

A Study on the Post-Earthquake Residual Displacements and Seismic Performance Assessment

Ufuk Yazgan, Prof. Alessandro Dazio

Institute of Structural Eng. (IBK)

Department of Civil Eng. (D-BAUG)

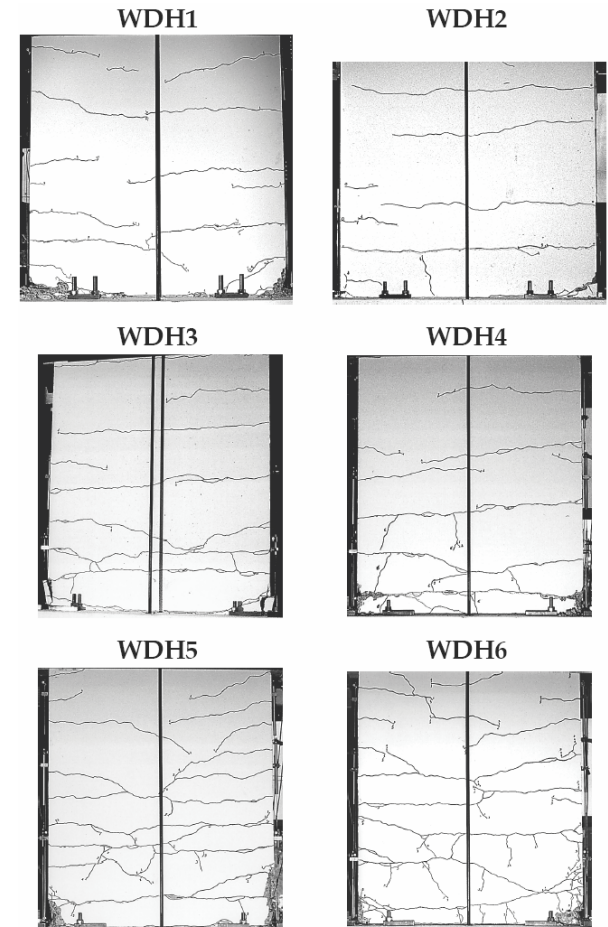
Swiss Institute of Technology, Zürich (ETH-Z)

- 20.05.2005 -



- Most of the buildings, both old and new ones, are expected to undergo inelastic cycles when subjected to a design-level earthquake.
- Inelastic response may cause residual displacements
- Residual displacements are critical for
 - Post-earthquake safety
 - Reparability

Residual Displacements at the Component Level



(Source: Lestuzzi P., Wenk. T & Bachmann T., (1999), "Dynamische Versuche an Stahlbetontragwänden auf dem ETH-Erdbebensimulator", IBK IBK Bericht Nr. 240, April 1999)





Courtesy National Information Service for Earthquake Engineering, University of California, Berkeley.

Estimate the
Maximum Values of
Response Parameters



Evaluate the Seismic
Performance of the
Building

Advantage:

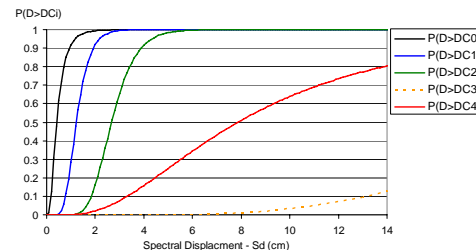
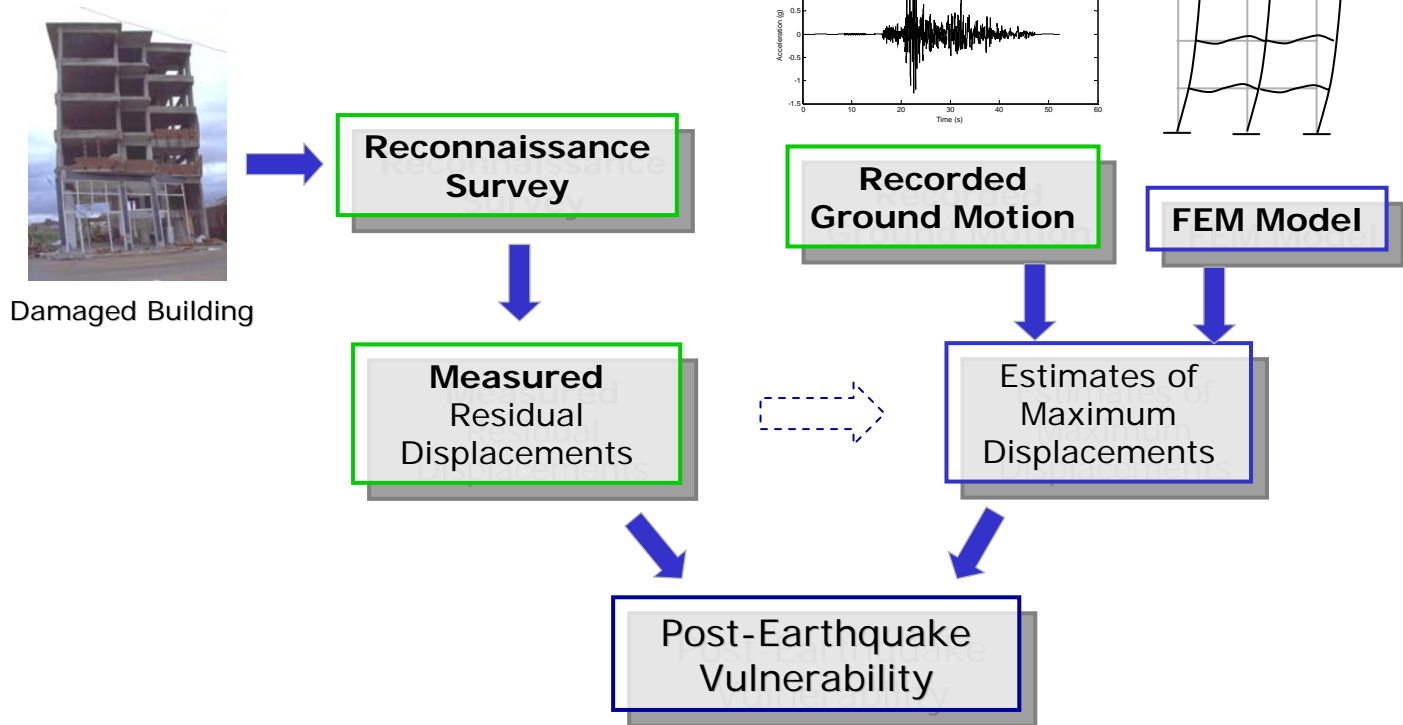
- Damage is usually well correlated with the maximum response values.

Disadvantage:

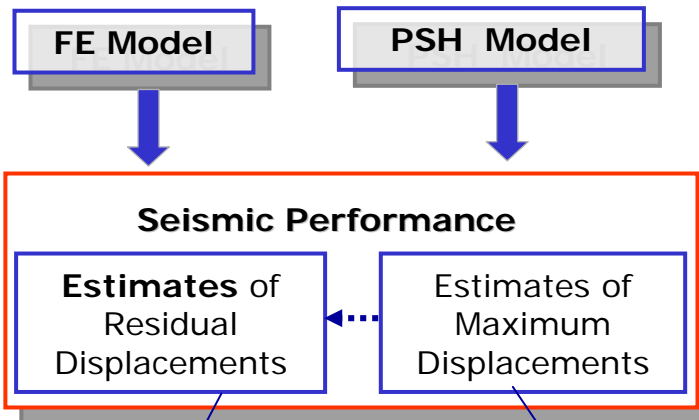
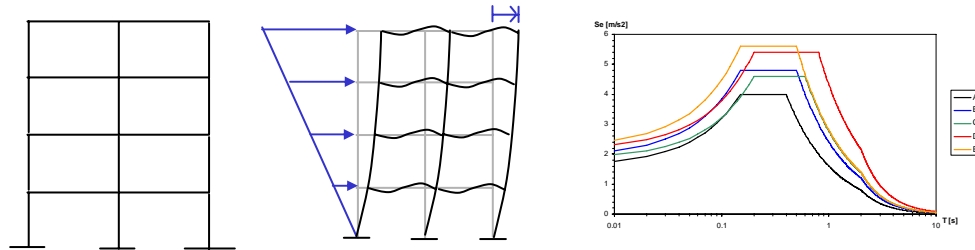
- After an earthquake, most of the time, maximum response values can only be roughly estimated.

A **Seismic Performance Assessment Method** for buildings based on **residual displacements** will be developed.

Post-Earthquake Assessment



Performance-based Design of a New Structure



Provide essential information about the the post-earthquake:

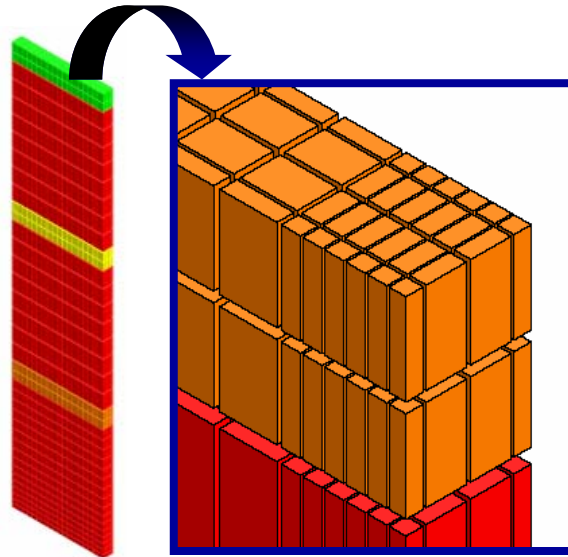
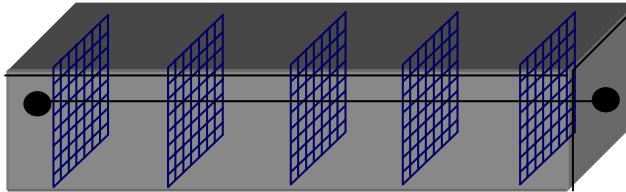
- Reparability/Usability
- Vulnerability

Known to be well correlated with the attained damage

Before making elaborate statistical analyses on the residual displacements one needs to answer the following question:

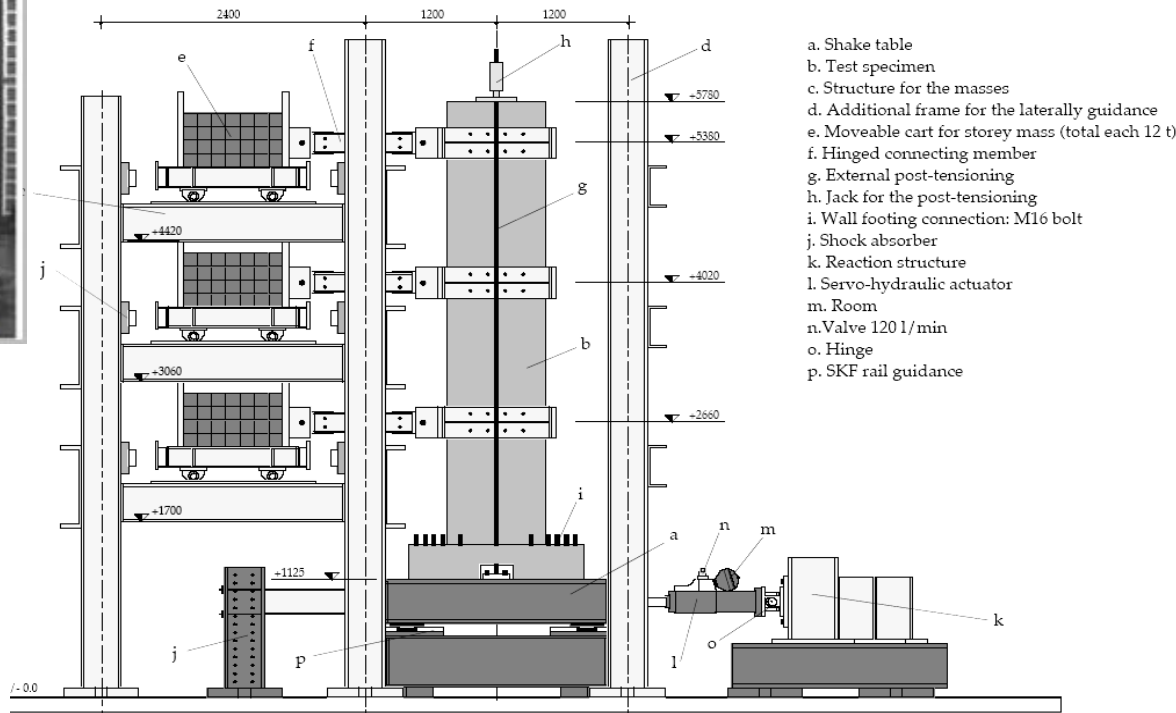
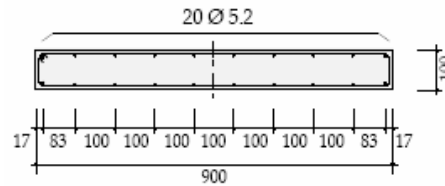
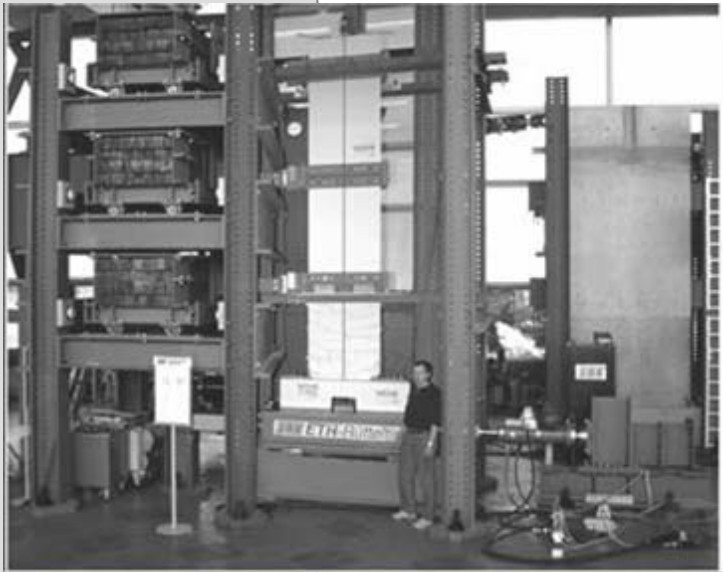
- How accurate can the available analysis tools simulate the seismic response of reinforced concrete structures in terms of residual displacements?

- Element Formulations



Shake-Table Test:

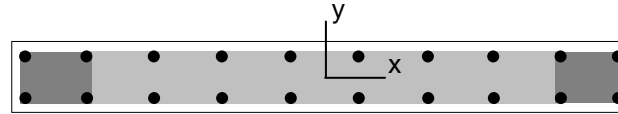
Lestuzzi, P., T.Wenk, H. Bachmann (1999), "Dynamische Versuche an Stahlbetontragwänden auf dem ETH-Erdbbensimulator", IBK Bericht Nr.240, Institut für Baustatik und Konstruktion, ETH Zürich



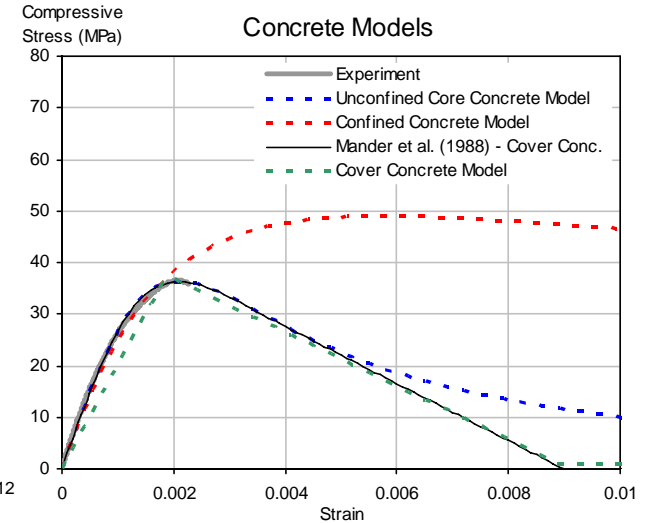
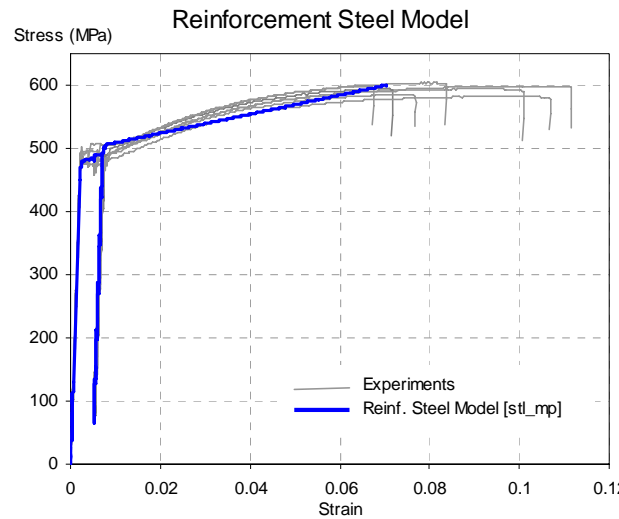
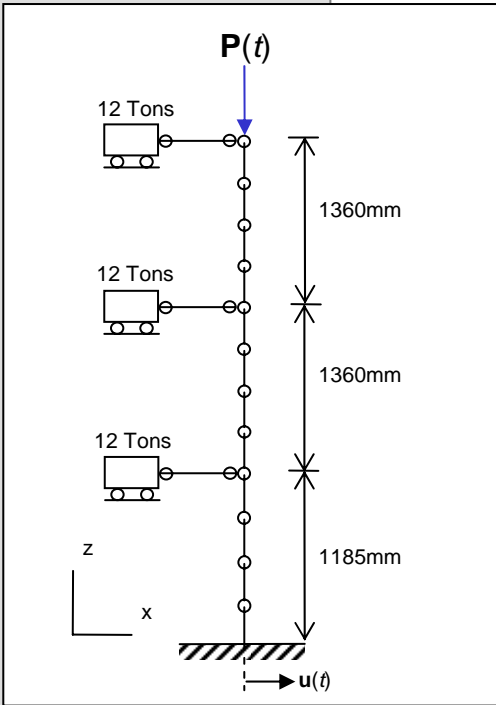
- An example simulation



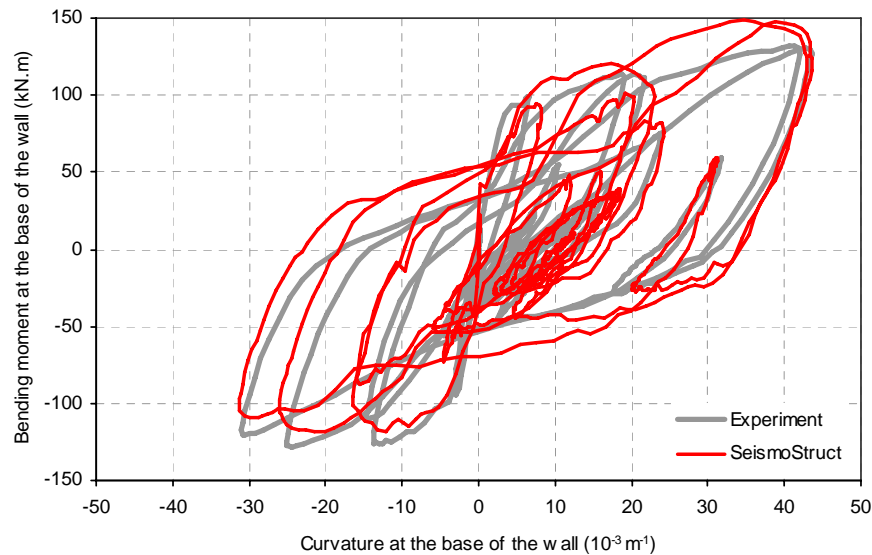
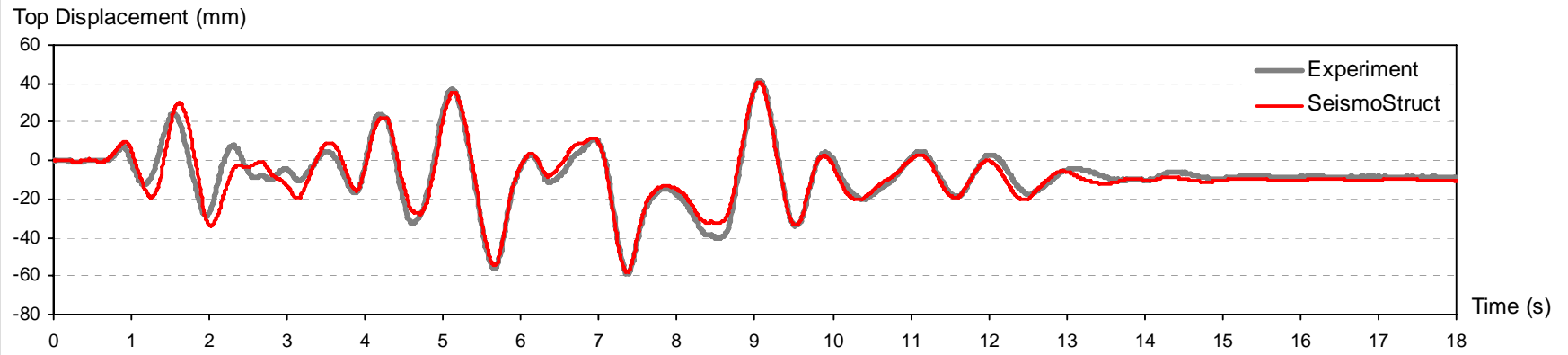
SeismoSoft (2003), "SeismoStruct – A computer program for static and dynamic nonlinear analysis of structures" by S. Antoniou and R. Pinho



Sections with 4 different materials and 300 fibers



- Some of the results ...



- The simulated response will be compared with the experimental data for a number of tests.
- The effects of various assumptions and simplifications will be identified focusing on residual displacements.
- The “better” modeling practices will be identified.
- Further investigation of residual displacements will be made accordingly

Thank you.