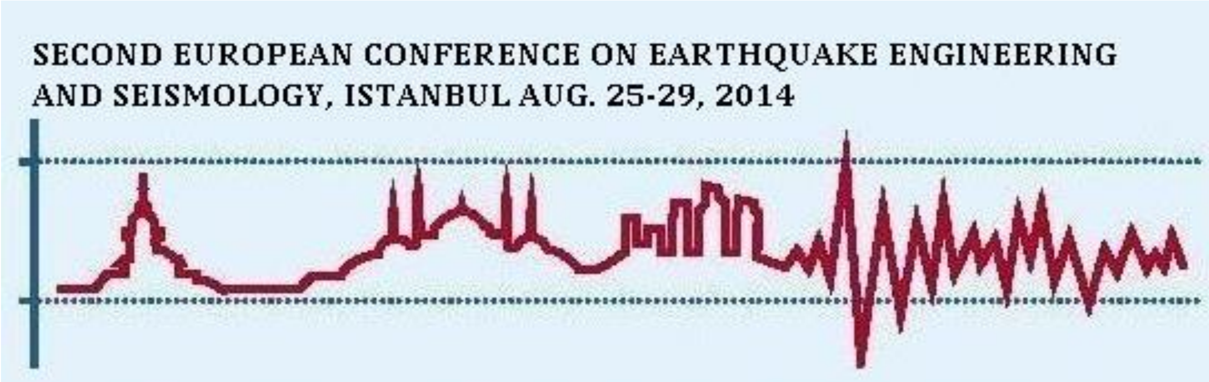

NETWORKING FIELD TESTING INFRASTRUCTURES

Mariantonietta Morga[1], TienThanh Bui[2], Guido De Roeck[3], Can Zulfikar[4], Simone Peloso[5], Kyriazis Pitilakis[6], Dimitris Pitilakis[7], Maria Manakou[8], Sotiria Karapetrou [9]

In structural engineering field testing indicates a large class of activities with the aim of improving the knowledge of existing structures and evaluating their actual conditions. This improved knowledge is the base for an actual real-time assessment of either the remaining life time or the seismic vulnerability of structures. The main objective of the NERA-NA6 is to harmonize the existing field testing procedures in vibration monitoring and promote their implementation in building practice to improve the seismic vulnerability assessment.

Information about the European and worldwide experience in field testing monitoring of structures was gathered together with a questionnaire, see Friedl et al. (2011), completed by 223 engineers of 35 different countries, whose 154 declared to have experience in field testing, as summarized in Table 1. The questionnaire results show that the field testing expertise is mainly domain of universities and the principal aim of the in-situ test is the assessment of structures for research or retrofitting. The field testing data are used by the experienced interviewees in the 50% of the cases for pre- and post-earthquake assessment and in the 70% of the cases for more generally Structural Health Monitoring and damage detection and mainly to improve the reliability of numerical models of structures. From the questionnaire it is plain that in the 75% of the cases a structure is tested only once and permanent monitoring system are installed more commonly on bridges than on buildings. More than half of the interviewees design the measurement layout on the base of the structural analysis results of the designed structure and the 90% of them declared to monitor the structural accelerations. Ambient vibration methods turn out to be more popular than forced vibration methods to test both buildings and bridges. The final result of the questionnaire indicates that in most of the cases no national standards or guidelines are available in the interviewees' countries, as better described in Table 1 (Friedl et al, 2011).

In order to meet the need of guidelines for the dynamic testing monitoring the NERA-NA6 has set out:

1. Guideline for designing optimal dynamic monitoring strategies (Friedl et al, 2012),
2. Guideline for optimal design of force vibration method (Morga et al, 2013).

[1] Dr., AIT Austrian Institute of Technology GmbH, Vienna (Austria), Mariantonietta.Morga@ait.ac.at
[2] Dr., KU Leuven – University Leuven, Leuven (Belgium), TienThanh.Bui@bwk.kuleuven.be
[3] Professor, KU Leuven – University Leuven, Leuven (Belgium), Guido.DeRoeck@bwk.kuleuven.be
[4] Dr., Bogazici University - KOERI, Istanbul (Turkey), can.zulfikar@boun.edu.tr
[5] Dr., EUCENTRE, Pavia (Italy), simone.peloso@eucentre.it
[6] Professor, Aristotle University of Thessaloniki, Thessaloniki (Greece), kpitilak@civil.auth.gr
[7] Dr., Aristotle University of Thessaloniki, Thessaloniki (Greece), dpitilak@civil.auth.gr
[8] Dr., Aristotle University of Thessaloniki, Thessaloniki (Greece), manakou@civil.auth.gr
[9] MSc, Aristotle University of Thessaloniki, Thessaloniki (Greece), gkarapet@civil.auth.gr

Table 1. Main results of the questionnaire

	Have you used any measurement technologies with respect to field testing	Are the national guidelines in your country that impose field testing as a tool for Earthquake Engineering?	
Yes	154	27	Yes
		101	No
		23	Under development
		3	Not given
No	69		
Total interviewees	223	154	Total interviewees with experience in field testing

These guidelines provide a basic overview of all the exiting monitoring techniques and describe the testing instruments technologies: they are directed to the engineering community with the aim of increasing the number of technicians working in companies or industries that carry out dynamic tests on structures to improve their seismic vulnerability assessment. Besides the description of the most common technologies used for forced vibration tests, the guideline for design of force vibration methods outlines the stages of the process to plan forced vibration tests:

- Classification of the structure to test (kind, material, primary elements),
- Identification of the structural characteristics to value,
- Selection of the forced vibration testing method to apply,
- Calculation of the force to apply and duration of the excitation for continuous force methods,
- Design of exciter attachment to the structure if a shaker is used,
- Design of the sensors grid and selection of the technologies for the data acquisition (Morga et al., 2013).

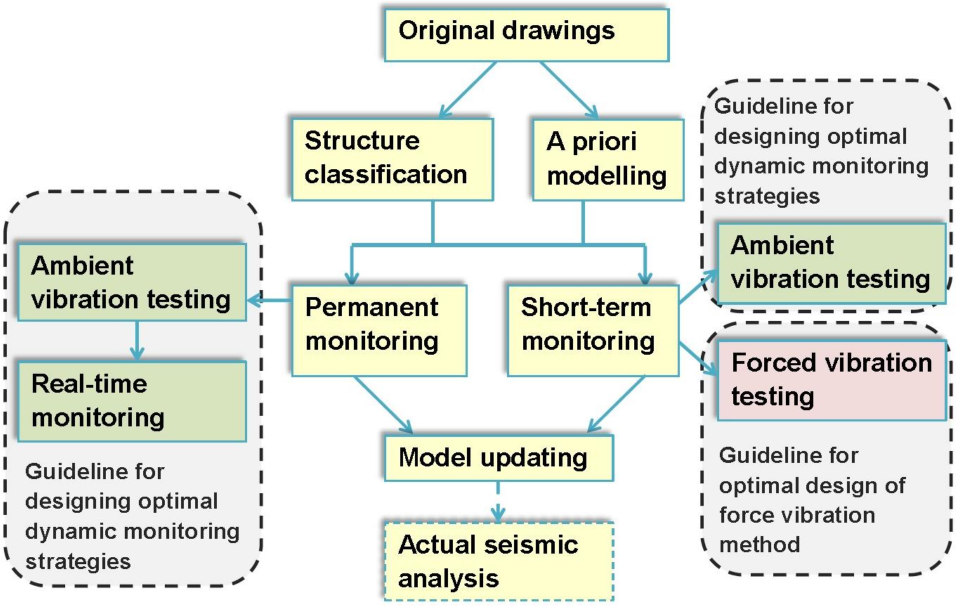

Figure 1. Outline of the guidelines.

The field testing data has to be processed and interpreted to be used in model updating: the guideline for optimal design of forced vibration methods describes the filtering procedures to post-process the field testing data and the algorithms to identify the structural dynamic characteristics (Morga et al., 2013). For ambient vibration testing the Stochastic Subspace Identification method and the poly-reference Least Squares Complex Frequency domain are explained, as well the main differences of these methods respect to the identification methods used to analyse the forced vibration testing data.

Both the guidelines propose a section to introduce and explain the field testing procedures to investigate the soil-foundation-structure interaction classifying between the force generated by the transient soil deformation acting on foundation and superstructure and the force generated by the superstructure vibration and transmitted to soil by the foundation (Friedl et al, 2012). In the guideline for optimal design of force vibration method the procedure to test the soil-foundation-structure interaction is better explained by means of a study case (Morga et al, 2013).

The three deliverables of NERA-NA6 collect 18 different case studies: 8 ambient vibration tests, including also cases of permanent monitoring, 3 forced vibration tests, 3 forced vibration tests with complementary ambient vibration tests and 3 case studies of soil-foundation-structure interaction. These selected case studies help the engineers to understand how to implement the described methods ((Friedl et al, 2011), (Friedl et al, 2012), (Morga et al, 2013)).

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