Operating testing facilities of global significance to keep our infrastructures safe

The European Laboratory for Structural Assessment (ELSA) is a centre of excellence in experimenting on what exactly happens to buildings and civil structures when they experience the effects of serious natural and man-made hazards, such as earthquakes and explosions. It is the only one of its kind in Europe and is run by the European Commission's in-house science service, the Joint Research Centre.

Scientists construct large model structures of buildings or structural components at full or nearly full-scale to assess their behaviour under simulated conditions, often over long periods. This work is complemented by advanced numerical modelling and analysis that provides unique insights into how existing and planned structures might be strengthened or repaired. For example, the metal employed for the construction of a large bridge between two islands might be stress-tested under multiple scenarios.

The scale and structural mechanical significance of this research means that JRC scientists collaborate with a large number of European and international private and public organisations. Results form part of the EUROCODES, a set of European standards for the design of buildings and other civil engineering works and construction products.

INNOVATION UNION

Joint Research Centre (JRC)

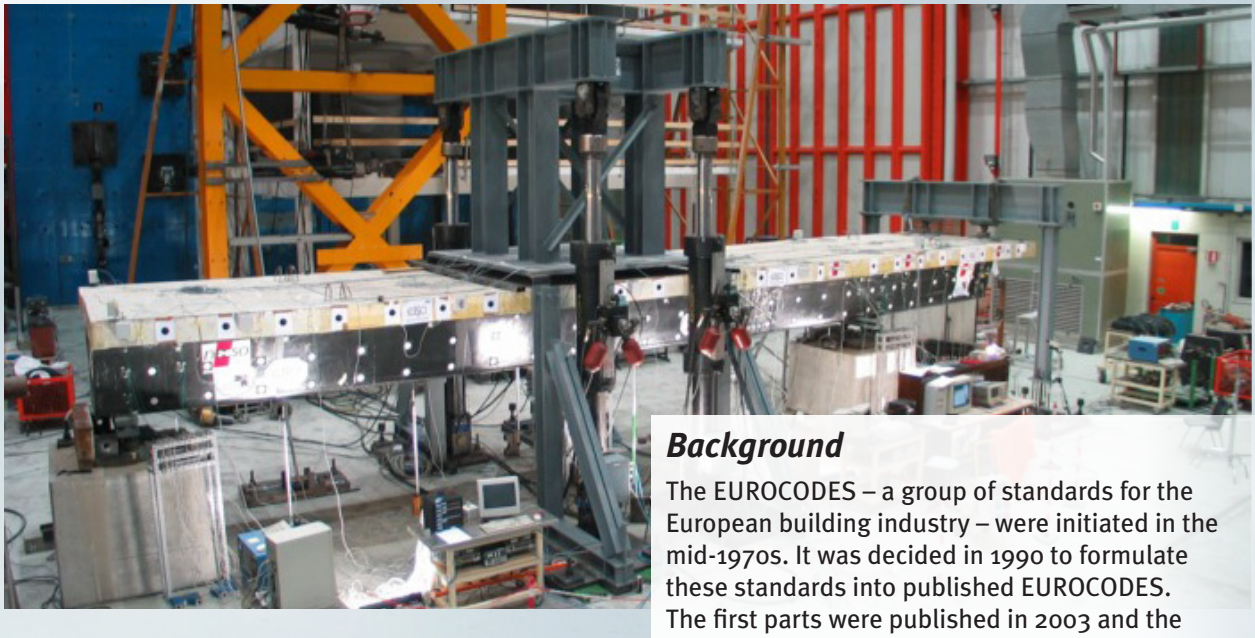
– the European Commission's in-house science service

As part of ELSA, the 'Reaction Wall' is one of the three largest in the world. It consists of an extremely stiff vertical, reinforced concrete wall and a horizontal floor rigidly connected together to test the vulnerability of buildings to earthquakes and other disasters.

How it works is that the structure being tested, usually a full-scale building that is built onsite, is fixed to the horizontal floor. Once the test structure is in place, the force that an earthquake would generate is applied through hydraulic jacks acting between the structure and the vertical wall. This tests the internal resisting forces of the building. For the purposes of testing, the 'earthquake' takes place in slow motion over one to two hours rather than the usual 10 seconds. This ability to control the force of the experiment allows scientists to more accurately monitor progressive damage and structural deformations.

The facility also has a large 'Hopkinson Bar', again a facility of European significance. This allows dynamic testing of materials and structures submitted to extreme loads. In essence it simulates high strain impacts representative of major impacts and explosions. Injuries due to flying debris and blast wave effects on humans are also simulated in confined urban areas such as city centres and train and subway stations. Special material modelling, structural mechanics and numerical simulation techniques have also been developed to complement physical measurements.

An example of a collaboration contract is 'Europlexus'. Began in 1999 with the French Atomic Energy Agency (CEA) and since then licensed to research and development teams around the world, it entails software for the non-linear analysis of fluid-structure systems such as pipelines that are being subjected to explosions, bombing or major accidental situations and the plasticity or viscoplacity of construction materials.



Background

The EUROCODES – a group of standards for the European building industry – were initiated in the mid-1970s. It was decided in 1990 to formulate these standards into published EUROCODES. The first parts were published in 2003 and the remainder in 2008. Since March 2010 their application is mandatory.

Did you know?

The construction and construction products sector represents approximately 10% of EU GDP and almost 30% of industrial employment. Construction also represents a key component of quality of life insofar as advances in the sector determine the quality of the building we live and work in and the urban or rural infrastructure we use. Increasingly, focus is also on the consequences of natural and man-made hazards depending on the performance of such structures under extreme conditions.

The European Laboratory for Structural Assessment is an important common resource leading the way in providing essential R&D to the establishment of EUROCODES. Their flexibility enables adoption and use not only in Europe, but internationally. This is helping increase the competitiveness of European civil engineering firms, contractors, designers and product manufacturers in their global activities.