progettosofie

PROVINCIA AUTONOMA DI TRENTO

ITALIAN HIGH-TECH BUILDING IN JAPAN TO PASS THE LAST TEST
For the first time in history, a seven-storey wooden house will be exposed to a simulation of the earthquake that destroyed Kobe in 1995.

Press release

The appointment is for the 23rd of October 2007. The place is Miki, a small Japanese town about 10 kilometres away from Kobe, a city in the Kansai region and capital of the Hyogo prefecture which in 1995 was the setting of one of the largest earthquakes of the last 50 years, and certainly the worst natural disaster in Japan from the postwar period to nowadays. Apart from causing considerable damage to roads and buildings, the seismic event with a magnitude of 7.2 killed more than six thousand people and hit a region completely unprepared to affront such an enormous catastrophe. Therefore, in 1999, it was decided to construct the world's biggest shaking table (called "E-Defence", where "E" stands for Earth) able to reproduce even the most destructive earthquakes just in Miki. On this shaking table, a seven-storey house with a height of 24 metres is erected and will be exposed to the very same earthquake that devastated the region 12 years ago. The building – and this is the most surprising news – is constructed entirely with wood (more than 250 cubic metres of wood!): massive cross-laminated timber panels with a thickness from 5 to 30 centimetres according to the X-Lam system, a technique developed ten years ago in Germany, but further developed and brought to perfection in Italy. For the first time in history, a building entirely made of wood and with such dimensions will be exposed to the severe Japanese earthquake tests which set the benchmark for the international scientific community.

The test is the final result of 5 years of research and study which identified among various material and connection combinations the ideal anti-seismic construction technique. An unthinkable hypothesis until a couple of years ago where it was even a problem to have a wooden floor in seismic regions, thought to be a dangerous construction element by structural engineers themselves. As a consequence, any research activity, at least in Italy, was stopped. IVALSA resumed it at exactly that point, beginning to discard prejudices and taboo.

This test is the gemstone of the SOFIE project (Sistema Costruttivo Fiemme) which was born as a collaboration between the institute IVALSA of the National

Research Council and the Autonomous Province of Trento and whose aim is to finally demonstrate the absolute reliability and safety, besides other values such as comfort, sustainability and saving of energy, of wood as a construction material: a valid and cost-effective alternative to traditional building methods. In fact, this test does not only follow a similar test also carried out on a three-storey building in Japan in July 2006, but also follows a large fire test during which the three-storey house succeeded in maintaining its mechanical properties and structural integrity even after more than one hour of blast.

The test during October is unique in his kind. An exclusively Italian research project succeeds in being first to accomplish such a project against analogous efforts in Japan and the United States (next year, US-Americans will test a six-storey wooden house on a shaking table). Both the USA and Japan possess not only regions with a very high seismic risk – more than ours – but are also countries where wood is traditionally used for housing, such that wooden residential houses have respectively 50 to 80 percent of the housing market share.

Apart from acquiring additional and important scientific data, the researchers of the institute do hope that the success of the test may help to definitively dispel a series of doubts of a cultural nature which associate wood in constructions simply to a mountain chalet or to accessories, dedicated only to furniture in a rustic style and not very fashionable. Above all, researchers seek to dispel the misheld conception that wood is a material which is not able to guarantee an adequate level of security (earthquake, fire, degradation). Nothing could be more wrong: compared to concrete and other common materials, wood in fact represents characteristics that make it particularly suited for use in the building industry. The costs? Are not higher, but benefit and return are better.

A lot of attention is attracted to the event in which more than a thousand people will participate: politicians, ambassadors, researchers from all over the world, architects, engineers, contractors, but primarily ordinary people that have experienced the tragedy of 1995. All optimistically watching to see with their own eyes the perfect equilibrium between technological innovation and environmental sustainability, a scientific statement from Italy – a success labelled Trentino.

progettosofie

The seismic test is part of the Italian-Japanese event "Italian Spring 2007" and is under the patronage of the president of the Autonomous Province of Trento and supported by the Italian embassy in Japan.

Info
Maria Giovanna Franch
CNR-IVALSA
T. + 39 0461 660220
franch@ivalsa.cnr.it
www.progettosofie.it

Photo gallery at progettosofie.it - «press releases»
Film material available upon request

IVALSA

progettosofie

THE SOFIE PROJECT

THE TECHNOLOGY

The seismic test in Miki is the gemstone of a comprehensive research project about sustainable constructions, called SOFIE (Sistema Costruttivo Fiemme). An extensive investigation that aims at defining the performance and capabilities of the construction system X-Lam (Cross-Laminated Timber), massive cross-laminated wooden panels with a thickness from 5 and 30 centimetres fabricated according to a technique born in Germany around ten years ago, but brought to perfection in Italy in the last couple of years thanks to the collaboration between the Trees and Timber Institute of the National Research Council and the Autonomous Province of Trento.

The panels, entirely fabricated of wood from the certified forests in the Trentino region, are cut to size, including openings for doors, windows and staircases according to the architectural design. They are then assembled and fastened with steel angles, ringed shank nails and self-drilling screws.

The wooden walls are covered with non-combustible insulation material and finally the building can assume any outer appearance that may be wished, just like brick houses. We should well remember that this system has nothing to do with American prefabricated houses – ordered from catalogues to get the idea – but that these are real houses, even apartment buildings adapted to the standards of European cities, solid and guaranteeing maximum thermal and acoustic insulation.

The aspects examined in the research are manifold: acoustics, energy saving, life cycle of materials, durability under severe thermo-hygrometric conditions,

biocompatible architecture with a considerable part dedicated to the study of seismic behaviour and fire performance.

THE EXPERIMENTS

The fire

The aspect of fire resistance is one of the most sensitive aspects affiliated with wooden buildings and represents one of the major problems which hamper its use in the building sector. For the public, the assumption that wood burns easily and is thus less safe than other building materials is one of the first issues they face when deciding whether or not to buy a wooden house.

The fire test on a three-storey SOFIE building carried out in March at the Building Research Institute in Tsukuba in Japan has shown that this building type can survive a blast of one hour maintaining its mechanical properties and structural integrity, thus never endangering its inhabitants and showing capacities absolutely comparable to those of concrete or brick buildings. For the test, one room was filled with mattresses and furniture which was then lighted with petrol. The flames spread within the room until reaching the ceiling, but the other rooms remained untouched and the load-bearing structures of the building were only marginally touched. A result expected by the researchers and adepts of the sector who know perfectly well that a building with a load-bearing system made of wood, designed and realised according to the state-of-the-art, has no higher fire risk than other buildings.

progettosofie

The earthquakes

Wooden structures possess some inherent characteristics that make them particularly suited for the use in regions with a high seismic risk, both due to material properties (lightness and load bearing capacity) and to system properties (ductility and capacity of energy dissipation).

The IVALSA together with the Autonomous Province of Trento, in cooperation with the National Research Institute for Earth Science and Disaster Prevention (NIED), Shizuoka University, Building Research Institute (BRI) and Centre for Better Living in Japan, are undertaking a joint research programme on the earthquake behaviour of multi-storey wooden buildings made with the X-Lam system. First step of the programme was a series of seismic tests carried out in the laboratories of the NIED in Tsukuba in July 2006. A three-storey SOFIE building has survived practically undamaged a series of 15 large earthquakes, hereunder the great Hanshin-Awaji earthquake in Kobe from 1995 at its maximum intensity showing only minimal damage which was repairable with only a few easy interventions.

The next challenge is on the 23rd of October 2007. Within the "Italian Spring 2007"-programme organised by the Italian embassy in Japan, another SOFIE building with this time seven storeys will be tested – premiere for a wooden building of these dimensions – on the seismic testing facility E-Defence in Miki, the biggest shaking table in the world. All this to finally demonstrate the absolute reliability of this construction system.

IVALSA

progettosofie

MIKI October 23, 2007 – TECHNICAL INFORMATION

The test specimen is a seven-storey house of about 15m x 7.7m floor plan area and 24m total height with a one-pitch roof.

The building walls are made of X-Lam panels with a thickness of 142mm at the first two floors, 125mm on floor 3 and 4 and 85mm at the last three floors where they are less loaded. Several inner walls with the same thicknesses as the outer walls serve as further load carrying walls or as simple partition walls. The walls are connected among themselves with self-drilling screws.

The floors are also made with X-Lam panels with a thickness of 142 mm connected to the walls by means of steel brackets and screws.

The total volume of wood required for the panels will be approximately 250m^3.

Additional masses are added to each floor to account for the weight of finishings - which is considerably high due above all to the heavy floor construction with an additional layer of sand for acoustic insulation - and for the 30% live load, as prescribed by European and Italian codes for the seismic load combination.

The testing programme provides for the consecutive application of two accelerograms:

- Niigata-Chuetsu-Oki earthquake from July 2007: magnitude 6.8 on the Richter scale, PGA (Peak Ground Acceleration) 1.0g - 100%intensity.
- Great Hanshin-Awaji earthquake from 1995 (known also as Kobe earthquake): magnitude 7.2 on the Richter scale, PGA 0.82g - 100%intensity.

IVALSA

All three space components of the earthquakes are given simultaneously.

The shaking table of Miki is the biggest in the world. E-Defence (3-D Full Scale Earthquake Testing Facility):
http://www.bosai.go.jp/hyogo/ehyogo/index.html

THE CNR-IVALSA

The Trees and Timber Institute (IVALSA) of the National Research Council (CNR) is the biggest Italian institute for research in the wood-forest sector (www.ivalsa.cnr.it). It was created in 2002 by the merging of three institutes of the CNR: the Institute for the Propagation of Tree Species (IPSL), the Institute of Wood Research (IRL) and the Institute of Wood Technology (ITL).

IVALSA operates in the area of wood technology and realises special research programmes directed on the one hand towards improving the knowledge of the material wood and on the other hand towards giving an answer and scientific support to a sector of great economic and social relevance, providing laboratories, scientific instruments and highly qualified personnel.

The institute has a long experience in collaborating with European and non-European wood research institutes and has participated in many national and European research projects. The research staff is officiating as Italian representatives in standardising, consulting and academic committees and works as scientific consultants for the European commission. Innovative and advanced technologies are aimed at the scientific research and at the support of SMEs.

The actual director of the IVALSA is Prof. Ario Ceccotti. The staff comprises 70 persons, divided between the two branches in Trento and Florence.

Info
Maria Giovanna Franch
CNR-IVALSA
T. + 39 0461 660220
franch@ivalsa.cnr.it
www.progettosofie.it