

UREDITEME project - building capacities through FP7 research networking



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SUMMARY

The paper refers to FP7 project for upgrading and renovation of research and personnel capacities of Institute of Earthquake Engineering and Engineering Seismology, IZIIS, Skopje, Macedonia. Protection of structures against strong seismic impact primarily depends on the quality of the applied standards for design and construction. The reinforcement of the IZIIS' RTD capacities creates the conditions for knowledge delivering which should be built-in into the technical standards. To realize these strategic goals, scientific network was established with similar research institutions from the EU member states (LNEC-Portugal, ELSA-EU, and University of Bristol - UK). Exchange of knowledge and experience in the field of earthquake engineering and geotechnical engineering was successful story that open vast opportunities for further collaboration between UKIM-IZIIS and LNEC. This paper emphasis very positive experience gathered during the execution of the UREDITEME project.

Keywords: Cooperation, Networking, shaking table, geo-models, laminar box

1. INTRODUCTION

Since the announcement of the FP7 Programme, the Institute of Earthquake Engineering and Engineering Seismology - IZIIS has been taking active part, i.e., has been applying with its project proposals to the calls announced by the European Commission. It should be pointed out that, in the beginning of the FP7 programme, the Macedonian scientific research institutions could not have the role of coordinators, i.e., principal investigators of a project. Once Macedonia became equal member of the FP7 programme, opportunities for access to the European funds were opened. At that very moment, IZIIS got involved in application for projects and was very successful. IZIIS was among the first institutions from Macedonia to be approved a project to be financed within the FP7 programme as coordinator – performer of all the project activities. The project refers to the REG-POT programme for upgrading and renovation of research and personnel capacities. The project proposal was given the highest grade of 14.5 out of possible 15 and the negotiating process began. After the successful negotiations, the project was approved for financing. The UREDITEME project was anticipated to be realized within a period of 30 months, starting from April 2009. Since there were some subjective and objective circumstances based on our request the project period was extended to 36 months.

2. SCOPE OF THE PROJECT

The basic aim of this project was to improve the IZIIS's RTD capacities. Therefore, by realization of this project, the following main tasks should be obtained:

- Renewal of existing analog control system of the bi-axial shaking table. This replacement should be done by digital control system expecting that the shaking table will have improved performance and will be operational in the next 20 years. The shaking table is one of the main

experimental facilities proposed for cooperation within the FP7 and other project proposals to be funded from EC, as well as for cooperation with industry in performing research for their development projects.

- Upgrading of the Laboratory for Dynamics of Soils and Foundations: The objective of this project is upgrading of the existing equipment. New state-of-the-art integral triaxial system for static and dynamic testing of soil specimen will be installed at the laboratory. Technical specifications of this triaxial system are extraordinary which enable performing of wide variety of tests. Apart from element tests that can be performed with the new triaxial equipment also laminar shear box is planned to be constructed. This box will increase the capacity of the laboratory and enable to perform dynamic testing on large geo-models on shaking table.
- The renewal and the upgrading of the existing RTD capacities is meant to overcome the gap of technical possibilities in respect to the leading European and World research centres. With the realization of this project, IZIIS will de facto and de jure become active member of the European research area, see Fig.1.
- Engagement of junior staff and their infection with the virus – the so called ‘scientific research’. In the last two decades Macedonia faced with the “brain drain” problem, where a lot of young researchers went abroad and never return, Fig.1 . The loss of these generation was unrecoverable problem which can be stopped only if we have the similar research environment as the young generation are looking in EU or USA centres.



Figure 1. Project objectives

3. BUILDING HUMAN CAPACITIES THROUGH NETWORKING

The renewal of the equipment available itself will not mean much without paying attention to engagement of junior staff and their training at some of our EU network partners. To realize these strategic goals, we need strong cooperation with similar research institutions from the EU member states. The cooperation that we have had so far is extended and a particular emphasis is given on creation of conditions for joint application for future research projects within the European research area and worldwide, training of staff in full compliance with the European norms and opening of our capacities for the EU partners who are interested in performing joint investigations.

Within the cooperation with network partners – research centres from EU Member States, our objective is realization of:

- Bilateral visits with the Research Centres from Member States and Associated States;
- Exchange of experience regarding the latest scientific and technological achievements ;
- Obtaining of information about the mode of organization and managing of the process of investigations;
- Improving of RTD’ human capacity by training of young scientists and researchers ;
- Planning of joint research projects;
- Planning of joint application for projects within the remaining and future EU programmes.

In order to strengthen the cooperation in the main area of IZIIS' activities, a network of research centres from EU Member States was created. Their role, in this project, was to assist in strengthening of the cooperation, as well as exchange of know-how and experience through trans-national two-way secondments of research staff between the selected research entities and IZIIS, such as:

- Exchange of experience and knowledge in the field of experimental investigations, (quasi-static, shaking table tests, dynamic testing of Geo-structures) of structures and components in order to reduce their seismic vulnerability and opening possibilities for bilateral cooperation with short visits of researchers to IZIIS and vice versa.
- Professional training of researchers and technician staff Study in selected research centres from EU Member States.
- Participation on several experts meetings at IZIIS

The following centres were partners in the research network within this project:

- European Laboratory for Structural Assessment – ELSA, Ispra, Italy
- Earthquake Engineering Research Centre- EERC, Department of Civil Engineering, University of Bristol, UK.
- The Laboratório Nacional de Engenharia Civil (LNEC), Lisbon, Portugal,

It should be stress out that very good relationship was established with the colleagues from LNEC. Similar research fields of interest and very compatible organization system were factors that excellent cooperation was achieved. Even the LNEC is much larger institution than IZIIS there were two topics which were defined as core of this cooperation. Geotechnical and Earthquake engineering especially in the domain of experimental studies were topics where all the networking activities were primarily focused. Discussions and meetings which were realized through several short visits in both ways clearly showed that there is willingness for stronger and deeper cooperation. In that manner Memorandum of understanding between IZIIS and LNEC was signed, Fig. 3, and stated that on annual basis there should be progress report which will be guideline for further mutual plans.



Figure 2. Cooperation between IZIIS and LNEC

Within these network activities 6 young researchers have opportunity to visit the LNEC research facilities. During their stay they were directly involved in some ongoing research activities at LNEC laboratories. Two young researchers from Geotechnical Department-IZIIS participate in preparation of the model in newly constructed shear box at LNEC, Fig.3. The experience they gathered with the shear box at LNEC will open new ideas for the laminar/shear container which is under construction at IZIIS and is also part of this project.



Figure 3. Young researchers from IZIIS at LNEC Laminar box

4. UPGRADING OF THE SHAKING TABLE

The existing bi-axial programmed seismic shaking table is the core part of the IZIIS' Laboratory. It has been in use for the past 25 years and served well the RTD activities of IZIIS. The existing analog control system, which is a crucial part for running the bi-axial shaking table, is an out of date technology and maintenance is a very difficult task, since there are no spare parts. Possible failure of this system means shutting down the shaking table, which will be heavy impact on IZIIS RTD capacity. By renewal/upgrading of old analog control system by digital control system it is expecting that the shaking table will have improved performance and will be operational in the next 10-15 years. The other parts of the shaking table are in very good operational conditions, very well maintained and will serve for more than 20.

The process of installation of the digital control system was be done by the producer of the equipment with participation of experts from IZIIS' laboratory. Installation of the new MTS 469D digital controller was performed in the period from 14.03.2011 to 01.04.2011. A complete survey of the existing seismic testing system has been performed prior to start with the installation. It was concluded that the whole system is in very good condition, operational and well maintained. During the installation, job training for advanced use of the upgraded equipment has been carried out by the producer itself for the IZIIS laboratory staff. The proof tests of quality of installation have been carried out based on a previously prepared protocol for acceptance, which was specified in the contract with the producer of the equipment.

For performance evaluation of the 469D controller algorithms, after its installation, series of shaking table test on IZIIS' bare table and table loaded with 14 t payload of rigid mass have been conducted. The acceleration time-histories obtained from the acceleration feedback signals measured during the tests were compared to those of the reference signals. The presented results from the tests conducted after the installation of 469D controller for IZIIS' shaking table show that MTS advanced adaptive control algorithms provides a significant performance improvement across all frequency band of interest.

It is worth to point out that the upgrading of the existing Seismic Shaking Table System in the Dynamic Testing Laboratory at IZIIS, Skopje, R. Macedonia with MTS 469D digital control system represents a significant and qualitative step forward in increasing the infrastructure's capacity for experimental earthquake engineering.

5. RENEWAL OF GEOTECHNICAL LABORATORY

The geotechnical laboratory at IZIIS covers variety of topics in the fields of soil mechanics with particular interest on behaviour of soils under dynamic loading. This is the only laboratory in the country dealing with investigation of problems related to seismic geotechnical hazards. Existing equipment is very well maintained due to extraordinary efforts by the laboratory staff. Cyclic simple shear apparatus and tri-axial system for dynamic testing of soils have been used for more 25 years. In the last decade there has been increasing interest from the students to continue their education and research in the field of earthquake geotechnical engineering. So there was clear demand to upgrade the capacity of the existing equipment in order to accommodate the new and fresh IT generation of researchers.

First objective is to renew the equipment for element tests with new integral tri-axial system for static and dynamic testing of soil specimen. The final solution that was chosen from several options was the WF7050 - Dynamic Triaxial System with 50kN Load Frame cap,+/-5kN pneumatic actuator and IMACS 13 channels control unit, produced by Controls, Italy, Fig.4. During the installation of the equipment the laboratory staff successfully was trained to be familiar with the features of the new apparatus, Fig.4.



Figure 4. Installed tri-axial system and training of the laboratory staff

Other objective within this package was to design and construct the Laminar box, which is very important tool for seismic testing of large scaled geo-structures and investigation of soil-structure interaction on shaking table. Japan and USA are several steps ahead of the other EU research centres in this field. There were several key criteria's that new laminar box should satisfy, which lead us in the designing process like:

- The laminar container should have a mass 'equal to zero';
- The layers (the rings) and the membrane should have zero stiffness for horizontal shear;
- Water tightness and hermetically closed area (in case of using a vacuum) should be provided;
- There should be no resistance to vertical settlements of soil;
- The height of each layers should be as small as possible to increase flexibility to soil deformation within the model;
- It should be sufficiently large for better simulation and manufacturing of larger scale models;
- Horizontal cross-section should be provided throughout the entire action of excitation;
- Development of shear stresses at the soil - vertical wall contact (the same as that in horizontal plane) should be provided.
- Good contact of the bearings between the layers should be provided

It is impossible to satisfy all these criteria completely but it is important to know the extent to which the box is acting as ideal tool to simulate the seismic behaviour of geo models. The design of laminar box at IZIIS's Geotechnical laboratory, is given in Fig.5

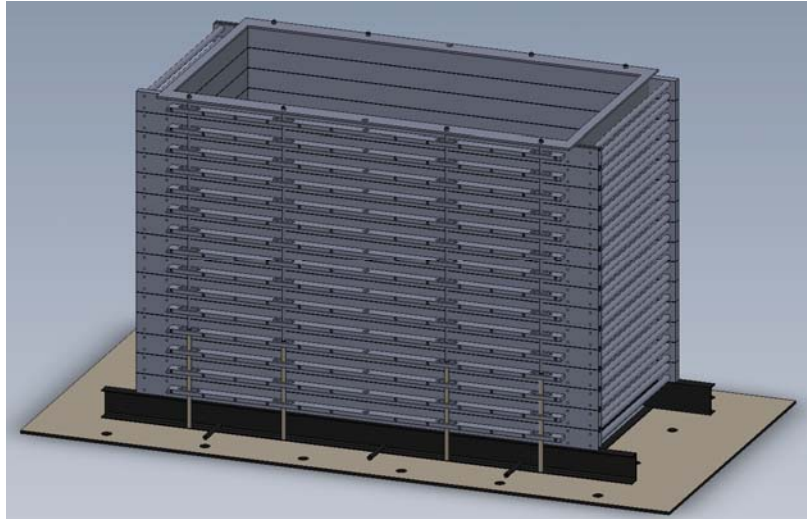


Figure 5. Laminar box designed at the IZIIS's Geotechnical Laboratory

6. CONCLUSIONS

The participation in the FP7 programme was excellent experience and big step toward better involvement of our Institution in similar programs and projects granted by European Commission. Activities realized through Networking improved our relations with the similar research European institutions. Cooperation and stronger ties were established on equal basis.

Upgrading and renewal of the experimental capacities allow us to perform investigations comparable with other research centres in EU and definitely closed the 'technological gap' that existed. At the same time building the human capacities and exchange of the knowledge with the network partners represents the solid basis to attract more young researchers to join us but also to cure the 'brain-drain' problem.

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REFERENCES

- European Commission FP7 Programme, Research Potential, Guide for Applicants: Coordination and support action (support),FP7-REGPOT-2008-1.
- Ikuo Towhata. (2008) Geotechnical Earthquake Engineering , Springer Series in Geomechanics and Geoengineering, ISBN 978-3-540-35782-7
- Vlatko Sesov (2003). Dynamic behaviour of potentially unstable soil media and application of a model for mitigation of seismic risk related to liquefaction occurrence. Ph.D , UKIM-IZIIS