CASE STUDY - CIVIL ENGINEERING

Engineering Integrity

Structural Health Monitoring at the Pontifical Javeriana University

Figure 1: School of Engineering, Pontifical Javeriana University

Background

In 2020, following years of careful planning, the Pontifical Javeriana University opened the doors of its School of Engineering Laboratory. The facility boasts 15 floors, making it the tallest building of the 400-year-old educational establishment.

The School of Engineering is strategically fitted with an array of force-feedback digital accelerometers. This allows for the response of the building to mechanical forces to be monitored, ensuring its integrity. This is ever more important given the building's unique design: at the base of the building is a structurally isolated civil engineering lab. Here, students will learn at a variety of scales how mechanical stresses, such as those experienced during an earthquake, can influence a structure's integrity: by simulating it!

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The civil engineering lab (figure 2) is host to an array of mechanical test and seismic simulation devices which are used to investigate the effectiveness of full and model scale construction practices. Effective monitoring is required in order to ensure the safety of the entire structure under the mechanical forces of these investigations.

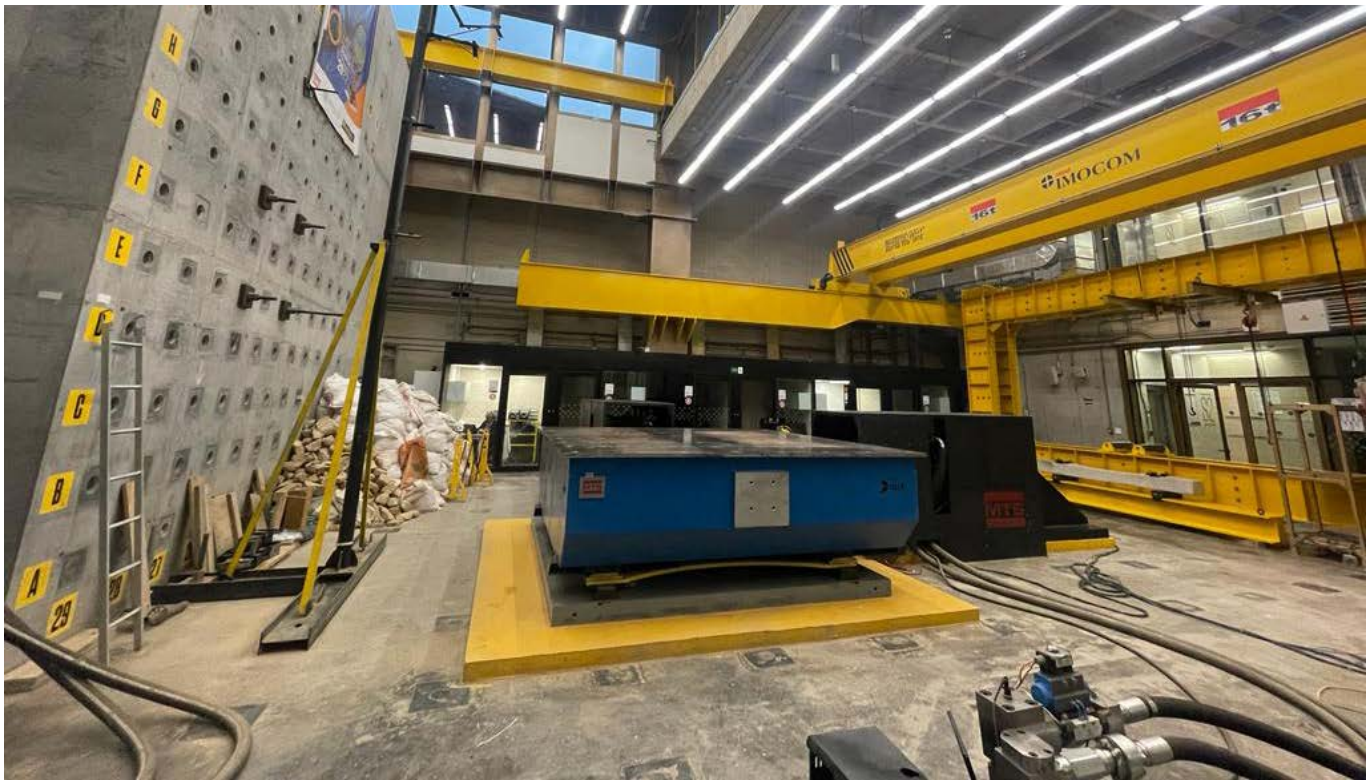

Figure 2: Civil engineering laboratory under construction

The strategic placement and coupling of accelerometers mean that the structural decoupling of the lower civil engineering laboratory can be constantly evaluated. In the case of a triggered event, the laboratory will be notified, and mitigation strategies can be implemented. Alternatively, in the case of a seismically triggered event, similar notifications from the array of monitors will allow for early warning of potential risks.

From this, students gain invaluable lessons in civil engineering and the risk that ground shaking has to structural integrity, but most importantly how they can mitigate these hazards through good practice. Not only does the network of accelerometers protect the building, it will also provide data from which investigations into urban seismicity may be conducted in the near future.

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Güralp Solution

Fortimus all-in-one digital force balance accelerometers (figure 3) were selected for this application due to their compact form factor and functional versatility.

Its range of networking features, including low-latency digitization, are well suited to structural health monitoring applications where minimal cable connections allow for ease of deployment, and low latency digitization yields fast response times (as low as 40 ms when used with GDI protocol).

Multi-instrument voting mitigates false positives and allows the lab to frequently evaluate the structural health if a real issue was to arise. On-board state of health monitoring and a great reliability record results in a monitoring package that can operate long-term with minimal maintenance.

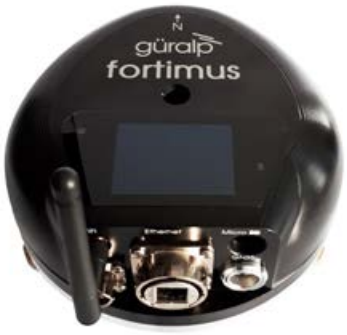

Figure 3: Fortimus digital accelerometer

Deployment

Dirimpex S.A.S. managed the construction project alongside the installation of other geotechnical and mechanical simulation instrumentation. They consulted closely with the university to maximise the monitoring potential.

Fortimus units are deployed in metal casings secured to the ceiling (figure 4), providing unique response information. During installation, units were embedded into the structure itself, which meant that time constraints were critical in this project. Furthermore, deployment was critical in that accessing the instruments post-deployment would become difficult.

Güralp's production was on time, allowing for the wider project to progress smoothly, leading to the completion of the building in early 2020.

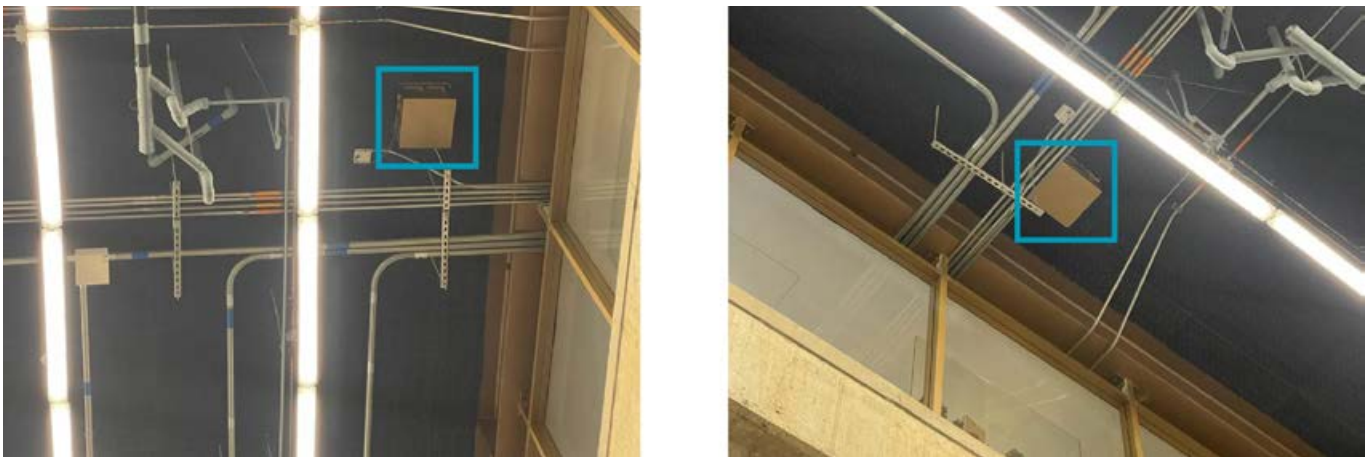

Figure 4: Installation of Fortimus instruments during construction, encased in metal boxes and eventually hidden in the structure by later fitted roof panels.

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Outcome

Since 2020, the Research and Laboratories Building for the faculty of Engineering at the Pontifical Javeriana University has provided a unique opportunity for thousands of students. The deployment and successful installation of 15 Fortimus digital accelerometers means that the building may continue to inspire students for the years to come, and ensure that the university's goals for the project are met.

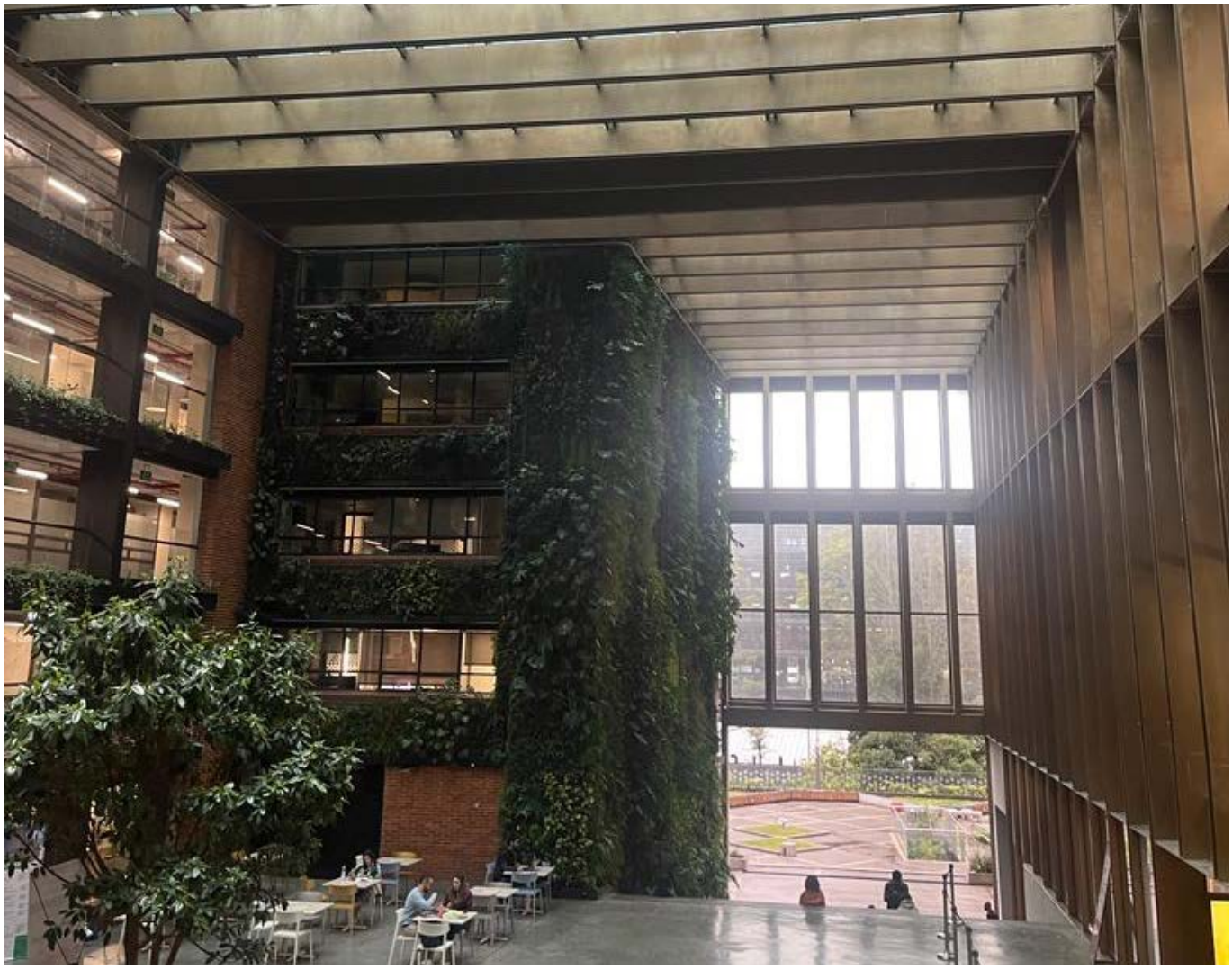

Figure 5: Finished civil engineering laboratory

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