STRUCTURAL HEALTH MONITORING

Case Study: Real-Time Seismic Monitoring Validates Structural Integrity at IKEA Oceania Store

In September 2022, a 7.7-magnitude earthquake struck near Coalcomán, Michoacán, triggering tremors across Mexico City. The event served as a crucial real-world test for StructureIQ's structural health monitoring (SHM) system, which was installed at the IKEA Oceania store. Within hours of the quake, building managers received automated alerts and detailed structural analyses, enabling them to make immediate, data-driven decisions about building safety and operations.

The Problem

Building owners and operators face a persistent challenge when seismic events occur, determining whether their structures have sustained damage without costly, time-consuming manual inspections.

- **Delayed Response**: Manual inspections take days or weeks
- **Subjectivity**: Visual inspections depend on the inspector's experience and may miss internal damage
- **Insurance Uncertainty**: Without objective data, building owners face uncertainty in claims and potential liability for undetected damage

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For IKEA's Oceania store, any prolonged closure would lead to significant revenue loss.

The Solution

StructureIQ deployed a comprehensive wireless structural health monitoring system at the IKEA Oceania store, creating a continuous digital twin of the building's structural behavior. The system provided:

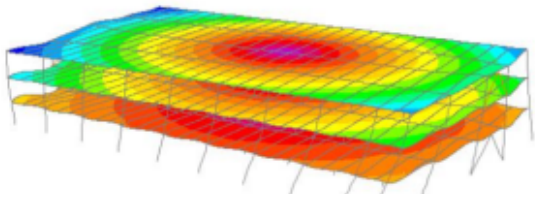
- **Automated Alerts**: Within minutes of the seismic event, the system distributed alerts to building managers, insurance partners, and engineering consultants.
- **Real-Time Analysis**: The system immediately compared structural response patterns against baseline data, completing analysis within hours instead of days or weeks.
- **Clear Recommendations**: The platform delivered actionable conclusions, "No meaningful changes" and "No structural damage estimated", enabling immediate, confident decision-making.

The post-earthquake report confirmed that the peak ground motion at the site measured 6.41 cm/s^2, well below the 10 cm/s^2 threshold that requires a detailed damage assessment. The system concluded that no structural damage had occurred and no action was needed, allowing IKEA to resume normal operations without interruption.

Technology: IoT Sensor Network Architecture and Data Analysis

High-precision accelerometers installed in the building measure ambient vibration in three directions: vertical, longitudinal, and transversal. These sensors continuously capture vibration data from various sources, including road traffic, wind, and earthquakes. The platform's core innovation lies in its ability to extract meaningful insights from raw acceleration data through system identification processes:

- **Frequency Analysis**: Computes energy content at each frequency and identifies natural frequencies where the building amplifies ground motion
- **Transfer Function Calculation**: Determines how ground vibration energy transfers to higher floors, revealing dynamic response characteristics



Simulation: 1 Digital twin output of the simulated dynamic structural model of the building

In the IKEA Oceania case, the system identified natural frequencies of 2.191 Hz (longitudinal) and 2.280 Hz (transversal) before the earthquake, with minimal changes afterward (1% and 0% respectively), confirming no structural damage.

Market Opportunity

StructureIQ's technology addresses growing demands across multiple stakeholder groups in the commercial real estate and insurance sectors:

For Building Owners and Insurers

- **Business Continuity**: Rapid structural assessment minimizes operational downtime and enables confident decision-making about building occupancy immediately following seismic events.
- **Asset Value Protection**: A documented structural health history enhances property value and marketability, providing objective evidence for buyers, lenders, and insurers.
- **Claims Validation**: Sensor data eliminates insurance disputes, streamlining the claims process.
- **Risk Assessment**: Actual structural data enables accurate underwriting and insurance premium pricing
- **Loss Prevention**: Early detection enables preventive interventions before catastrophic failures occur.

Conclusion

By providing automated alerts, rigorous technical analysis, and clear recommendations within hours of the seismic event, the platform enabled confident decision-making without costly delays or subjective uncertainty. The case demonstrates that modern structural health monitoring has evolved beyond simple data collection to become a critical business continuity tool. Key outcomes from the deployment included:

- **Zero operational downtime**: IKEA continued normal business operations without precautionary closures
- **Rapid stakeholder communication**: Automated distribution of comprehensive structural assessment to all relevant parties
- **Documented structural integrity and regulatory compliance assurance**: Objective evidence of building performance for insurance and liability purposes

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