

Task 2: Valutazione dell'influenza di diverse forme di dissipazione sullo SRS

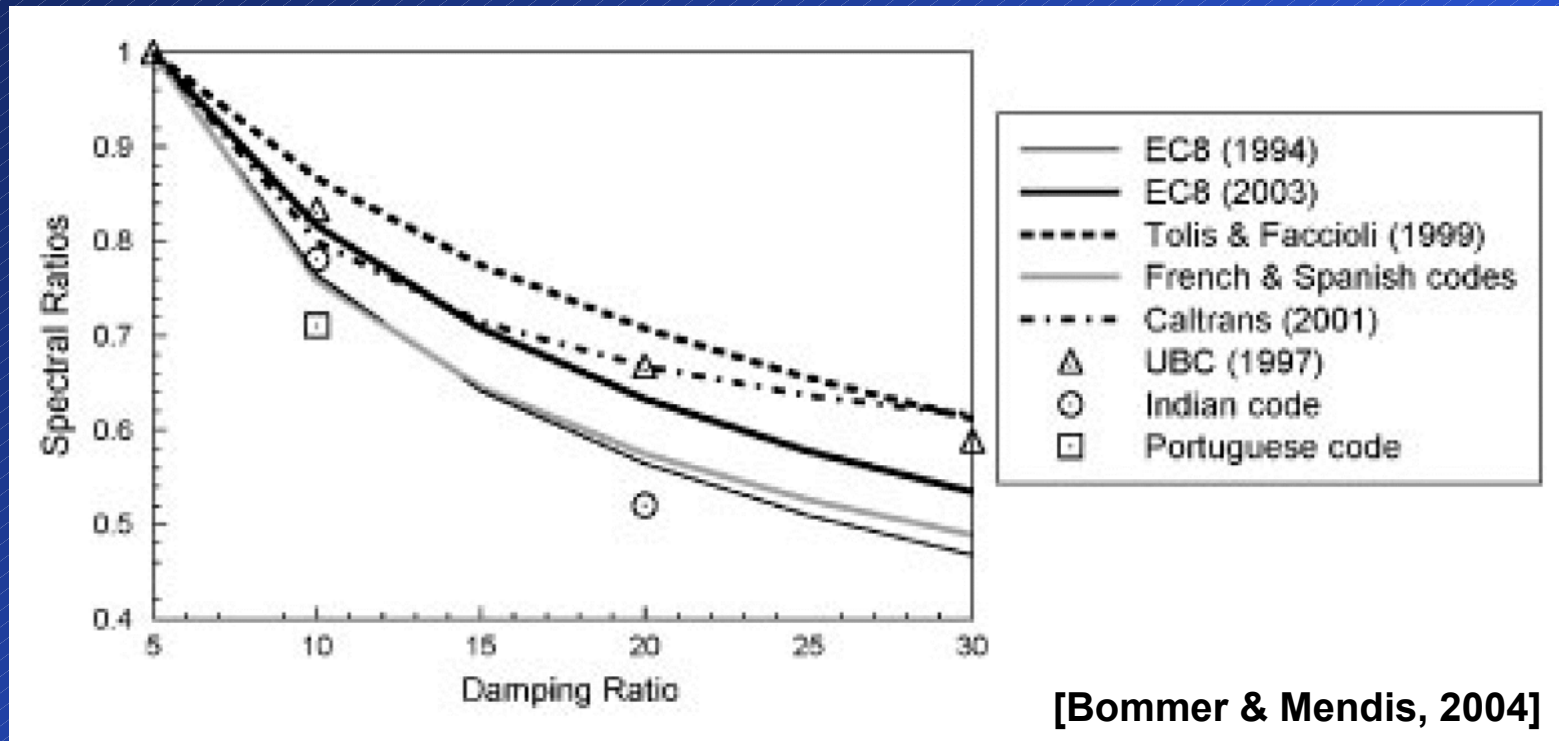
General Objectives

Review existing formulations used to scale the 5% damped spectral ordinates for higher damping values

Review existing equations employed to estimate equivalent viscous damping

Identify needs for development and devise parametric methodology for carrying out such improvements

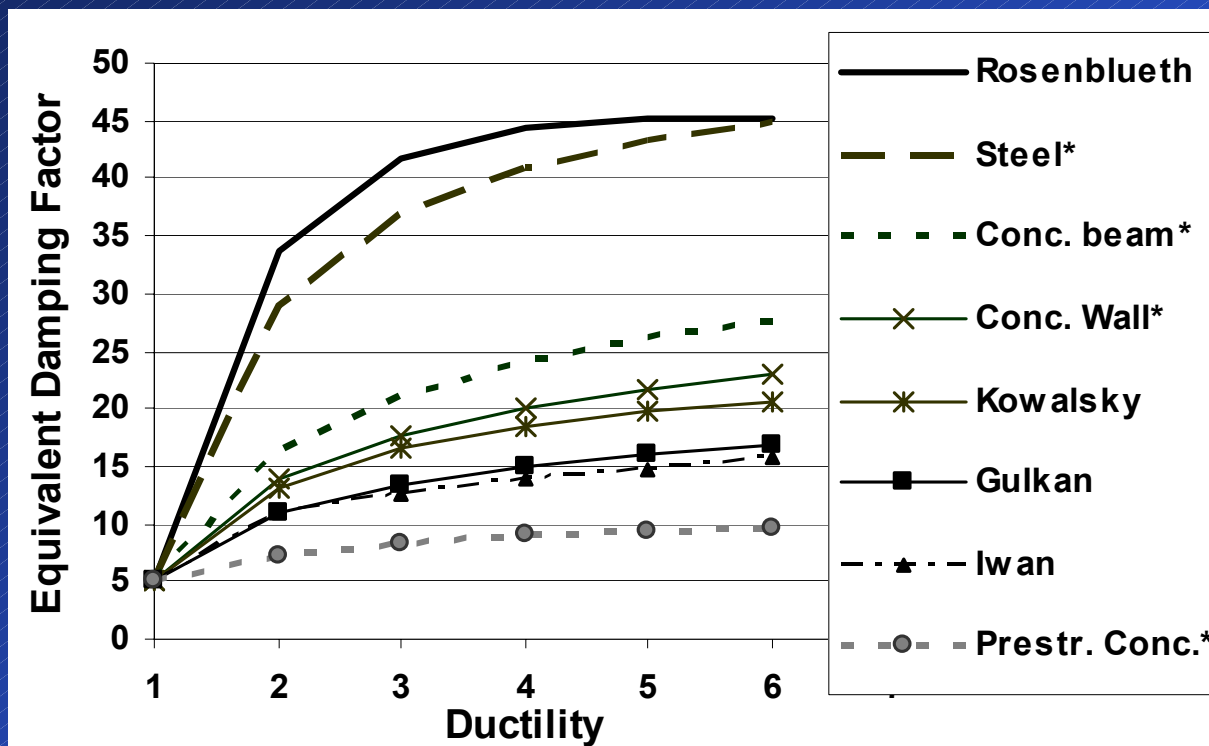
Existing spectral reduction factors



For high damping values, up to 50% variation may be observed in values obtained by different proposals

Origin of such discrepancies likely to be related to variation in the seismic demand considered in the studies

Existing equivalent viscous damping equations



- For high ductility values, up to 100% variation may be observed in values obtained by different proposals
- Likely dependency of equivalent damping on period of the structure has been overlooked
- Possible relationship between damping and input motion characteristics has also not been considered

Approach devised to tackle identified limitations

- 1) Parametric study aiming at deriving more reliable relationships between equivalent viscous damping and ductility, period and structural type
- 2) The above should initially exclude, for as much as possible, the effects of ground motion variability → i.e. spectrum compatible records are used
- 3) Once point (2) is concluded, introduce the effects of ground motion variability, i.e. verify derived equations against a collection of representative ensemble of real records. Introduce modifications if and where necessary

Structural types considered and modelling

- 1) Reinforced concrete framed buildings
- 2) Wall structures and bridge piers
- 3) Precast reinforced concrete structures
- 4) Isolated structures (with different types of isolaters)
- 5) Steel structures

Hundreds of analysis need to be carried out $\Rightarrow$ simplified SDOF models, featuring adequate hysteretic models need to be employed, e.g.:

TAKEDA MODEL 1 (Narrow)

$\alpha = 0.5$

$\beta =$

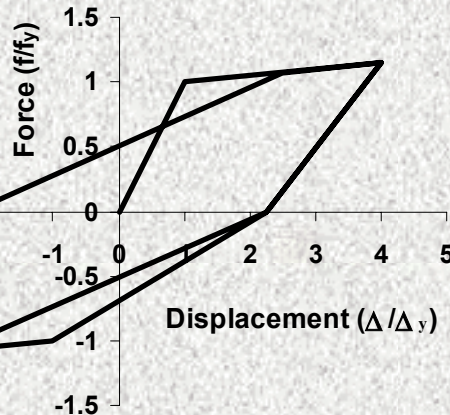
$K_2/K_1 =$

$\alpha = 0.3$

$\beta = 0.6$

$K_2/K_1 = 0.05$

TAKEDA MODEL 2 (Fat)

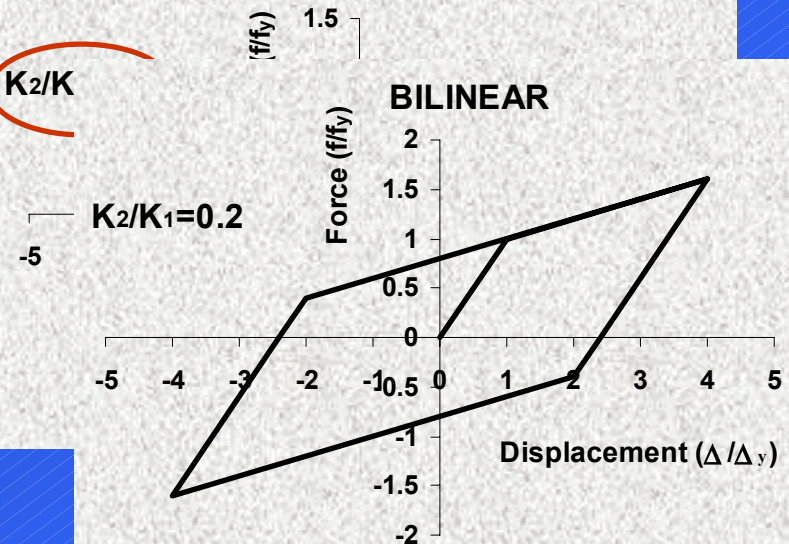


EPP

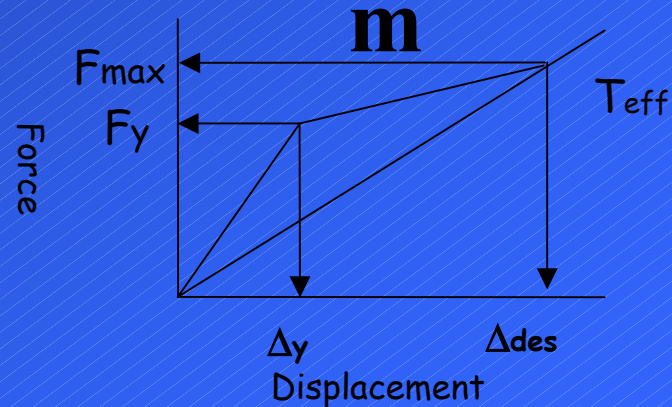
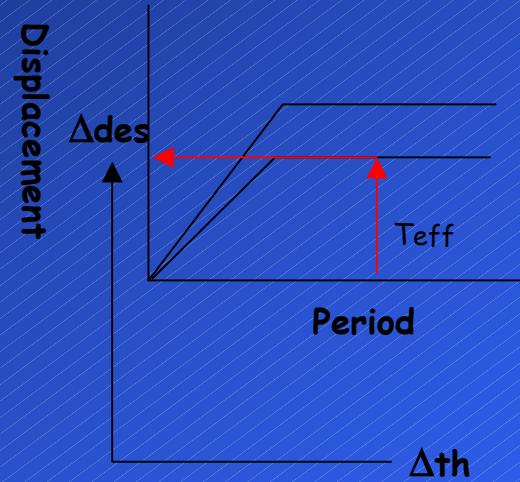
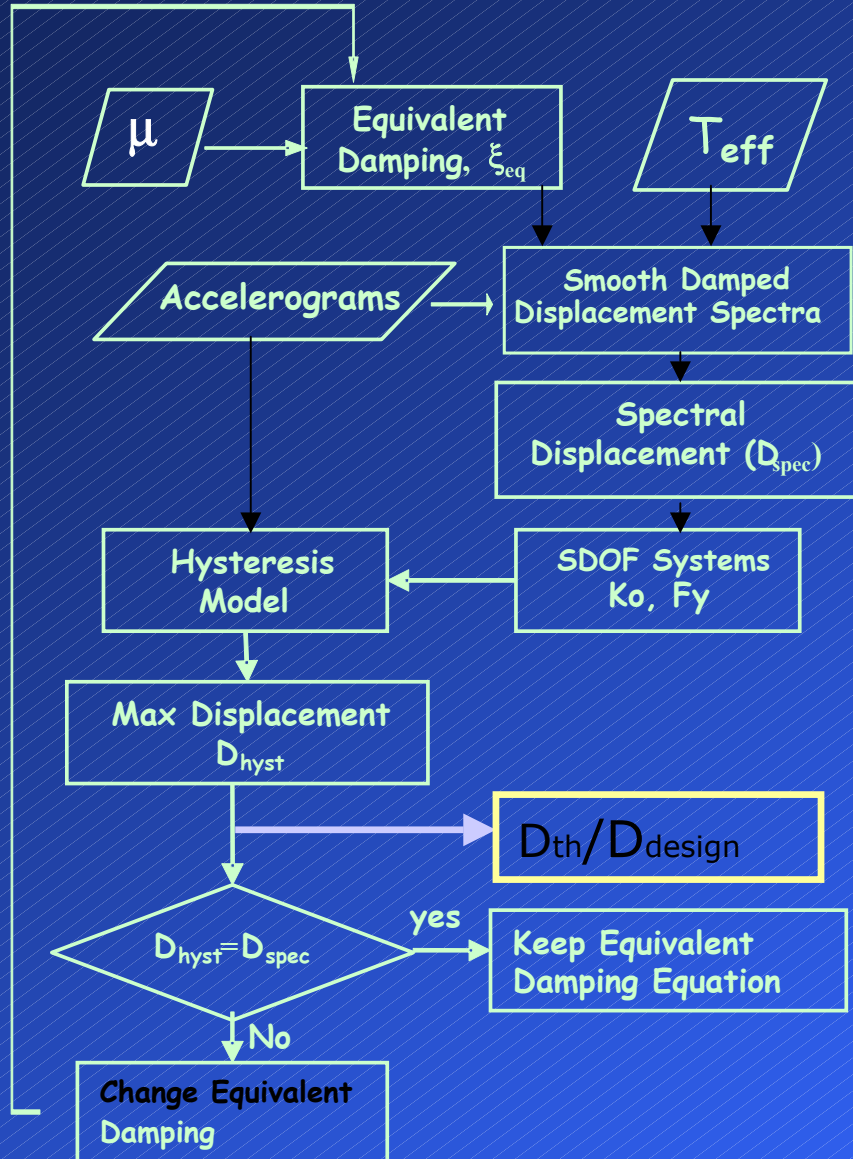
K_2/K

$K_2/K_1 = 0.2$

BILINEAR

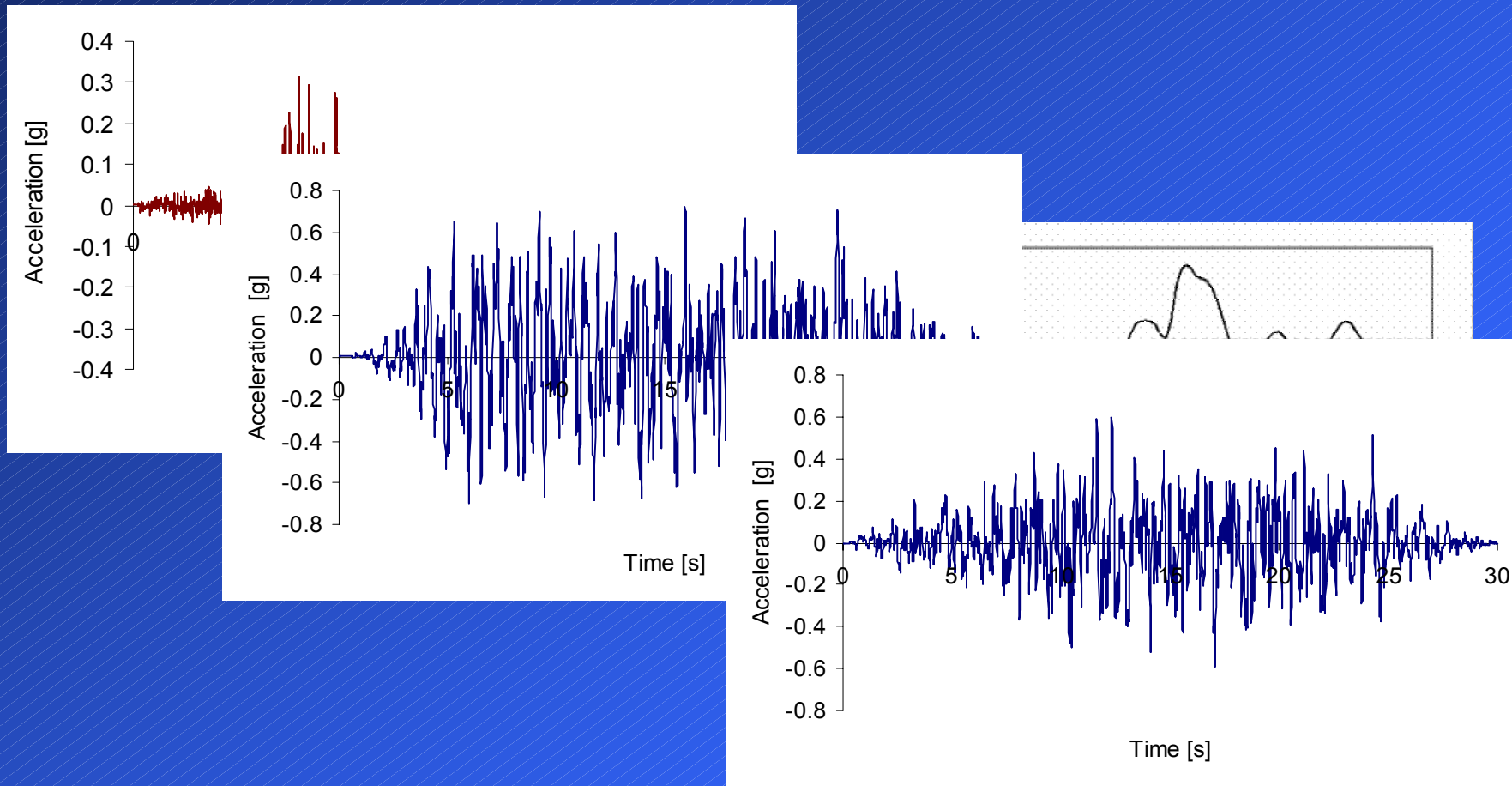


Parametric Study - flowchart

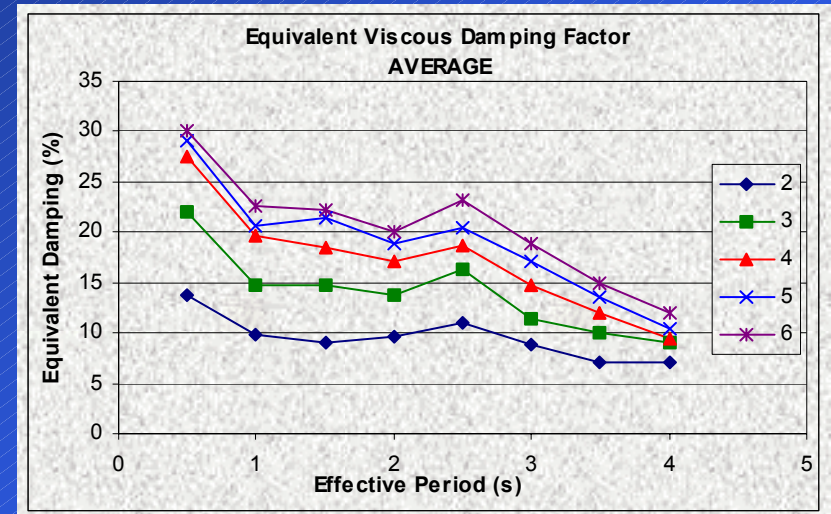
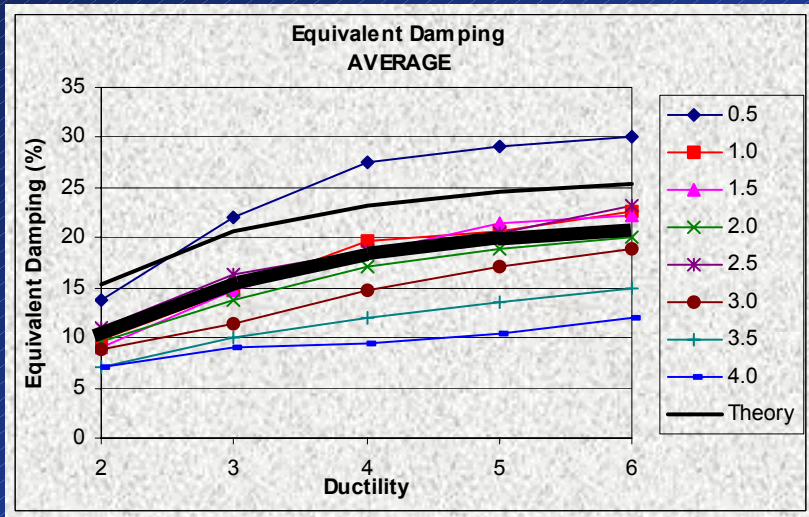


Initial set of spectrum compatible time-histories

- One spectrum-matched record [Bommer and Mendis]
- Four artificially-generated records



Currently in progress: results post-processing



- equivalent viscous damping is clearly dependent on effective period
- these trends are being observed for practically all structural types considered
- period dependent equations will need to be, for the first time, derived

Currently in progress: results post-processing

$$\xi_{effective} = \frac{a}{\pi} \cdot \left(1 - \frac{1}{\mu^b} - 0.1 \cdot r \cdot \mu \right) \cdot \left(1 + \frac{1}{(T + c)^d} \right) \cdot \frac{1}{N}$$

Constant	Takeda Thin	Takeda Fat	Bilinear	EPP	Ramberg Osgood	Ring Spring
a	95	130	160	140	150	50
b	0.5	0.5	0.5	0.5	0.45	0.5
c	0.85	0.85	0.85	0.85	1	1
d	4	4	4	2	4	3

Currently in progress: results post-processing

