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Experimental tests on seismic upgrading techniques for RC buildings

*F. M. Mazzolani, Gaetano Della Corte,
E. Barecchia, M. D'Aniello*



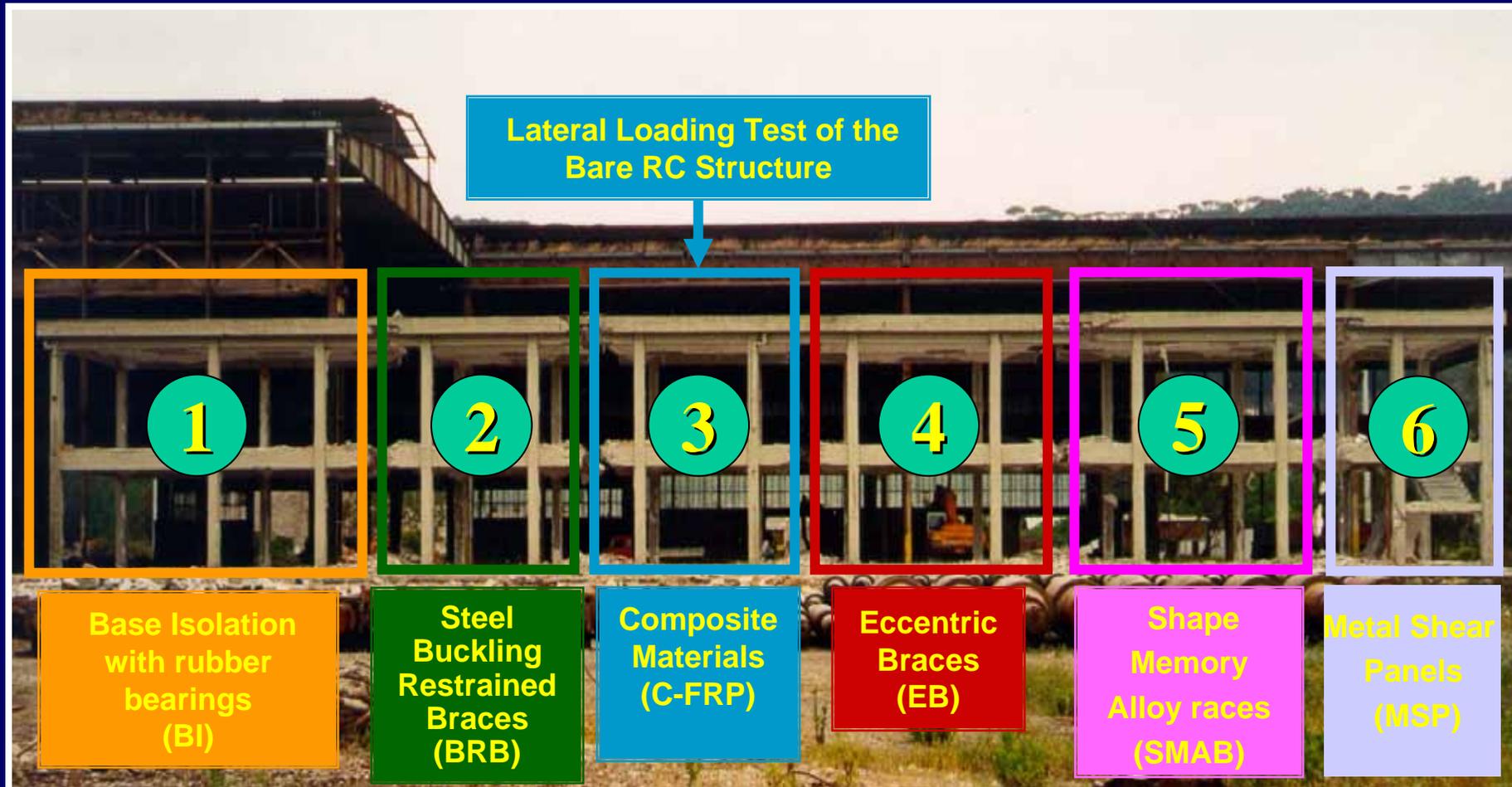
**Dept. of Structural Engineering
University of Naples “Federico II”**

The BUILDING



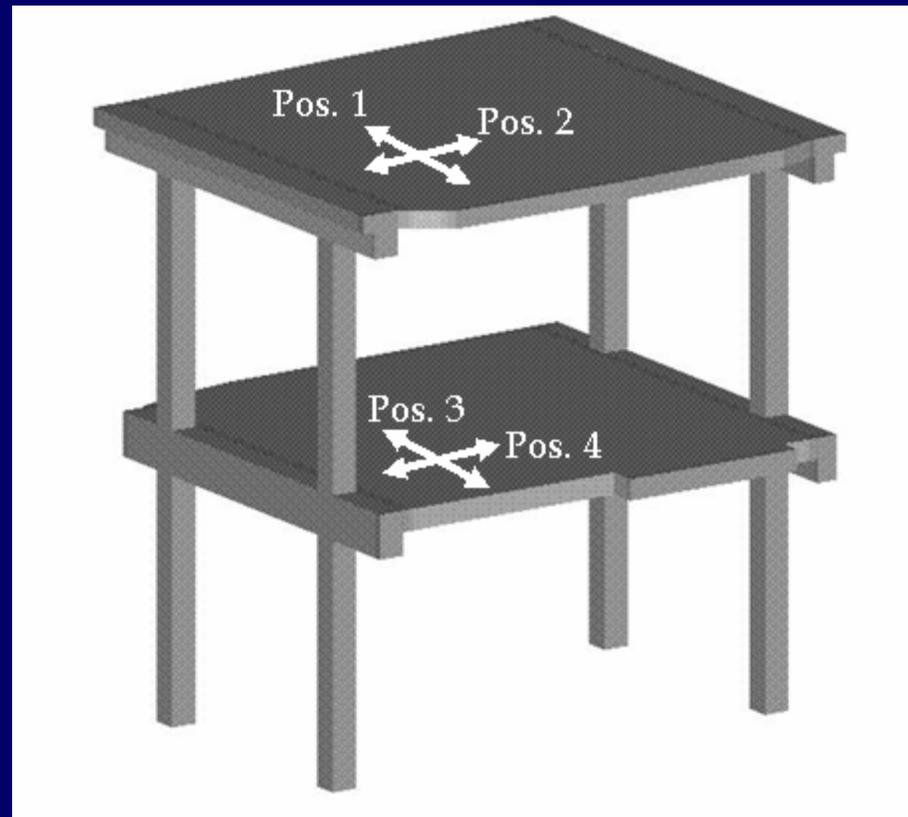
Prof. F.M. Mazzolani - UNIVERSITY of NAPLES "FEDERICO II"

The BUILDING (substructuring)



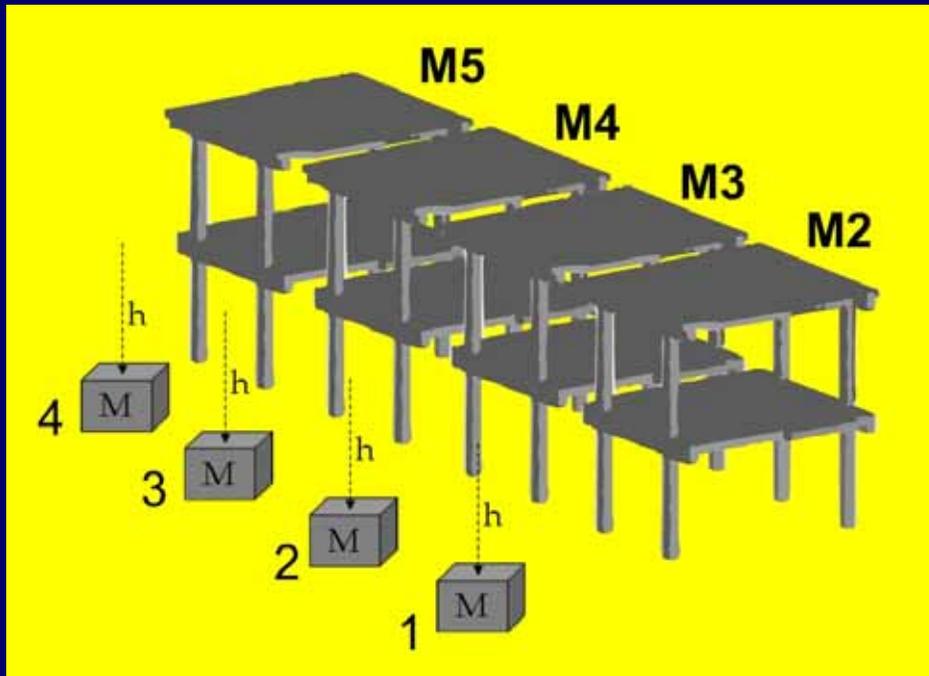
Dynamic Identification Tests

Dynamic shaker (vibrodyne) test



Dynamic Identification Tests

Falling mass test



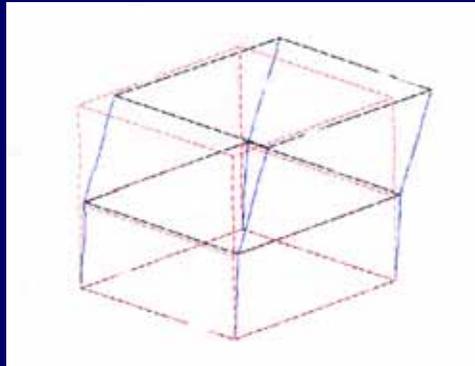
Dynamic Identification Tests

Impacting hammer test

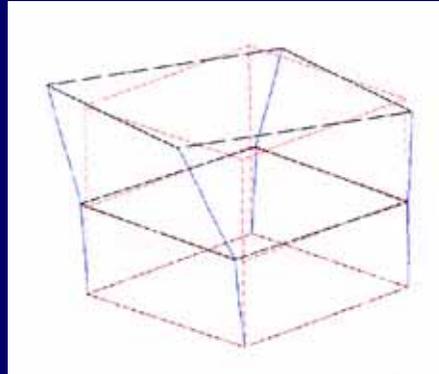


Dynamic Identification Tests

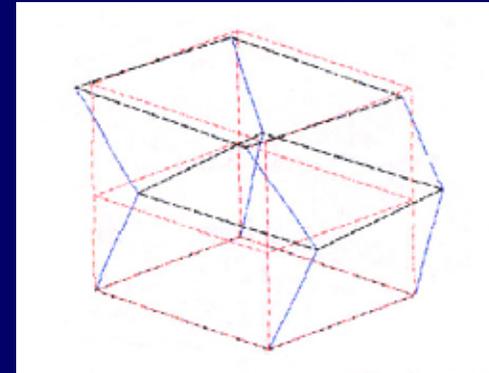
Mode 1



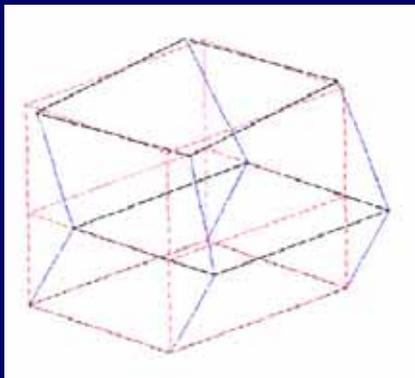
Mode 2



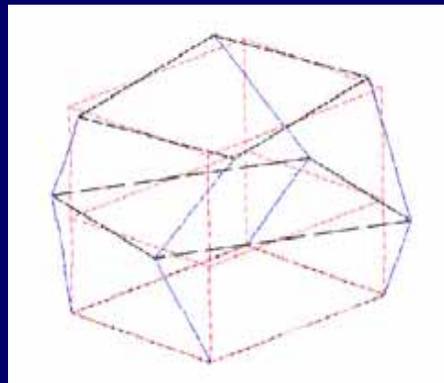
Mode 3



Mode 4



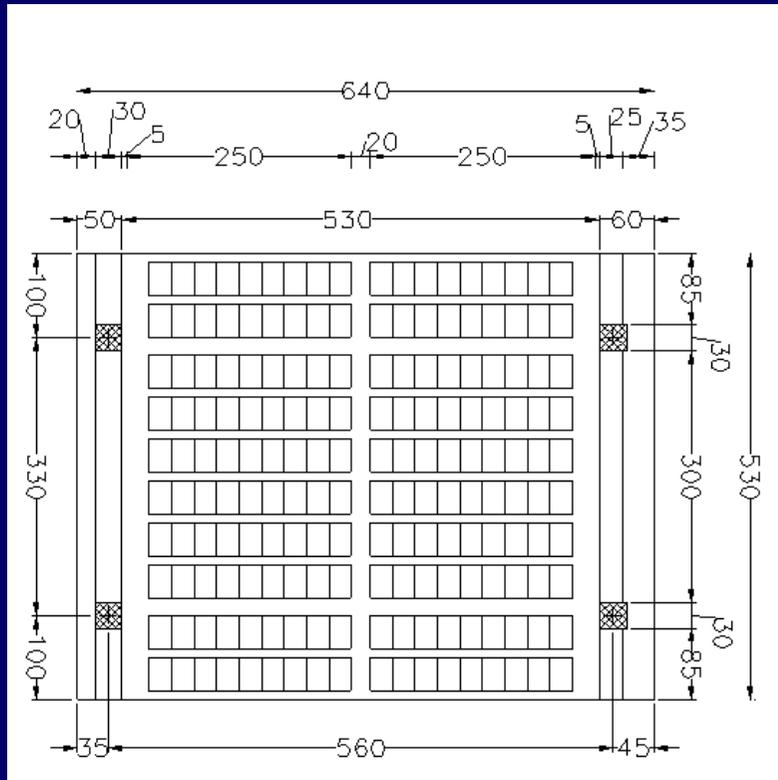
Mode 5



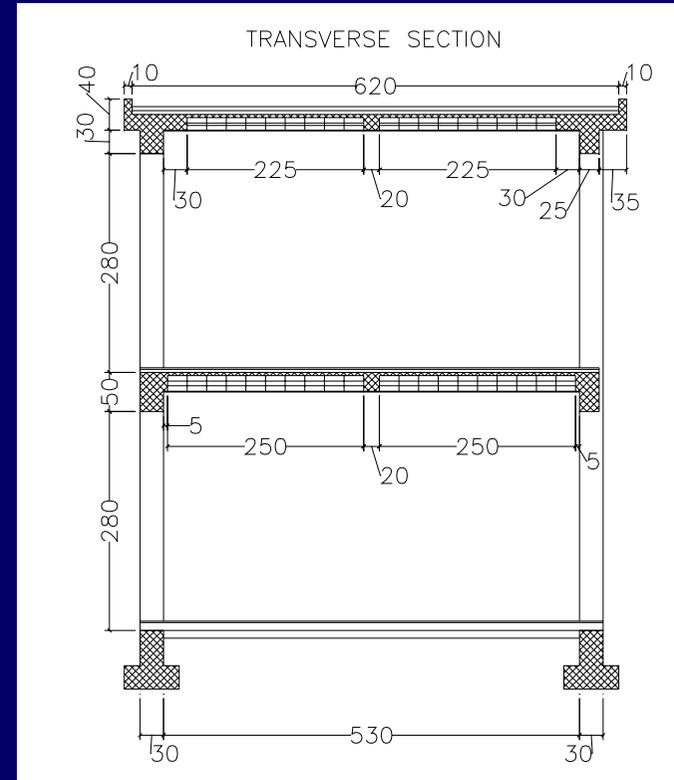
| Mode | Frequency (Hz) | Damping (%) |
|------|----------------|-------------|
| 1 | 1.44 | 2.7 |
| 2 | 2.20 | 3.0 |
| 3 | 4.63 | 2.5 |
| 4 | 5.56 | 6.3 |
| 5 | 6.85 | 2.6 |

TEST on the bare RC structure

GEOMETRY OF THE STRUCTURE



Direction of Loading



Direction of Loading

TEST on the bare RC structure

LOADING AND MEASURING DEVICES



General views of the reacting structure

Close-up views of the reacting structure with the load jacks



Displacement measuring devices



TEST on the bare RC structure

PHYSICAL TEST RESULTS

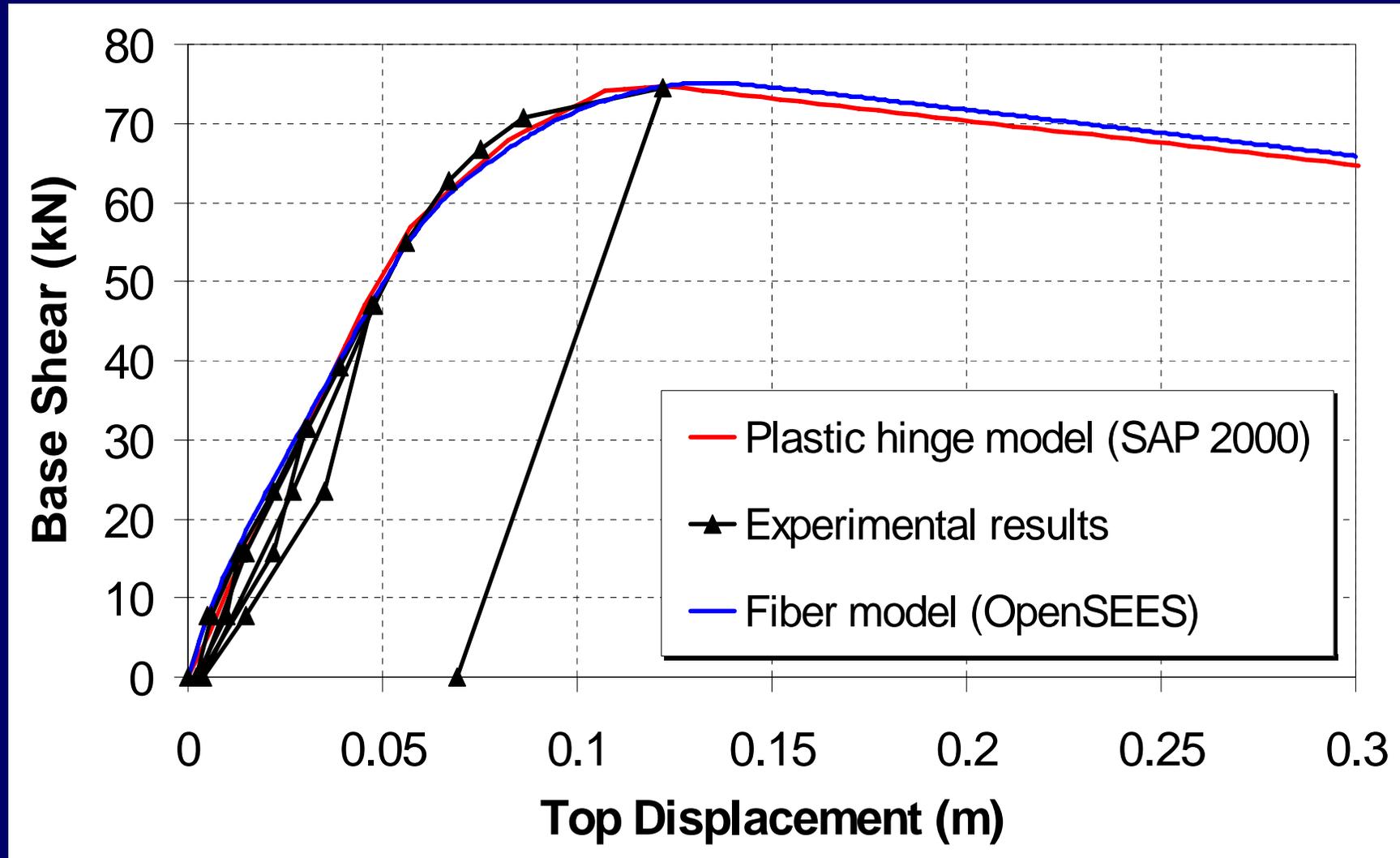


Top-story column mechanism

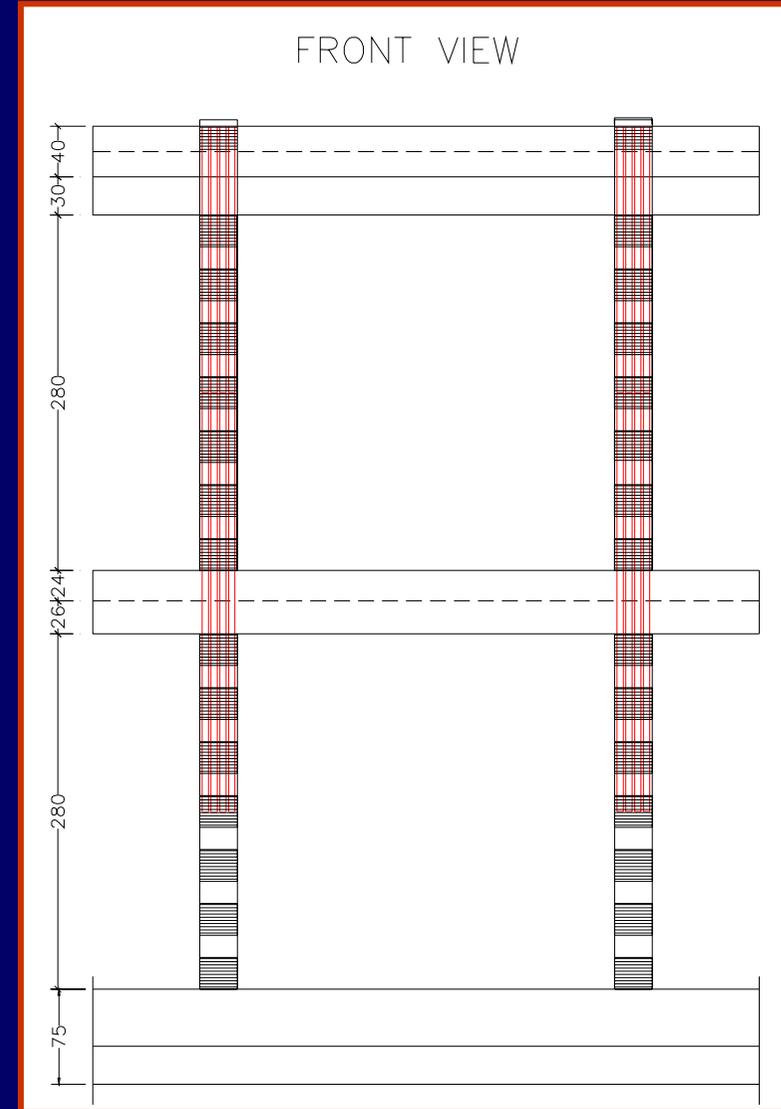
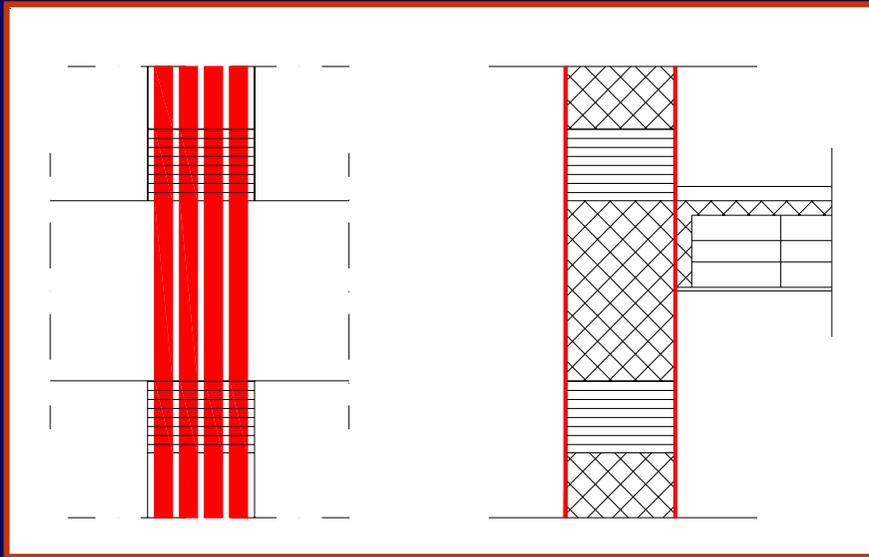
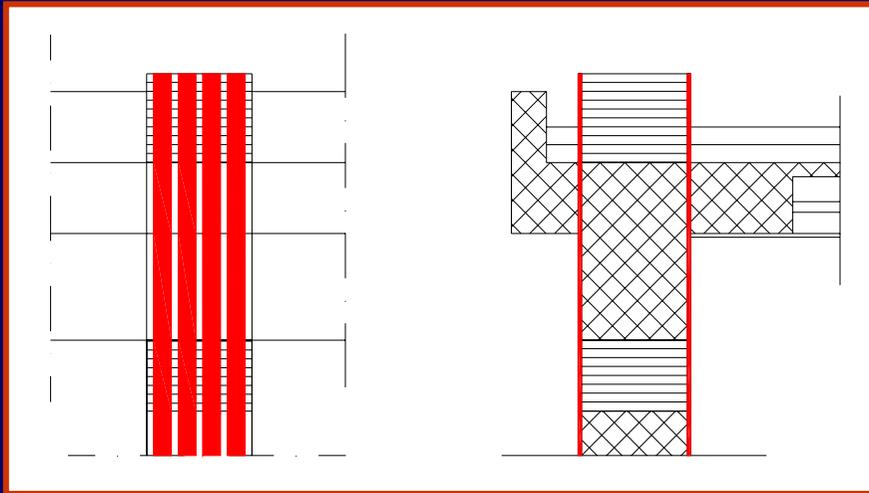
Close-up views of plastic hinges



TEST on the bare RC structure



Composite fiber reinforced materials



Composite fiber reinforced materials

LOADING AND MEASURING DEVICES



General views of the reacting structure



Close-up views of the reacting structure with the load jacks



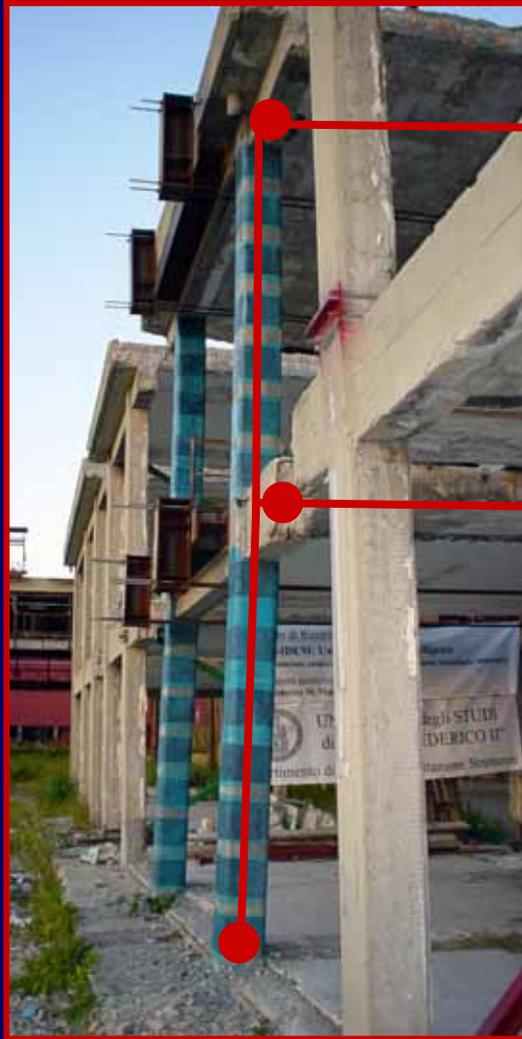
Displacement measuring devices



Composite fiber reinforced materials

PHYSICAL TEST RESULTS: damage pattern

Global collapse mechanism



Close-up views of plastic hinges at the column bases



Composite fiber reinforced materials

PHYSICAL TEST RESULTS: damage pattern

Peeling off at a wrong end detail



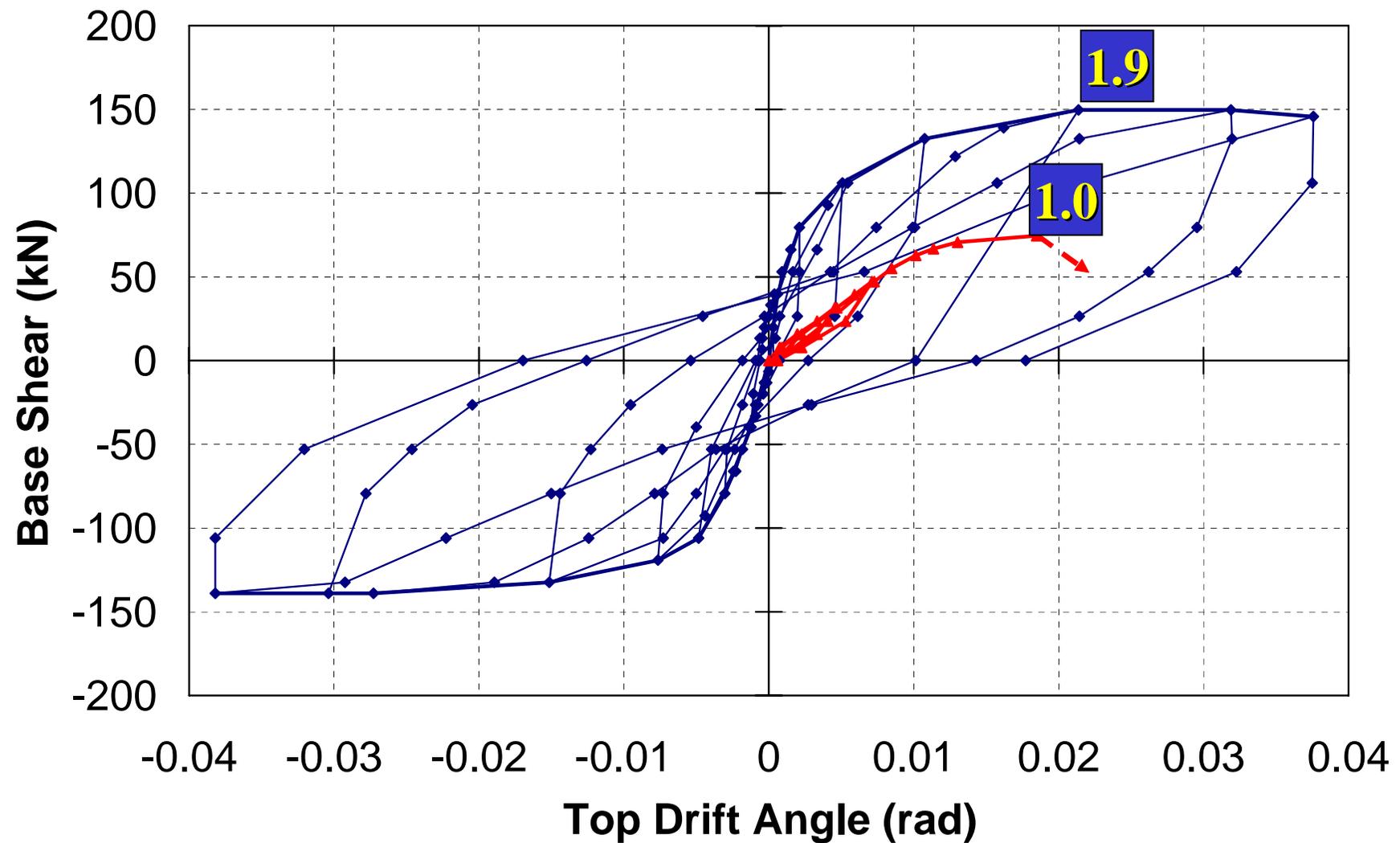
Cracking of beams in torsion



Local buckling of free length portions of strips



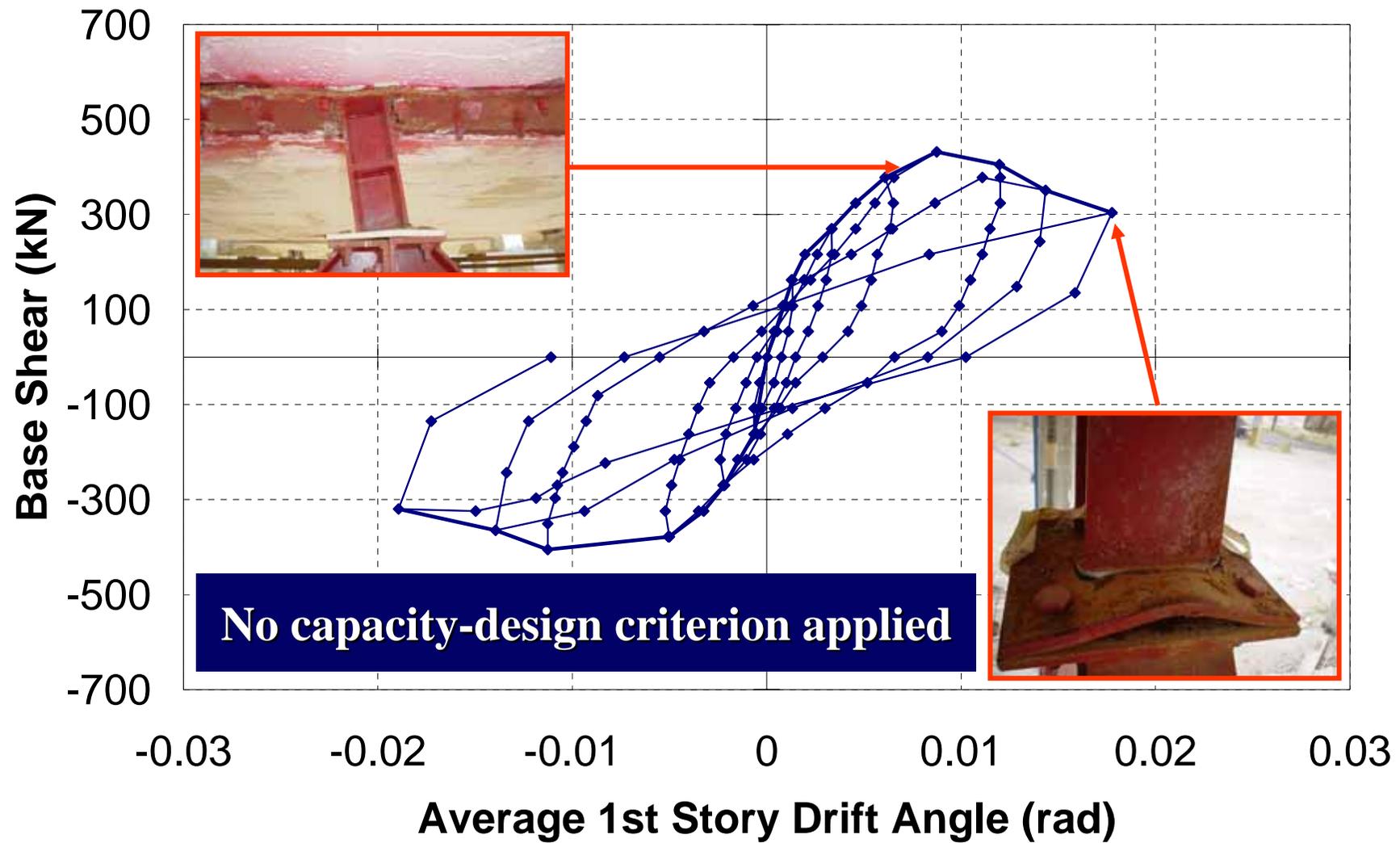
Composite fiber reinforced materials



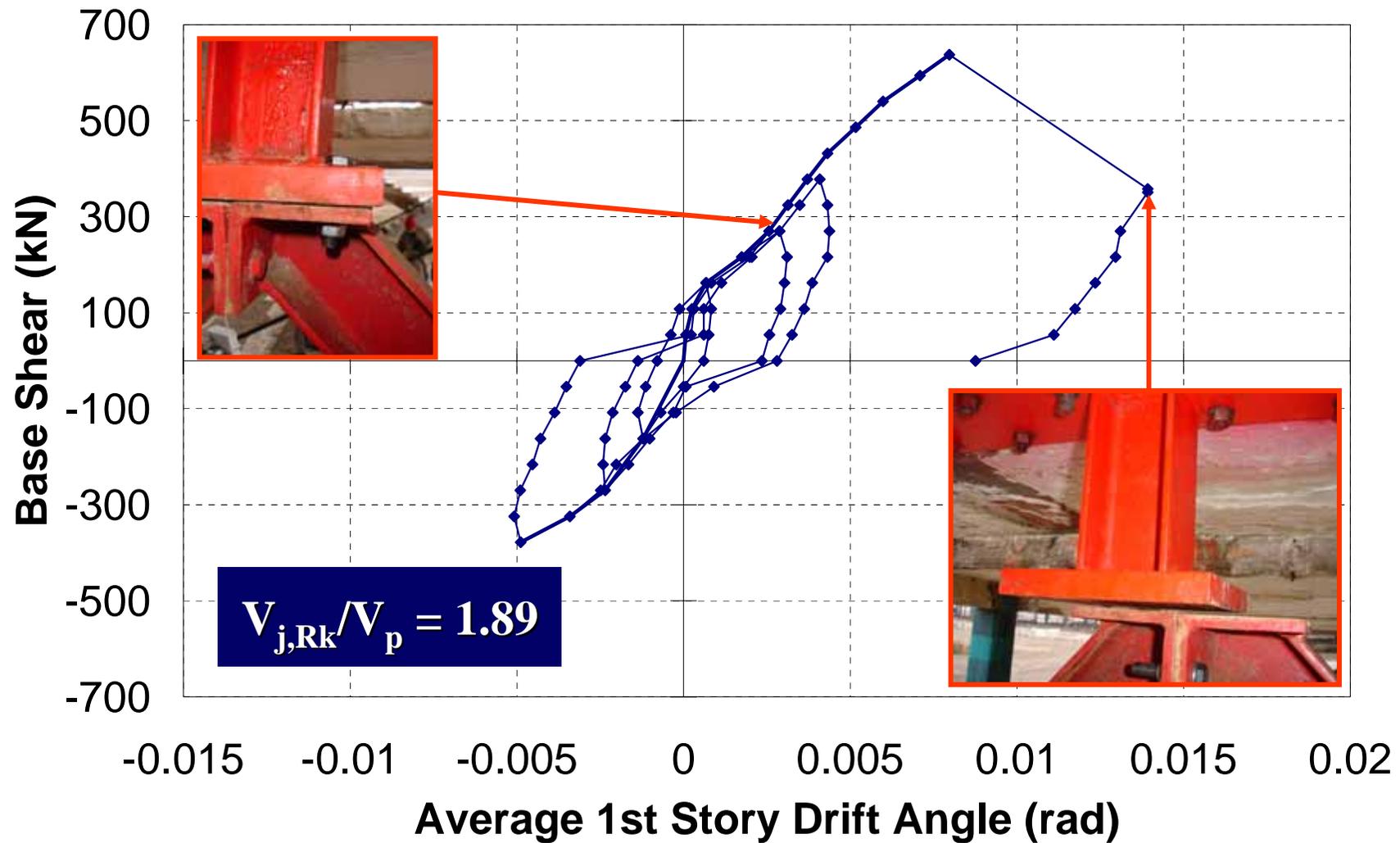
Steel Eccentric Braces (EB)



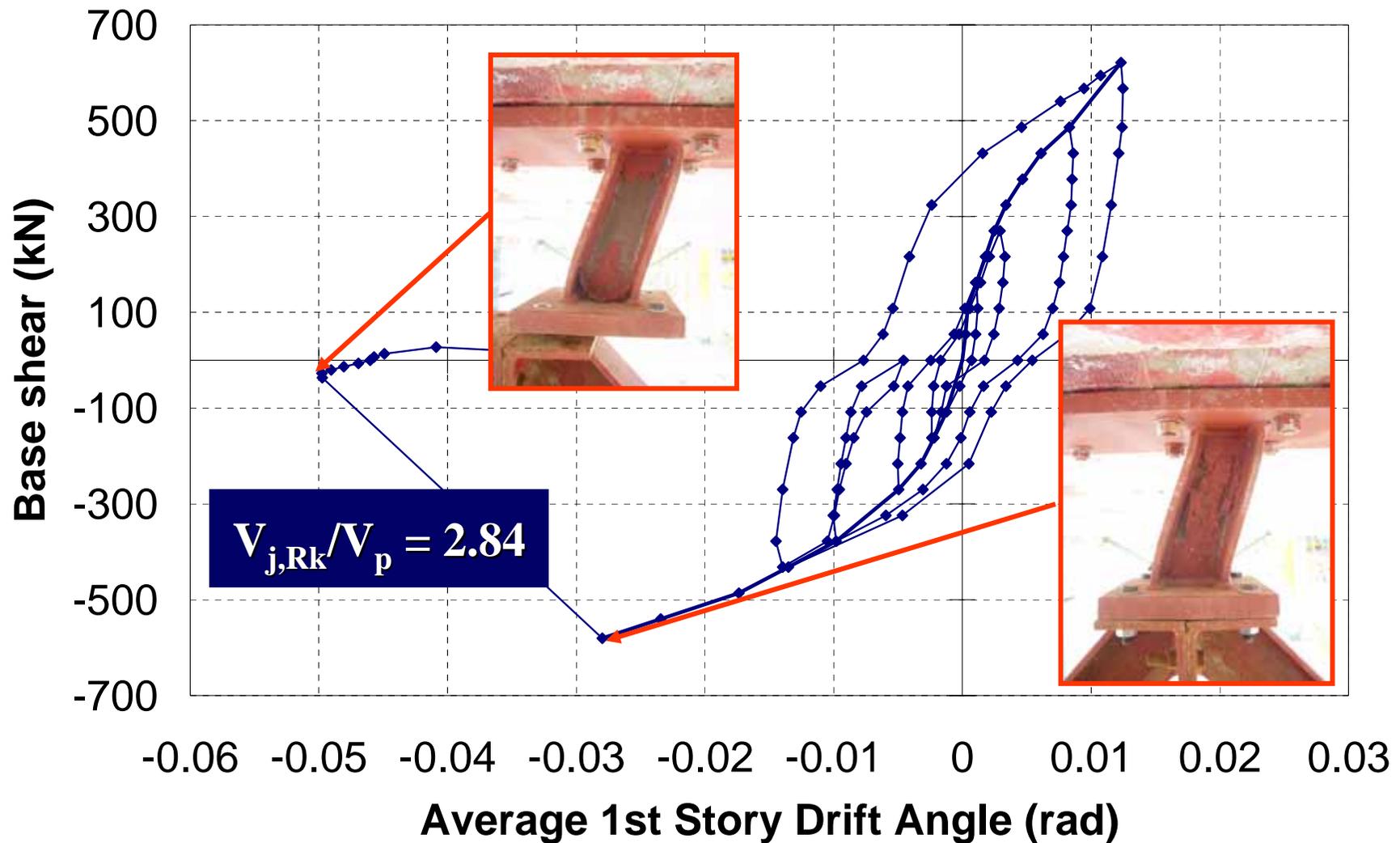
Steel Eccentric Braces (test #1)



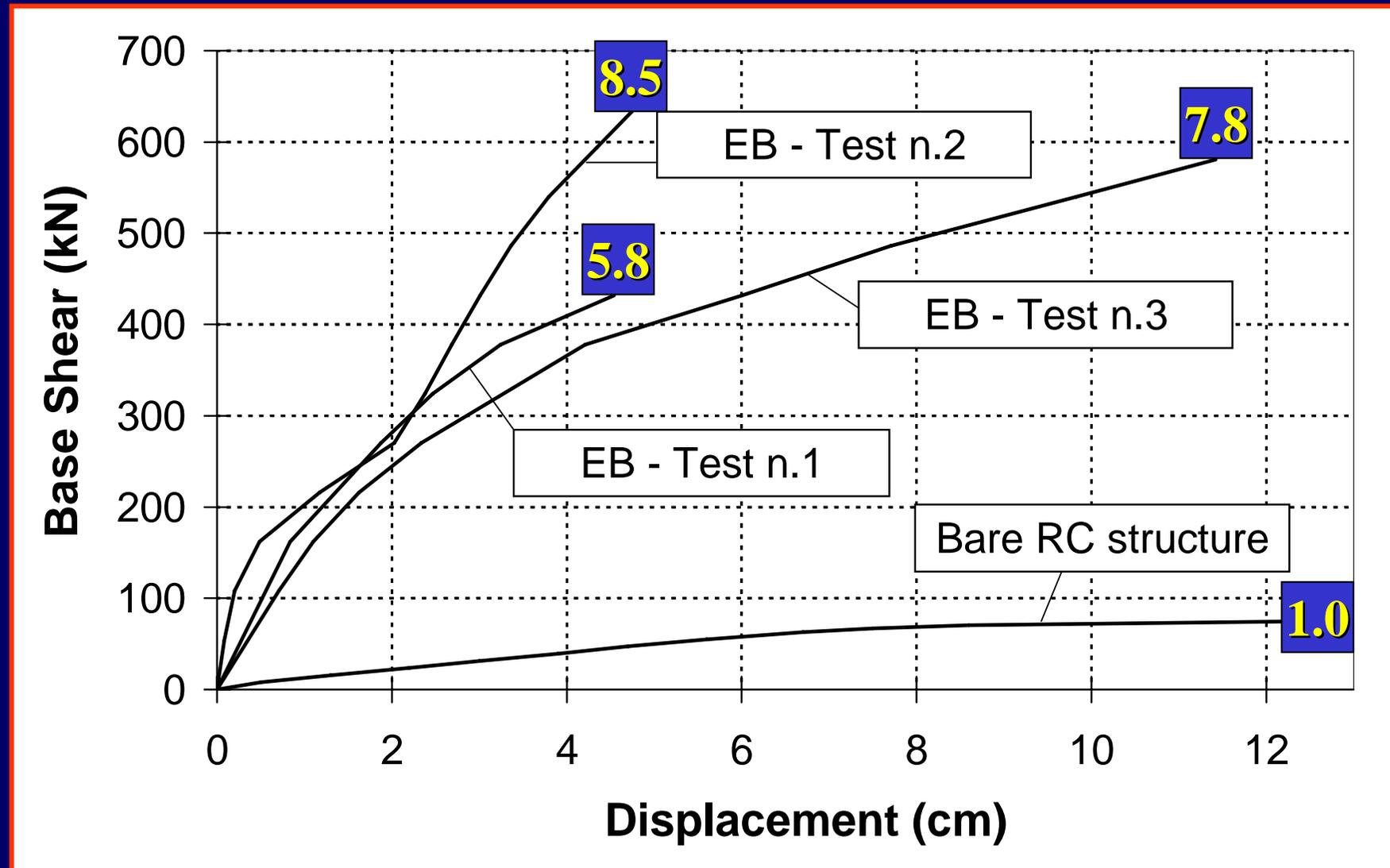
Steel Eccentric Braces (test #2)



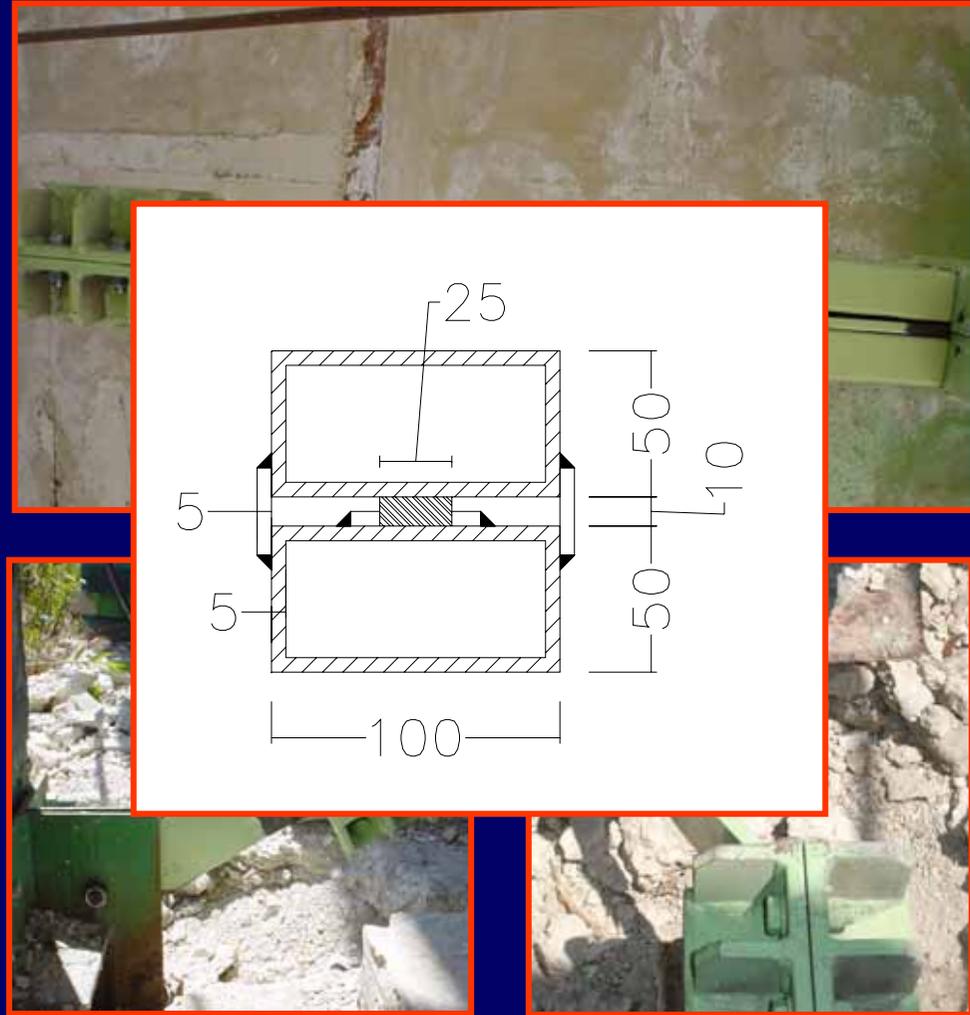
Steel Eccentric Braces (test #3)



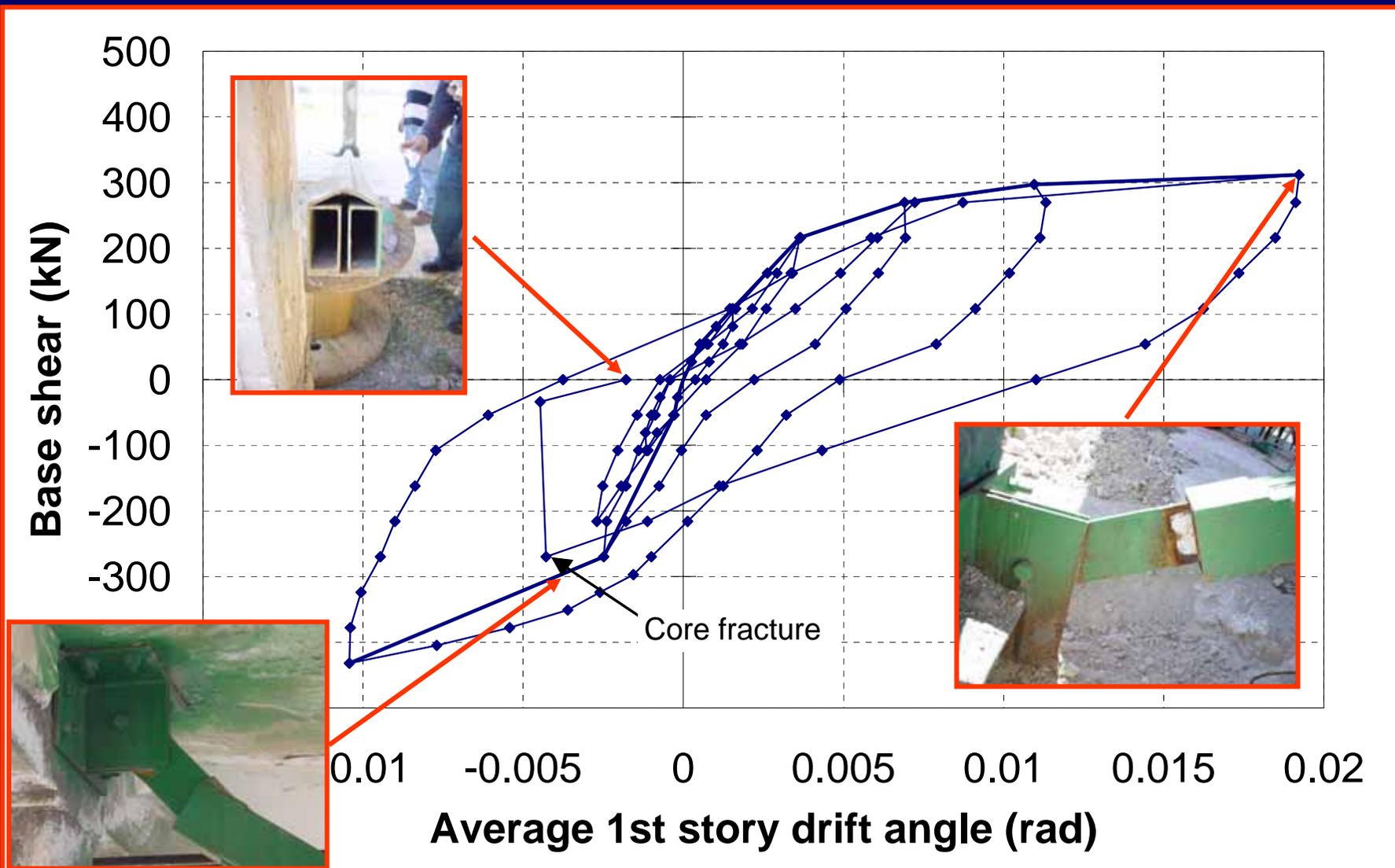
Steel Eccentric Braces (comparison)



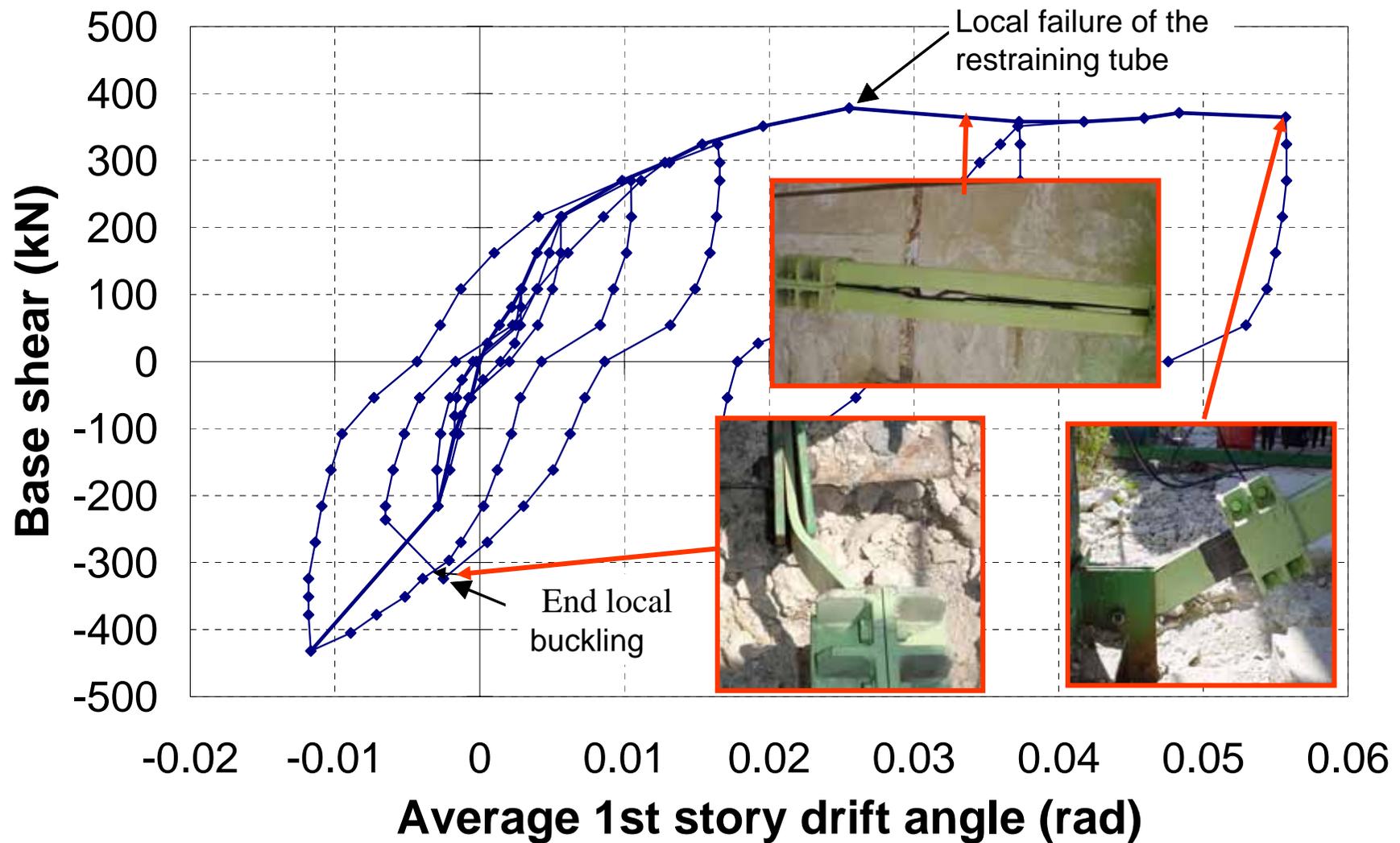
Steel Buckling Restrained Braces (BRB)



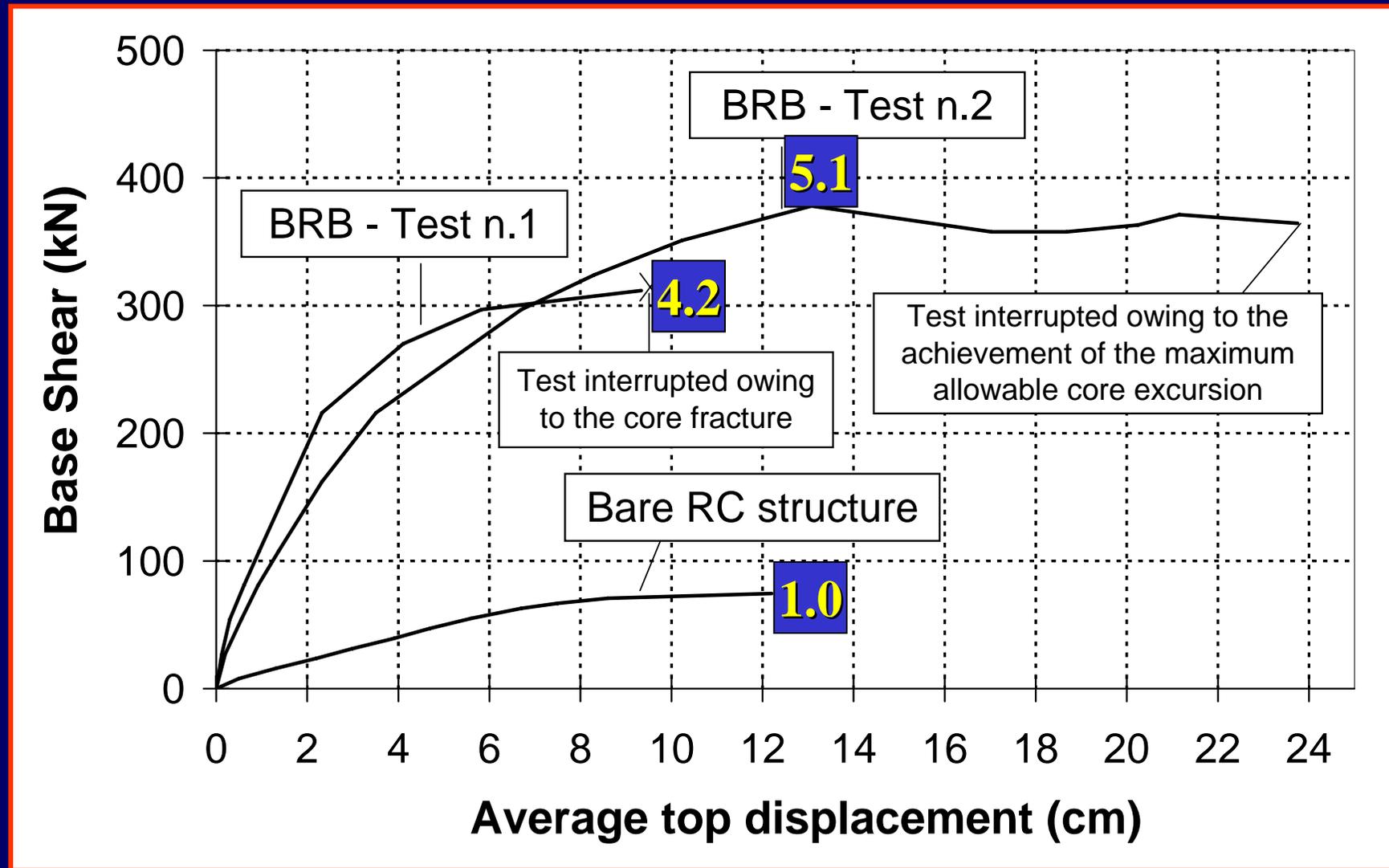
Steel Buckling Restrained Braces (test #1)



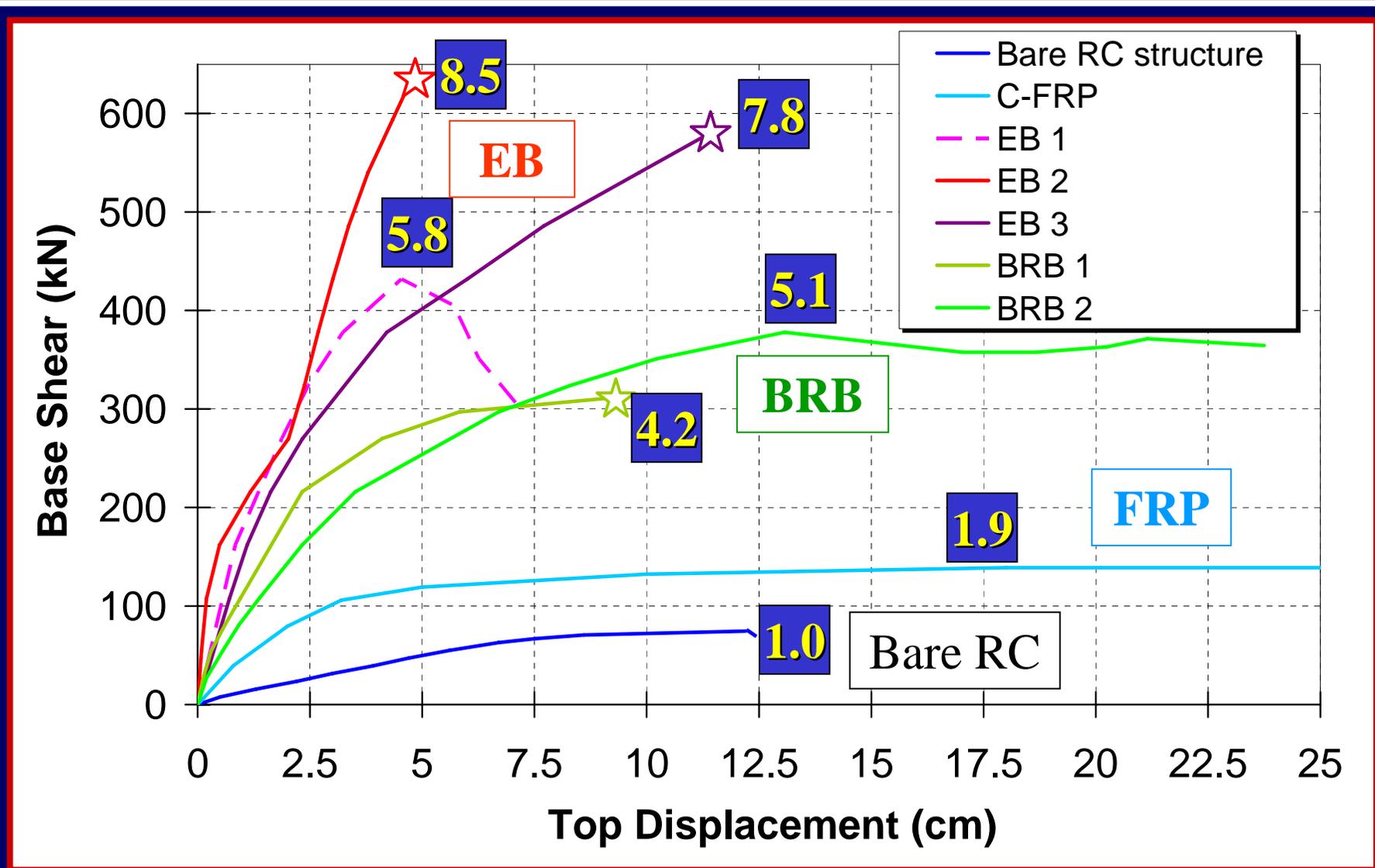
Steel Buckling Restrained Braces (test #1)



Steel Buckling Restrained Braces (comparison)



Comparison of results



Base Isolation



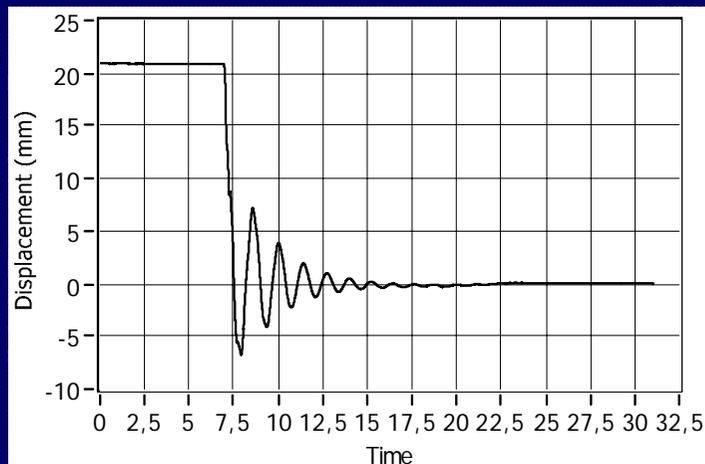
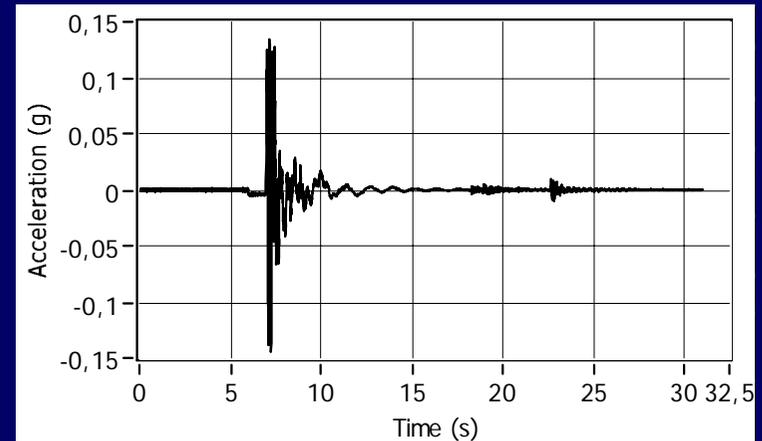
Base Isolation



Base Isolation



Base Isolation



This Volume is a collection of scientific contributions dealing with a wide experimental/theoretical research developed during the years 2000-2005, in the former industrial area of Bagnoli (Naples, Italy). The results of 15 full-scale tests (both static and dynamic) on real RC structures seismically upgraded by means of different, innovative and advanced, techniques are presented and discussed, together with the comparison with relevant theoretical/numerical studies.

The following upgrading techniques have been considered:

1. Base isolation
2. Buckling restrained braces
3. Composite materials
4. Eccentric braces
5. Shape memory alloy braces
6. Steel and aluminium shear panels

The activity has been developed by four Institutions:

- University of Naples "Federico II" (coordination)
- University of Basilicata
- University of Chieti-Pescara
- Italian Department of Civil Protection

Federico Mazzolani is Professor of Structural Engineering at the University of Naples "Federico II", Italy. He is an internationally recognised expert in metal structures, seismic design and rehabilitation of structures. He is the Chairman of the STESSA Conference, which is dedicated to the behaviour of steel structures in seismic areas. In addition, he is the Chairman of the CEN Committee responsible for Eurocode 9 on "Design of Aluminium Structures" and of the ECCS Committee 13 on "Seismic Design of Steel Structures". At national level, he is the Chairman of the UNI-SC3 Committee on "Steel and Composite Structures" (the mirror Committee for Eurocodes 3, 4, 9). Currently, he is coordinator of the international research project PROHITECH on earthquake PROTECTION of Historical buildings by reversible mixed TECHNOLOGIES.

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The ILVA-IDEM Research Project

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Federico M. Mazzolani
co-ordinator & editor

Seismic upgrading of RC buildings by advanced techniques

The ILVA-IDEM Research Project



Prof. F.M. Mazzolani - UNIVERSITY of NAPLES "FEDERICO II"