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EU RI collaboration network in the building sector

RINET Project

Fabio Taucer

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Abstract

The present deliverable is part of project 612 RINET (Networking and advancement of RIs for safety and sustainability in the building sector), which aims at building a sustained platform for collaboration of Research Infrastructures (RIs) in earthquake engineering and structural dynamics in the EU and internationally, encompassing the objectives of the ESFRI. The report describes the activities carried out in 2013 to promote the collaboration of research infrastructures at EU level, as well as the networking carried out at international level.

Keywords: research infrastructures, transnational access, networking, collaboration

Deliverable Contributor

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Table of Contents

List of Figures

List of Tables

1 Introduction

The present deliverable reports the activities carried out by the ELSA Unit to promote the setting up of a network of collaboration in the building sector at EU and International level.

The work is framed within project 612 RINET (Networking and advancement of RIs for safety and sustainability in the building sector), which aims at building a sustained platform for collaboration of Research Infrastructures (RIs) in earthquake engineering and structural dynamics in the EU and internationally, encompassing the objectives of the ESFRI.

Since the setting up of the European Laboratory for Structural Assessment (ELSA) and its reaction wall facility, the staff of the Unit has been engaged in carrying out its mission in close collaboration with Universities and research institutions across Member States in the EU, having served as a reference point for EU researchers, leading to the promotion of collaborative research in Europe, especially during Framework Programmes FP4 and FP5. Notably, ELSA participated in COST Actions, in Marie Curie Training Networks, and in FP5, in the ECOLEADER project that granted transnational access to European researchers to the reaction wall facility.

More recently, the JRC was partner in the FP7 project SERIES (Seismic engineering research infrastructures for European synergies), which was subdivided in three distinct activities: networking, transnational access and joint research. The first two activities were key in promoting the integration of EU research infrastructures.

The networking activities focused on several aspects: the creation of a distributed data base for sharing results in the field of earthquake engineering, the set-up of a common protocol for the qualification of research infrastructures, the set-up and maintenance of a web portal for the project, the organization of workshops and collaboration with EU and international partners, and the drafting of a strategic research agenda for international collaborative research in earthquake engineering.

The transnational access activities provided access to seven world-class laboratories (among these, ELSA) to user groups in Europe, free of charge. The ELSA Unit delivered access to three projects in the period 2009-2014.

At international level, SERIES developed links with institutions in Asia and in the US, in particular to the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES, USA), that held jointly with the JRC in 2013 the Concluding SERIES Workshop.

In the following sections, this report describes the activities carried out in 2013, as a continuation of the work achieved through SERIES and previous FP projects to promote the collaboration of research infrastructures at EU and international level.

2 Objective

The objective of the RINET project is to build up a sustained platform for collaboration of Research Infrastructures (RIs) in earthquake engineering and structural dynamics in the EU encompassing the objectives of the ESFRI.

This is achieved mainly by establishing a framework for collaboration with the best in class institutions at international level for the development of new technologies, techniques and standards promoting efficient and joint use of research infrastructures.

3 International collaboration

During the year 2014 the JRC networked with its international partners in the USA, China, South Korea and Japan, either through established collaborative research agreements or through meetings with relevant staff of these institutions to promote and establish ways for better collaboration.

3.1 THE GEORGE E. BROWN, JR. NETWORK FOR EARTHQUAKE ENGINEERING SIMULATION (NEES)

The JRC has had a long standing collaboration with the NEES network, which had focused in the past in the sharing of tools for telepresence and for the development of control procedures for hybrid testing. More recently, in the SERIES project, NEES was invited to jointly organize with the JRC the SERIES Concluding workshop, held at the JRC Ispra, Italy on 28-30 May 2014 (figure). The workshop counted with nine papers presented by NEES.

One of the most important outcomes of SERIS concerning the networking activities was the development of a distributed database of experimental results in the field of earthquake engineering. After the end of SERIES and in 2014 the JRC and NEES expressed their interest in further integrating their databases.

On 22 May and 26 June 2014 Dr Julio Ramirez, and Shirley Dyke, from Purdue University, visited the JRC to discuss possibilities for further collaboration. From these meetings the following issues were discussed as being relevant for potential collaboration between the JRC and NEES:

- The US will be developing its vision in earthquake engineering research within the next five years, and recognizes that including resilience and sustainability, as well as reaching an effective and coordinated International collaboration with the EU, China, Taiwan, Japan and New Zealand will be essential in achieving this vision.
- High performing civil infrastructure and distributed infrastructure networks for multi-hazard resiliency and sustainability to reduce their impact on the natural environment with a holistic view of risk reduction integrating multiple issues from engineering, social, political, and economic sciences.
- Structural health monitoring, integrating condition assessment and decision making tools improving structural performance to reduce the costs for the operation, maintenance and upgrading of civil infrastructures.
- The preparation of standards for collecting data following a disaster is an important topic for research both in the US and in the EU. This data will allow the access of information after an event for data sharing, thus facilitating damage assessment during the emergency phase. The collected data should also include the preparedness and recovery phases in order to assess resilience.
- Open access for publishing data.

- Development of a Portal (clearing house) providing links, and description, of all the tools/projects related to the work of NEES and of European Research Infrastructures in earthquake engineering (i.e. SERIES and future similar Horizon2020 projects). Such a platform will enhance the use of project websites and measure their impact (i.e. number of visits to each project's website).
- Development of wireless and optical sensor technologies enabling higher performance and use of test results.

The discussion between Shirely Dyke and Pierre Pegon on Real Time Hybrid Simulation identified common interests and approaches between the JRC and NEES, as well as priority areas where more research is needed to advance on the topic. An International Workshop on the topic is being planned by NEES and EU partners to be held in the EU in 2015.

On 11 November 2014, the JRC expressed its interest in participating as partner with Purdue University to a proposal answering to a National Science Foundation (NSF) solicitation for the Natural Hazards Engineering Research Infrastructure (NHERI) Network and Cyberinfrastructure Coordination Office for the period 2015 – 2019.

During the second half of December 2014, the JRC prepared a proposal for setting up a collaborative research arrangement with Purdue University. The setting up of such an agreement, together with the potential award of the NSF solicitation, will open the ground for a fruitful collaboration with Purdue University, especially in the integration of experimental data and for the development of hybrid testing procedures. Moreover, US research laboratories are already collaborating with China, Taiwan and South Korea, therefore, a collaboration with Europe will pave the way for a truly integration at international level.

3.2 TONGJI UNIVERSITY

The JRC set up on 20 January 2014 a collaborative research agreement with Tongji University, in Shanghai, China, to contribute more effectively to understanding and resolving scientific issues in the field of seismic vulnerability and protection of civil engineering structures and critical infrastructures. The agreement follows a preceding agreement set up in 2009 for a duration of two years.

Previous to these agreements Tongji University had sent a visiting scientist, Dr Bin Zhao, to the ELSA Unit of the JRC, for a period of two years. This period led to a fruitful collaboration between the two institutions, including a mission following the Wenchuan earthquake in 2008, that resulted in several journal papers related to the damage experienced by the built infrastructure. Dr Zhao also published a paper with the JRC dealing with a comparison between the Eurocodes and the Chinese standards for construction for the seismic design of reinforced concrete and masonry structures.

Tongji University has also invited the JRC to the last three Kwang-Hua Forums on Innovations and Implementations in Earthquake Engineering Research. The JRC was invited to the Sixth Forum on 11-14 December 2014, to give a presentation on "European Collaborative Research in Earthquake Engineering: Transnational Access to Large RIs". The forum provided the JRC to network with peers from the USA, Asia and Europe. The round table at the end of the forum resulted in the following conclusions:

- It is of outmost importance to translate research into actions in order to mitigate seismic risk. The JRC proposed that owners should carry out seismic retrofit when

refurbishing buildings for architectural or energy efficiency aspects, either by compulsory regulation or by tax incentives. Prof Mohele suggested that for example, LEAD platinum grading (mainly for energy efficiency) should be given only if a building is seismically safe.

- The question aroused on what is seismically safe. In the US is being commonly accepted that a 10% collapse probability for a Maximum Credible Earthquake (MCE) is acceptable. This, however, would be a catastrophe for a city like San Francisco or Tokyo, not to mention the number of buildings with high residual drifts that would need to be demolished.
- It was proposed that for large urban centres the seismic hazard should be artificially increased, as the collapse of a few buildings can compromise the resilience of the whole city. In fact, minimum standards of performance should not be left to the choice of the owner. Over time we might move from ensuring minimum safety to ensuring minimum levels of losses.
- In order to fully certify that a new idea works, the engineering community would need real earthquakes to happen. Since this is not feasible, there is a need to maintain experimental research, education and, guidelines.
- It was also raised the issue of engineers taking responsibility: this is facilitated by codes. Without the support of standards many engineers would not adopt innovative designs.
- The analogy of buildings being maintained as cars was proposed: it should be accepted that renovation, including structural upgrading, is part of the normal cycle of life of a building. Buildings were designed fifty, twenty-five years ago according to the best standards available at the time. Twenty-five years from now we will also have revised the standards in use today. Therefore, it should be acknowledged that buildings should go thorough periodic cycles of renovation.

The JRC also visited the State Key Laboratory of Disaster Prevention in Civil Engineering. It consists of an array for four shaking tables combined with a reaction wall, allowing for real time hybrid testing. The laboratory also has an L shaped reaction wall and a bearing testing facility. The visit showed that Tongji staff is working at full capacity.

For 2015 the JRC expressed to Tongji University the interest of hosting Tongji researchers for a short period of time. Moreover, Dr Bin Zhao will be visiting the University of Perugia in March 2015; the JRC invited Dr Zhao to visit the JRC during his stay in Italy.

3.3 BUILDING RESEARCH INSTITUTE

The JRC signed on May 2014 a Memorandum of Understanding with the Building Research Institute (BRI), a governmental agency established in Tsukuba, Japan. The BRI is the institute where the pseudodynamic test method, the experimental technique which is used at ELSA for simulating the earthquake response of full-scale structures, was first established.

The agreement was established following a previous MoU signed in 1995, which resulted on an effective collaboration that lasted ten years based on the exchange of information about experimental techniques and results. The collaboration between the JRC and BRI is strategic, due to the enduring leading expertise in experimental methods, to the existence at

the BRI of one of the largest laboratories in the world, to the experience acquired from recent earthquakes, to the Japanese interest in earthquake-resistant sustainable constructions and to the direct involvement of BRI staff in code drafting. The areas of collaboration under the current MoU are:

- Code Harmonization
- Experimental and Analytical Findings
- Lessons learned from disasters
- Sustainability
- Code Interface

Dr Inukai Mitsuo from BRI attended the NEES concluding workshop at JRC-Ispra, on May 28-30, 2013, and served as an opportunity for exchanging of information on the activities carried out by JRC and NEES.

At the 2nd European Conference on Earthquake Engineering and Seismology, 2ECEE, held in Istanbul, Turkey, on 24-29 August, 2014, Paolo Negro, from JRC, held a meeting with Dr Mitsuo, to discuss the status of the Collaborative Research Agreement with BRI. After a review of the activities being currently conducted by both sides, it was decided to foresee a joint meeting to take place in Ispra during 2015. The possibility to have the meeting on the occasion of either a test or the final workshop for the SAFECLADDING project will be explored. M. Inukai will explore the possibilities for the secondment of a young Japanese researcher at the JRC.

3.4 INSTITUTE OF ENGINEERING AND MECHANICS

The Institute of Engineering Mechanics (IEM), China Earthquake Administration (CEA), formerly the Institute of Civil Engineering and Architecture, Chinese Academy of Sciences, established in 1954, is one of the national non-profit research institutes in China, mainly focusing on earthquake engineering and safety engineering. IEM has two campuses, Harbin campus (the main campus), and Yanjiao campus (experimental bases) near Beijing. The staff of the Harbin campus paid a visit to the JRC on 25 November 2014, following an initial contact undertaken through Tongji University.

IEM carries out research in the following fields:

- Strong Motion Observatory
- Engineering seismology
- Structural engineering
- Lifeline engineering
- Geotechnical engineering
- Disaster prevention for urban and engineering

and has compiled about 20 technical codes and standards, such as

- Code for seismic design of nuclear power plants;
- Chinese seismic intensity scale;

- Classification of earthquake damage to buildings and special structures;
- Classification of earthquake damage to lifeline engineering;
- Code for earthquake disaster evaluation and its information management system;
- Codes for Post-earthquake field works. IEM has also participated in more than 40 technical codes and standards, for example
- Code for seismic design of buildings;
- Code for seismic design of special structures;
- Seismic ground motion parameters zonation map of China.

Following the visit to JRC, IEM invited the JRC to visit IEM, and expressed their interest in establishing a collaboration agreement. Such an agreement would benefit both JRC and IEM, as IEM is part of the China Earthquake Administration, and therefore close to the government. At present, IEM is much interested in collaborating with the JRC on the safety assessment of civil infrastructures of nuclear power plants, an area that is currently under very rapid expansion in China. Moreover, since IEM is responsible for the technical work on drafting standards in China, there is a good opportunity for collaborating with the ELSA activities in the Eurocodes.

In 2002, IEM and other 6 earthquake research centers (PEER, MCEER, MAE, DPRI, KEERC and NCREE) initiated to establish Asian-Pacific Network of Centers for Earthquake Engineering Research (ANCER). The ANCER Secretariat is located at IEM. The current President is Prof SUN Baitao from Oct. 2012. An agreement signed between the JRC and IEM would much benefit international collaboration between Asia, US and Europe.

3.5 KOECD CMI

The JRC was contacted in 2014 by the Secretary General and Deputy Director of the Hybrid Structural Testing Center, Prof Chul-Young Kim, to establish cooperation with the KOCED Collaboratory Management Institute (KOCED CMI). KOCED CMI is a world leading research institution in the fields of transport and construction, with cross-cutting technologies based on cyber-infrastructure testing facilities covering structural safety, mitigation of seismic risk, climate change and extreme environment actions, energy efficiency and extreme events loads. At international level KOECD CMI collaborates with the most important networks, namely NEES (USA), E-DEFENSE (Japan) and NCREE (Taiwan).

KOECD possesses one of them most important centres for experimental research in civil engineering at world level, namely a Hybrid Structural, a Geotechnical Centrifuge, an Advanced Construction Materials, a Seismic Simulation, and a Wind Tunnel Testing Centre, as well as an Experimental Centre for Coastal and Harbor Engineering. All these testing facilities are existing and are part of a first phase of the development. At the same time, KOECD is undergoing the construction of other six facilities, namely a Structural Testing Facility for Extreme Events, a Large-scale Multi Environment, a Large-scale Hydraulic Model, a Complex Road Safety, a Vehicle Driving Simulation and a House Performance Testing Facility. All these testing facilities are complementary, and in some cases unique, to the experimental capabilities of the JRC, therefore, mutual collaboration will bring added benefits to the two institutions to promote the development of new technologies, techniques and standards promoting efficient and joint use of RIs.

The expertise of KOECD in hybrid structural testing, in seismic simulation and in advanced construction materials, together with the competences of the JRC in field of structural testing at the reaction wall facility, will be of benefit to the JRC and KOECD. Moreover, the construction of the house performance testing facility at KOECD will serve to both the JRC and KOECD to develop and exploit the field of experimental research for energy efficiency

4 Horizon 2020

In the period 2009-2013, the JRC was partner of the FP7 project SERIES (Seismic Engineering Research Infrastructures for European Synergies), financed under the Seventh Framework Programme by the Capacities Specific Programme for Research Infrastructures. The SERIES project succeeded in achieving the following objectives:

- Bridged the gap between Europe and other countries with advanced experimental seismic engineering
- Brought together European countries with high seismicity but no research infrastructures and those with large infrastructures but low seismicity
- Fostered co-operation of all labs and teams active in European Earthquake Engineering.
- Provided access to the most powerful European Infrastructures to researchers from other countries
- Collaboration of research infrastructures towards new testing technologies.

SERIES provided access to 27 projects and almost 200 users, delivering a total of 616 access days to its seven large scale research infrastructures (one reaction wall, four shaking tables and two centrifuges). Moreover, SERIES developed a distributed database for experimental results in earthquake engineering, and a protocol for the qualification of experimental facilities, as part of the Networking Activities. In all these activities the JRC was one of the main contributors to the SERIES project, and has still been engaged following the end of SERIES on July 31, 2013.

During 2014 (on 17 September) there had been discussions with the SERIES project coordinator, Prof Michael Fardis from the University of Patras, on how to profit from the achievements of SERIES beyond its end, to maintain and reinforce the collaboration of research infrastructures in structural engineering and dynamics in Europe. From the discussion it aroused that if H2020 were to finance a project along the lines of SERIES, emphasis would be placed on Transnational Access. Such financing would come from the Research Infrastructures program under the topic H2020 – INFRAIA: Integrating and opening research infrastructures of European interest / Research and Innovation Action. Careful choice should be made on the topics for transnational access (e.g. sustainability, multi-hazard, etc.), on the next project coordinator and on the facilities delivering transnational access. Funds would also be needed for the upgrading, maintenance and further feeding of data to the distributed database.

In 2015 the JRC plans to publish as EUR report, the work carried under SERIES, together with Maurizio Zola of P&P, Bergamo, Italy, on the “Common Protocol for the Qualification of Research Infrastructures in Earthquake Engineering and Technical Annexes”.

5 ESFRI: Pilot Project to open access

The European Laboratory for Structural Assessment (ELSA) was proposed by the Working Group JRC-ESFRI1 (the European Strategy Forum on Research Infrastructures) relations as pilot project to open access and be associated to the European Strategic Forum for Research Infrastructures (ESFRI). A short analysis was presented on the current status of ELSA (see Annex 1) for more information on technical aspects for the implementation of the pilot project) and the needs in terms of infrastructure and resources to become a project associated to ESFRI.

5.1 PAST EXPERIENCE

The ELSA infrastructure has offered open access to European researchers in earthquake engineering through European Projects financed by the RTD Framework Programmes for Research Infrastructures (RI). These projects are ECOLEADER (European COnsortium of Laboratories for Earthquake and Dynamic Experimental Research, 2002-2004, FP5) and SERIES (Seismic Engineering Research Infrastructures for European Synergies, 2009-2013, FP7). During these projects, ELSA has acquired ample experience in offering access to its reaction wall infrastructure to user teams carrying out experimental testing on near-to-full scale structures on earthquake engineering.

During the SERIES Project ELSA offered open access to three large scale projects and 29 users throughout the Transnational Access activities. These activities were supported by two other activities: Networking and Joint Research. The first was aimed at enhancing the services provided by the research infrastructures, transcending their current extreme fragmentation; the second focused on innovative research toward new fundamental technologies and techniques promoting efficient and joint use of the RIs.

5.2 ENCOMPASSING ESFRI REQUIREMENTS: EXISTING AND NEEDED CAPABILITIES

The investments made in the ELSA infrastructure, the excellence in the research activities carried out by its staff and its role as catalyser of research in earthquake engineering in Europe, have confirmed during its participation in past FP Research Infrastructure funded projects that ELSA has many of the features and capabilities to provide open access to its research infrastructure, these are:

- Uniqueness of the facility for the scientific community, with proven pan-European interest, delivering top-level services attracting a widely diversified and international community of scientific users.
- Major equipment and instruments, state-of-the-art scientific and technological cutting edge, and managerial excellence recognised at European and international level.
- Education and training, expert support and analytical services.

- Awarding open access through international competition on the basis of excellence (selection by peer review) by the setting up of application, evaluation, selection and admission procedures of proposals.
- An existing framework for contractual and legal obligations regulating access, including intellectual property rights as well as safety, health and security issues.
- Collaboration with International Institutions and coordination at European level of earthquake engineering research.
- Past involvement with industry in the design and construction of the ELSA infrastructure providing support to technology transfer.
- Logistic support to users during their visits to the infrastructure.
- Wide dissemination of results published in the public domain.
- The features and capabilities listed above are part of the conditions a research infrastructure should meet to offer open access. However, there are a number of other requirements, mainly linked with networking capabilities that in spite of having been a subject of past research, especially during SERIES, require further research and development to become mature and reach an operational stage so as to offer the full range of services expected by ESFRI to deliver open access to users, these are:
- Knowledge-based resources such as collections, archives or scientific data, e-infrastructures (i.e. data acquisition and management, digital repositories, access to standardised, calibrated and inter-operable data, data curation, mining of archived data and its release for broad access) and communication networks to maximise availability and visibility of the data and/or services provided.
- Ubiquitous Access, enabling users to get the widest possible access to scientific data and/or digital services, resources and services provided by the Research Infrastructure wherever located for collaborative efforts, across geographical and disciplinary boundaries.
- Ensure that research data is managed, stored and preserved in a cost-efficient way with quality and security assurances.

The effective delivery of these services to users can be implemented by ELSA through the full development of the following three features: wide sharing of data and knowledge across the field of earthquake engineering through a distributed database of past, present and future test results and the creation of a very large virtual European research laboratory through telepresence and geographically cyber-physical testing. The achievement of full functionality of these features requires specialized staff in electronics and ICT that at present is not available at ELSA.

Moreover, the implementation of an e-infrastructure with the capabilities listed above is essential for ELSA to confirm itself as a knowledge driven world-class infrastructure at the forefront of innovation, being able to offer high quality training to its users while working with the best. This will allow ELSA to encompass itself as part of the leading research institutions in the world in structural engineering. In particular, the JRC should play a key role in Europe in collaborating with the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) financed by the National Science Foundation (NSF) in the USA, by integrating their respective databases through the distributed database and by further developing a virtual laboratory through cyber-physical testing.

5.3 CHARTER OF ACCESS

DG RTD presented a Charter for Access to Research Infrastructures, which is a new initiative developed to create non-binding common standards and harmonized access rules and conditions for the use of RIs. JRC is examining the possibilities and implications of eventually adopting such guidelines, thus officially participating in the testing phase of the document.

The JRC (F Taucer, ELSA) attending a meeting organized by DG RTD in Brussels on 8 Octoebr 2014, to discuss of the Charter of Access, being drafted by DG RTD, ESFRI e-IRG and collaborating partners (EUA, LERU, Science Europe, EARTO, NordForsk and CESEAR). The Charter of Access responds to the ERA communication of 2012 where Access to Research Infrastructures (RIs) is a priority. The Charter of Access should serve for long term sustainability of Research Infrastructures.

The workshop was attended by 31 RIs: 12 single sited, 11 distributed and 8 e-infrastructures, from 10 different countries (BE, DE, ES, FI, FR, IE, IT, NL, SE, UK), and aimed at taking on board the comments from RIs concerning the first draft of the Charter of Access. The meeting was chaired by Andrea de CANDIDO (DG RTD) and David BOHMERT (ESFRI Roadmap).

A summary of the comments discussed (and collected prior to the workshop) is given in the following:

- Clarify if access includes that of researchers inside the facility
- It is important to keep in the selection committee at least on representative from the RI in order to assess feasibility. This may be done in two steps in the selection process: technical + feasibility
- Negotiation between the RI and Users is very important before agreeing on the level of access offered. It was in fact encouraged that users should contact the RI facility during the proposal preparation process.
- The discussion on the four Access Modes depicted in the Charter (Merit, Quota, Market, Ubiquitous) resulted in a redefinition of the access modes. It was proposed to divide access modes in two: collaborative and service oriented.
- Co-authorship with the RIs in publications using the data generated was discussed as part of the Terms of Use

The charter for access should be general, simple and transparent with a feasible level of ambition. It will not be imposed to RIs, but rather will serve as guidance when delivering access to users.

The drafters of the Charter will update the document based on the discussions from the workshop. The document will be circulated again among participants. The Charter should be a live document updated at periodic intervals of time, with the input from RIs and Users. It is possible that feedback from users and RIs will be collected from DG RTD.

The JRC will keep contact with DG RTD for further commenting the Charter following its long experience in delivering Transnational Access at the ELSA laboratory.

6 ECTP

The JRC has networked with ECTP since its establishment, mainly by attending workshops and meetings, and by revising the vision and action plans of the reFINE and E2B initiatives.

reFINE is a networking forum within ECTP (European Construction Technology Platform) to comprehensively tackle the challenges infrastructures are facing. ECTP provides the grounds to facilitate innovative approaches for the needs of European society; reFINE targets a European-wide infrastructure initiative aiming to develop an RDI-programme dedicated to infrastructure topics.

ReFINE covers three domains in mobility and infrastructures issues: Multi-modal Hubs, Urban Mobility and Long Distance Corridors with the aim of achieving smart, green and low cost transport infrastructure. Networking with ReFINE is of outmost importance for the JRC as it will enable the JRC to settle its priorities in carrying research in the area of critical infrastructures in transport, as well as for paving the way for providing access to project in this field.

ECTP set up in 2008 the Energy Efficient Building European Initiative (E2B EI), steered by the Energy Efficient Buildings Association (E2BA), in order to help the construction industry reach the 20/20 targets. It is a European wide industry driven research and demonstration programme for energy efficient buildings and districts, with the ambitious vision that all European buildings will be designed, built or renovated to high energy efficiency standards by 2050.

The JRC participated on 17-19 June 2014, Brussels, to the ECTP-E2BA Conference on “Construction and Built Environment: Future Horizons”, organized jointly with ENCORD (European Network of Construction Companies for Research and Development) and ENBRI (European Network of Building Research Institutes), and with the support of ECCREDI (European Council for Construction Research, Development and Innovation). The conference allowed the JRC to get insight and contacts with experts in new trends in the construction sector concerning sustainable buildings and infrastructures. The collaboration of the JRC with E2B is of outmost importance, as it will allow the JRC to enter the area of safety assessment of innovations proposed for sustainable buildings, as well as the experimental assessment of energy efficiency, in partnership with leading European institutions in this area.

7 Conferences: 2ECCS

The JRC participated to the 2nd European Conference on Earthquake Engineering and Seismology (2ECEE), a joint event of the 15th European Conference on Earthquake Engineering – the major event of the earthquake engineering community in Europe, taking place every four years – and the 34th General Assembly of the European Seismological Commission.

The conference provided an excellent opportunity for networking and for getting informed of the most recent developments and directions in the field of earthquake engineering and seismic design code developments. It allowed the JRC to get in contact with its peers in Europe and at international level for the planning of future activities to promote collaboration and more effective coordination of EU research. The following activities were carried out:

- Bi-lateral meeting with Christis Chrisostomou (Cyprus University of Technology) and Michael Fardis (University of Patras) to discuss the preparation of an ELSA report on strengthening of RC buildings.
- Bi-lateral meeting with Kyriazis Pitilakis (University of Thessaloniki) focused on the possible signature of a high-level agreement between the European Commission and the Chinese Earthquake Administration addressing resilience and risk management.
- Bi-lateral meeting with Mizuo Inukai (Building Research Institute, Tsukuba, Japan) (See Section 3.3).
- Special Session on “Future directions for Eurocode 8” organized by Working Group 1 (WG1) of the European Association for Earthquake Engineering (EAEE) with the objective of setting out a long term vision for Eurocode 8 (EC8) to be achieved by the year 2025.
- Chairing session ‘Seismic Design Code Developments and related Issues’, and two JRC presentations: ‘Adoption of the Eurocodes in the Balkan Region’, and ‘Overview of adopted Nationally Determined Parameters for Eurocode 8’.
- Bi-lateral meeting with Michael Fardis to discuss future projects in line with SERIES project.
- Second meeting of the WG 1 - Future directions for Eurocode 8 - of the EAEE
- FP7 STREST Project (Harmonized approach to stress tests for critical infrastructures against natural hazards) multi-lateral Meeting to plan the 1st STREST workshop held at the JRC on 29-31 October 2014.
- Special Session of the SYNER-G project, where the JRC, together with the Aristotle University of Thessaloniki, prepared a special brochure describing the main outcomes of the FP7 SYNER-G Project (Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain)
- Special Session of the FP7 SAFECLADDING Project (Improved Fastening Systems of Cladding Panels for Precast Buildings in Seismic Zones), where the JRC is in charge of carrying out full-scale testing at ELSA.

- Plenary keynote lecture by M. Fischinger. Professor M. Fischinger read a plenary keynote lecture entitled “Seismic response of precast industrial buildings”. The keynote lecture gave much credit to the experimental work conducted at ELSA on the subject.

At the conference, the JRC divulgated the results of the Transnational Access activities of SERIES, by distributing 150 copies of the TA access brochure summarizing all 27 projects that accessed the seven large research infrastructures of SERIES.

8 Publications

In 2014 the JRC submitted to PUBSY nine publications not planned in the program of work. These publications are related to the development of the distributed database, techniques in hybrid testing, qualification of RIs and to networking activities. The list is given in Table 8.1.

Table 8.1 List of non-planned publications for the RINET project

Title	Authors	Journal / Conference	PUBSY Number
Integration and cooperation of European research infrastructures in earthquake engineering	F. Taucer	The Sixth Kwang-Hua Forum On Innovations and Implementations in Earthquake Engineering Research	JRC92325
Experimental Research in Earthquake Engineering, EU-SERIES Concluding Workshop	F. Taucer and R. Apostolska	Springer Book, Geotechnical, Geological and Earthquake Engineering Series	JRC93042
Qualification of seismic research testing facilities in Europe	M. Zola and F. Taucer	Experimental Research in Earthquake Engineering, EU-SERIES Concluding Workshop	JRC93325
Hybrid simulations of a multi-span RC viaduct with plain bars and sliding bearings	G. Abbiati et al.	Earthquake Engineering and Structural Dynamics Journal	JRC93279
The SERIES Virtual Database: Exchange Data Format and Local/Central Databases	A. Bosi et al.	Experimental Research in Earthquake Engineering, EU-SERIES Concluding Workshop	JRC93277
The SERIES Virtual Database: Architecture and Implementation	I. Lamata Martinez et al.	Experimental Research in Earthquake Engineering, EU-SERIES Concluding Workshop	JRC93278
The SAFE Experimental research on the frequency dependence of shear wall seismic design margins	P. Labbe et al.	Journal of Earthquake Engineering	JRC93280
The process and future of data integration within the European	I. Lamata Martinez et al.	Journal of Computing in Civil Engineering	JRC88751
Pseudo-dynamic testing based on non-linear dynamic substructuring of a reinforced concrete bridge	G. Abbiati et al.	Experimental Research in Earthquake Engineering, EU-SERIES Concluding Workshop	JRC93376

9 Visits to the JRC

The ELSA Unit welcomes every year many researchers from across the EU and internationally. In 2014 researchers from three European Institutions visited the JRC and gave presentations to the staff of ELSA. For international visits see Section 3. The list of visitors in given in Table 9.1

Table 9.1 List of visit to ELSA in 2014

Name	Institution	Date of visit	Presentation
Prof Lluís Gil	Universitat Politècnica de Catalunya Barcelona, Spain	11/07/2014	TRM-strengthened brick masonry walls subjected to eccentric axial load
Joao Paulo Lobo-Ferreira	Laboratorio Nacional de Engenharia Civil (LNEC) Direction International Relations Lisbon, Portugal	02/10/2014	LNEC activities under the Framework
Prof Radu Văcăreanu	Technical University of Civil Engineering Reinforced Concrete Department Bucharest, Romania	28/11/2014	Premises for Risk Reduction

The possible collaboration with Prof Gil may benefit the JRC in the area of innovative materials. As an example, he has developed a textile ceramic technology used as a curtain wall for the reinforcement of masonry walls.

The visit of Mr Lobo-Ferreira, member of the LNEC Board of Directors, in the International Relations Division, aimed at fostering cooperation for applications to the H2020 and other calls. LNEC is preparing the application EcoDam, which was presented at ELSA. He also presented an application to H2020 'Water 2014 one stage' together with China, and the application PIANO (Proposal title: Policies, Innovation and Networks is enhancing Opportunities for China Europe Water Cooperation). The JRC will maintain its channel of communication with LNEC, especially in new areas different from those with which the JRC has collaborated in the past with LNEC, i.e. earthquake engineering.

The presentation of Prof Văcăreanu consisted for seven parts: (1) Seismicity of Romania; (2) Seismic hazard assessment; (3) Major earthquakes in Romania; (4) Seismic risk assessment; (5) Japan International Cooperation Agency Technical Cooperation Project for Seismic Risk Reduction in Romania - Goals, activities and results; (6) Opportunities for cooperation in the field of seismic risk reduction; and (7) Conclusions. The cooperation with Prof Văcăreanu for the JRC can give potential benefits in the area of risk assessment. Contacts will be maintained in 2015 for possible participation in indirect actions or within the framework of the JRC Institutional project RESURB.

10 Outlook for International Collaboration

The JRC, since the setting up of the ELSA unit, has always acted as a centre of reference for European research in earthquake engineering. The work carried out in FP4, FP5 and FP7 through the Marie Curie Training Networks, COST and Integrated Projects for Research Infrastructures (ECOELADER and SERIES) have achieved extraordinary outcomes that have contributed to science and standardisation in the construction sector in Europe.

At international level, the US through NSF had funded the NEES project, with scope similar to ECOLEADER and SERIES, but at much large scale, both in time (2004-2014), budget and number of infrastructures involved (14). While the US has based its work on competition among researchers and institutions, the EU has focused on integration and collaboration, profiting, in view of the limited budget, from complementarities and bringing to higher levels of competence the less advanced institutions.

The European approach has been considered a success by its peers in the US and Asia, especially in consideration of the great achievements and limited budget and duration of EU funding.

The US is now funding a new network of collaboration; in Europe it is auspicable that Horizon2020 also funds a similar project. What is clear is that European, US and institutions in Asia (China, Japan, South Korea and Taiwan) all agree that more coordination and cooperation is necessary, especially in sharing data, best practices and in setting a shared vision for the future.

In the following it is proposed an outlook for guiding were international collaboration may move forward. At European level cooperation will still focus on inclusion and integration, while at international level it will focus more on sharing and exchanging expertise.

10.1 CHALLENGE

- Setting up an effective and coordinated network of integrated and complementary Research Infrastructures (RI) able to address infrastructure/community resilience in a multi-hazard context.
- Favour the access of academic and industrial partners to RIs, promote their cooperation and accelerate the transfer of know-how from research to industry.

10.2 SCOPE / TOPICS FOR TRANSNATIONAL ACCESS

- Enhance the resilience of critical infrastructures, namely in the Energy and Transport Sectors.
- Favour the development of metrics for infrastructure performance during and after hazardous events, e.g. earthquake, fire, tsunamis, etc., and setting concepts of recovery and functionality.

- Achieve, yet safe, an energy efficient European building stock, through the development of innovative materials and technologies.
- Develop smart early warning and health monitoring systems based on innovative multi-sensing technologies for vulnerable infrastructures resulting from substandard design and construction, increased loading and aging. This will reduce the costs for the operation, maintenance and upgrading of civil infrastructures.
- Assessment of safety margins and new design technologies of civil infrastructures for Nuclear Power Plants.

10.3 NETWORKING AND JOINT RESEARCH

- World wide data integration in earthquake engineering: semantic web technologies, ontology
- Building Information Models (BIMs) and Advanced Virtual and Hybrid Simulation
- Development of wireless and optical sensor technologies enabling higher performance and use of test results

10.4 EXPECTED IMPACT

- Integration and complementarity of different type of RIs (e.g. specialized in earthquake, fire and tsunami research) to enhance the capacity, innovation and synergy of the International research community.
- Enhanced socio-economical impact owing to resilient infrastructures/communities.

11 Conclusion

The JRC carried out in 2014 a broad range of activities for building a sustained platform for collaboration of Research Infrastructures (RIs) in earthquake engineering and structural dynamics in the EU and internationally. The activities as summarised in Fig. 11.1.

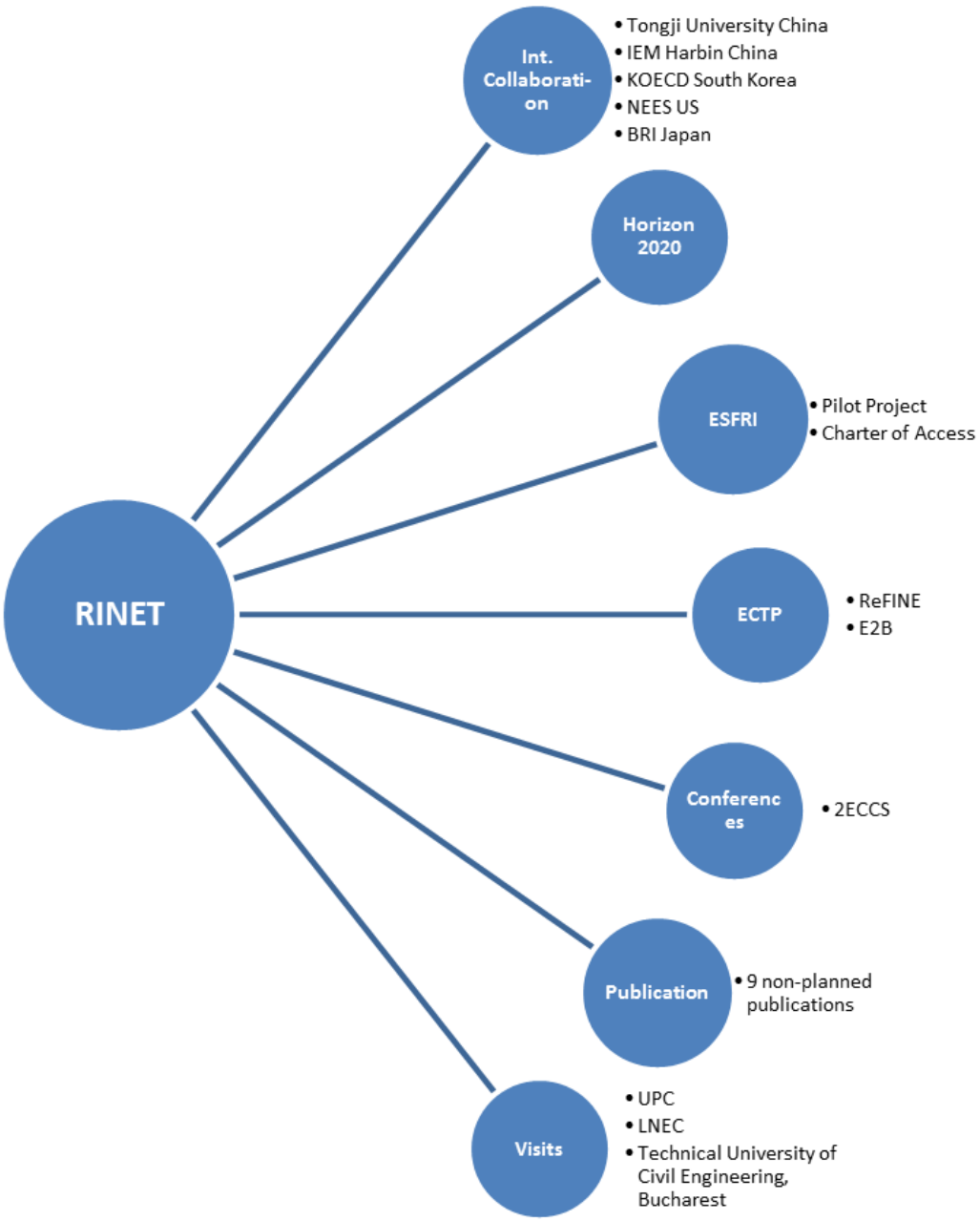

Fig. 11.1 Summary of RINET activities in 2014

During the year 2015 and ahead the ELSA Unit will focus on:

- Setting up a framework for delivering access to its reaction wall infrastructure as part of the pilot project within the ESFRI roadmap. The framework will include modality of access, services offered, selection of projects and relevant topics. At the end of 2015 a first call for transnational access should be launched
- Strengthen the links with the ReFINE and E2B initiatives
- Promote the collaboration agreements already in place, namely with Tongji University and BRI, for welcoming incoming researchers and organization of joint workshops
- Work on setting collaboration agreements with Purdue University, KOECD CMI and IEM Harbin.
- Network with European RIs for preparing the grounds for answering (and promoting) a possible under Horizon 2020 under the Capacities Specific Programme for Research Infrastructures. Identify a potential coordinator, members of the consortium and topics of interest for Transnational Access.
- Publish as EUR report the work on “Common Protocol for the Qualification of Research Infrastructures in Earthquake Engineering and Technical Annexes”, jointly with Maurizio Zola
- Where the collaboration agreement with Purdue University, pursue the further development and integration of databases of experimental results, and support the organization of a workshop to be held in the EU on hybrid testing.

Annex 1

Opening up access and associating ELSA pilot project to ESFRI

Practical implications and needs

DESCRIPTION OF THE ELSA INFRASTRUCTURE

The European Laboratory for Structural Assessment (ELSA) is a large research infrastructure consisting of the ELSA reaction wall and the HOPLAB, both among the world's largest facilities of their kind. The ELSA reaction wall is capable of conducting experimental tests on near to full-scale structures for the safety assessment of existing buildings and infrastructure and for the calibration of new design methods against earthquakes and other natural and man-made hazards. The HOPLAB facility is used for studying the performance of materials and structural components to very fast dynamic loads, such as those due to blasts and impacts.

The JRC offers to research institutions and industrial partners in the EU the expertise of the ELSA staff in running its experimental installations, which are unique in Europe. The work at ELSA has served in developing pre-Normative research for the calibration of the Eurocodes, the European standards for construction. It has also allowed for the development of new technologies, offering a major opportunity to the European construction industry to enhance its competitive position in world-wide markets, especially in countries with high seismic risk.

The ELSA facility is used within the framework of European Union wide integrated research programmes and is also available to external customers for performing demonstration and qualification tests on large-scale prototypes and/or validation of innovative constructions. During several framework programmes, ELSA has provided free of charge Transnational Access to many user groups in Europe.

WHAT ELSA OFFERS

Users will be given access to the infrastructure with visits ranging from a few days up to a few weeks, depending on the complexity of the test and the type of activities carried out, ranging from the design of the test model and of the instrumentation, to the execution of the tests and processing and interpretation of results (i.e., meetings for planning the test campaign will require fewer days, while on-hands training, instrumentation and analysis of test data will require longer stays).

The services that will be given to users having access are:

- Technical assistance in the definition and design of the test model and of the experimental set-up, in order to adapt the testing programme to the characteristics of the infrastructure.
- Assistance in the fabrication of near to full scale test models. The construction of models may be covered by JRC resources, partly shared or entirely covered by users, depending on available resources (see section on resources).
- Preliminary destructive or non-destructive tests for material properties identification of the test model.
- Assistance in the design, calibration and implementation of the instrumentation, providing, within the availability constraints of the sensor stock of ELSA, state-of-the-art sensors, materials and components and the workmanship for their installation.
- Data acquisition systems.
- Assistance in the choice of the input signals.
- Support in the use of analytical tools to support the design of the specimen and test campaign.
- Photographic and video records of the test model before, during and after the test campaign.
- Photogrammetric techniques for tracing deformations and damage of structures.
- A computer network with access to large computer codes for static and dynamic analysis of structures.
- A data repository system accessible via Internet (see section on resources).
- Telepresence, yet to be implemented (see section on resources).
- Training of users in topics specific to their interest and to the project to which access is offered, in areas related to the experimental activities of the infrastructure.
- Opportunity to collaborate with the international partners of the infrastructure.
- Safety training of users.
- Data processing, analysis and interpretation of the test results.
- Demolition and disposal of the test model

Concerning the actual performance of experimental tests, the following services will be offered:

- Use of the Pseudo-Dynamic (PsD) method with sub-structuring techniques for the simulation of the seismic action on large-scale structural systems, including push-over through monotonic and cyclic tests , as well techniques for modal assessment and system identification (modal evaluation, hammer tests)

The ELSA staff will plan in the test campaign preparatory tests conducted to guarantee the functionality and safety of the experiment, to ensure the reliability of data and to calibrate the instrumentation and servo-systems.

The infrastructure offering access will provide at the end of the test campaign all the generated data via internet, and will deliver a test report co-authored with users.

Users will be integrated into the scheduling of the infrastructure during the execution programme of each project, from the design and construction of the test model, to instrumentation, experimental testing and interpretation of the experimental results, receiving from the staff of the infrastructure all the support needed to carry out their project. A user support team will be allocated to each user on a daily basis, to develop and execute the test programme, including appropriate technicians for test model fabrication, instrumentation, etc.

A long-term schedule of the experimental projects and use of the infrastructure is carried out and continuously updated along the course of the year. This updating is facilitated by the significant time spent for the preparation of very large and complex specimens and test set-ups. Any conflict between new activities and the ones already assigned to the infrastructure is thus prevented.

Logistic support offered

The JRC is well prepared to host external researchers that during their stay will be integrated with the permanent staff, from which they will receive technical and scientific assistance. After receiving the necessary training, users will be able to fully participate in the test preparation, execution, data acquisition and interpretation.

The JRC will provide assistance and information for organizing the logistics for transportation, accommodation and subsistence, which will be reimbursed to users through a dedicated budget for T&S. The infrastructures will also provide facilities for the organisation of project meetings. Users will also have access to the library facilities of the institution hosting the infrastructure.

All infrastructures will maintain a log book where they will record the dates and actions delivered, indicating the type of tests performed and the project or user group to which access is offered.

OPEN CALL FOR PROPOSALS AND USER SELECTION COMMITTEE

The JRC will grant access through open calls for proposals that will be evaluated by a User Selection Panel (USP). The USP will be integrated by JRC staff together with experts external to the JRC.

The calls for proposals will include a list of priority topics for research and will be addressed to the European S/T community of earthquake engineering via the JRC Science Hub, the web portal of ELSA and other channels (e.g. S/T journals) provided by international European or national organisations, networks or projects with which ELSA collaborates. The calls will be announced at relevant international conferences and by directly contacting potential users.

Instructions for application for access, information on the user selection procedure and panel, the status of the selection process, the selected proposals, and the schedule for their implementation will be announced at the ELSA website.

Prospective users will be instructed to include in their proposal a: i) Brief description of proposed research; ii) User Organisations (Main user, Partner users) including CVs of

principal investigator and of other researchers; iii) Total number of researchers in TA; iv) Expected cost of the tested specimens.

Proposals will be submitted via the web portal or by e-mail to the JRC, and will be promptly forwarded to the members of the User Selection Panel. Proposals will be graded by each member of the USP (as outlined in Annex) and ranked according to their overall weighted-average grade. It is expected that the projects carried out will vary in size and acceptance will depend on the available resources and planned testing schedule of the ELSA facility.

The USP will meet to review and decide on the submitted proposals. The meetings will take place at the JRC or where more convenient for the members of the panel. The dates of the USP meetings will be chosen so that there is sufficient number of proposals for evaluation.

A successful team will sign a contract agreement with the infrastructure, delineating the test program and the specimen(s), estimating the length of User stays at the facility. The contract will require the User to publish the knowledge generated, first in interim and public final reports (conforming to a common format) and then in Journal or Conference papers. The contract will define the rights and obligations of the facility and the Users including provisions for early termination.

RESOURCES NEEDED

The opening up of ELSA as a pilot project to offer access to potential users in Europe is conditional to the availability of staff and specific credits resources to meet the services delineated in the previous three sections.

Human resources

The ELSA infrastructure has a pool on experienced engineers, scientists and technicians that can ensure high quality access to user groups. However, there are three areas that have been part of the research activities of ELSA, many of which funded through FP Projects, where the JRC has played a key role, but where an operational and continuous level of services has not been achieved and are essential for offering access to users. These areas are:

- **Distributed Database of experimental data**: The ELSA infrastructure possesses its own database which has been used for more than ten years to store and transfer results from experiments to users. During the FP7 Research Infrastructures Project SERIES, the JRC together with other partners of the project played a key role for developing the architecture of a central distributed database of experimental data, where the European and International community of users in earthquake engineering can search, retrieve and use the experimental data of all the connected laboratories by interacting with a single portal and receiving data in a common format. The prototype developed at the end of SERIES needs further development and at present is not operational. The University of Oxford and other institutions together with the NEES network in the US are further developing the database. At present the JRC is not participating in this development, as it does not have the ICT staff needed for this, with the risk of lagging behind and not being able to keep on playing the key role it did during the conception of the database. The distributed database is one of the main services that ELSA offers to users and is a key instrument for its collaboration with European partners and the NEES network in the USA.

- **Telepresence**: In person access at the infrastructures may be supplemented with teleconferencing / telepresence for real-time data visualisation, allowing users to participate in the experimental campaigns. This service has been developed by ELSA in collaboration with NEES and is constantly evolving following the developments and new possibilities offered by IT. At present telepresence is not operational and requires further development and implementation by ICT experts that at present are not available at ELSA.
- **Cyber-physical testing**: The ELSA infrastructure has been at the forefront in Europe and internationally in carrying out pseudo-dynamic earthquake tests with sub-structuring, which allows testing full-scale structures, such as bridges, by combining physical testing of selected elements with the numerical simulation of the remaining ones. A natural extension of sub-structured testing – single sited – is geographically distributed testing – multi-site – where different laboratories are connected and communicate during a test, with the objective of taking advantage of complementarities and sharing resources. This is an essential feature that increases collaboration towards a distributed network of infrastructures. At present ELSA does not have the ICT staff to develop, achieve and make operational distributed testing.

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Abstract

The present deliverable is part of project 612 RINET (Networking and advancement of RIs for safety and sustainability in the building sector), which aims at building a sustained platform for collaboration of Research Infrastructures (RIs) in earthquake engineering and structural dynamics in the EU and internationally, encompassing the objectives of the ESFRI. The report describes the activities carried out in 2013 to promote the collaboration of research infrastructures at EU level, as well as the networking carried out at international level.

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