# **SEISMIC RISK MANAGEMENT IN GREECE** THE ROLE OF E.P.P.O. -**RECENT ACTIVITIES**

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BSEC Ad hoc Working Group on Seismic Risk



HELLENIC MINISTRY OF INFRASTRUCTURE, **TRANSPORT AND NETWORKS** 







### Seismicity - Mediterranean area & Greece



# Earthquake Planning and Protection Organization (E.P.P.O.)

- Is a Legal Entity of Public Law and operates under the supervision of the Hellenic Ministry of Infrastructure, Transport and Networks
- Was founded in 1983, as the responsible authority for planning and processing the earthquake policy in Greece
  as well as to coordinate the
  - public and private resources for the implementation of this policy



Seismicity of Greece (1900-2007)



# European Center on Prevention and Forecasting of Earthquakes (E.C.P.F.E.)



- It was founded in 1987 and <u>operates within the administrative and financial</u> <u>support of E.P.P.O.</u>
- E.C.P.F.E. operates within the framework of Open Partial Agreement of the European Council of Major Hazards confrontation. It belongs to the group of 27 specialized Centers based in Mediterranean Countries of the E.U.
- E.C.P.F.E.' s objectives are intereuropean and in accordance with regulations imposed by the European Council.
- E.C.P.F.E. contributes in the development of methods of dealing damages caused by earthquakes, organizes educational speeches, publishes informative material and urges cooperation with Open Partial Agreement European Centers and International Organizations, and policies relevant to the Center's targets.
- <u>Recent activities:</u> Seismic Protection of the Monuments, E-Learning Platforms for people with disabilities, etc.

The Center is administrated by the Administration Committee and supported by
 Scientific Committee.

#### http://ecpfe.oasp.gr/en

# EQ Policy in Greece through E.P.P.O.'s Priority Actions

- Strengthening seismic capacity of structures through seismic design codes
- Enhancing knowledge on seismic risk and seismic hazard (Support & development of the National Network of Seismographs and Accelerographs, Neotectonic Maps, etc.)
- Planning & monitoring earthquake preparedness measures
- Contributing in case of a destructive earthquake (responding immediately after an event and collaborating with other involved parts, as advisory body of experts to the local authorities)

### Supporting & Conducting applied earthquake research (funding scientific projects with relevant to the seismic risk subjects, participating in projects -Research Unit "ITSAK", etc.)

### The EQ mitigation policy in Greece



### **Earthquake Mitigation Initiatives**

Seismic Building Codes - Hazard Maps (updating process)

### Seismic Hazard Zones (till 2003)



### Seismic Hazard Zones (after 2003)



### **Earthquake Mitigation Initiatives**

### Code of interventions (KANEPE - EC8 compatible)





### The EQ preparedness policy in Greece



### **Emergency Planning for Seismic risk** management

 E.P.P.O. has drawn actions, such as EARTHQUAKE PLANNING WORKSHOPS, for enhancing earthquake preparedness measures & the interoperability in seismic risk management at regional and local level.





### **Emergency Planning for Seismic risk** management

 General Contingency Plan "Xenokratis-Earthquakes" for GREECE (national level) through the Internal Emergency Planning for the Ministry and other legal interventions, of the Regional Level (Decentralized Administrations) and Local Level (Regions & Municipalities)



χωρος

ΔΗΜΟΣ ΚΑΛΑΜΑΤΑΣ



# Emergency Planning for Seismic risk management

### Operational Exercises:

E.P.P.O. provides guidelines and coordinates exercises for seismic risk management, at local and regional level with all the involved parties (both <u>table-top &</u> <u>field exercises</u>)







### **EQ Preparedness Measures**

 Composes and publishes <u>Technical Handbooks and</u> <u>Guidelines</u> in relevant subjects (are translated also in English – as pdf files are located at

#### http://www.oasp.gr/inform/executives )

MINISTRY OF ENVIRONMENT PLANNING AND PUBLIC WORKS EARTHQUARE PLANNING AND PROTECTION ORGANISATION EUROPEAN CENTRE ON PREVENTION AND FORECASTING OF EARTHQUARES

RISK ELEMENTS REMOVAL, TEMPORAL SUPPORT AND PROPPING



EMERGENCY EVACUATION OF THE POPULATION IN CASE OF AN EARTHQUAKE

EUROPEAN CENTRE ON PREVENTION

EARTHOUAKE PLANNING AND PROTECTION ORGANIZATION

AND FORECASTING OF EARTHQUAKES



Handbook No 3



Handbook No

EUROPEAN CENTRE ON PREVENTION AND

EARTHQUAKE PLANNING AND PROTECTION ORGANISATION (EPPO)

SEARCH & RESCUE OPERATIONS

**IN EARTHQUAKES** 

Handbook No 2

### **EQ Educational Policy**

 Working towards seismic risk reduction, E.P.P.O. has already developed an earthquake educational framework for all citizens.

The main scope is to shield people against a destructive earthquake having the minimum consequences to themselves and to their environment



### **EQ Educational Policy**

Information of the population and specific target groups (volunteers, teachers, pupils - students, people with disabilities, tourists <u>at 7</u>
 <u>languages</u>, etc) for the Earthquake Risk in Greece and the appropriate Prevention Measures using several means (speeches, media, leaflets, etc)



### **EQ Educational Policy**

#### Earthquake School Safety (emergency plans and drills at schools)

providing the guidelines for school emergency plans and earthquake drills

#### Earthquake training programs at schools

- Lectures on "Earthquake and Protection measures at schools" aim at familiarizing students, teachers, educators, with the earthquake as a physical phenomenon and how they can cope in case of a disastrous event. Its aim is to train teachers and educators through regular 2-days seminars, in Regional Level in the whole country.
- Informative material The E.P.P.O.'s educational material is consisting of several brochures, posters, books, CD-ROM's, games, interactive unit in E.P.P.O's website for students and teachers, etc.



### **EQ Response Policy**



- E.P.P.O. is entitled to a 2-delegate representation in the National Civil Protection Operational Center
- E.P.P.O. mobilizes to the disaster area:
  - Assessment Expert Teams which consists of well educated experienced EPPO -personnel and members of EPPO-administrative council
    - it is responsible for the information concerning the intensity of the earthquake and the extend of the disaster.
  - Emergency Management Teams (EMT) which consists of E.P.P.O. staff
    - It supports by advising the local authorities in managing the disasters after an earthquake.
    - Executing Safety inspection and temporary accommodation of buildings housing critical Facilities (Hospitals, police stations, Bridges, Fire Departments Emergency Operation Centers, specific public functions), Damage inspection and re-operation of life – lines, Shelter provision, etc.



# EQ Response Policy - International Cooperation

#### E.P.P.O.:

- participates in the National Units of Civil Protection of the Fire Brigade MUSAR-1 GR & -2GR (Medium Urban Search & Rescue Teams), in the framework of the European Civil Protection
- Participates in Greek missions to other countries for the provision of assistance (Leninakan 1988, Kobe 1995, Izmit, Duzce 1999, etc)
- Provides with Scientific Staff (geosciences and civil engineers) the technical support to <u>the</u> <u>Hellenic component of JHET-SDRU</u> (Joint Hellenic-Turkish Standby Disaster Response Unit)



## **Applied Research**

### E.P.P.O.'s Research Unit

 operates <u>a free-field</u> <u>strong motion network</u> <u>throughout the country</u> (>200 accelerographs).

 focuses on applied research & validation in various fields of
 Seismology, Engineering Seismology, Applied
 Geophysics, Soil Dynamics and Earthquake
 Seismology.





http://monographs.itsak.gr



## **Applied Research: Seismology**

- Research of earthquake distribution by size in space and time.
- Studies on time independent and time dependent seismicity models.
- Seismotectonic studies for the compilation of reliable seismic source models





# Applied Research : Engineering Seismology

- Deterministic and Probabilistic seismic hazard studies in terms of various seismicity and seismotectonic models of area and hybrid types (areas and faults).
- Site effect studies using strong motion data as well as ambientnoise recordings.
- Contribution to a databank of macroseismic information consisting of 30000 observations used for the validation of the results of site specific seismic hazard studies.





# **Applied Research: Applied Geophysics**

- Reflection, refraction, Cross-Hole and Down-Hole surveys for revealing the structure of the subsurface layers
- Single station and array microtremor surveys for evaluating the physical properties of the uppermost soil layers and their response characteristics
- Local and regional surveys using electromagnetic induction methods for recognizing different structures from the surface (sediments) to deeper layers (bedrock) as well as for providing information on the geometrical characteristics of faults.



## **Applied Research: Soil Dynamics**

#### Microzonation - Study of local site effects

 Studies of the effect of local geology on seismic ground motion using experimental and 1D and 2D simulation methods in urban areas as well as areas of specific interest.

#### Downhole arrays

 Data acquisition and analysis from permanent surface and downhole seismic networks (evaluation of elastic and plastic soil parameters used in non linear software codes).

#### Foundations and geostructures

 Seismic Design and analysis of building and bridge foundations, earth and rockfill dams, embankments, cut and natural slopes.

#### Retaining structures

 Stability and deformation analyses of retaining (quay walls) structures under earthquake loading.



Microzonation studies: Limasol, Cyprus



# **Applied Research: Soil Dynamics**

#### Soil liquefaction and geotechnical failures

- Analyses of geotechnical failures, (liquefaction, lateral spreading, landslides, rockfalls, etc)
- Underground structures
  - Experimental and theoretical analysis of underground structures (tunnels, metro stations etc). Validation of numerical codes based on experimental data.

#### Subsoil intervention methods

- Effect of common and innovative subsoil interventions on the seismic response of structures
- Modern and historical structures
- Soil structure interaction
  - Experimental and theoretical research on coupled soilstructure systems.
  - Static and dynamic response of foundations with emphasis on piles
    - Filtering effect of foundations on input motion of structures





# Applied Research: Earthquake Engineering

 Seismic risk studies of urban areas and of industrial facilities







# Applied Research: Earthquake Engineering

- Research on seismic code provisions (EC8, KANEPE, KADET)
- New materials and procedures for seismic strengthening/ retrofitting







# Applied Research: Earthquake Engineering

- Assessment of seismic capacity of existing structures through analytical procedures and recorded seismic response
- Structural health monitoring of buildings, bridges, monuments











### Publications, Research Projects and International Collaborations at E.P.P.O.

### Publications:

More than 800 papers in established scientific journals and peer-reviewed international and national conferences

### Research Projects:

Implementation of more than 80 research projects aiming to mitigate earthquake consequences

### International collaborations :

 Development of international scientific collaborations with more than 50 Research Centers (mainly EU/US – hopefully more from BSEC in the near future!)



### **Special Account for Research Funds**

- In the last 10 years, more than 60 EU/international research projects have been approved with a total budget of over 2.7 mil. €
- 15 research projects are currently under way, with a combined budget of over 0.5 mil. €

- Minimization of necessary funding from the state
- Employment of new scientists (PhD candidates)



### Laboratory infrastructure



### Laboratory infrastructure

#### "SeismoBug" (www.seismobug.com)

- Digital low-cost accelerograph based on MEMS technology
- · In-house design and development of hardware / firmware / software

SeismoBug (cost of materials <100 €) Guralp (≈ 4.000 €)





## Pilot application in the city of Lefkada



E.P.P.O.

### Cephalonia Seismic Seq

MALL MINISTRY OF INFRASTRUCTURE, TRANSPORTATION AND NETWORKS EARTHQUAKE PLANNING AND PROTECTION ORGANIZATION INSTITUTE OF ENGINEERING SEISMOLOGY & EARTHQUAKE ENGINEERING (ITSAK)



### **Cephalonia Seismic Sequence**



#### Building after the 26-1-2014 Eq







### Post – earthquake field reports

### On-site visits to earthquake – stricken areas and compilation of field reports for the government and the scientific community



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