

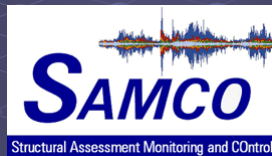


RESEARCH UNIT OF SOIL DYNAMICS AND  
GEOTECHNICAL EARTHQUAKE ENGINEERING

Aristotle University Thessaloniki, Greece



## Laboratory Unit of Soil Dynamics and Geotechnical Earthquake Engineering



ISO9002

Kyriazis Pitilakis  
*Professor A.U.Th.*  
*Scientific Responsible*



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Department of Civil Engineering



Laboratory of Soil Mechanics and Foundation Engineering  
/ Research Unit of Soil Dynamics and Geotechnical Earthquake Engineering

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## Research Activities

- Geotechnical Engineering
- Geotechnical Earthquake Engineering
- Engineering Seismology – Strong ground motion – Site effects
- Environmental Geotechnical Engineering
- Lifeline Earthquake Engineering
- **Aseismic design** of technical projects
- **Soil dynamics**
- Development of new technology and innovative methods to **assess the dynamic soil properties**
- Development of methods and technology to improvement and **enhance static and dynamic soil properties**
- Dynamic **Soil-Foundation-Structure Interaction**
- **Numerical and stochastic methods** in geotechnical/earthquake engineering
- **Landscape preventing** and remedial measures
- **Microzoning** studies
- Seismic **vulnerability** assessment
- Protection of **monuments and historical structures** against natural hazards



## Major Research Projects

Acronym	Funding	Role
Analysis and mitigation of earthquake triggered landslide hazard affecting dams, routes and lifelines	European Union, DG XII	Partner
EUROSEISTEST	European Union, DG XI	<b>Coordinator</b>
EUROSEISMOD	European Union, DG XI	<b>Coordinator</b>
EUROSEISRISK	European Union, DG XI	<b>Coordinator</b>
ISMOD	European Union, Copernicus	Partner
Seismic ground displacement as a tool for town planning, design and mitigation	European Union, DG XI	Partner
CORSEIS	European Union, DG XI	Partner
RISK-UE	European Union, DG XI	Partner
SAMCO	European Union, GROWTH	Partner



## Major Research Projects

Acronym	Funding	Role
New Methods for Mitigation of Seismic Risk of Existing Foundations	European Union, GROWTH	Partner
Soil dynamic testing of geophysical survey for the design of Metro Infrastructure	Bouygues T.P.	Coordinator
Microzoning study of Thessaloniki	General Secretary of Central Macedonia	Coordinator
Microzoning study of Volos urban area – N.Ionia	Prefecture of Magnesia	Coordinator
Microzoning study of Kozani urban area	Municipality of Kozani	Coordinator
Microzoning study of Livadia urban area	Municipality of Livadia	Coordinator
Microzoning study of Lemesos and Paphos urban areas	Ministry of Agriculture and Environment, Cyprus. Department of Geological Survey, Cyprus	Coordinator



Acronym	Funding	Role
Analytical and experimental study of the effect of local soil conditions for the evaluation an review of the EAK design forces.	OASP	Coordinator
Stability study for the Lindos Acropolis	Ministry of Culture	Coordinator
Reconstruction and retrofitting studies in the Rhodes Medieval City Fortress	Ministry of Culture	Coordinator
Improvement of the infrastructure for the performance of specific studies. Consultancy and verification services.	General Secretariat of Research and Technology- Ministry of Development- Greece	Coordinator
Justified selection of the TVX Hellas metallurgy intallation	IGME	Coordinator
Laboratory testing for the Drama mine geotechnical study	DEH – Public Electricity Organization	Coordinator
Study of the effect of the AIS Kardias expansion towards the West and North site	DEH – Public Electricity Organization	Coordinator



SCOPE: FUNDAMENTAL RESEARCH:

to conduct **experimental & theoretical research** for improving existing methods, tools and procedures that estimate **local ground motion variations due to site specific effects** within the context of engineering applications

to **develop and improve methods**, models and tools for **hazard vulnerability and risk assessment**

to **enhance the earthquake resistance** of **ordinary R/C buildings and bridges**

to contribute to the ongoing **elaboration** of the new generation of **Eurocode 8**

to create a **database** of high quality data easily and world-widely accessed from researchers through Internet for **validation** and **improvement of existing methods** as well as for the **development of new approaches** in earthquake engineering

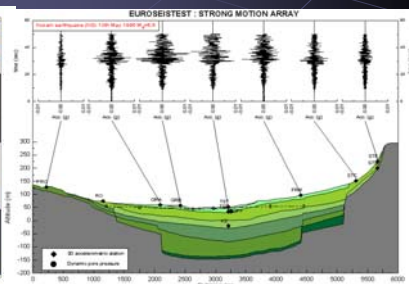
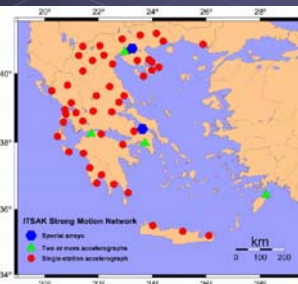


A multi-functional test site located at the Mygdonian valley for the study of Engineering Seismology, Seismology, Geotechnical Earthquake Engineering and Earthquake Engineering issues.



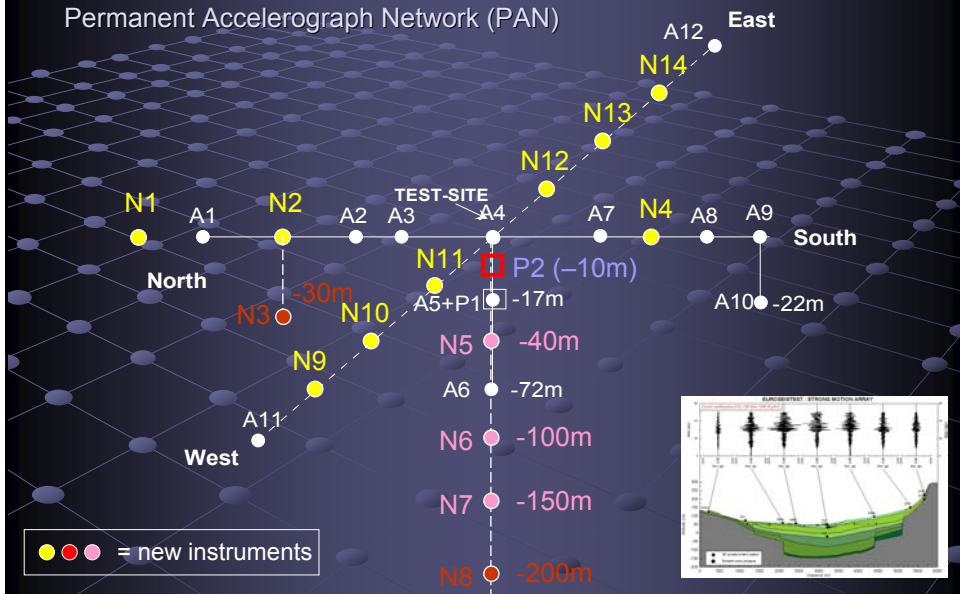
<http://euroseis.civil.auth.gr>

- EURO-SEISTEST (EV5V-CT.93-0281) (1993-1996) **Cordinator & Scientific responsible**
- EURO-SEISMOD (ENV4-CT.96-0255) (1996-1999) **Cordinator & Scientific responsible**
- EUROSEIS-RISK (EVG1-2001-00022) (2002-2005) **Cordinator & Scientific responsible**

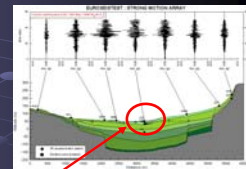
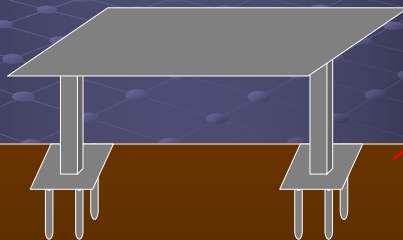




### Permanent Accelerograph Network (PAN)



### Study of SSI effect on the 6-storey building & a prototype bridge model



- Complete and permanent instrumentation of soil surface, foundation and superstructure
- Performance of dynamic, seismic and pull out tests
- Investigation of Soil-Structure interaction in the presence of yielding
- Study of wave propagation, inertial SSI interaction effects for all coupled modes of vibration
- Experimental vs. theoretical and analytical dynamic impedance of the SS system
- Study of the physics of the problem in depth physic
- Effect of various retrofitting techniques
- Implications with design, norms and codes
- Impact on Bridge Engineering



EUROSEIS-RISK : EVG1-CT-2001-00040



# Seismic Hazard Assessment, Site Effects & Soil Structure Interaction Studies in an Instrumented Basin

<b>Coordinator:</b> Laboratory of Soil Mechanics and Foundation Engineering, Aristotle University of Thessaloniki	
Laboratory of Strength of Materials, Geophysical Laboratory	
<b>Institute of Engineering Seismology and Earthquake Engineering</b>	
<b>Laboratoire Central Des Ponts-Et-Chaussées</b>	
Lehrstuhl fuer Baustatik Und Baudynamik (Lbb) - Rheinisch-Westfaelische Technische Hochschule Aachen	
Unitat de Geologia, Institut Cartographic De Catalunya	
Universita' Degli Studi Di Trieste Dipartimento Di Scienze Della Terra	
Earthquake Research Institute, The University Of Tokyo	
Department Of Geophysics, Faculty Of Mathematics, Physics And Informatics, Comenius University	
Institute For Systems, Informatics & Safety / European Laboratory For Structural Assessment, Joint Research Center of the European Commission	



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## Equipment / Infrastructure

- Current value of infrastructure estimated to **1500 KEuros**
- Area of **450m<sup>2</sup>** including laboratories, offices, lecture and seminar rooms and complementary spaces.



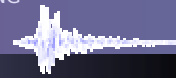
Resonant Column Apparatus



Ring Shear Apparatus



Cyclic Triaxial Apparatus

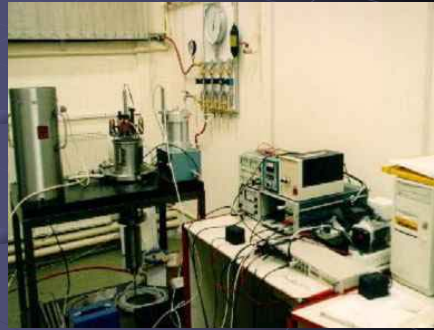


## Equipment / Infrastructure

- The **in-situ** (cross-hole, down-hole), **laboratory & computer equipment** is one of the most advanced at an international level.
- Four (4) CMG-40T-1 sensors (Guralp) and four (4) recorders RefTek (Refraction)
- **ISO 9002**



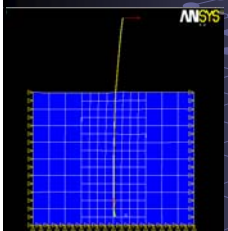
Triaxial Apparatus



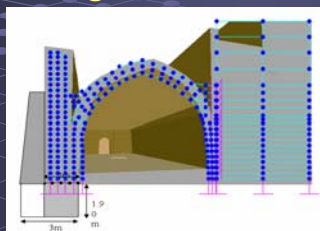
Torsional Shear / Resonant column Hollow Cylinder Apparatus



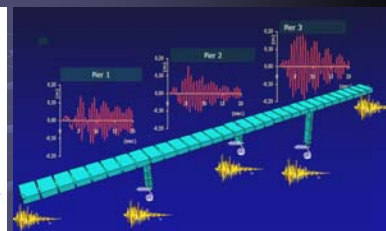
## Modelling Soil-Structure Interaction



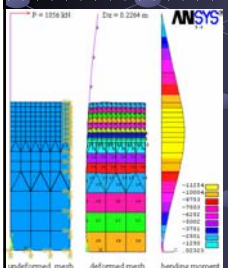
2D Pier-Pile-Soil System



Medieval City of Rhodes SSI study



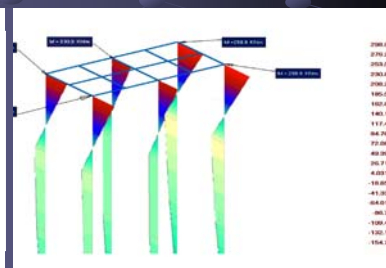
3D Dynamic SSI Analysis of Bridges




2D Pier-Pile-Soil System




3D Pile-Soil-Pile System



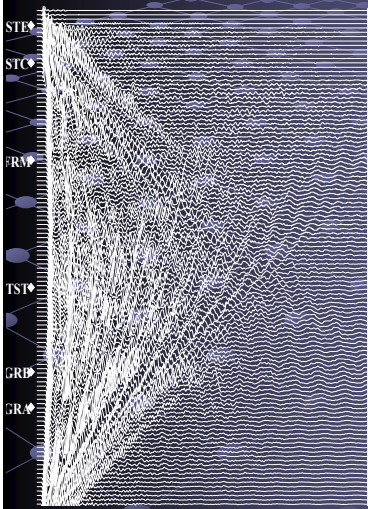
3D Pile-to-Pile Interaction



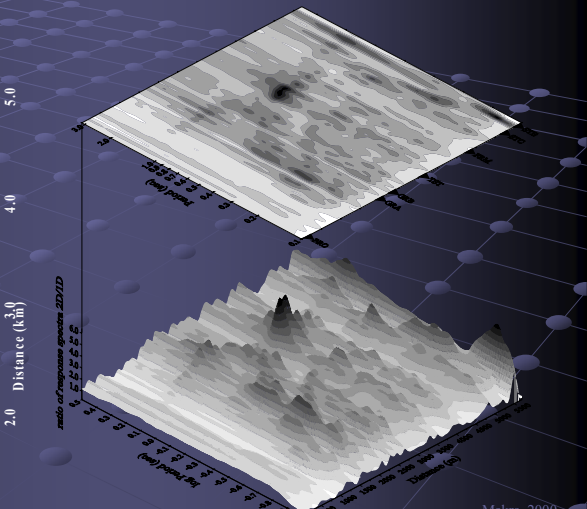
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## Modelling of Site Effects




2D FD Modelling. Synthetic Seismograms




2D/1D Aggravation factor


Makra, 2000



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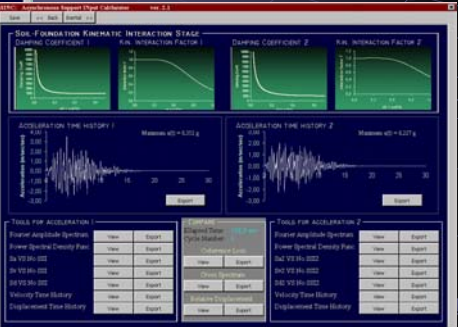
## Software Development



**ASING** :  
Asynchronous Support Input Generator

- spatial variability,
- site effects
- soil-structure interaction analysis

for bridge pile foundations







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## Scientific Publications 1992-2002

- Over 25 scientific journal publications in the last 10 years
- Over 60 international conference publications
- Over 10 invited lectures given by scientific responsible Prof. K. Pitilakis
- Over 250 scientific publications since the operation of the laboratory