arsenal research

Ein Unternehmen der Austrian Research Centers.

Evaluation of Civil Structures for Natural Hazards (ECiS)

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Arsenal Research

27th January - Vienna

5th SAMCO Workshop

- **Introduction & General Aspects**
- **State of the Art in Earthquake Engineering**
- **Innovation and Project Idea**
- **RDT Approach and Implementation**
- **Summary and Conclusions**

Content of Presentation

Earthquake Damages

Earthquake Damages

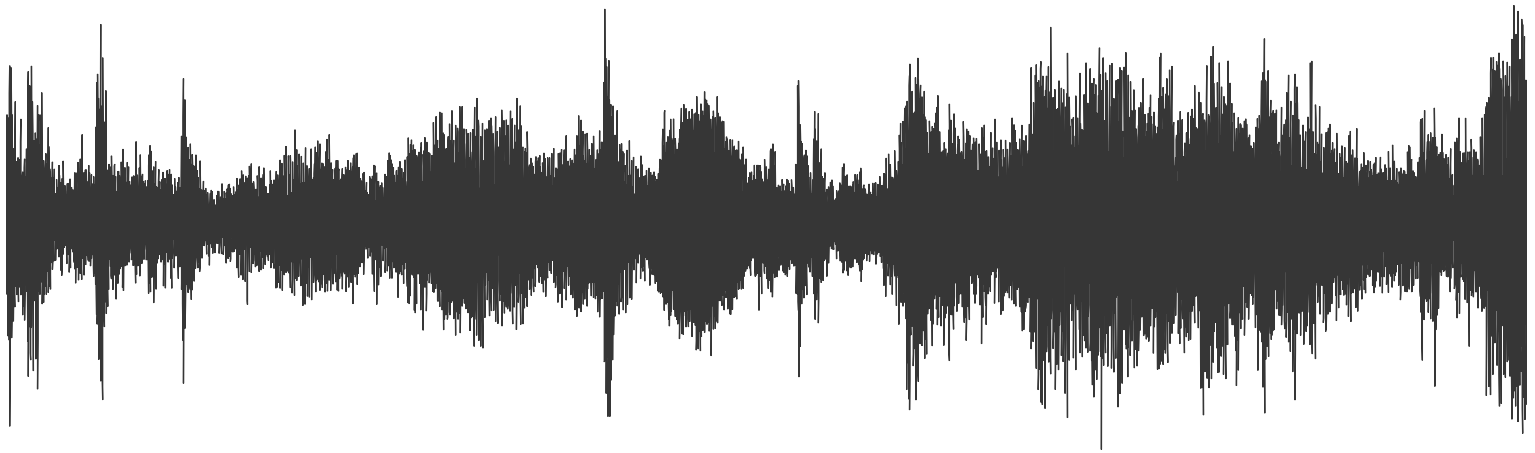
Fault Rupture

Large Displacements

Surface Rupture

Intensity of ground shaking which induces stresses and strains that exceed the strengths of the structures.

If it is possible to predict precisely the ground motions that will occur at the site during the lifetime of the structure, a corresponding design could be done.



Earthquake Definition

Earthquake leads to secondary damages caused by soil-based characteristics:

- **Soil settlements**
- **Soil Liquification**
- **Landslides**
- **Uplift and Sinking Movements**

Effect of Earthquakes

FOCUS

- **important existing structures (hospitals, important bridges, telecommunication, energy supply, etc.**

- **Industry with secondary hazards (chemical hazards, etc.)**

WORKPACKAGES

- **Satelite investigations, maps for microzonation** (EADS or Bureau for Applied Geoscientific Remote Sensoring)
- **Soil dynamics; soil – structure – interaction** (University of Thessaloniki –AUTH)
- **Analysis of lifelines and equipment** (WOELFEL CONSULTING ENGINEERS)
- **Assessment of structures (buildings)** (arsenal research)

In case of STRAP in addition:

- [Assessment of Geometry via Laser Scanners]
- [Elaboration of realistic earthquake input for the site]

Terrestrial Investigations:

- Measurement of the dynamic properties of the structure
- Assessment of the dynamic properties of the soil
- Seismic vulnerability: Response of structure to excitation
- Soil works as „filter“: frequencies are amplified or damped
- Structure – soil interaction

Soil-Structure Identification

Hospital – Test Site

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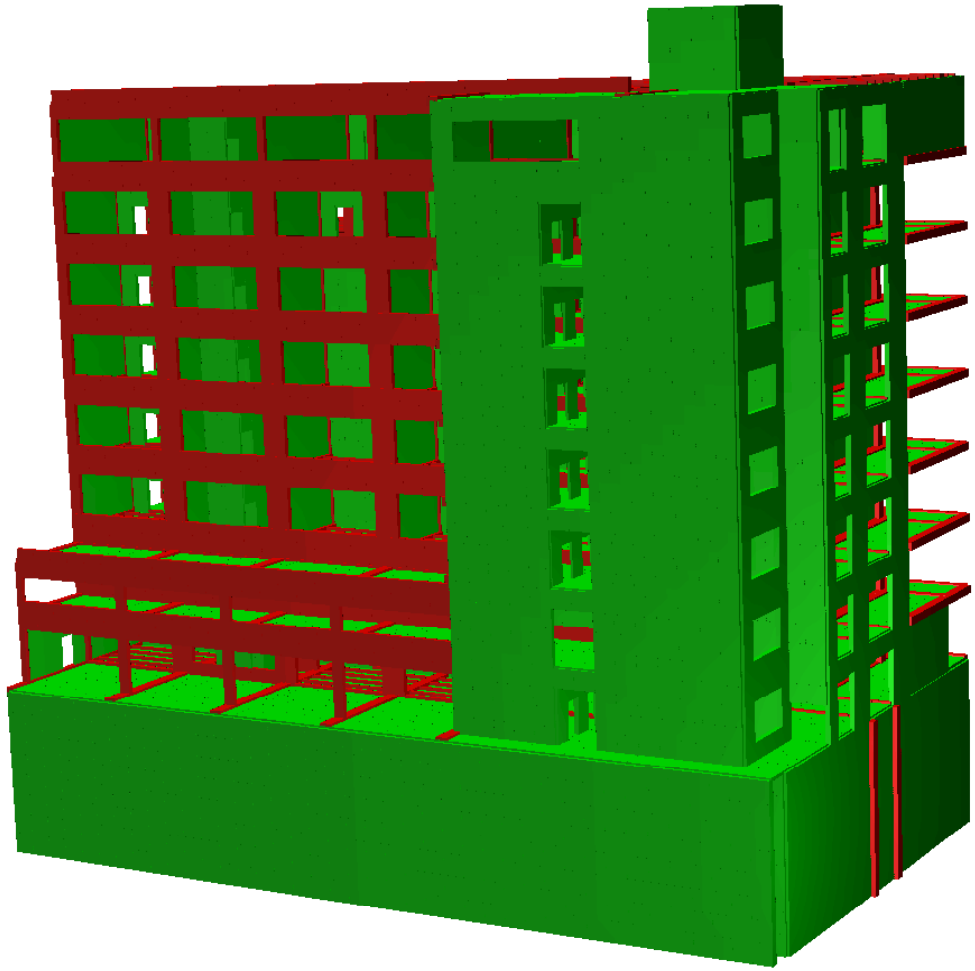

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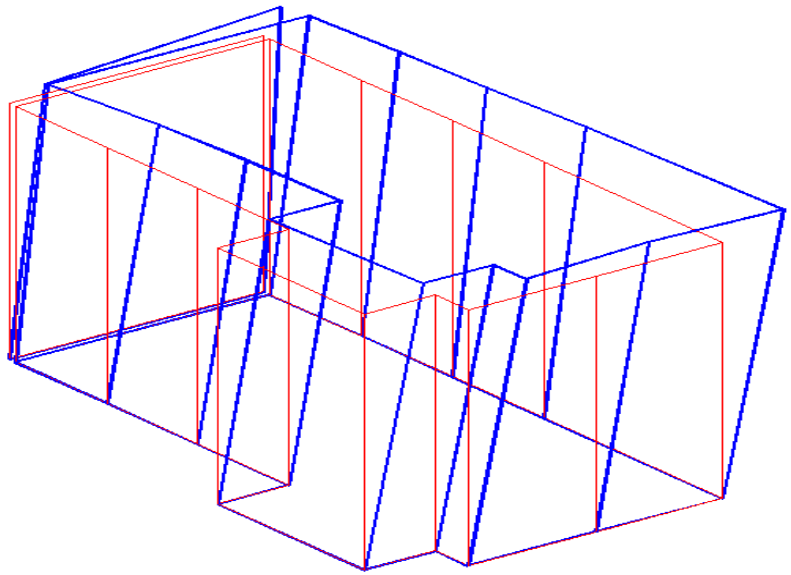
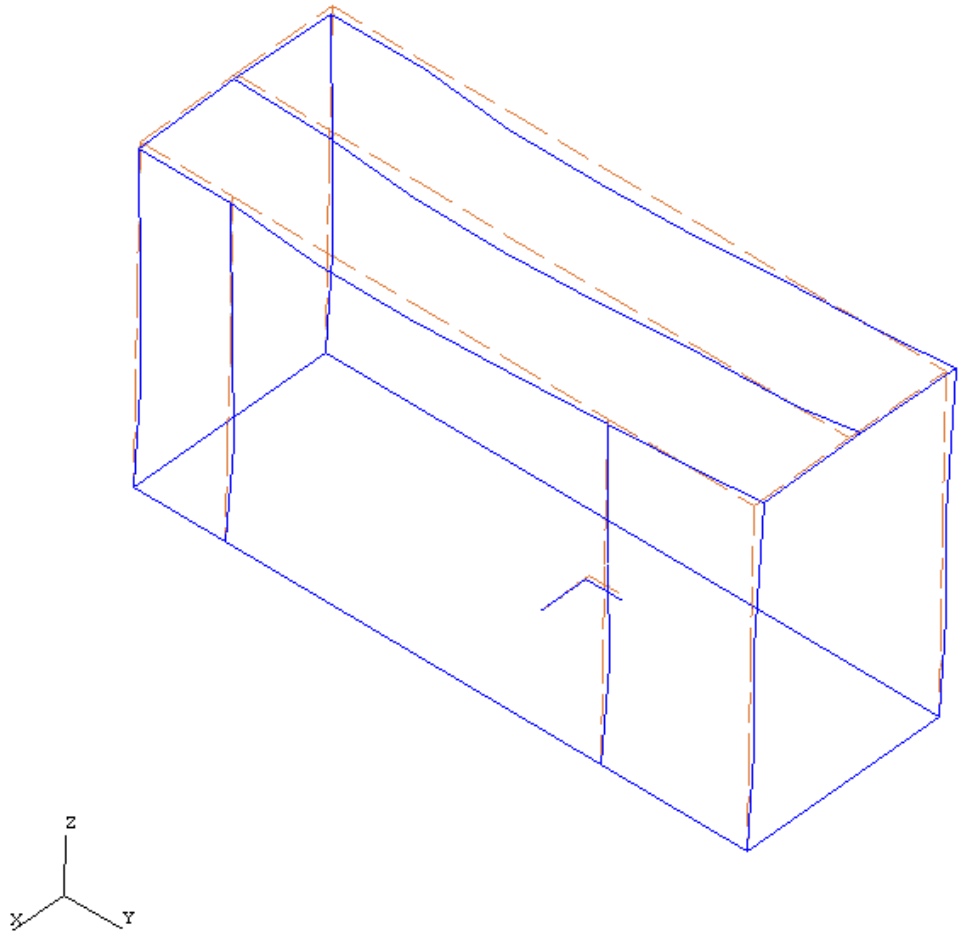
Finite Element Simulation

[a1.shp] Mode 2/3 f = 1.778Hz ξ = 1.0%



Finite-Element Simulation

7.43 Hz, 2.5615%



Mode Shape

- **Terrestrial Research only concentrates on the structure and the local site conditions**
- **No information about the surrounding area and the risk level allocated to the respective site (faults, soil condition, etc)**

$\Rightarrow$ Advanced Methodology required

Research – why?


Advanced Approach of Seismic Risk Analysis and Mitigation Strategy
„Conventional“ Terrestrial Investigation
„Advanced“ Satelite-Data
-Interaction-

- **Earthquake damage is varying locally**
- **Damage and loss of life concentrated in areas underlain by deposits of soft soil**
- **Earthquake damage is function of type of structures in the subsurface and/or soil mechanical ground conditions (faults and fractures), ground water**
- **Seismic waves refracted at sharply outlined discontinuities as faults leading to summation effect**
- **Identification of higher risk areas. Elaboration provides method for microzonation and site characterisation.**

Important Facts

- **Assessment of vulnerability of important civil and lifeline structures to natural hazards („conventional“)**
- **Identification of site conditions in the area of important structures (from Satellite Images)**
- **Assessment of capability of the respective structure by dynamic measurements**
- **Risk Assessment of the structure**

Objective of Research

- **During <u>design stage:</u> seismic risk and vulnerability of the selected site by Satellite Images – assessment if site is reasonable for realisation of structure**

- **<u>Existing structure:</u> seismic risk of the site in combination with dynamic response of the structure (terrestrial investigation)**

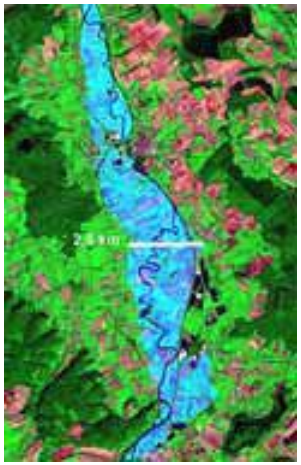
Outcome of Research

- **Ground motion database which should include seismograms recorded around the world**
- **Advanced technologies for probabilistic seismic hazard analysis, site response and liquefaction studies**
- **Site characterization studies, defining the area and soil condition by advanced satellite image technology**

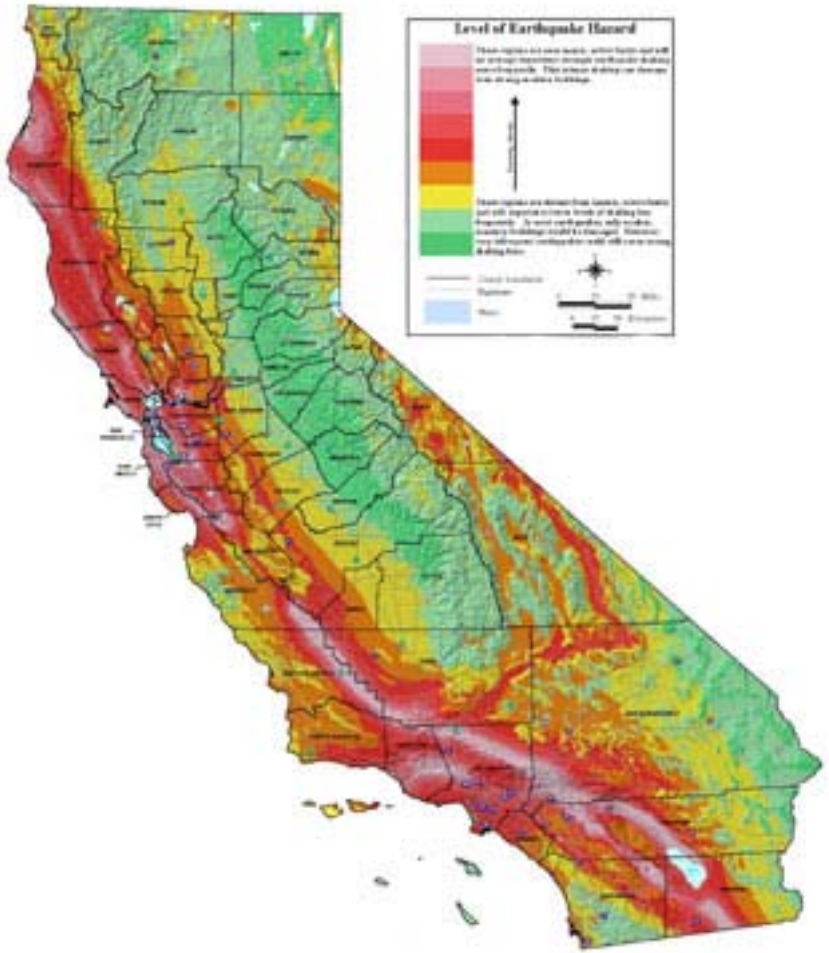
Outcome of Research

- **Macroseismic intensity for risk mitigation measures**
- **Macroseismic maps of risk areas are rarely and not very detailed**
- **Investigation of mechanisms influencing damage intensity, contour and degree of seismic shock and secondary effects**
- **Considerable improvement of knowledge about macroseismic intensity in the investigated area**
- **Existing hazard maps can be updated**

Project Targets



Satellite Images



Result - Seismic Risk Map

- **Development of European operational servicing capacity**
- **Taking benefit of Earth Observation capabilities in combination with advanced ground measurement technologies, data sources and models**
- **Support the organisations and institutions mandated for the management of Natural Hazards, throughout the prevention, anticipation, response and post-response phases**

Summary

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Thanks for Your Attention !

Let´s create a successful project together...

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Contact