EUROPEAN COMMISSION
JOINT RESEARCH CENTRE
Directorate E - Space, Security and Migration
Safety and Security of Buildings Unit

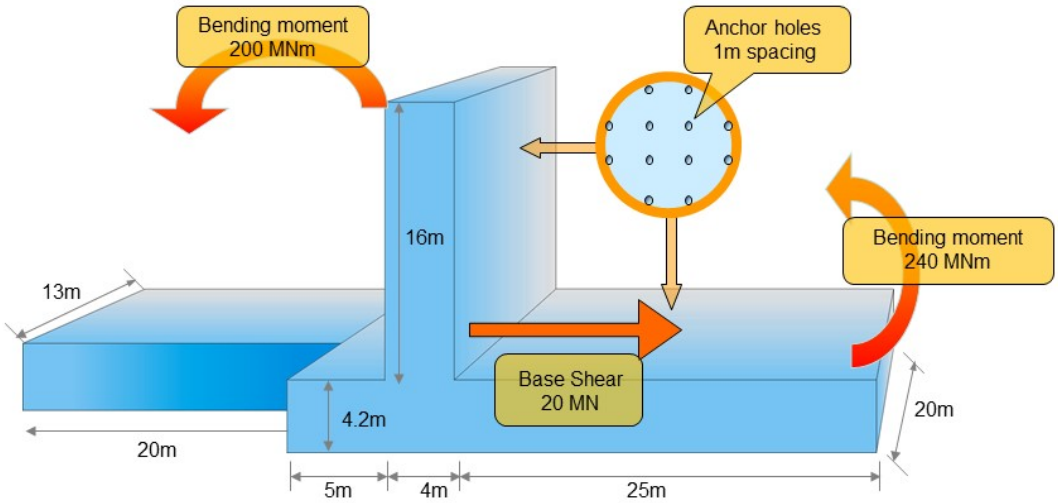
JRC EUROPEAN LABORATORY FOR STRUCTURAL ASSESSMENT

Reaction Wall facility

The European Laboratory for Structural Assessment (ELSA) was opened in 1992. It operates a reaction wall facility of unique dimensions and testing capabilities in Europe and worldwide. ELSA has become a world renowned reference for experimental research, fostering collaboration across EU laboratories, research centres and industry.

Interactive 360° Virtual tour of the ELSA Reaction Wall

ELSA operates a **16 m-tall, 21 m-long reaction wall, with two reaction platforms of total surface 760 m²** that allow testing real-scale specimens on both sides of the wall. The laboratory is equipped with **28 actuators with capacities between 0.2 and 3 MN and strokes between ±0.125 and 1.0 m**. The actuators control system is designed in-house to perform tests with the continuous pseudo-dynamic method with substructuring, that permits testing elements of large structures, bidirectional testing of multi-storey buildings, and testing of strain-rate dependent devices.



Dimensions and capacity of the ELSA Reaction Wall

The services offered by ELSA are of vital importance for European research in structural and earthquake engineering, enabling scientists to carry out high-quality research through:

- experimental facilities that are unique in Europe for testing full-scale large structures under seismic or other loads;
- the competence in computational mechanics to support the design, simulation and interpretation of experiments;
- the critical mass of its research team, that allows the set-up of co-ordinated research projects;
- the established collaboration with the main earthquake engineering research institutions in Europe and abroad;
- a database containing the experimental data generated by the infrastructure and already used for calibration/adoption of European standards and mitigation of seismic risk for existing ordinary and heritage structures.

Scientific and technical staff

The ELSA team comprises more than 10 scientific and technical staff and is recognised as a major European player in the field of construction and earthquake engineering research, will provide high-quality scientific support. It has developed and implemented the pseudo-dynamic testing method and performed numerous large-scale reference tests. The staff includes known specialists in different areas, such as experimental techniques (control, measurement techniques), analytical and numerical modelling of materials and structures, standardisation.

International collaboration

Since its opening, ELSA developed a tradition of collaboration with research and industrial partners from all over Europe. Thanks to its recognition as a large-scale facility through the HCM, TMR and IHP programmes, the ELSA laboratory has been able to host a large number of users in the framework of European programmes. Around 100 international users benefit every year from the ELSA infrastructure and users from new Member States have had increased access to ELSA during FP7. In the FP7 SERIES project, ELSA hosted 30 users from nine European countries.

ELSA established scientific co-operation agreements with leading international research institutions in the field (China, Japan, Korea, Taiwan, USA, etc.). These activities create a stimulating environment for exchanging knowledge and expertise and gives the opportunity to users of ELSA to establish contacts and collaborations, as well as broad exposure to the most prominent scientific developments at European and world level.

Areas of research

ELSA has been supporting research related to the structural/seismic safety of structures, including:

- reference tests on reinforced concrete buildings with and without infill wall panels;
- reference and pioneering tests on full-scale bridges, including irregular configurations, isolation and asynchronous input motion using the PsD method with non-linear substructuring;
- tests on models of parts of monuments for the development of assessment methods and protection techniques;
- reference tests on concrete-steel composite structures;

- experimental tests on fibre-reinforced concrete composite structures;
- reference tests on models representative of existing vulnerable structures for the development of conventional or novel techniques and the calibration of European codes for assessment, strengthening and repair;
- development of the continuous PsD method, allowing more efficient seismic testing of large-scale specimens; development of base isolation and energy dissipation systems;
- experiments on active and semi-active control of wind- or traffic-induced vibrations.

RECENT PROJECTS AT ELSA REACTION WALL

SERFIN: Seismic retrofitting of RC frames with RC infilling

The SERFIN project studied the effectiveness of seismic retrofitting of multi-storey multi-bay RC-frame buildings by converting selected bays into new walls through RC infilling with reinforced concrete. A full-scale model, consisting of two four-storey (12m tall) three-bay (8.5m long) parallel frames linked through 0.15m slabs with the central bay (2.5m) infilled with a RC wall, was tested with the pseudo-dynamic method. The frames were designed and detailed for gravity loads only and are typical of similar frames built in Cyprus in the 1970's. Different connection details and reinforcement percentages for the two infilled frames were used in order to study their effects in determining structural response.

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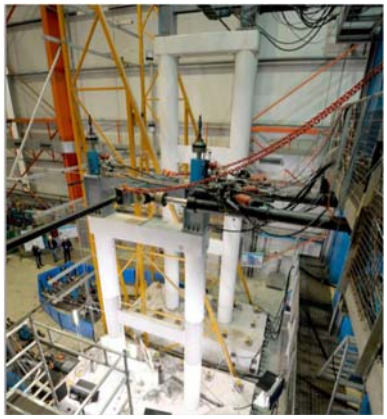
RETRO: Assessment of the seismic vulnerability of an old RC viaduct with frame piers and study of the effectiveness of different isolation systems through pseudodynamic test on a large scale model



The RETRO project aimed at studying the seismic behaviour of existing RC bridges and the effectiveness of innovative retrofitting systems. Two specimens (scale 1:2.5), a frame pier of 2 levels (height 5.8 m) and a frame pier of 3 levels (height 10.3 m), have been built and tested using the continuous Pseudo-dynamic (PsD) method with non-linear substructuring technique, including the modelling of the remaining entire viaduct to which they belong. Two test configurations have been considered: 1) retrofitted viaduct using Friction Pendulum Isolators, and an 2) 'as-built' configuration.

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DUAREM: Full-scale experimental validation of dual eccentrically braced frame with removable links

Conventional seismic design is based on dissipative structural response, which implicitly accepts structural damage under the design earthquake, thus leading to significant economic losses. The DUAREM project aimed at reducing the repair costs and downtime of a structure hit by an earthquake through the concept of removable dissipative members and re-centring capability of the structure. The concept was implemented in a dual structure that combined i) steel eccentrically braced frames with removable bolted links and ii) moment resisting frames. The feasibility of the concept was validated through pseudo-dynamic tests of a full-scale model.

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