



EUCENTRE
FOR YOUR SAFETY.



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“God does not play dice with the universe”

Albert Einstein

“Stop telling God what to do with his dice”

Niels Bohr

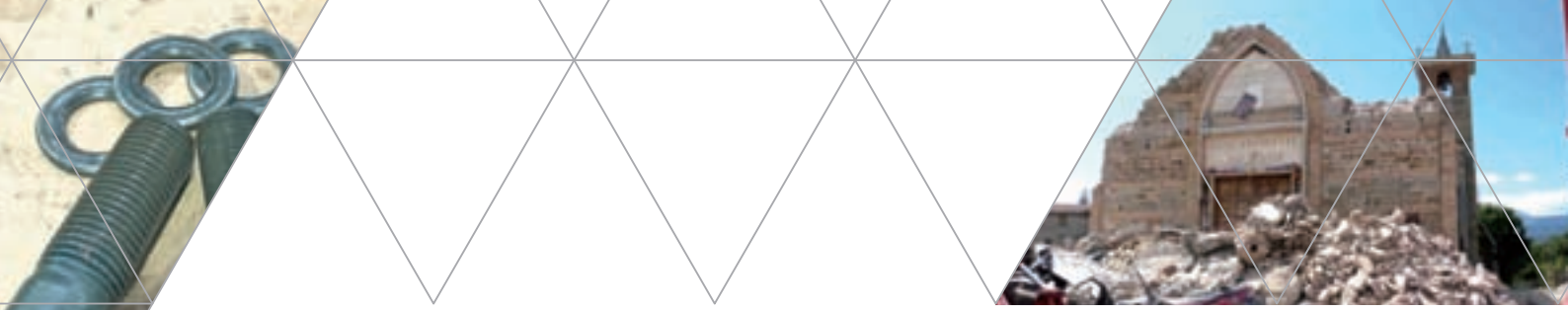
From the correspondence between Albert Einstein and Niels Bohr (1926)



The Mission



**Build safety,
live in a safer future.**



Safety is one of the main values for the human beings of the 21st century, safety for one's life, possessions, children, culture, and future. Safety is often considered a right. With the extraordinary impact of technology in our lives, life expectation has increased, together with a concern for the threats to this worthy ambition. Eucentre was born to focus on safety as a value, to mitigate the risk that natural events, especially earthquakes, can damage the houses we live in, the places we work in, the streets and the infrastructures we use and with them our values and affections. Earthquakes cannot be predicted, we only know that some regions of the Earth are more subject than others to such natural events. We only know what could happen in those circumstances to the structures that humankind has built in those places.



In this context, risk scenarios indicate how structural vulnerability combined with the probability of a natural disaster can cause collapse and destruction, threatening our safety. **Earthquake engineering and applied seismology contribute to evaluate the vulnerability of buildings**, the probability that a seismic event occurs and any losses that it may cause, estimating a global and integrated risk. Earthquake engineering can also provide indications on how to mitigate such a risk by reducing the vulnerability with interventions on structures and non-structural elements.

Italy is one of the most seismically active countries in Europe, it has a widespread heritage of buildings and infrastructures and owns one of the most important

Eucentre aims at promoting supports and sustain training and research in the field of natural and man-made risk mitigation as well as more generally in the field of civil protection, through the following actions:

- applied research in the field of earthquake engineering, with a view to improve existing practice in assessment and reduction of seismic vulnerability and risk;
- support work towards the development of guidelines for both practitioners and governing bodies, bringing international state-of-the-art into Italian design codes and regulations;
- scientific and technological consultancy, at both national and international levels;
- training for practitioners and technicians.

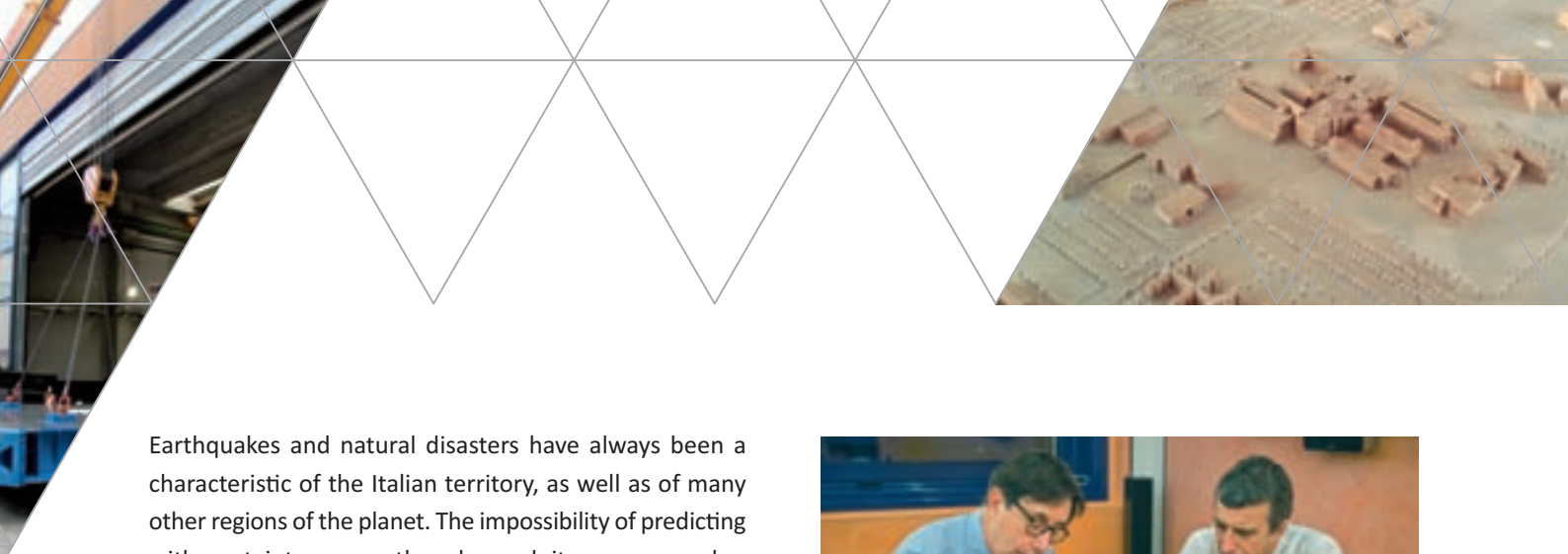
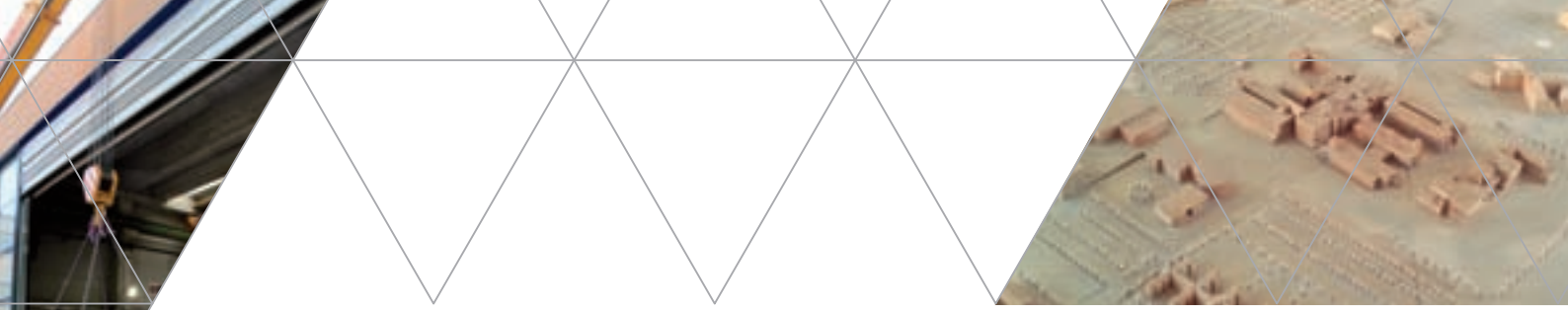
cultural heritage in the world; all this together constitutes an incredible asset both public and private, both historical and artistic. Therefore, it is in the best interest of everyone, citizens, institutions, industry and cultural stakeholders, to protect the country by ensuring adequate control of the risk associated with natural disasters. For this reason, in 2003 the *Department for Civil Protection (DPC)*, the *University of Pavia (UniPV)*, the *University School for Advanced Studies IUSS of Pavia (IUSS)* and the *National Institute of Geophysics and Volcanology (INGV)* established in Pavia the *European Centre for Training and Research in Earthquake Engineering* which then transformed, in 2005, into the *Eucentre Foundation*, whose mission is **to create value for its Founders and for the Country in the field of risk engineering.**



The History



**Eucentre.
An international
landmark for
earthquake engineering.**



Earthquakes and natural disasters have always been a characteristic of the Italian territory, as well as of many other regions of the planet. The impossibility of predicting with certainty an earthquake and its energy makes necessary to activate all the processes aimed at limiting the damage caused to buildings, to people, to everything of value to the territory. **In 2001, the Rose School for higher education in the mitigation of natural risks was established in Pavia.** In 2002, the earthquake of San Giuliano caused too many young victims and the Department of Civil Protection reconstituted the Major Risks National Committee with the task, among others, to define recommendations for the reduction of seismic risk. Consequently, **in 2003 the Eucentre Association and the ReLUIS network of university laboratories were established** both with the aim to study the effects of seismic ground shaking on buildings and damage reduction methods. **In 2005 the Eucentre laboratory (today Shake-Lab) was inaugurated and the Association became a Foundation.** From that moment on the development path of the Eucentre Foundation began, thanks to the active collaboration with the Founders, with the territory, with other national and international stakeholders and with many research partners. Some important dates are:

- 2006** The Rose School includes an Erasmus Mundus programme and Eucentre inaugurates a new facility for higher education.
- 2007** The Cardinale Agostino Riboldi College is inaugurated.
- 2008** The first edition of the Rose Prize is awarded to Nigel Priestley, the ROSE School co-founder after whom the prize is now named.
- 2009** Eucentre supports the Department of Civil Protection in the realization of the C.A.S.E. project following the L'Aquila earthquake. Eucentre wins the hosting of the Secretariat of the GEM Foundation (Global Earthquake Model) an initiative of the OECD. The first issue of the journal *Progettazione Sismica* is published.
- 2011** The UME (Understanding and Managing Extremes) School is created, expanding the fields of the Rose School.
- 2012** The Nascimbene section of the College is inaugurated, thus increasing the hospitality offer



for students, professors and researchers. Eucentre supports the Department of Civil Protection in the post-earthquake emergency of Emilia Romagna.

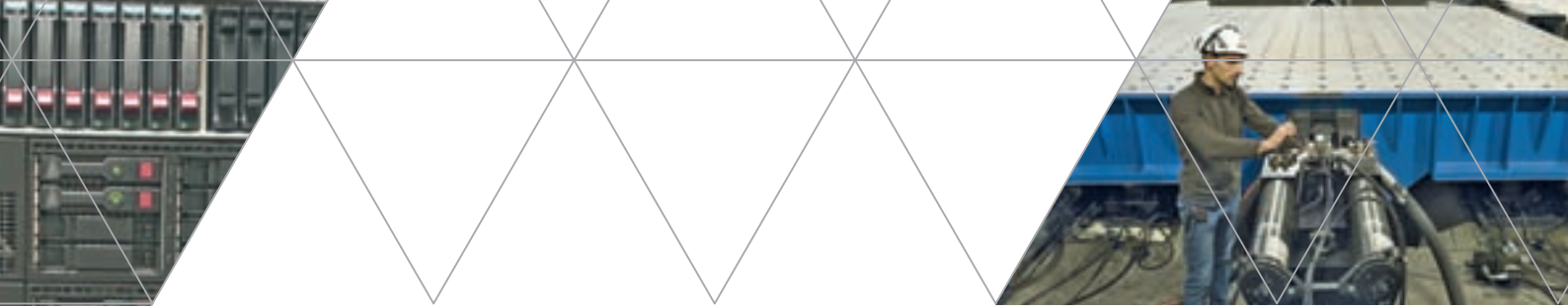
- 2014** Eucentre participates in the establishment of the Foundation Cluster Technologies for Smart Cities & Communities - Lombardy. Eucentre stipulates a multi-year contract with the NAM Consortium (Shell and ExxonMobil) for the characterization of the seismic response of buildings in the Groningen area (NL).
- 2015** Eucentre participates in the constitution of the SPONSE Association (International Association for the Seismic Performance of Non-Structural Elements).
- 2016** Eucentre supports the Department of Civil Protection in the post-earthquake emergency of Central Italy.
- 2017** Eucentre inaugurates the new laboratory with a 6 degrees of freedom simulator for tests on non-structural elements and the new mobile laboratory for in situ tests. The internal structure of the Foundation is reorganized with the creation of new Departments.



The Innovation: the Laboratories



**Estimate the effects,
calculate the risks,
design the solutions.**



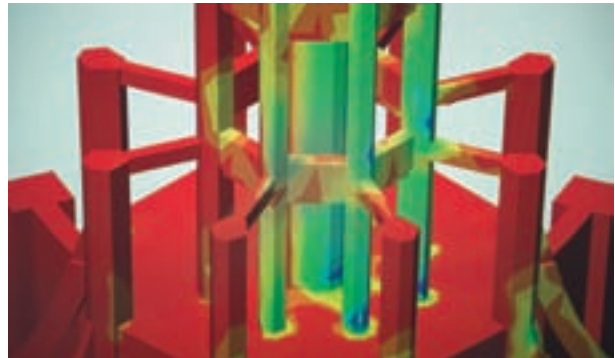
The assets of Eucentre are the relationship with the four Founders, the staff and the laboratories. Over 100 people who work and collaborate with Eucentre constitute a set of professional, scientific and cultural expertise that have allowed the growth of the reputation and the role of Eucentre at national and international level in the field of earthquake engineering. Of course this growth was possible thanks to the availability of **laboratories that represent singularly and as a whole a qualified structure of research activities and services, unique in Europe and among the first in the world**. The laboratories have grown over the years since the first investment in 2003 until the last ones in 2017 and 2018, and further improvements and upgrades have already been planned. There are 4 Eucentre laboratories:

ShakeLab features:

- a mono-axial shake table able to reproduce any seismic event that has been measured to date, on large dimension prototypes and full-scale buildings;
- a bi-axial bearing tester system for testing of full-scale bearing and isolation devices, with 5 degrees of freedom;
- a 3D strong floor-reaction wall system for full-scale pseudo-static and pseudo-dynamic tests on prototype buildings and structural elements.



MobiLab consists of a system of mobile laboratories unique in the world that allows on-site testing and measurements for the vulnerability assessment of buildings and infrastructure, but also to generate on-site seismic ground shaking aimed at the calibration of numerical models of structural and soil types which are difficult to reproduce in the laboratory.



DataLab produces risk analysis and damage scenarios using WEB GIS platforms that use exposure, vulnerability and hazard data. At the moment the system contains data on about 100,000 artifacts including:

- 18.210 bridges
- 310 ports
- 1.071 galleries
- 30.687 retaining walls
- 532 dams
- 52.435 school buildings
- 38 airports

6DLab features:

- a multi-axial shake table for the study of non-structural elements performance. Components of electrical systems and machines, fixing systems, fixtures, furniture, countertops, panels and facades they are among the systems that can be qualified through experimental tests on the 6DLab shake table;
- a system for tests on dampers and large dynamic restraints.



An aerial photograph of an industrial or manufacturing facility, overlaid with a white diamond-shaped grid pattern. The facility consists of several large, interconnected buildings with flat roofs, some of which are dark grey or black, while others are light grey or white. There are parking lots with several cars, and some outdoor equipment or structures are visible. The background shows some trees and a road.

Departments: Products and Services

**Software, simulators
and cutting-edge
technologies to test
safety of each product.**



Eucentre develops research activities mainly through the use of experimental facilities and by performing numerical analyses. These activities are addressed to stakeholders (Founders, industry, institutions, etc.) and shared with partners (Founders, universities and research institutions). The activities are carried out by 6 Departments, each with its specific competence.

Department of Risk Scenarios

This Department carries out **hazard, vulnerability and risk assessments** related to a multiplicity of natural and man-made events. The multi-year experience in earthquake engineering has been oriented to **seismic micro-zonation** with probabilistic and deterministic methods, to the drafting of hazard maps for both shaking and co-seismic effects such as liquefaction and slope instability, to the **vulnerability assessment of structures and infrastructures at different geographical scales**. Following the evaluation of the expected damage from an event, it is also possible to define and mitigate cascading effects. The department takes advantage of a data lab for the **realization of platforms** (mostly web based and with GIS interface for spatially distributed data) for **emergency preparation and management**.

Department of Emergency Support

This Department develops and manages **technical support services to the emergency in a “preparedness” perspective and the services of rapid response**. The fields of interest are both the development of tools for the technical management of the emergency, including those for fast damage assessment, for decision-making support, for emergency management, for damage identification through the use of drones and advanced sensors, and the operating services to effectively deal with the emergency including real-time damage scenarios, the inspection of structures and infrastructures, the experimental tests of structural and soil characterization and structural monitoring systems.

Department of Education

This Department contributes to the **training of practitioners and technicians in the field of earthquake engineering and risk mitigation**. Such a goal is pursued through the organisation of courses, sponsored by professional associations, in cooperation with academic partners such as the University of Pavia, IUSS and ReLUIS. The Department

can rely on two important free tools aimed at the stakeholders such as the journal “Progettazione Sismica” and the **Eucentre library**.

Department of Experimental Techniques

This Department deals with the development and implementation of **new experimental techniques for the study of structures and non-structural elements**. The Department aims to cooperate with companies, institutions and research organisations, in order to realize efficient solutions for the optimization of the performances and for a better reliability of the results. The Department has the mission of designing and implementing experimental tools and laboratories for earthquake engineering and to contribute to the training of specialists and technicians in the field of the experimentation dedicated to the study and prevention of natural disaster effects.

Department of Construction and Infrastructure

This Department deals with the **reduction of seismic vulnerability of reinforced concrete and precast structures, steel structures, masonry structures, timber structures and infrastructures** and the consequent development of all the activities useful to the definition of guidelines and regulations. The scientific and technological consulting activities are carried out in the context of analysis, tests and modeling of such structures and infrastructures through advanced and simplified approaches in order to define intervention priority for buildings and infrastructures.

Department of Industrial Products

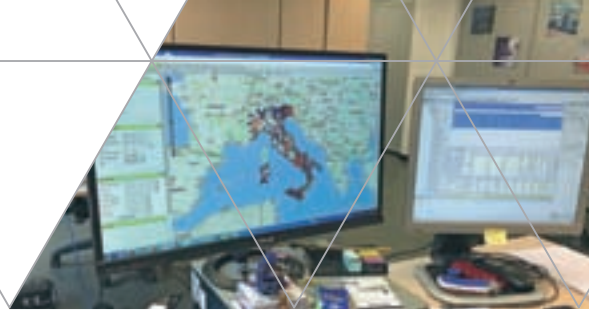
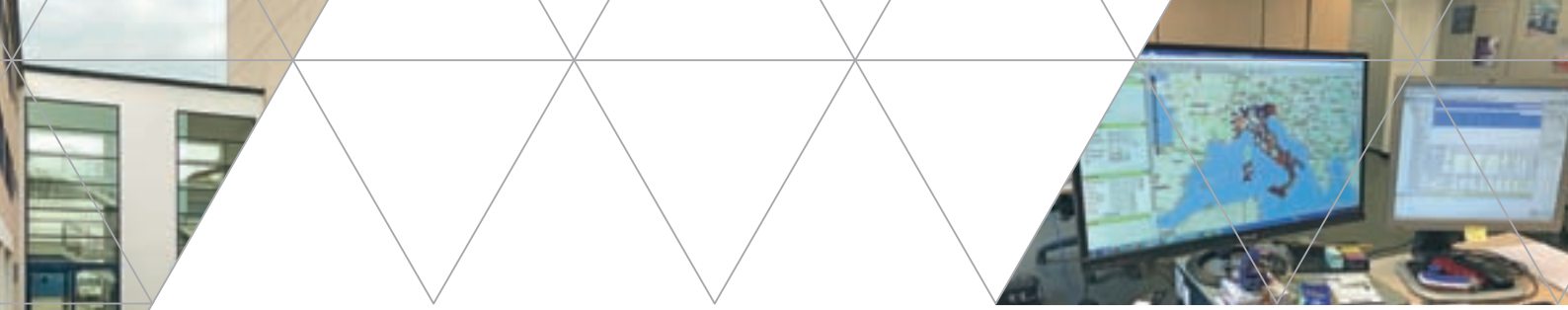
This Department studies the seismic **behaviour of structural elements (such as isolators and dampers) and non-structural elements (such as fastening systems, systems of distribution of energy, walls and fixtures) which foresee industrial production processes**. The acquired experience and knowledge allow the needs of national and international companies in the activities of development, prototyping and qualification of their products to be supported. The Department also provides support for the certification of industrial products.

The experience gained in this field has led to the accreditation of the Foundation’s experimental lab, according to EN ISO/IEC 17025: 2005. The expertise of the Department also includes **development and installation of innovative structural monitoring systems** also supported by the **Eucentre cloud platform**.

Education

A modern, multi-level computer lab with students working at desks and large monitors on the ceiling. The room features a grid of desks with black partitions and orange chairs. Two large monitors are suspended from the ceiling, displaying a grid of small images. The walls are orange, and the ceiling is white with recessed lighting. The floor is dark grey.

**Courses and masters
to enhance
professionalism
and promote prevention.**



Since the beginning of its activities, Eucentre has promoted, supported and sustained the training in the field of seismic risk reduction and, more recently, in that of emergency management, through different actions at different levels. The goal of the Foundation is **to train young researchers** as well as **to increase the expertise of practitioners and/or staff of institutions and industry.**

Training for practitioners and industry

Since 2004, Eucentre has been organizing **short courses and seminars dealing with specific topics related to earthquake engineering.** In particular, these courses are addressed to practitioners and technicians working in this sector, who are interested in learning more regarding the issues and problems related to the behavior of structures in seismic zones, and in acquiring the necessary tools to design and test such structures. The courses and seminars are held by the main national experts coming from universities as well as industry. Overall Eucentre has already organized almost 100 training modules with about 3500 participants.



The topics addressed range from structural design to seismology, geology, geotechnical engineering, behaviour of materials and structures, structural analysis, design of new structures, assessment and adaptation of existing structures, even in an emergency.

Higher education

Eucentre supports the *UME post-graduate school (Understanding and Managing Extremes)*, born from the international success of the earthquake engineering and engineering seismology programme of the *University School for Advanced Studies IUSS* of Pavia. The UME offers **advanced and interdisciplinary master and doctorate programmes**, in the field of assessment of uncertainties, risk mitigation and emergency management, with courses held by professors of the highest reputation from all over the world. The goal of the School is to provide a system in which masters and doctorate students can study and understand how to prevent the risk from extreme events. Since 2001, more than 500 students from over 60 countries have participated in the programmes of the School. Thanks to its educational and experimental facilities, Eucentre collaborates with the University of Pavia and with the IUSS in the field of civil engineering and the mitigation of natural risks, in addition to research doctorates on the same subject.



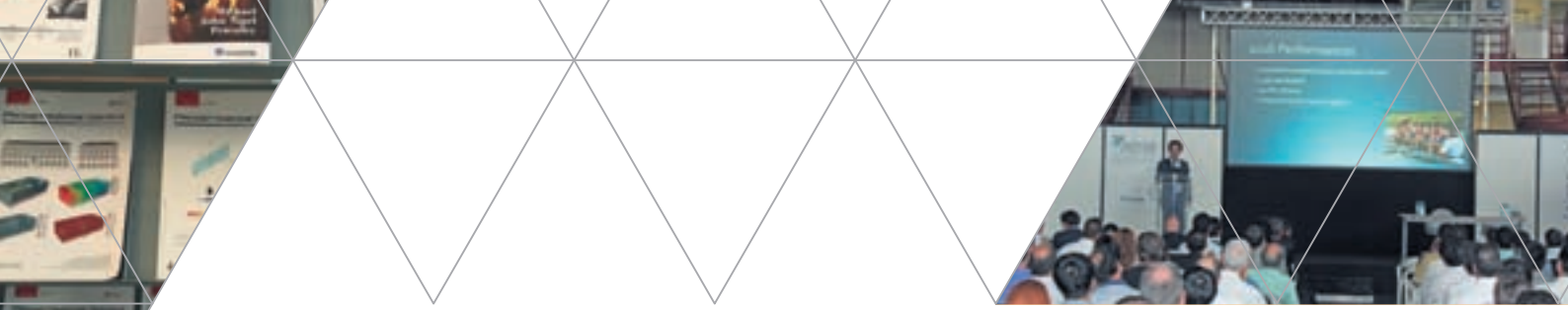
Events and publications



EUCENTRE
FOR YOUR SAFETY.



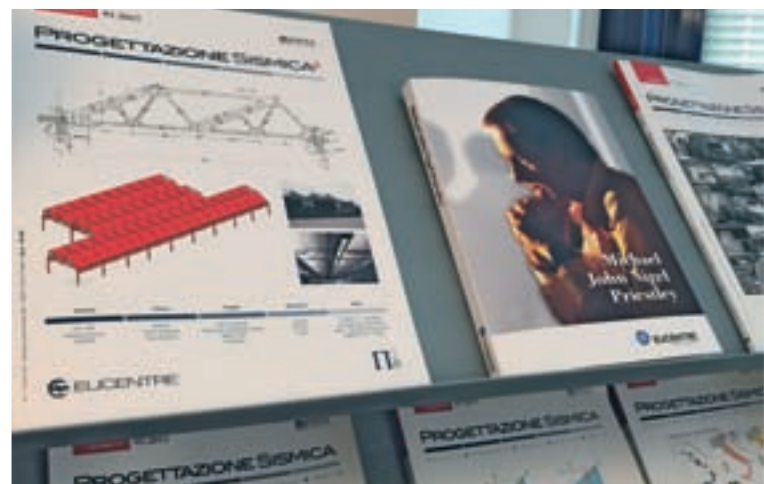
**Promoting science,
communicating values
and knowledge
with all media and tools.**



Scientific research for Eucentre also means **promoting and disseminating knowledge**, through all means and tools. The Foundation has always been active in scientific dissemination, so that the results of the research and the experimental activities may support and help citizens, governments, the national Department of Civil Protection, institutions and companies in **preventing the consequences of seismic events and structural damages**, and in designing and building according to safe and reliable criteria and technologies.

Throughout its history, Eucentre has become a point of scientific reference not only for the world of **national and international research**, but also and especially for **the practitioners and the operators in the field of earthquake engineering, design, and construction**. Books, monographs, reports and design manuals are published continuously to provide constant updating to the practitioners. In particular, the journal “Progettazione Sismica”, born between 2008 and 2009 and a must-read for all those involved in seismic design, features contributions by international experts in the field of earthquake engineering, as well as contributions and reports by the Eucentre partners: the *National Department of Civil Protection*, the *National Institute of Geophysics and Volcanology*, the *Global Earthquake Model Foundation* and other entities such as the *Network of Italian University Laboratories of Earthquake Engineering*.

Among the other scientific dissemination tools, the **Eucentre web portal** represents an important virtual meeting place for the world of research and the population, and it includes sections where students, practitioners, officials or ordinary citizens can refer to the Foundation and be updated or involved in safety and risk awareness initiatives.



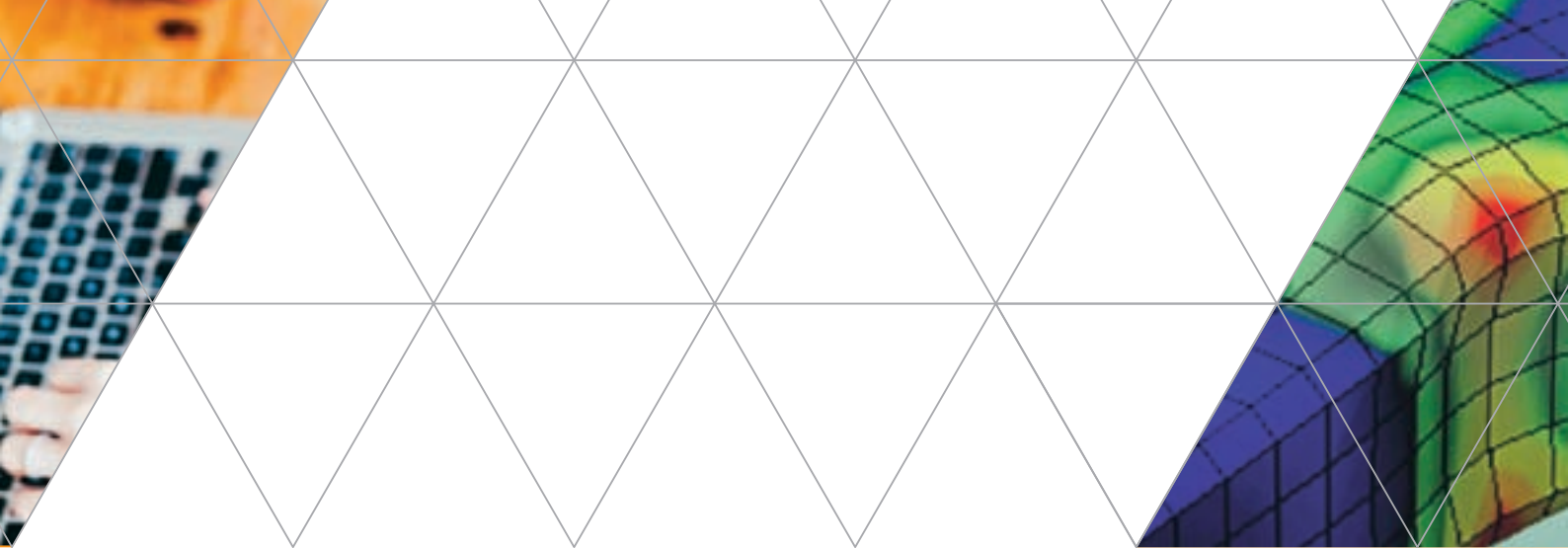
Alongside the website, Eucentre is actively involved in **academic conferences** as well as in **exhibitions, social campaigns, public meetings** and in those **events** that put science in direct contact with citizens, schools, society, through a clear and immediate language, with interactive and multi-sensorial modes, in order to communicate not only to the brain but also to the heart of people.



Eucentre for

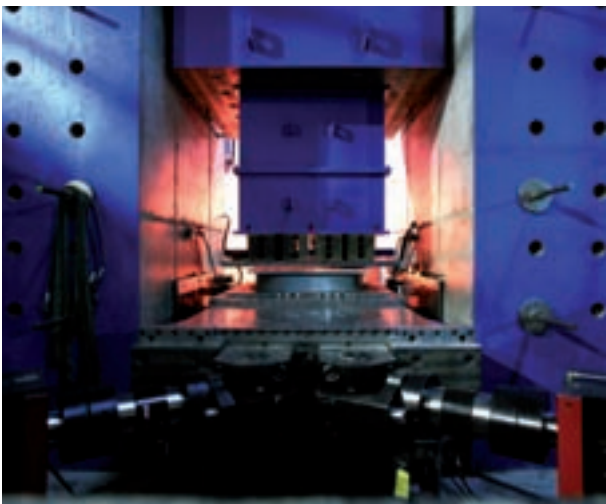
Science, research
and innovation
at the service
of the community.





Research

All the activities carried out by the Eucentre Foundation originate from research and, at the same time, research is its purpose: on one side, in fact, a state-of-the-art knowledge is crucial to be able to give adequate response to Founders, organizations, companies, practitioners and partners. On the other side, it is also undeniable that experience and expertise gained during the years must find an echo in the research itself, through publications and training activities for practitioners and students from all over the world.



Industry

When an earthquake occurs, what is the performance of a screw, glue, a shelf, a closet, a window, a countertop, a wall, a pillar, a beam, a room, an entire building or a complex of buildings? Industry needs clear and certain answers: the Eucentre Foundation is able to provide them from both a theoretical and experimental point of view, thanks to the expertise and experience gained over the years and in cutting-edge laboratories.



Eucentre for Research



- Elaborates and participates in applied research projects
- Participates in scientific networks
- Offers internships to Masters and PhD students
- Offers the facilities of its laboratories
- Designs and performs experimental tests
- Performs numerical simulations of structural and geotechnical analysis
- Elaborates interpretive models

Eucentre for Industry



- Provides support for industrial product certification
- Contributes to the seismic characterization of products
- Develops new types of experimental tests
- Develops patents on seismic protection devices
- Supports prototyping activities
- Performs qualification tests
- Carries out environmental and health risks assessment



Institutions

Since its establishment, a substantial part of the Eucentre activities is carried out for public bodies and governments. From the participation in research projects to the support in training technicians for the vulnerability assessment of structures and buildings; from the production of damage scenarios in case of seismic events to the intervention in the disaster areas to assess buildings and strategic structures; from the realization of management systems for the accommodation needs of the population affected by emergencies to the experimental evaluation of structures. When it comes to knowing, evaluating, dealing with, mitigating seismic risk, Eucentre is an ideal partner for institutions at any level. From Municipalities to Regions, States, to the European Union.



Eucentre for Institutions



- Elaborates natural and man-made risk scenarios
- Participates in the drafting of regulations and guidelines
- Evaluates the vulnerability of structures and infrastructures
- Designs tools for emergency management
- Offers structural and damage monitoring services
- Performs post-disaster assessments
- Supports activities of territorial management and control on building regulations

Practitioners

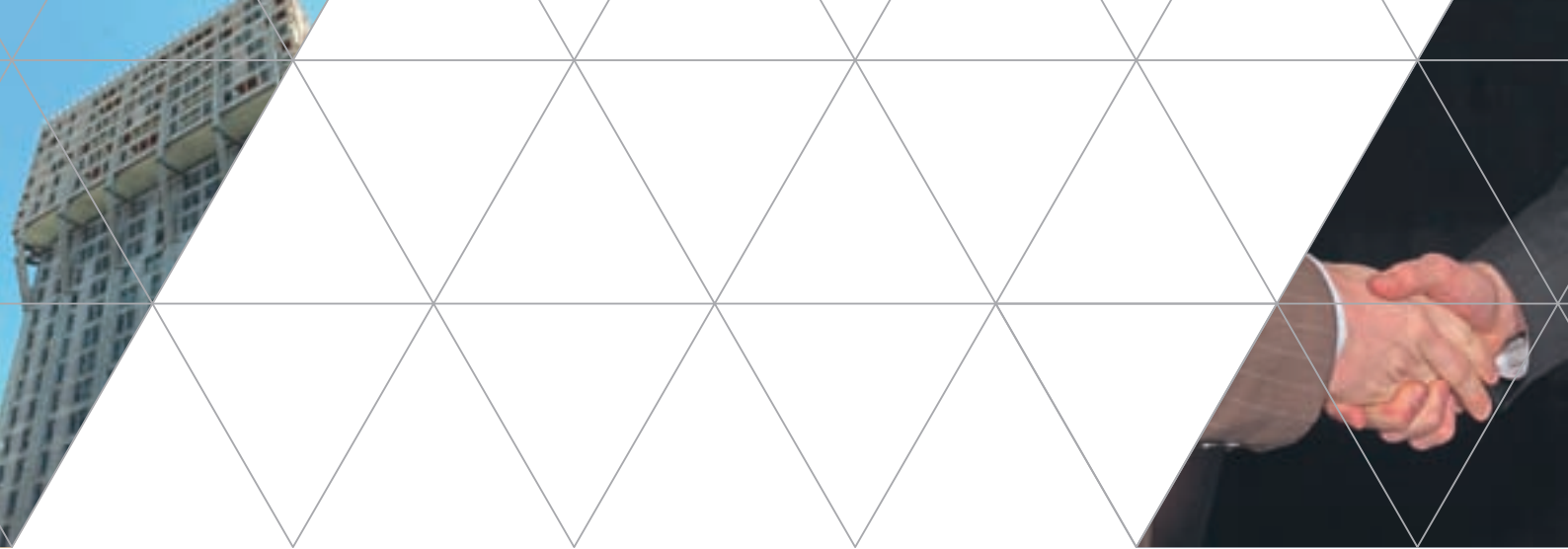
Practitioners in the construction field (surveyors, engineers, geologists, architects and other technicians) may find in Eucentre a privileged interlocutor for increasing their expertise in the seismic field. Every year Eucentre organizes a series of courses, consistently at the highest levels of updating both from the scientific point of view and from the regulatory one. Moreover, the journal “Progettazione Sismica”, published by Eucentre, offers to a wide audience of practitioners the opportunity to be updated on the latest knowledge in earthquake engineering and its application by academics, experts and technicians in the field of earthquake engineering.



Eucentre for Practitioners



- Offers refresher courses on seismic design
- Publishes journals and monographs on seismic design
- Performs on-site tests to support risk estimates
- Performs tests of characterization on materials and soils
- Optimizes and installs structural monitoring systems
- Develops simplified methods of design and assessment
- Offers assistance for bibliographic and normative research



Citizens

In the last decades health and environmental education has contributed to the significant improvement of life conditions as well as an increase in its duration. We do believe we should also aim at a seismic education: our homes, offices, schools, hospitals can be built or strengthened in order to better respond to a seismic event, in order to reduce, if not eliminate, the risk of damages and collapses. The Eucentre Foundation aims at increasing, on the one hand, citizens' awareness of the seismic hazard level of where they live and work; on the other hand, their knowledge of availability of methods and tools capable of improving the resilience of the buildings, in the belief that prevention is the only strategy to limit damage and loss.



Eucentre for Citizens



- Contributes to informing about risks and their reduction
- Host schools for lessons on seismic risk
- Performs scientific dissemination activities
- Offers technical and scientific expertise to the press
- Collaborates to the generation of a culture of prevention
- Participates in the post-emergency population management
- Supports those who can benefit from economic benefits related to risk

Stakeholders and Partners

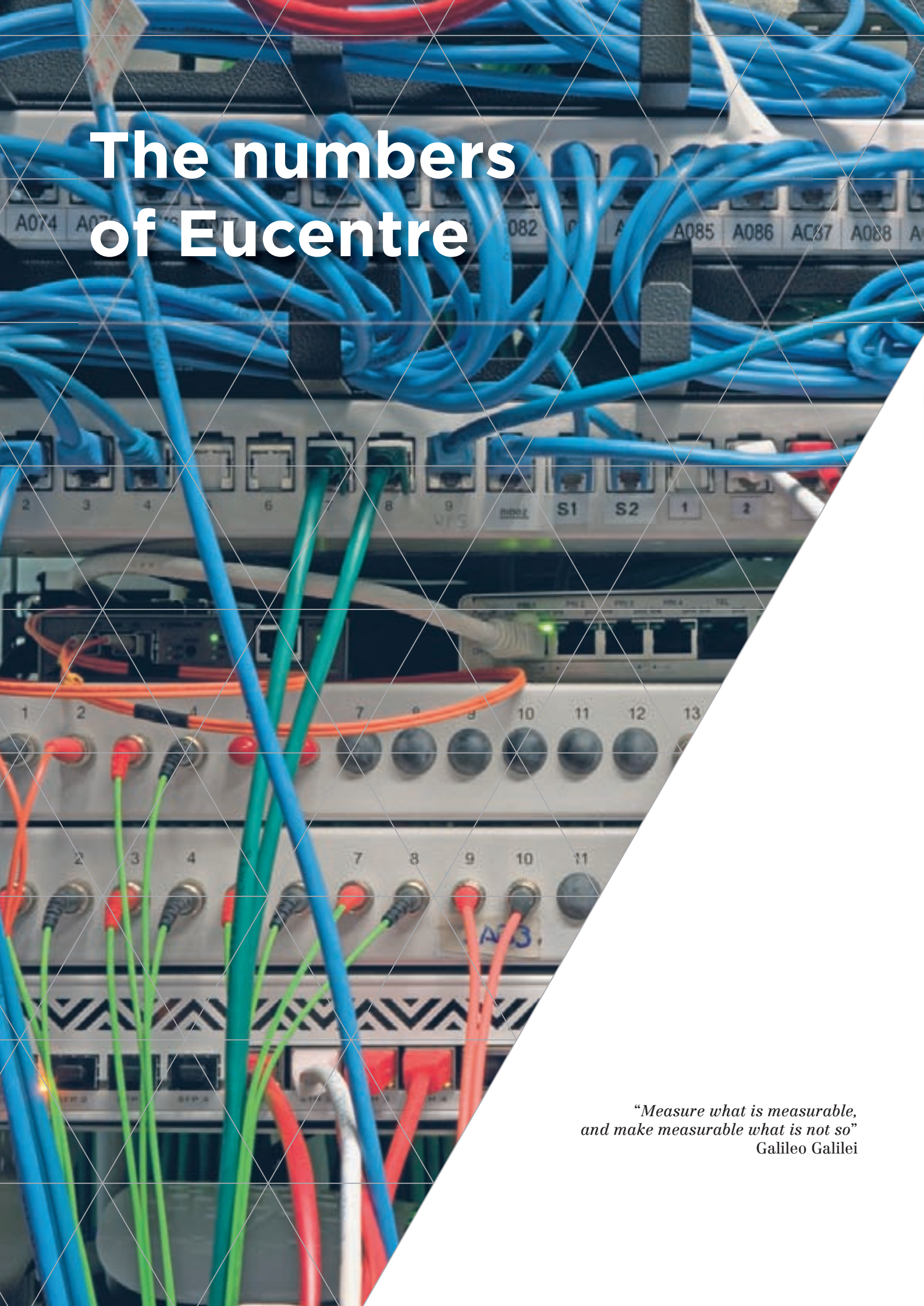
Eucentre needs allies: research, experimentation, training, information in the field of earthquake engineering must be nourished by ideas, incentives, critiques, requests that cannot come only from the inside, but they must be gathered from the outside world, from those who deal daily with reality and with the problems of people, companies and institutions. Thanks to its expertise and experience, Eucentre aims at being both the promoter and member of a competence network, influencing positively both the progress of earthquake engineering and the prevention culture, ultimately generating an improvement of living conditions of the population.



Eucentre for Stakeholders and Partners



- Develops projects in the field of safety engineering
- Cooperates in university training activities
- Supports continuing training activities
- Promotes the integration of complementary expertise and interests
- Provides databases for data usability
- Implements platforms for natural and man-made risk assessment
- Realizes "incident evolution tools" for emergency support



The numbers of Eucentre

*“Measure what is measurable,
and make measurable what is not so”*
Galileo Galilei

Dipartimento della
Protezione Civile



PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile



IUSS
Scuola Universitaria Superiore Pavia

Scuola Universitaria
Superiore IUSS di Pavia

Università
degli Studi di Pavia



INGV

Istituto Nazionale
di Geofisica
e Vulcanologia

SHAKELAB
EU CENTRE

DATALAB
EU CENTRE

MOBILAB
EU CENTRE

6DLAB
EU CENTRE

1

Auditorium

2

University
Colleges
in Pavia

4

Laboratories

50

Researchers

1

Installed capacity
of Mega Watt

110

Employees
and collaborators

6

Departments

7

M€ annual budget

30

PhD students

Activities
in last 5 years

200

National
research projects

260

Research projects for
public bodies and companies

131

MSc and
PhD courses

4.6

M€ Tests on
commission

50

International
research projects

12

Volumes
published

11

Issues of journal
Progettazione
Sismica

51

Courses for
practitioners

1

Multi-target
web portal





EUCENTRE

FOR YOUR SAFETY.

EUROPEAN CENTRE
FOR TRAINING AND
RESEARCH IN
EARTHQUAKE ENGINEERING

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