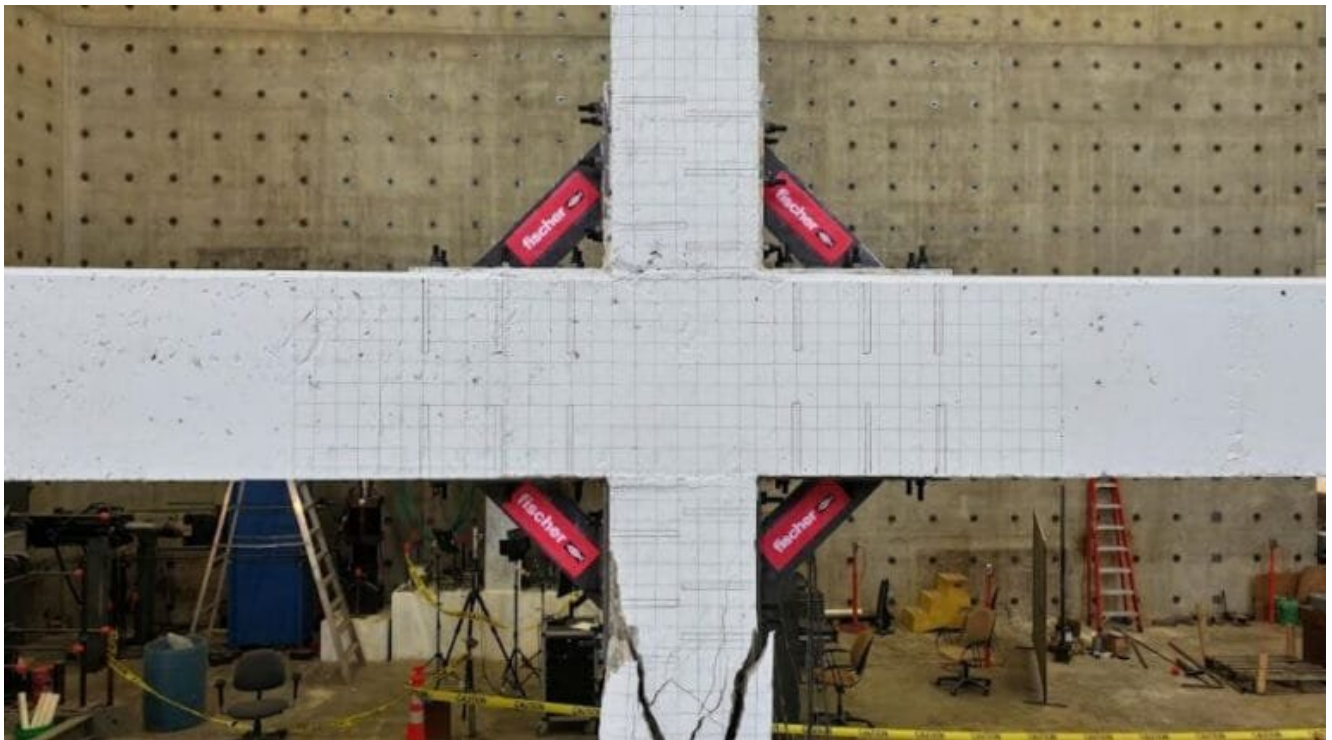


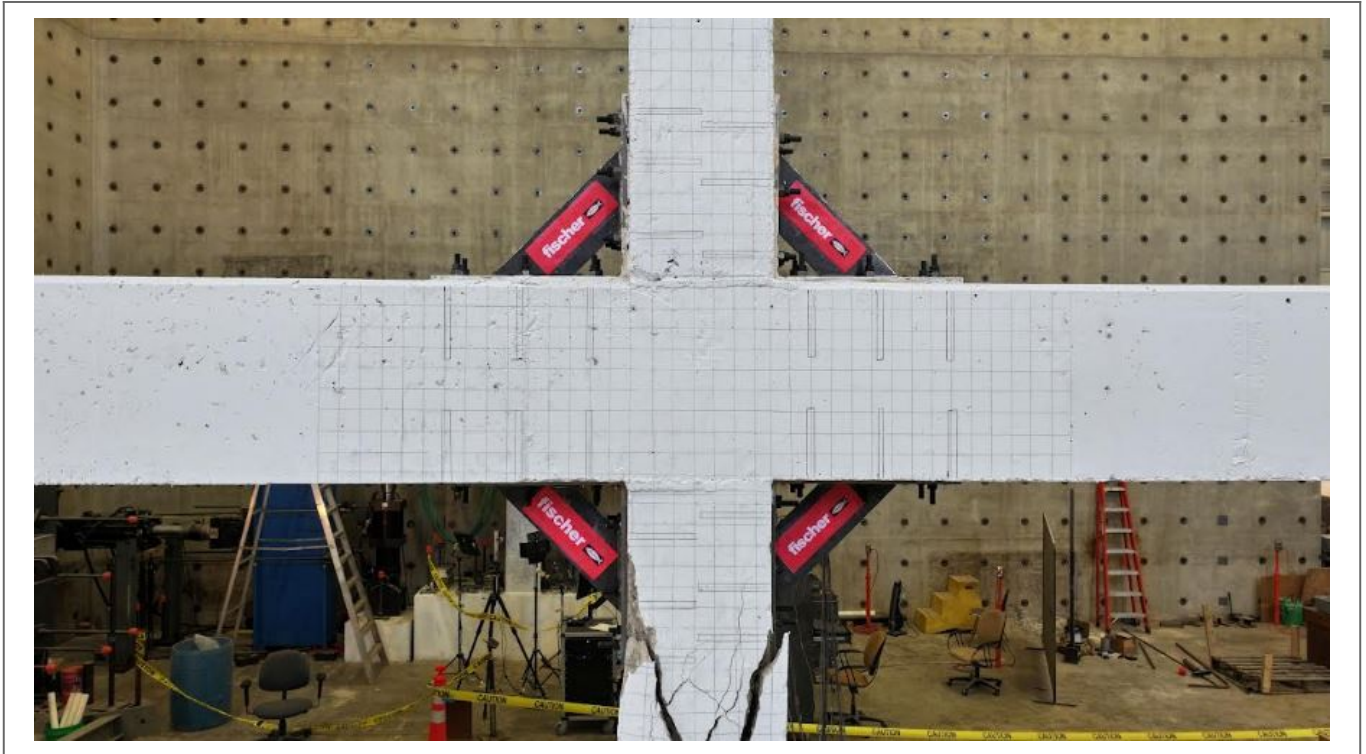
fischer Earthquake-Proof Retrofitting Solutions Tested to Offer Stability Under Seismic Influence

Category: Business

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Earthquakes are among the greatest global challenges for the safety of structures. Existing buildings constructed before the introduction of modern earthquake standards are particularly vulnerable, as they are often unable to withstand seismic loads. This raises an urgent question: how can such buildings be retrofitted to improve their earthquake resistance? Unternehmensgruppe fischer and Purdue University (USA) carried out full-scale tests on reinforced concrete structures. These tests enabled the definition of new approaches for the seismic retrofitting of existing buildings.



fischer earthquake-proof retrofitting test

The earth is a dynamic planet; it rotates, orbits the sun and is always in a tumultuous state under the surface. Approximately 500,000 earthquakes are registered across the globe every year (source: US Geological Survey (USGS)). Regions in the Pacific Ring of Fire, the Himalayas, the Mediterranean, Central America and the Caribbean are particularly at risk due to regular tectonic movement. However, human activity, such as the extraction of oil and gas, fracking, geothermal drilling and the construction of large reservoirs, can also trigger seismic activity. When building structures in regions prone to earthquakes, structural designers and engineers must not only ensure the building's load-bearing capacity, but also guarantee that non-load-bearing components don't fail or fall down, such as pipes, cables, suspended ceilings, cable runs, air conditioning units or facades. However, many of those who live in seismic areas live in existing buildings that were built before modern earthquake standards were introduced. These buildings are often unable to withstand seismic activity.

Full-scale earthquake tests

The fixing specialist fischer and one of its partner universities, Purdue University, therefore carried out a large-scale research project. An innovative solution for retrofitted seismic structural reinforcement was verified through extensive tests on full scale reinforced concrete structures. The behaviour of beam column joints was of particular interest to the researchers. "These node points in supporting structures are subjected to particularly high stresses and significant force caused by horizontal loading during an earthquake", explains Dr Margaritis Tonidis, a former PhD Candidate at Purdue University and leading Project Engineer of the project. These joints represent critical points of the supporting structure. If they fail, the entire system can collapse.

New reinforcement solution for beam-column joints

A system consisting of bonded anchors and haunch elements was successfully tested for the retrofitting of beam-column joints, using fischer injection mortar in combination with threaded rods. The bonded anchor system barely deforms under loading and can reliably absorb and transfer forces, ensuring that the haunch retrofit solution can efficiently protect the joints under seismic stress. This results in a safe and controlled load-bearing behaviour, even in the event of an earthquake. The reinforcement solution modifies the force flow between the beam and column. Loads acting on the joint area are redistributed into adjacent structural elements. Defined failure mechanisms prevent the system from collapsing entirely.

*"The injection mortar proved to be a highly reliable adhesive anchor for post-installed strengthening even under very high seismic demands and led to achieving ground breaking results during the tests", emphasises **Prof Akanshu Sharma**, Associate Professor at Purdue University and former Endowed Professor at the Institute of Materials Science at the University of Stuttgart. "We were able to demonstrate a significantly improved performance of the strengthened structure under seismic loading". During the comparative test, the structural system without strengthening demonstrated major damages in beam-column joints, while the structure strengthened with the fischer system displayed superior performance. "The fischer bonded anchor system can also be installed while the building is in use, without causing any major interruption," Prof Sharma adds.*

*"The project was a fantastic and unique opportunity to review and test the results and concepts we gained in our previous research under realistic conditions," emphasises **Dr Erik Johannes Stehle**, Head of Development FiXperience at fischer. "This once again demonstrated that the success of a seismic reinforcement solution such as this highly depends on the performance of the anchorage. This is where our bonded anchor system was able to achieve impressive results at both the structural level and within the beam-column joints, demonstrating high rigidity and low deformation at high-load levels."*

International research partnerships drive innovation

Dr Erik Stehle emphasises, *"We need international research collaboration. By communicating with each other, we gain inspiration, ideas and impetus for new innovations while strengthening our position as a global innovator."* Prof Sharma

meanwhile highlights the importance of international cooperation between the scientific community and businesses, *"At Purdue University, we're proud to have already conducted several groundbreaking research projects with the fischer Group of Companies, including the world's first seismic test using full-scale structures with a post-installed reinforcement solution for joints with haunch elements."* This successful scientific validation is now being translated into practical application for existing buildings. The results offer hope: they show that realistic and affordable ways exist to make older buildings more resilient – and thereby save lives and protect infrastructure in the event of an earthquake.

Commenting on the significance of this innovation for India, **Mayank Kalra, Managing Director, fischer India**, said, *"India is among the fastest-growing infrastructure markets in the world and has several regions that are vulnerable to seismic activity. While modern construction follows advanced earthquake-resistant design standards, strengthening existing buildings remains equally important. This validated seismic retrofitting solution demonstrates how innovative fixing technologies can enhance structural safety, extend the life of existing infrastructure and contribute to more resilient cities."*

At fischer India, we are committed to bringing globally proven engineering solutions to the Indian market and supporting safer, more sustainable infrastructure development."

