezza in caso di sisma.

L'unica via sicura di adeguamento è pertanto quella che oltre al rinforzo dei principali elementi strutturali prevede la drastica riduzione delle forze generate dalle accelerazioni sismiche del suolo.

L'intervento previsto si compone delle seguenti fasi esecutive :

1. Rinforzo dei pilastri fra le quote -5.00 e +18.00.
2. Montaggio di un graticcio metallico di irrigidimento a quota -4.00
3. Sconnessione dell'edificio dai volumi di riempimento adiacenti le pareti di contenimento in c.a. perimetrali.
4. Puntellatura e taglio alla base delle strutture verticali in c.a. con enucleazione di un piccolo volume di calcestruzzo da sostituire con gli isolatori.
5. Introduzione degli apparecchi di appoggio isolanti ad elevato smorzamento mediante l'impiego di attrezzature idrauliche servo assistite in grado di evitare possibili traumi alla struttura in elevazione.
6. Completamento del nuovo impalcato metallico.
7. Realizzazione di nuove solette a tutti i piani onde integrare le esistenti nella funzione di lastra orizzontale.
8. Ripristino delle strutture in conglomerato deteriorate dalla ossidazione delle barre d'armatura.

Per quanto riguarda le procedure di progetto ci si è attenuti alle ***LINEE GUIDA PER PROGETTAZIONE ESECUZIONE E COLLAUDO DI STRUTTURE ISOLATE DAL SISMA,*** redatte a cura del Servizio Tecnico Centrale presso la Presidenza del Consiglio Superiore del LL.PP. che al momento rivestono il ruolo di suggerimenti.

Lo spettro elastico di risposta locale è stato preso dall'EC8 in quanto risulta più severo.

Trattandosi di intervento di *Retrofit* la definizione dei parametri del sistema di protezione passa anche attraverso la valutazione delle capacità strutturali dell'organismo su cui si opera. In questo senso la valutazione delle caratteristiche del sistema di isolamento deve essere preceduta dall'acquisizione delle caratteristiche geometriche fisiche e meccaniche della struttura in questione.

Tale fase ha richiesto la definizione di un accurato piano di indagini in sito. Tale piano d'indagini è oggi al vaglio della ISMES di Bergamo che ha ricevuto mandato esplorativo.

L'analisi preliminare è stata svolta su SAP2000N Ver. 6.11

Complessivamente il modello è composto di oltre 15,000 entità (Nodi, frame, shell).

Le analisi su modello semplificato suggeriscono per la struttura esistente un periodo proprio T_0=1.025 s.

Sulla base delle prime verifiche svolte sulle capacità resistenti della struttura esistente si ritiene accettabile la scelta di un valore del fattore di isolamento c=0.18.

Da questo consegue la necessità di progettare il sistema di isolamento in modo che il complesso raggiunga un periodo proprio almeno pari a T_0= 1.795 sec.

Il peso totale a *pieno carico* dell'edificio ammonta a W=52,800 Tonn.

Si evince quindi che il sistema di isolamento deve avere una rigidezza totale di 65,950 T/m.

Si è fatto riferimento, ai fini di rendere attuale la stima economica dell'intervento, agli apparecchi di appoggio prodotti dalla Alga S.p.A. di Milano.

Il progetto del sistema di isolamento, con la conseguente introduzione di un nuovo impalcato a q. -3.70, insieme alle nuove strutture orizzontali per le biblioteche ed il cinema hanno determinato un riassetto dei carichi verticali in fondazione con la conseguente necessità di rinforzare parte dei plinti di fondazione.

Per tutti i pilastri è stato previsto l'interventi di rinforzo atto ad integrare le armature presenti con quelle necessarie al conseguimento dei minimi da normativa.

L'intervento tipo prevede per tale rinforzo la realizzazione di fasciature delle sezioni in c.a. con profilati d'acciaio angolari di dimensioni appropriate, saldati con idonei calastrelli in modo da assorbire l'intera eccedenza di flettente rispetto ai valori del progetto originario.

Al fine di solidarizzare l'intera struttura conferendole un comportamento monolitico nei confronti delle oscillazioni nel piano di isolamento è stata prevista la reliazzazione di solette armate a tutti i piani.

Lo spessore previsto, pari a 4 cm., consente di tenere il nuovo elemento strutturale all'interno del pacchetto destinato alla pavimentazione che pertanto dovrà essere direttamente incollata su di essa.

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IL NUOVO OSPEDALE DI FROSINONE DOTATO DI ISOLAMENTO SISMICO ALLA BASE

The new Hospital in the town of Frosinone will be seismically protected by a base isolation system made of high damping steel laminated rubber bearings. Frosinone is located 80 km south of Rome in a seismically prone area, belonging to medium seismic Italian category (S=9).
The Lazio Region, with the agreement of the Ministry of Public Health, chose to use part of the economic resources available in the national plan for the sanitary buildings to design and build a prototype of seismically protected hospital. In this context the Region involved the the National Seismic Survey and the Chieti University as consultants. Such Institutions are collaborating with the designer, Studio Speri s.d.i., for the following activities:

- Definition of the seismic input motion, geothecnical investigations and analyses of the local amplification,
- Feasibility study of the isolation system,
- Conceptual structural design and functional analysis,
- Criteria for structural, non structural elements and equipment design.

The hospital is composed of three blocks having rectangular plans (two 58 x 30 m and one 22 x 30 m), eight floors above grade and a common floor below grade. The whole structure is in reinforced concrete. The total volume is approximately 160.000 m^3 and each typical elevation floor has approximately 3650 square meters. Each block is separated from the adjacent ones by structural joints which are suitably dimensioned to accommodate the expected seismic relative displacements. The common floor contains most of the equipment and its base is about 60 meters wide, larger than the whole base of the three blocks. Isolation devices will be located under the base of the common floor at about 8 meters below grade. The design of the structure and of the isolation system is made according to the Italian Seism Code (D.M. 16 Jan. 1996) and to the "Guidelines for design, execution, testing of seismic isolated structures "(in Italian) drafted by the Ministry of Public Work on June 1996. The design criteria, fixed by the guidelines for strategic buildings are:

- Structure, systems and component shall remain functional after an event having a return period of 300 years;
- Structure, systems and component shall not collapse after an event having a return period of 1000 years.

Further criteria, fixed specifically for this prototype by the Region and University of Chieti, have been:

- Structure systems and component shall remain functional or quickly repairable after an event having the probability to occur grater than 10% in 50 years (Tr=475 years).
- Structure systems and component shall not collapse after an event having the probability to occur greater than 2% in 50 years (Tr=2500 years).

The feasibility study has been already finished and the final design is under completion. The following activities have been already carried out:

- Geological and geotechnical investigations, definition of the seismogenic zones and structures of interest,
- Seismic historical analysis on all the events which have stricken the area of Frosinone.
- Hazard analysis and definition of design spectra for different probability of occurrence .
- Amplification analyses and definition of the site specific spectra

Sensitivity analyses of the hazard results to model hypotheses (seismic zonation, attenuation law, seismic rates determination).

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ADEGUAMENTO SISMICO DELLA SCUOLA MEDIA "GENTILE FERMI" IN FABRIANO (AN) MEDIANTE L'USO DI DISSIPATORI D'ENERGIA VISCOELASTICI

La scuola media "Gentile Fermi" di Fabriano è un edificio costruito negli anni 50 con struttura in c.a. e rappresenta uno dei pochi espressivi esempi d'architettura razionalista a Fabriano. Durante il terremoto Umbro-marchigiano del 1997 ha subito seri danni sia alle strutture sia al portato. L'Amministrazione Comunale ha deciso di impostare un progetto di recupero e d'adeguamento sismico in considerazione anche che, quando fu costruito il fabbricato, la città di Fabriano non era compresa fra le zone dichiarate sismiche.
Allo scopo è stata improntata una campagna di rilievi ed indagini sia per definire la struttura sia per conoscere le caratteristiche elastomeccaniche dei materiali strutturali in opera. La fase conoscitiva è stata completata da un'analisi numerica della struttura sottoposta alle sollecitazioni sismiche di norma.
Le informazioni ottenute sono:
- l'armatura presente (acciaio omogeneo), sia per quantità sia per disposizione, non è in grado di fornire un'adeguata duttilità e resistenza;
- il calcestruzzo è di qualità scadente, più precisamente il carico di rottura è stato stimato di 14.4 N/mm^2 per il piano terra, 12.5 N/mm^2 per il primo piano e di 8.5 N/mm^2 il secondo piano;
- la struttura, per le dimensioni contenute dei pilastri, è molto deformabile;
- le sollecitazioni nel cls. raggiungono valori incompatibili con la qualità del materiale in opera.

Per adeguare l'edificio si è deciso di inserire una serie di controventi dotati di dispositivi dissipatori viscoelastici costituiti da gomme naturali soffici opportunamente additivate al fine di aumentarne la dissipazione energetica.

Approccio teorico

La teoria alla quale si è fatto riferimento nel progetto dell'adeguamento sismico della scuola, è quella sviluppata da alcuni ricercatori presso la State University of New York di Buffalo, USA.
Date le grandi incertezze nell'analisi del comportamento dinamico di una struttura sottoposta a sollecitazione sismica e la complessità nel descrivere il comportamento dei materiali viscoelastici stessi, la teoria che è stata sviluppata si basa su un approccio di tipo energetico al problema cioè sul metodo dell'energia di deformazione modale (modal strain energy method) e quindi lo smorzamento della struttura può essere descritto da uno smorzamento equivalente dato dal rapporto tra energia dissipata ed energia elastica accumulata dalla struttura (per un oscillatore a più gradi di libertà si può utilizzare uno smorzamento modale con le energie dissipate e di deformazione associate a ciascun modo di vibrare). Il valore calcolato per lo smorzamento modale non tiene però conto di un ipotetico valore iniziale che potrebbe essere non trascurabile in strutture in c.a. o in muratura.
La teoria è stata rivista svolgendo un'analisi modale con matrici complesse per modellare al meglio il materiale viscoelastico e tenendo in conto la presenza dello smorzamento iniziale della struttura. In questo modo si giunge alla definizione di una relazione diretta tra la rigidezza del dissipatore e quella della struttura in funzione, dello smorzamento finale che si vuole raggiungere. La relazione contiene un fattore, detto 'loss factor', che dipende dalle caratteristiche dissipative del materiale utilizzato nei dissipatori.
In una struttura reale i dissipatori sono montati su dei controventi generalmente metallici che avranno una loro rigidezza traslazionale alta ma non infinita. Nella teoria qui descritta va considerato che è stato del tutto trascurato la presenza dei controventi supponendo che questi fossero di rigidezza infinita.

Considerando che nel controvento non ci sia dissipazione il sistema controvento + dissipatore può essere modellato mediante un semplice sistema formato da una molla di rigidezza in serie ad una coppia molla/smorzatore viscoso in parallelo.

Procedimento di progetto

Viste le formule teoriche utilizzate vediamo il processo di progetto utilizzato per determinare le caratteristiche dei dissipatore per la struttura in oggetto.
Fissato il valore di smorzamento originale pari al 5% , il loss factor dei materiale pari a 0.5, si è determinata la rigidezza di ogni piano della struttura nuda e la rigidezza dei controventi ; vengono dati valori crescenti alla rigidezza dei dissipatori, per ogni valore si calcola il valore della rigidezza dei sistema controvento + dissipatore e quindi il valore dello smorzamento della struttura, si procede quindi finché tale ultimo valore non raggiunge il valore di 20% scelto quale obbiettivo dell'adeguamento.
Il passo successivo è stato quello di eseguire una serie di analisi numeriche con più accelerogrammi.
I risultati di questa analisi hanno confermato l'efficacia dell'intervento poiché i valori delle sollecitazioni nel cls sono rientrati nei valori prefissati come accettabili nella quasi totalità delle sezioni, limitando quindi gli interventi

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EN 1998 EUROCODE 8 – REVISION PART 2 CHAPTER 7

Structures with antiseismic devices

1. Scope

This chapter provides the basis for the design, production, testing and utilisation of antiseismic devices used to connect structural elements of structures in seismic regions to increase their stability.

2. Normative References

All parts of EN 1337 Structural Bearings:

EN 1337.1 General design rules
EN 1337.2 Sliding elements
EN 1337.3 Elastomeric bearings
EN 1337.4 Roller bearings
EN 1337.5 Pot bearings
EN 1337.6 Rocker bearings
EN 1337.7 PTFE spherical and cylindrical bearings
EN 1337.8 Guide bearings and restraint bearings
EN 1337.9 Protections
EN 1337.10 Maintenance and replacement
EN 1337.11 Handling, transport and installation

3. Definitions and symbols

3.1 Definitions

Isolation System: complex of devices that permits decoupling a structure's prevailing mass from ground motion to ensure the following four main functions:

- Support the gravity loads
- Provide lateral flexibility
- Provide restoring force
- Provide energy dissipation

Antiseismic devices: devices that significantly influence the seismic response of a structure. The modification of the response may be obtained by:

- shifting the natural period and/or
- increasing the damping capacity of the structural system and/or
- limiting the forces transmitted between the connected parts of the structural system

The most usual types of Antiseismic Devices are described in Annex B.

Isolator: device that incorporates the four main functions of an isolation system within one unit.

Linear devices: devices whose load vs. deflection curve approximates a straight line between zero and the maximum force $\pm F_{max}$. so the following conditions are met:

- the actual force ~~F~~ for any deflection up to $\pm F_{max}$ does not vary from the linearity more than $\pm 0{,}2F_{max}$.
- $\xi_I \leq 10\%$

Non-linear devices: antiseismic devices that cannot be defined as linear.

Velocity independent devices: antiseismic devices whose characteristic strength F_0 varies less then ±5% when subject to a dynamic loading within the frequency range 0,3÷1 Hz in comparison with a quasi-static load application.

Velocity dependent devices: antiseismic devices that cannot be defined velocity independent.

Characteristic strength: the reaction F_o of the antiseismic device at zero displacement on the hysteresis loop (see Fig.1).

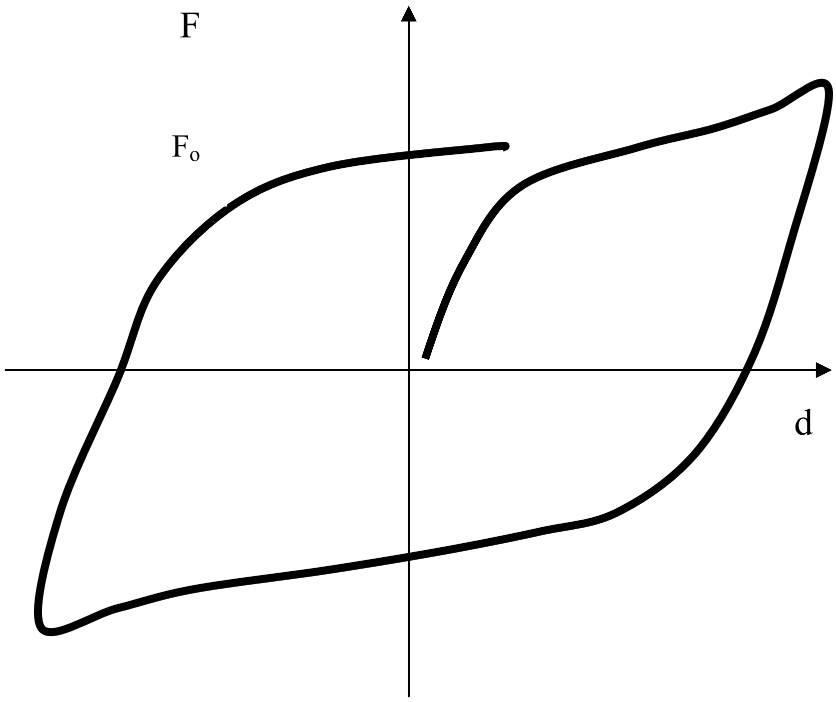

Figure 1.- Experimental definition of Characteristic Strength F_o for an Isolator

3.2 Symbols
d_E maximum displacement resulting from the seismic analysis
d_G displacement due to permanent or quasi permanent actions (e.g. post-tensioning, shrinkage and creep for concrete decks)
d_{Ts} combination value of the thermal displacement according to Part 2, Clause 2.3.6.3
F_{max} the reaction of an antiseismic device when deflected at displacement d_E
V_{max} the maximum unfactored vertical load acting on an isolator under seismic conditions
V_{min} the minimum unfactored vertical load acting on an isolator under seismic conditions

4. Requirements

4.1. Performance stability
The behaviour of the device shall be stable under repeated cyclic loading at the design displacement. The device is considered stable when the following requirements are met:
- the maximum deviation of the Characteristic Strength in the fully reversed cycles 4th to 20th is not greater than 10% of the value obtained during the 3rd cycle;

-the energy dissipated in the fully reversed cycles 4th to 20th is not lesser than 90% of the energy dissipated in the 3rd cycle;*)*

4.2. Resistance
The devices shall be able to resist 20 cycles at displacement d_E plus 1 cycle at $1,5d_E$ or $1,5\ F_{max}$ whichever applicable.
If the devices are isolators 10 cycles shall be performed with vertical load $0,8V_{min}$ and 10 with vertical load $1,2\ V_{max}$
Cycle 21 shall show an absolute variation of the force not greather than 15%-from the 3rd cycle up to d_E displacement and a monotonic force increase up to $1,5d_E$ or $1,5\ F_{max}$. Vertical load shall be equal to $V_{max.}$ All fixing shall resist the maximum forces attained in cycle 21

4.3 Replaceability
Antiseismic devices and structures shall be designed so that devices or parts of them can be inspected, maintained and replaced if necessary, in order to enable them to fulfil their function throughout the intended life of the structure.

4.4 Resistance to corrosion and environmental effects
The devices shall be protected by the corrosion in accordance with EN 1337.9.
If the performance of the devices is influenced by ageing and temperature effects by more than ±5%, the manufacturer shall define by tests the performances:

- at the extremes temperatures of utilisation
- at the maximum expected age of the device

If not differently agreed the maximum expected age of the device is 60 years; the behaviour of the device after 60 years may be estimated through suitable accelerated ageing tests and extrapolation of the results.
The extreme performance values shall be considered for the design of the structure.
The influence of ageing and temperature effects on steel devices may be ignored.

4.5 Particular requirements for service conditions
All the antiseismic devices of an isolation system shall not impair the performance of the structural system under service (non seismic) conditions.
Isolators shall fulfil the requirements of the relevant parts of EN1337 in non seismic conditions.

4.7. Particular requirements for shock transmitters
For slow movement test the reaction of the shock transmitter shall not fluctuate more than ± 10% from the average reaction. The design reaction of the device shall be assumed as the average reaction multiplied by 1,1 obtained from test at the lowest foreseen temperature.

5. Design of the devices

5.1. General
All fixings of the devices to the structure shall be verified for ULS considering an overstrength factor $\gamma_0 = 1,2$

5.2. Particular requirements for isolators
The design of the parts of the isolators bearing the vertical load shall be made in accordance with the relevant parts of EN 1337 under non seismic conditions.

6. Design of the structure

6.1. Design seismic action

6.1.1 Design spectra

Properly substantiated site-specific spectra with 5% damping are required for the design of structures with a fundamental period of the isolated structure (effective period) T_I greater than 3.0 seconds, or located on a soil type C or a softer soil, or located within 15 km of an active fault. Such spectra shall not be taken less than the normal elastic site dependent spectra defined by Part 2, Clause 3.2.2 which may be used for the design of all other bridges. The effect of distant sources (around 100 km) shall be taken into account in the definition of site-specific spectra, since they may radiate significant energy at periods of few seconds.

6.1.2 Time-history representation

Time histories shall be selected according to the general criteria of annex E, with the particular provisions reported below.

Accelerograms shall be consistent with the chosen response spectrum referred to a 5% damping ratio for period longer than 0.15 sec. Such consistency shall be verified with respect to the following characteristics:

a-the duration of the strong part shall be greater than 10 seconds,

b-the average 5%-damped response spectrum of the accelerograms does not fall below the 5%-damped design spectra by more than 20% .

c-the average 5%-damped response spectrum does not fall below the 5%-damped design spectra by more than 10% in the period range from 0.7 T_{fb} (natural period of the pier without deck or of the fixed base structure) to 1.2 T_I.

Provisions b and c substitute those contained in par. E.4.

The duration of time-histories shall be consistent with the magnitude and source characteristics of the design earthquake. Time-histories developed for sites within 15 km of a major active fault shall incorporate near-fault phenomena.

6.2. Method of analysis

6.2.1 Full or partial isolation

Full isolation of a structure is achieved if under the design seismic action the structure -with the possible exception of the isolation system itself- remains within the elastic range. In the opposite case the structure is considered as partially isolated.

In the case of full isolation and of linear isolation devices equivalent linear response spectrum analysis (Fundamental or Multimode Analysis) can be used. In this case the effective secant stiffness of the isolation system at the design displacement may be applied under the additional conditions mentioned in Clauses 6.2.2 and 6.2.3 below. In the case of partial isolation, or of non linear devices, non-linear time-history analysis shall be used.

6.2.2 Fundamental mode method

This method may be used when the following criteria are met:

a. General criteria

a.1 The distance of the structure site from the nearest active fault is greater than 15 km.

a.2 The soil category is A or B.

a.3 The effective period T_I does not exceed 3.0 seconds,is at least three times the highest period of the piers without deck

a.4 The criteria of Part 2, Clause 4.2.2.2 (a) to (c) are met.

b. Criteria regarding the antiseismic devices

b.1 The antiseismic devices shall be linear

6.2.3 Response spectrum analysis

This method may be used when designing for full isolation if criterion (b) of the previous clause is met.

6.2.4 Procedure of the response spectrum analysis

Multimode and fundamental mode response spectrum analysis shall be performed using the effective damping ξ_I (in %) of the antiseismic devices, at an amplitude equal to the design displacement, in the period range of $T \geq 0.8T_I$. In the period range $T < 0.8T_I$, the damping of the structure without devices shall be used.

The modification factor η_I of the spectral values for $\xi_I \neq 5\%$ shall be taken as :

$\eta_I = (7.0/(2+\xi_I))^{0.35} \geq 0{,}7$ (6.1)

The combination of the two horizontal components of the seismic action shall follow the rules of Part 2, Clause 4.2.1.4.

Torsional effects according to Part 2, Clause 4.1.5 and 4.2.2.5 shall be considered.

6.2.5 Time-history analysis

Time-history analysis may be used in all cases.

Each pair of time-histories shall be applied simultaneously. The results of the analyses shall be used according to clause E.5 of annex E .

6.3. Modelling

6.3.1 Antiseismic devices

When a linear analysis is carried out (either fundamental mode, response spectrum or time history) the antiseismic devices shall be modelled using the minimum effective secant stiffness (K_{min}) at the maximum design displacement considering extreme ageing and environmental effects.

The model of the isolation system shall be able to account for the effects of vertical load, and/or the rate of loading if the force deflection properties of the antiseismic devices are strongly dependent on one or the other of these attributes.

When the response spectrum analysis or linear time-history analysis is used, the model of the isolation system shall also be able to :

- Account for the spatial distribution of isolator units
- simulate the actual behaviour of the devices subjected to displacements in both horizontal directions and to rotation about the vertical axis.

When non linear analysis is performed the model of the isolation system shall also be able to account for the modifications due to ageing and temperature effects, possibly by parametric analyses.

6.3.2 Structure

When the fundamental mode method or the response spectrum analysis is used the linear model of the structure above and below the antiseismic devices interface shall reflect the actual distribution of the stiffness and mass. For reinforced concrete piers and abutments the possibility of using the stiffness of the uncracked sections shall be evaluated considering their actual state of stress.

When non-linear time history analysis of a partially isolated structure is performed, the deformation characteristics of the yielding elements (piers) shall adequately approximate their actual post-elastic behaviour.

6.4. Verification

6.4.1 Structure with full isolation

The design seismic action effects (E_{Id}) on the isolated structure, above and below the isolation interface, shall be determined as:

$$E_{Id} = \gamma_{oI} E_I \qquad (6.2)$$

where E_I are the action effects resulting from the analysis of the isolated structure and γ_{oI} is an overstrength factor to be assumed equal to:

- $\gamma_{oI} = 1.10\ K_{max}/K_{min}$ when a linear analysis is carried out.
- $\gamma_{oI} = 1.0$ when a non linear analysis is carried out, to be applied to the worst situation from the parametric analyses (clause 6.3.1).

6.4.2 Structure with partial isolation

The flexural strength of the sections of the intended plastic hinges shall be verified using design action effects determined from equation (6.2) with $\gamma_{oI} = 1$ and considering the worst situation from the parametric analyses (clause 6.3.1).

All other design of sections shall be effected according to Part 2, Clauses 5.6.3.2, 5.6.3.3 and 5.6.3.4 using capacity design effects based on the overstrength of the intended plastic hinges, according to Part 2, Clause 5.3

The detailing rules for ductility in the regions of plastic hinges, according to Part 2, Clause 6.2 shall be applied.

Ductility demands in terms of curvature or rotational ductility exceeding the value of 13 shall be specifically checked against the available ductility.

6.4.3 Antiseismic devices

The total design displacement of the antiseismic devices (d_{Exd}) under seismic conditions shall be estimated as follows:

$$d_{Exd} = d_E + d_G + d_{Ts} \qquad (6.3)$$

Adequate clearances shall be provided to accommodate the total design displacement amplified by factor 1.2.

7. Conformity evaluation of the devices

7.1 General

The tests and inspections specified in this clause shall be carried out to demonstrate conformity of the antiseismic devices with the requirements stated in Clause 4

7.2 Control of the construction product and its manufacture

The extent and frequency of the factory production control by the manufacturer as well as controls during type-testing and audit-testing by a third party shall be conducted in accordance with Table 1. In addition, it shall be checked by controlling the inspection certificates that the incoming raw materials and components comply with the relevant standard or manufacturer's specification.

Factory production control procedures shall be in accordance with Annex A.

Type-testing shall be performed prior to commencing the manufacture. It shall be repeated if changes in the construction product or manufacturing process occur.

Audit testing may be required for the purpose of checking the construction product as well as verifying test results recorded in the documentation of the factory production control or declared in inspection certificates.

7.3 Raw materials and constituents

Compliance with the requirements given by the relevant standard if applicable or by the manufacturer's technical specifications shall be verified by means of inspection certificates in accordance with EN 10204 and Annex A.

7.4 Particular statements for isolators
The parts of isolators bearing the vertical load shall fulfil the conformity evaluation given in the relevant parts of EN 1337

Table 1 - Testing on devices

Test See Parag.	Type of control	Device	Frequency
8.1	Type test	All devices except hysteretic dampers	once
	Factory production control	All velocity dependant devices	20%
8.2	Type test	Hysteretic dampers	once
	Factory production control	All velocity independent devices except hysteretic dampers	20%
		Hysteretic dampers	1%
8.3	Type test	All devices	Once
8.4	Type test	Non metallic materials	once
8.5	Type test	Non metallic materials	once
8.6	Type test	Shock transmission unit (test at ambient + low temperature)	once
	Factory production control	Shock transmission unit ambient temp. low temperature	20% 1 per lot (1)

Note : If it can be demonstrated that the heat generated during testing is not affecting the behaviour of the device, type test on devices may be made on scaled specimens within the scale range 3:1 to 1:3.
Devices subjected to type test shall not be incorporated in the structure.

8. Testing of the devices

8.1. Dynamic load-deflection characteristics
Unless otherwise required:
- Frequency shall be 0.5 Hz
- Application of deflection shall be sinusoidal
- Number of fully reversed cycles shall be 20

8.2. Quasi-static load-deflection characteristics
- The deflection shall be applied at a velocity not greater than 1 mm/s
- Displacement shall be ± design displacement
- Number of fully reversed cycles shall be:

20 for type test
3 for routine test

8.3 Cycle 21
Where applicable cycle 21 shall be performed at velocity not greater than 1 mm/s.

8.4 Ageing tests

Ageing tests shall be performed on non-metallic materials.
The effects on the devices may be evaluated through tests on the relevant mechanical properties of material specimens.
As an example ageing tests on shear modulus and damping on rubber specimens may be applied to evaluate the variation on load-deflection characteristics and damping on devices. Normally the ageing is accelerated by heating.
Heating shall not be excessive in order not to damage the specimens.
It shall be demonstrated by application of the Arrehnius low or similar that the accelerated ageing corresponds to the foreseen period.
Values shall be obtained as average of at least 3 specimens.

8.5 Effects of temperature variations
Effects of temperature, shall be evaluated in non metallic materials.
The effect on the devices may be evaluated through tests on the relevant mechanical properties of material specimens.

8.6 Slow movement of shock transmission units
Slow movement at velocity of 0.01 mm/s ± 5% shall be applied to the device for a fully reversed cycle.

9. Transport, storage and installation of the devices

The general requirements given in EN 1337.11 shall be fulfilled.
The installation shall be made in accordance with a method statement issued by the manufacturer

10. Maintenance of the devices

The general requirements given in EN 1337.10 shall be fulfilled.
A specific maintenance manual shall be issued by the manufacturer

Annex A (normative)

Factory production Control (FPC)

A.1 General

A.1.1 Objects
The manufacturer shall exercise a permanent FPC 8e.g. a quality management system based on the relevant part of the EN ISO 9000 series, or otherwise).
The manufacturer is responsible for organising the effective implementation of the FPC system.
Tasks and responsibilities in the production control organisation should be documented and this documentation should be kept up-to-date. In each factory the manufacturer may delegate the action to a person having the necessary authority to:

a) identify procedures to demonstrate conformity of the construction product at appropriate stages;
b) identify and record any instance of non-conformity;
c) identify procedures to correct instances **of** non-conformity.

A.1.2 Documentation

The manufacturer should draw up and keep up-to-date documents defining the FPC which he applies.
The manufacturer's documentation and procedures should be appropriate to the construction product and manufacturing process. Ali FPC systems should achieve an appropriate level of confidence in the conformity of the construction product. This involves:

a) the preparation of documented procedures and instructions relating to FTP operations, in accordance with the requirements of this European Standard (see 1.3);
b) the effective implementation of these procedures and instructions;
c) the recording of these operations and their results;
d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary revise the FPC to rectify the cause of non-conformity.

A.1.3 Operations

FPC includes the following operations:

a) the verification and verification of raw materials and constituents;
b) the controls and tests to be carried out during manufacture of the construction product according to a frequency laid down;
c) the verifications and tests to be carried out on finished construction products according to a frequency which may be laid down in the technical specifications and adapted to the product and its conditions of manufacture.

NOTE: the operations under b) centre as much on the intermediate states of the construction product as on manufacturing machines and their adjustment, and equipment etc. These controls and tests and their frequency are chosen based on type of construction product and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters etc.

- with regard to operations under c), where there is no control of finished construction products at the time that they are placed on the market, the manufacturer shall ensure that packaging, and reasonable conditions of handling and storage, do not damage construction products and that the construction product remains in conformity with the technical specifications.
- The appropriate calibration must be carried out on defined measuring and test instruments.

A.2. Verifications and tests

A.2.1 General comments

The manufacturer shall have or have available the installations, equipment and personnel which enable him to carry out the necessary verifications and tests. He may, as may his agent, meet this requirement by concluding a sub-contracting agreement with one or more organisations or persons having the necessary skills and equipment.
The manufacturer shall calibrate or verify and maintain the control, measuring or test equipment in good operating condition, whether or not belongs to him, with a view to demonstrating conformity of the constructions product with its technical specification. The equipment shall be used in conformity with the specification or the test reference system to which the specification refers.

A.2.2 Monitoring of conformity

If necessary monitoring is carried out of the conformity of intermediate states of the product and at the main stages of its dispatched.
This monitoring of conformity focuses where necessary on the construction product throughout the process of manufacture, so that only product having passed the scheduled intermediate controls and tests are dispatched.

A.2.3 Tests

Tests should be in accordance with the test plan (table 1) and be carried out in accordance with the methods indicated in this European Standard.

NOTE: initial type tests on the product may not be carded out by the manufacturer himself but may be carried out or validated by an approved body.

The manufacturer should establish and maintain records which provide evidence that the construction products have been tested. These records should show clearly whether the construction products has satisfied the defined acceptance criteria. Where the construction products fails to satisfy the acceptance measures, the provisions for non-conforming products should be applied.

A.2.4 Treatment of construction products which do no conform

If control or test results show that the construction product does not meet the requirements, then necessary corrective action shall immediately be taken. Construction products or batches not conforming shall be isolated and properly identified. Once the fault has been corrected, the test or verification in question shall be repeated.
If construction have been delivered before the results are available, a procedure and record should be maintained for notifying customers.

A.2.5 recording of verifications and tests (manufacturer's register)

The results of factory production controls shall be properly recorded in the manufacture's register. The construction proper description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the register under the signature of the person responsible for control who carried out the verification.
With regard to any control result not meeting the requirements of this European Standard, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, scrapping or rectifying the product) shall be indicated in the register.
In case of third party surveillance the records shall be made available to the third party for examination.

A.3. Traceability

It is the manufacturer's, or his agent's, responsibility to keep full records of individual construction products or product batches, including their related manufacturing details and characteristics, and to keep records of to whom these construction products or batches were first sold. Individual construction products or batches and the related manufacturing details shall be completely identifiable and retraceable. In certain cases, for example for bulk products, a rigorous traceability is not possible.

Annex B (informative)

Types of Antiseismic Devices

The most usual types of Antiseismic Devices are described below.

Shock Transmission Unit (STU): device that offers no appreciable resistance to low speed movements and become very rigid with high speed movements, thus acting as temporary restraint between adjacent structural members.
Steel Hysteretic Damper (SHD): device that dissipates mechanical energy through plastic deformation of steel elements.
Friction Damper : device that dissipates mechanical energy through the friction developed between two solid bodies sliding relative to one another.
Viscous Fluid Damper (VFD): device that dissipates mechanical energy by forcing a viscous fluid through a suitable valve or orifice system.
Visco - Elastic Damper (VED): device that dissipates mechanical energy through visco – elastic properties of special polymers.
Shape Memory Alloy based Device (SMAD): device that dissipates mechanical energy through the stress – induced transformations occurring in SMA elements or wires, also capable to provide additional restoring forces to re-centre the structural system.
High Damping Rubber Bearing (HDRB): seismic isolator comprising an elastomeric bearing manufactured with special rubber admixture with damping properties.
Lead Rubber Bearing (LRB): seismic isolator comprising a conventional laminated rubber bearing with a lead plug insert to provide hysteretic mechanical energy dissipation.
Slider with Steel Dissipators: seismic isolator comprising a conventional PTFE free sliding bearing that provides both vertical support and lateral flexibility as well as a set of steel dissipating elements to guarantee both recentering force and energy dissipation.

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tbi : to be invited by; tbc : to be confirmed by; i : invited by; c : confirmed by
Titles of lectures are tentative

International Post-SMiRT Conference Seminar on

SEISMIC ISOLATION, PASSIVE ENERGY DISSIPATION AND ACTIVE CONTROL OF VIBRATIONS OF STRUCTURES

Cheju, Korea
August 23 to 25, 1999

ANNOUNCEMENT

Organized by

Korea Earthquake Engineering Research Center (KEERC)

in cooperation with

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Korea Panel on Structural Control and Monitoring, Korea,

and

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BACKGROUND

Seismic isolation (SI) is considered to be a mature technology of providing a mitigation of seismic damage for civil structures and equipment and has proven to be reliable and cost-effective for many structures such as buildings and critical facilities. There are already more than one thousand applications of SI in various countries, which concern not only new constructions but also retrofits of existing structures, as judged necessary especially after the Loma Prieta (1989), Northridge (1994) and Kobe (1995) earthquakes.

The design and behavior experience concerning the base isolated civil structures (for which the application of SI are the most numerous) is extremely important for widely extending the use of this technique to the industrial facilities, including the nuclear plants and other high risk facilities (e.g. some chemical plants). In fact, the applications in this field are not very numerous yet, although some of them are quite important and several new projects are in a rather advanced development stage.

R&D studies have shown that passive energy dissipation has also a great potential for reducing the seismic risk of several types of structures and retrofitting existing structures, and has recently seen important progress, also in applications. In particular, great interest again arose in the research activities for the development and optimization of energy dissipation systems of various types: viscous, elastic-plastic, viscoelastic and electromagnetic systems, as well as systems using shape memory alloys and other smart materials. In addition, the progress of active, hybrid and semi-active vibration control techniques has already led to some promising results for the seismic protection.

International cooperation and detailed exchange of information and experience in both civil and industrial (nuclear and non-nuclear) fields are extremely important for the correct development and application of all the above-mentioned innovative techniques. To this aim, International Seminars connected to the International Conferences on Structural Mechanics in Reactor Technology (SMiRT) have been jointly co-organized by Chilean, French, Italian, Japanese, Korean, New Zealand and U. S. experts, as well as representatives of the European Commission (EC) and International Atomic Energy Agency (IAEA) since 1989. This will be the sixth Post-SMiRT Seminar dealing with the innovative seismic and vibration control techniques: the previous ones were held at San Francisco, U. S. A. in 1989, Nara, Japan in 1991, Capri, Italy in 1993, Santiago, Chile in 1995, and Taormina, Italy in 1997. In particular, the sixth Seminar is being organized by Korea Earthquake Engineering Research Center (**KEERC**) through the sponsorship of Korea Science and Engineering Foundation (**KOSEF**) to establish a basis for international collaboration for research, transfer of technology and information, and implementation in practice. Co-operation for the organization of the Seminar is being provided by several national, foreign and international Istitutions, in particular by the Seoul National University, Earthquake Engineering Society of Korea, Italian Agency for New Technology, Energy and the Environment (ENEA), Italian Working Group on Seismic Isolation (GLIS) of the Italian National Association for Earthquake Engineering, International Atomic Energy Agency (IAEA), and Korea Panel on Structural Control and Monitoring.

SCOPE

The sixth seminar is being organized based on the increasing success of the previous ones and according to the recommendations made by participants in the Closing Panel of the last seminar at Taormina, Italy, 1997. Similar to such a Seminar, it is being organized jointly with the final Research Coordination Meeting (RCM) of the IAEA, due to the common topics covered in both events. It will provide again an opportunity for the exchange of updated, detailed information concerning the state-of-the-art on the development and applications of the previously mentioned innovative antiseismic techniques. Topics covered by the seminar will be base and floor isolation and passive energy dissipation, similar to previous seminars. In addition, more attention, with respect to previous seminars, will be devoted to the development and applications of active, semi-active and hybrid control of seismic and non-seismic vibration in civil structures as well as nuclear and non-nuclear industrial facilities. Compared to the previous seminars, more room will also given in the Oral Sessions to passive energy dissipation and topics such as seismic input, design rules and cost evaluation, while the oral presentations on seismic isolation will be limited to state-of-the-art lectures on progress of development and applications. Specific important topics concerning seismic isolations will be presented in the Poster Session. Taking into account the low and moderate seismicity of some Asian countries, critical issues on the application of antiseismic techniques in low and moderate seismic regions will also be dealt with.

GENERAL REMARKS ON THE PROGRAM

The Seminar will last three days, starting in the morning of **August 23, 1999, at 8:15 a.m.** The Seminar consists of **Oral Program** and **International Exhibition** including **Poster Presentation**. Since the Seminar is being organized jointly with the final RCM of the IAEA, one additional day, August 27, 1999, will be fully devoted to more detailed presentations, discussion, and preparation of the RCM Summary Report in the framework of the activities of the Coordinated Research Program (CRP) on Intercomparison of Seismic Analysis Methods for Seismically Isolated Nuclear Structures.

The **Oral Program** will consist of invited lectures presented or co-authored by experts from the countries and international organizations that are the most involved in the development and applications of the new techniques, namely: Australia, Chile, Chinese Taipei, the European Commission, France, Germany, Greece, Hong Kong, IAEA, India, Japan, Korea, Mexico, New Zealand, Portugal, the P. R. China, the Russian Federation, Singapore, Spain, Thailand, the United Kingdom and the U.S.A.. Presented in such lectures will be the state-of-the-art of applications and designs in both civil and industrial (nuclear and non-nuclear) fields, overviews on the experimental and numerical R&D activities in progress and future programs, and observations (if any) of behaviors of structures provided with the innovative systems in actual earthquakes occurred after the last Seminar at Taormina, Italy in 1997, as well as the progress in the development of codes and standards, design rules, seismic input for isolated structures, and cost evaluation. In particular, new development of active, semi-active and hybrid control techniques for seismic and non-seismic vibrations and new applications of such techniques, as well as key issues in the application of innovative antiseismic techniques in low and moderate seismic regions will also be addressed.

International Exhibition will be organized in parallel to the oral sessions, which will last the whole Seminar duration. It will allow both for ***Poster Presentation*** *of further selected technical papers* dealing with specific topics of particular interest for the seminar and for *displaying the general activities and products* of research centers, industrial companies and other organizations. The contributed papers to be presented in the Poster Session, after acceptance of the Scientific Committee, will be published in the seminar proceedings together with the invited lectures. Such an acceptance will be based on 1~2 pages abstract, to be received by one of the members of the International Scientific and Organizing Committee **within the end of March 1999**. Acceptance of contributed papers will be notified to the main author by the end of April 1999. The Seminar proceedings will also contain detailed written contributions on CRP activities, prepared by the participating countries.

Both lectures and technical papers presented in the Poster Session will be published in the Seminar Proceedings and will be distributed to the participants some months after the Seminar. All the authors will be requested to submit the full papers **within July 15, 1999** so that photocopies of full paper manuscripts can be distributed to the participants at the Seminar. The Seminar official language will be **English**. No simultaneous translation will be available. A detailed seminar announcement containing information on the updated technical program, hotel rates, transportation, expected climate conditions, etc., will be distributed in May 1999. The Announcement, including the program and other information is available on Internet at the address **http://plaza1.snu.ac.kr/~psccheju/**, and will be modified with most up-to-date information.

PROGRAM OF THE ORAL SESSIONS

August 22, Sunday, 1999

16:00 – 18:00 Registration
17:00 – 18:00 Meeting of session chairpersons and panelists
18:00 – 19:30 Welcome Cocktail

August 23, Monday, 1999

07:30 – 08:15 **REGISTRATION**

08:15 – 08:55 **WELCOME ADDRESS AND INTRODUCTION TO THE SEMINAR, COORDINATION RESEARCH MEETING OF IAEA AND EXHIBITION**

- Welcome Address of the Honorary Chairman (S.P. Chang, KEERC, Seoul National University, Seoul, Korea)
- Welcome Addresses of the Main Organizers and Introduction to the Seminar and Exhibition (A. Martelli, ENEA & GLIS, Bologna, Italy, and H.M. Koh, KEERC, Seoul National University, Seoul, Korea)
- Welcome Address of IAEA and Introductory Lecture to the Coordination Research Meeting on “IAEA Activities on LMR Seismic Technology, Key Results and Recommendations of the CRP on Intercomparison of LMR Core Seismic Analysis Codes” (A. Rineiskii, IAEA, Vienna, Austria)

09:00 – 10:40 **SESSION 01: PROGRESS OF APPLICATIONS AND DEVELOPMENT IN BASE ISOLATION AND PASSIVE ENERGY DISSIPATION FOR CIVIL AND INDUSTRIAL STRUCTURES (I)**

Chairpersons : J.M. Kelly (University of California, Berkeley, USA)
S.P. Chang (Seoul National University, Korea)

09:00 – 09:05 Introduction of the Session (Chairpersons)

09:05 – 09:20 (01) *Progress of Application and Development in Seismic Isolation for Civil and Industrial Structures in Japan* (T. Fujita, Institute of Industrial Science, University of Tokyo, Japan)

09:20 – 09:35 (02) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in New Zealand* (W.H. Robinson, Robinson Seismic Limited, New Zealand)

09:35 – 09:50 (03) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in P. R. China* (F.L. Zhou, South China Construction University, P.R. China)

09:50 – 10:05 (04) *State-of-the-Art on Development and Applications of Seismic Isolation and Passive Energy Dissipation in the European Union* (M. Forni, ENEA & GLIS, Bologna, Italy, et al.)

10:05 – 10:30 Discussion and Conclusion of the Session (Chairpersons)

10:30 – 11:00 **Coffee Break**

11:00 – 13:00 **SESSION 02: PROGRESS OF APPLICATIONS AND DEVELOPMENT IN BASE ISOLATION AND PASSIVE ENERGY DISSIPATION FOR CIVIL AND INDUSTRIAL STRUCTURES (II)**

Chairpersons: T. Fujita (University of Tokyo, Japan)
A. Dorfmann(University of Applied Science, Vienna, Austria)

11:00 – 11:05 Introduction of the Session (Chairpersons)

11:05 – 11:20 (05) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in USA* (J.M. Kelly, EERC, University of California, Berkeley, USA)

11:20 – 11:35 (06) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in Chile* (M. Sarrazin, University of Chile, Santiago, Chile)

11:35 – 11:50 (07) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in the Russian Federation* (V. Beliaev, Research Center of Capital Construction, St. Petersburg, Russia)

11:50 – 12:05 (08) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in Korea* (B. Yoo, KAERI, D.G. Lee, C.B. Yun, H.M. Koh et al., Korea)

12:05 – 12:20 (09) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in Chinese Taipei* (K.-C. Chang, J.S. Hwang, K.C. Tsai, M.H. Tsai, National Taiwan University, Chinese Taipei)

12:20 – 12:35 (10) *Progress of Applications and Development in Base Isolation and Passive Energy Dissipation for Civil and Industrial Structures in India* (T. Selvaraj, IGCAR, India: i, tbc - Martelli)

12:35 – 13:00 Discussion and Conclusion of the Session (Chairpersons)

13:00 – 14:30 **Lunch**

14:30 – 16:15 **SESSION 03: SEISMIC INPUT, DESIGN RULES AND COST EVALUATION (I)**

Chairpersons: T. Sanò (GLIS & ANPA, Roma, Italy)
R. Kulak (Argonne National Laboratory, Argonne, USA: - tbc)

14:30 – 14:35 Introduction of the Session (Chairpersons)

14:35 – 14:50 (11) *Recent Developments of Studies in Europe for the Definition of Realistic Seismic Input for Structures Provided with Innovative Antiseismic Systems* (F. Romanelli, University of Trieste, Italy)

14:50 – 15:05 (12) *Progress of Studies Performed in Japan on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (A. Wada, Structural Engineering Research Center, Tokyo Institute of Technology, Japan)

15:05 – 15:20 (13) *Progress of Studies Performed in Chile on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (R. Saragoni H., University of Chile, Santiago, Chile)

15:20 – 15:35 (14) *Progress of Studies Performed in Greece on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (G.C. Manos, Aristotle University, Thessaloniki, Greece)

15:35 – 15:50 (15) *Progress of Studies Performed in Korea on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (H.M. Koh and J.K.Kim, KEERC, Seoul National University, Seoul, Korea)

15:50 – 16:15 Discussion and Conclusion of the Session (Chairpersons)

16:15 – 16:45 **Coffee Break**

16:45 – 18:30 **SESSION 04: SEISMIC INPUT, DESIGN RULES AND COST EVALUATION (II)**

Chairpersons: R. Saragoni H. (University of Chile, Santiago, Chile)
A. Wada (Tokyo Institute of Technology, Japan)

16:45 – 16:50 Introduction of the Session (Chairpersons)

16:50 – 17:05 (16) *Seismic Isolation and Energy Dissipation: Why, Where, When* (A. Parducci and M. Mezzi, University of Perugia, Italy)

17:05 – 17:20 (17) *Reliability and Performance Based Seismic Design Criteria for Structures with Energy-Dissipating Devices: Present Experience and Trends in Mexico* (L. Esteva and Sonia E. Ruiz, Institute of Engineering, UNAM, Mexico)

17:20 – 17:35 (18) *Progress of Studies Performed in Japan on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (K. Kawashima, Tokyo Institute of Technology, Japan)

17:35 – 17:50 (19) *Progress of Studies Performed in USA on Seismic Input, Design Rules and Cost Evaluation in relation to Base Isolation and Other Antiseismic Techniques* (R. Mayes, DIS, USA)

17:50 – 18:05 (20) *Empirical Model for Estimating Design Input Ground Motion in Taiwan Region* (C.H. Loh and V. Sololov, Chinese Taipei)

18:05 – 18:30 Discussion and Conclusion of the Session (Chairpersons)

August 24, Tuesday, 1999

08:30 – 10:45 **SESSION 05: SPECIFIC ISSUES IN R&D AND APPLICATIONS OF PASSIVE ENERGY DISSIPATION SYSTEMS (I)**

Chairpersons: L. Esteva (Institute of Engineering, UNAM, Mexico)
F.L. Zhou (South China Construction Univ., P.R. China)

08:30 – 08:35 Introduction of the Session (Chairpersons)

08:35 – 08:50 (21) *Specific Issues in R&D and Applications of Passive Energy Dissipation Systems in Japan* (S. Fujita, Tokyo Denki University, Japan)

08:50 – 09:05 (22) *Specific Issues in R&D and Applications of Passive Energy Dissipation Systems in USA* (possibly Whittaker or Nelson or others, USA: tbi – Kelly/Kulak)

09:05 – 09:20 (23) *Specific Issues in R&D and Applications of Passive Energy Dissipation Systems in New Zealand* (---, NZ: tbi – Robinson)

09:20 – 09:35 (24) *Development and Application of Electro-Inductive Dissipators* (A. Marioni, ALGA S.p.A., Milano, Italy)

09:35 – 09:50 (25) *Large scale testing with PSD technique on Structures Provided with Energy Dissipation System at JRC Ispra* (V. Renda, JRC, European Commission)

09:50 – 10:05 (26) *Seismic Hardware Suitable for Energy Approach Design* (C. Braun, MAURER SÖHNE, München, Germany)

10:05 – 10:30 Discussion and Conclusion of the Session (Chairpersons)

10:30 – 11:00 **Coffee Break**

11:00 – 13:00 **SESSION 06: SPECIFIC ISSUES IN R&D AND APPLICATIONS OF PASSIVE ENERGY DISSIPATION SYSTEMS (II)**

Chairpersons: W.H. Robinson (NZ Institute of Industrial Research, N.Z.)
R. Medeot (Consultant, Padova, Italy)

11:00 – 11:05 Introduction of the Session (Chairpersons)

11:05 – 11:20 (27) *Specific Issues in R&D and Applications of Passive Energy Dissipation Systems in USA* (possibly Whittaker or Nelson or others, USA: tbi – Kelly/Kulak)

11:20 – 11:35 (28) *Optimization of Visco-Elastic Dampers and Rolling-Ball Systems in the Framework of the EC-Funded REEDS Project* (K.N.G. Fuller, TARRC, Hertford, UK: i, tbc – Martelli)
Optimization of Elastic-Plastic Dampers, Viscous Dampers and Shock Transmitters in the Framework of the EC-Funded REEDS Project (A. Dusi, ENEL SpA, CRIS, Milano, Italy: i, tbc – Martelli)

11:35 – 11:50 (29) *A New System of Energy Dissipation Used in High Rise Building for Antiseismic Design* (J. L. Xie, 4th Bai Yun Architecture and Engineering Company, P.R. China)

11:50 – 12:05 (30) *Seismic Protection of Cultural Heritage Using Shape Memory Alloy Devices – An EC Funded Project (ISTECH)* (M.G. Castellano, FIP, Italy)

12:05 – 12:20 (31) *Development and Application of Innovative Energy Dissipation Systems in the SPIDER Project* (G. Introini, JARRET S.A., Gallarate, Italy)

12:20 – 12:35 (32) *Progress of Studies and Applications in Portugal Concerning the Use of Passive Energy Dissipation Systems in Bridges and Buildings* (J.J. Azevedo, Instituto Superior Tecnico, Lisboa, Portugal)

12:35 – 13:00 Discussion and Conclusion of the Session (Chairpersons)

13:00 – 14:30 **Lunch**

14:30 – 16:00 **SESSION 07: NEW APPLICATIONS AND DEVELOPMENT OF ACTIVE, SEMI-ACTIVE AND HYBRID CONTROL TECHNIQUES FOR SEISMIC AND NON-SEISMIC VIBRATIONS (I)**

Chairpersons : S.F. Masri (University Southern California, Los Angeles, USA)
F. López-Almansa (Technical University of Catalonia, Barcelona, Spain: - tbc)

14:30 – 14:35 Introduction of the Session (Chairpersons)

14:35 – 14:50 (33) *Experimental Promotion of Semiactive, Active and Hybrid Control* (F. Casciati, University of Pavia, Italy)

14:50 – 15:05 (34) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Seismic and Non-Seismic Vibrations in Japan* (A. Nishitani, Waseda University, Tokyo, Japan)

15:05 – 15:20 (35) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Seismic and Non-Seismic Vibrations in USA* (B.F. Spencer Jr., University of Notre Dame, USA)

15:20 – 15:35 (36) *Experimental Verification of a Refined Intelligent Stiffner for Bridges at the I-35 Walnut Creek* (Jeff Kuehn, Jinghui Sun, Gang Song, University of Oklahoma, USA)

15:35 – 16:00 Discussion and Conclusion of the Session (Chairpersons)

16:00 – 18:00 **Visit and Discussion on International Exhibition and Poster Presentations**
(Coffee served at Exhibition Hall)

19:00 **Garden Party**

August 25, Wednesday, 1999

09:00 – 10:45 **SESSION 08: NEW APPLICATIONS AND DEVELOPMENT OF ACTIVE, SEMI-ACTIVE AND HYBRID CONTROL TECHNIQUES FOR SEISMIC AND NON-SEISMIC**

VIBRATIONS (II)

Chairpersons : B.F. Spencer Jr. (University of Notre Dame, USA)
A. Nishitani (Waseda University, Tokyo, Japan)

09:00 – 09:05 Introduction of the Session (Chairpersons)
09:05 – 09:20 (37) *Design of Dampers for Control of Building Structures Based on Optimal Control Theory* (P.E. Lim, C.H. Loh, K.C. Chang, Chinese Taipei)
09:20 – 09:35 (38) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Seismic and Non-Seismic Vibrations in Korea* (C. Mo, et al., Korea)
09:35 – 09:50 (39) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Seismic and Non-Seismic Vibrations in USA* (S. Masri, University of Southern California, Los Angeles, USA)
09:50 – 10:05 (40) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Seismic and Non-Seismic Vibrations in Europe* (F. López-Almansa, Technical University of Catalonia, Barcelona, Spain: tbc – Casciati, López-Almansa)
10:05 – 10:20 (41) *Topics on New Applications and Development of Active, Semi-Active and Hybrid Control Techniques for Vibrations of Buildings in Japan* (T. Fujita, University of Tokyo and T. Kamada, Tokyo University of Agriculture and Technology, Japan)
10:20 – 10:45 Discussion and Conclusion of the Session (Chairpersons)

10:45 – 11:15 **Coffee Break**

11:15 – 13:00 **SESSION 09: KEY ISSUES IN BASE ISOLATION AND OTHER ANTISEISMIC TECHNIQUES IN LOW AND MODERATE SEISMIC REGIONS**

Chairpersons: J.K. Kim (KEERC, Seoul National University, Korea)
A. Toft (ANDRE SILVERTOWN, U.K.: i, tbc – Martelli)

11:15 – 11:20 Introduction of the Session (Chairpersons)
11:20 – 11:35 (42) *Segmental Buildings for Seismic Isolation* (T.-C. Pan, and Z. Zhu, Nanyang Technological University, Singapore)
11:35 – 11:50 (43) *Passive Vibration Control of Multistorey Buildings in Low Seismicity Regions* (B. Samali, University of Technology Sidney, Australia and K.C.S. Kwok, Hong Kong University of Science & Technology, Hong Kong)
11:50 – 12:05 (44) *Semi-Active Control of Buildings Subjected to Far-Field Ground Motion* (P. Lukkunaprasit and T. Pinkaew, Chulalongkorn University, Thailand)
12:05 – 12:20 (45) *Key Issues in Base Isolation and Other Antiseismic Techniques in Low and Moderate Seismic Regions* (S.P. Chang, H.M. Koh, J.K. Kim, KEERC, Seoul National University, Seoul, Korea)
12:20 – 12:35 (46) *Large Oil Tank Using Base Isolation in Moderate Seismic Regions* (Z.G. Xu, South China Construction University, P.R. China)
12:35 – 13:00 Discussion and Conclusion of the Session (Chairpersons)

13:00 – 14:30 **Lunch**

14:30 – 16:30 **SESSION 10: CLOSING PANEL ON TECHNOLOGY TRANSFER AND FUTURE DIRECTIONS**

Chairpersons: A. Martelli (Italy)
------------ (USA) (tbi, tbc – Martelli, Koh)

Other Panelists: (03) F. Casciati (Italy)
(04) K.-C. Chang (Chinese Taipei)
(05) J.M. Eisenberg (Russian Federation)
(06) T. Fujita (Japan)
(07) S.F. Masri (USA)
(08) J.M. Kelly (USA)
(09) H.M. Koh (Korea)

(10) V. Renda (European Commission)
(11) A. Rineiskii (IAEA)
(12) W.H. Robinson (New Zealand)
(13) R. Saragoni Huerta (Chile)
(14) F.L. Zhou (P.R. China)
(15) A. Nishitani (Japan)

16:30 – 16:40 **CLOSING REMARKS**

H.M. Koh
----------- (tbi, tbc – Martelli, Koh)

16:40 **Visit to the Exhibition Hall**

POSTER PRESENTATIONS OF TECHNICAL PAPERS

The complete list of contributed papers accepted for presentation in the Poster Session will be published in the Second Announcement, which will be distributed in May 1999.

LOCATION OF THE SEMINAR AND EXHIBITION

The Seminar and exhibition will take place at the Seogwipo **KAL Hotel**, 486-3, Topyong-dong, Seogwipo-city, Cheju-do, Korea (Tel: +82-(0)64-733-2001, Fax: +82-(0)64-733-9377). Cheju, one of the most unspoiled island resort in the Pacific, is famous for dramatic landscape with rugged volcanic mountains, cascading waterfalls, pristine white sand beaches and crystal clear waters. There are all kinds of water sports available, as well as hunting, fishing, boating and golf around the year. Hiking is also popular on Mt. Halla, an inactive volcano located at the center of the island and rising 1,950 meters in height. Cheju's culture is unique, different from the Korean mainland and unlike any other in the world. The Seogwipo KAL Hotel is located in the seashore and Seogwipo Harbor, the center of tour and leisure. Limousine Bus & Taxes takes about 60 minutes to the Cheju International Airport, offering the best views of Mt. Halla and the ocean. Views of the hotel and map of the site are available on Internet.

The International Exhibition will be held in Crystal Hall of the Hotel, together with the Poster Session for contributed papers, during the whole period of the Seminar. The cost for the participation of research centers, industrial companies, etc., in the exhibition will be fixed case by case. Those who are interested in the exhibition are advised to contact directly to the Korean Seminar Co-Chairman.

REGISTRATION

The individual registration fee is **400 US dollars** for participants registering before **June 30, 1999** and **450 US dollars** after this date. **Korean** participants shall pay the equivalent amount in **Korean Won** at the rate of exchange applicable on the day of payment. Registration fees shall be directly paid to the Seminar Secretariat. Detailed information on the payment will soon be available. The registration fee includes:

- proceedings, which will be available some months after the Seminar;
- abstract volume, which will be distributed at the Seminar;
- photocopies of the available papers, which will be distributed at the Seminar;
- the welcome cocktail on August 22, 1999;
- 3 lunches and 5 coffee breaks on August 23 to 25, 1999;
- garden party on August 24, 1999.

The registration fee is due by **all participants** with the exception of the co-organizers and members of the International Technical and Scientific Committee, Honor Committee and Seminar Secretariat. The registration fee is also due by the participants in the RCM of IAEA. Please refer to **FORM B** (*Registration Form*) for the payment of the registration fee.
Since **the number of participants will be limited** for organization reasons, **advanced registration** is strongly recommended. For the same reason, those who intend to participate in the Seminar are requested to fill the attached **FORM A** (*Commitment to Attend*) and to send it by fax or e-mail to the Seminar Secretariat. Should the number of the already registered participants be too large as to allow for accepting new registrations, this will be notified by the Seminar Secretariat to the applicants **within one week**. (The co-organizers, session chairpersons, speakers, sponsors, panelists, main authors of poster presentations and exhibitors are not obliged to wait such a time, but are kindly asked to urgently send the registration forms to avoid complications in registering.) In the absence of such an notification from the Seminar Secretariat, advanced registration procedures shall be completed by the participants using the attached **FORM B** (*Registration Form*) **within 40 days** after the submission of **FORM A**, together with photocopy of **the documentation of payment** to the Seminar Secretariat. Late or on-site registration will be possible only if

sufficient room is still available.

HOTEL ACCOMMODATION AND RESERVATIONS

A limited number of rooms are being reserved by the Seminar Travel Agency at special discount rates for the Seminar participants. Because August is **high season period** at Cheju, it is strongly recommended for participants to **make quite advanced hotel reservations** as soon as the reservation information is issued by the Seminar Secretariat. In any case, Hotel Boarding Form (**FORM C**) should be sent to the Travel Agency **DAESAN TRAVEL SERVICE CO., LTD.,** 7F. Royal Bldg., 5, Dangju-dong, Jongro-ku, Seoul, 110-071, Korea, tel +82-2-730-8520, fax +82-2-730-3688, e-mail: dstravel@netsgo.com ***before June 30, 1999***. A preliminary deposit of **USD 100** is due by the participants to the Travel Agency to confirm their reservation. Please note that rooms at the Seogwipo KAL Hotel may not be available, even at regular rates, after June 30, 1999, and there are no hotels at such special rates within walking distance from the Seminar venue.

TRANSPORTATION TO CHEJU

Cheju is connected to several cities in Korea and other Asian Countries by international and domestic flights. The most frequent flights are from Seoul, Korea, where domestic flights bounding for Cheju are available at nearly every 30 minutes during the daytime. Seogwipo-city, the Seminar site, is located in the south of island and can be reached from the Cheju International Airport by Limousine Bus or Taxi in 60 minutes. Transportation information will be available in the final Announcement and on Internet.

COMPANIONS, COMPANION PROGRAM AND SOCIAL EVENTS

For organization reasons, the participants are kindly requested to let the Seminar Secretariat know the number of their companions (persons not attending the seminar). Companion programs will be organized by the Seminar Travel Agency **DAESAN TRAVEL**. The Travel Agency shall be directly contacted by the interested participants for information on payment and tour details. Social events are being organized: in particular, in addition to the garden party (which will be offered by the Organization Committee), one-day tour inside Cheju or to the Mt. Halla will be organized on August 26 if a sufficiently large number of participants is interested in it (see Forms A and B). This and other tours will be on the costs of the participants.

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