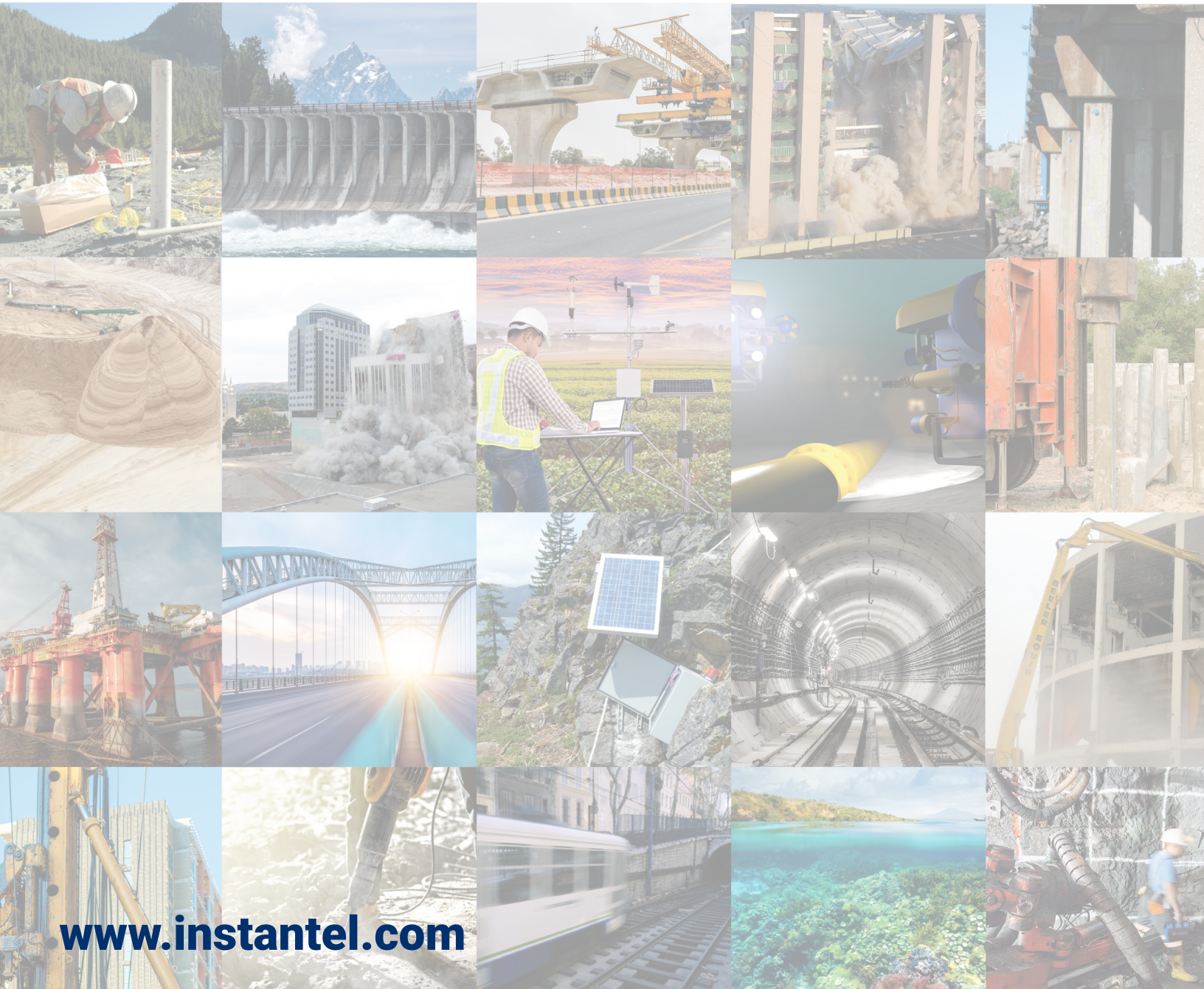


CASE STUDIES

Vibration · Noise · Air Overpressure · Remote Monitoring
Cloud-Based Data Management · Software Solutions



Case Study: Assessing Surface Vehicle Traffic Vibrations in Lima, Peru

BACKGROUND

As part of the underground metro construction project in Lima, Peru (Stations E-26 and E-27, Line 2), Geoteknik conducted a vibration monitoring study with InstanTel equipment to assess how vibrations from surface vehicle traffic impact the underlying infrastructure at the Javier Prado Extension (Station E-26) and at the intersection of Nicolás Ayllón and Perú avenues (Station E-27). Both stations lie directly beneath major high-traffic junctions, the study was designed to capture representative dynamic load conditions and verify whether their impact remained within the limits set by the international standard DIN 4150-3.



Subway Map, including Line 2 indicated in yellow.
Courtesy: AATE (Autoridad Autónoma del Sistema Eléctrico de Transporte Masivo) de Lima y Callao

Location 1 - Station E-26



Micromate Unit Monitoring Vibrations

BACKGROUND

As part of the construction progress at Station E-26 on the underground section of Line 2 of the Lima Metro, the project called for assessing vibrations induced by surface vehicle traffic in critical areas of the structure. In response to this requirement, a specialized technical study to record and analyze vibration levels was carried out by Geoteknik using the DIN 4150-3 standard as a reference. The station is located at the intersection of high-traffic avenues and represents a complex dynamic environment—ideal for monitoring structural response to external loads.

CHALLENGE

- Determine the peak particle velocity (PPV) levels generated by surface traffic.
- Evaluate the impact of vibrations on the underground structure, especially in the station's concourse.
- Verify regulatory compliance based on Category III (sensitive structures) of the DIN 4150-3 standard.

CASE STUDY OVERVIEW

Applications:

- Construction
- Civil Projects
- Heavy Transportation
- Structural

Location:

Lima, Peru

The Challenge:

Authenticate and understand vibrations induced by surface vehicle traffic.

The Solution:

Instatel Micromate and Minimate Pro6 monitoring units.

Monitoring Timeline:

Two representative time periods, March and April 2025.

Companies Involved:

- Geoteknik
- Instatel (Equipment)

Key Benefits:

- Verified compliance
- Evaluated the impact of vibrations on the underground structure.

APPROACH

Utilizing a combination of Micromate and Minimate Pro units and DIN triaxial geophones, monitoring campaigns were carried out during two representative time periods (12:35–15:45 and 17:30–20:40). Sensors were installed on the street surface and inside the structure. Each unit was configured to capture data along three axes (vertical, longitudinal, and transverse) and pointed in the same direction of the traffic flow on Avenida Prolongación Javier Prado.

The Minimate Pro4 offers a robust design and advanced analysis when utilizing THOR Advanced software. With the Minimate Pro4 and THOR Advanced, the structural

response can be calculated based on a comparison of two waveforms recorded simultaneously inside and outside a structure.

The Micromate monitoring unit can store up to 1,000 events, and when utilizing Vision II software, data is automatically uploaded and ready for analysis.

Both triaxial geophones are calibrated to the international DIN standard with a frequency range of 1 to 315 Hz or 1 to 80 Hz for the Minimate Pro unit and 1 to 315 Hz for the Micromate unit.



Minimate Pro4 with DIN Triaxial Geophone



Micromate with DIN Triaxial Geophone

RESULTS

The vibration monitoring campaign demonstrated that the dynamic loads induced by surface traffic remain well within internationally accepted thresholds for sensitive structures. Across both monitoring periods, none of the recorded peak particle velocity (PPV) values—measured in vertical, longitudinal, and transverse components, as well as vector sum—exceeded the DIN 4150-3 Category III limit of 3 mm/s. The data further indicated a consistent trend of reduced vibration amplitudes during the 17:30 to 20:40 time window, correlating with diminished traffic intensity. Vector sum calculations and dominant frequency analysis confirmed that vibration characteristics remained outside the resonance range of the station's structural elements, mitigating the risk of fatigue or long-term degradation. Measurements taken both at surface level and within the concourse validated the structural integrity and operational safety of the station under current traffic conditions, affirming compliance with the most stringent applicable regulatory criteria.

CONCLUSION

- All records remained within the critical threshold of 3 mm/s established by DIN 4150-3 (Category III).
- A slight decrease in vibration levels was observed during the second monitoring period (late afternoon–evening).
- All measured values—vertical, longitudinal, transverse, and vector sum components—remained below the strictest regulatory limit.
- The evaluated structure showed no signs of risk from vibration fatigue under current conditions.

Case Study Partner



Location 2 - Station E-27



Setting up the Minimate Pro4

BACKGROUND

As part of the underground metro construction project in Lima, Peru (Station E-27, Line 2), Geoteknik conducted a vibration monitoring study with InstanTEL equipment to assess how vibrations from surface vehicle traffic impact the underlying infrastructure at the intersection of Nicolás Ayllón and Perú avenues. Because the station lies directly beneath a major high-traffic junction, the study was designed to capture representative dynamic load conditions and verify whether their impact remained within the limits set by the international standard DIN 4150-3.

CHALLENGE

- Determine the peak particle velocity (PPV) levels generated by surface traffic during peak hours.
- Evaluate the impact of vibrations on the underground structure, especially in the station's concourse.
- Verify regulatory compliance based on Category III (sensitive structures) of the DIN 4150-3 standard.

CASE STUDY OVERVIEW

Applications:

- Construction
- Civil Projects
- Heavy Transportation
- Structural

Location:

Lima, Peru

The Challenge:

Authenticate and understand vibrations induced by surface vehicle traffic.

The Solution:

InstanTEL Micromate and Minimate Pro6 monitoring units.

Monitoring Timeline:

Two representative time periods, March and April 2025.

Companies Involved:

- Geoteknik
- InstanTEL (Equipment)

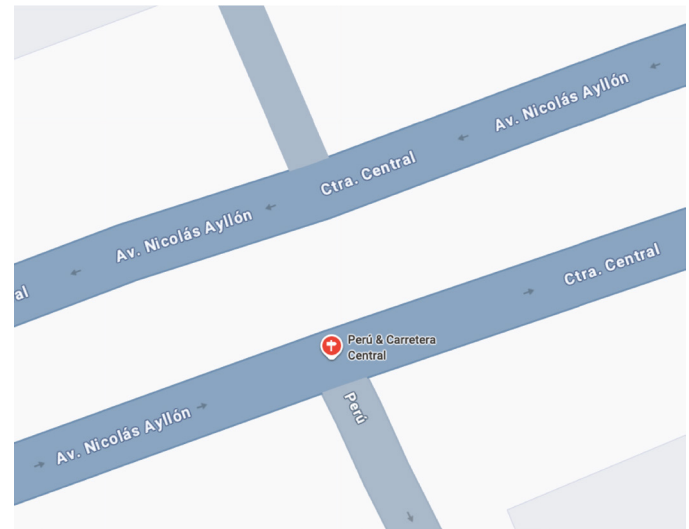
Key Benefits:

- Verified compliance
- Evaluated the impact of vibrations on the underground structure.

APPROACH

Utilizing a combination of both Micromate and Minimate Pro units with DIN triaxial geophones, continuous measurements were taken during two time slots (12:45–16:16 and 18:15–21:30), using sensors strategically placed on the surface and in the concourse. The equipment was configured to capture three-dimensional data aligned with the traffic flow on Nicolás Ayllón Avenue. Measurements included the vertical, longitudinal, and transverse axes, as well as calculations of the vector sum and dominant frequencies.

Both triaxial geophones were calibrated to the international DIN standard.



Monitoring Location - Study Point 2

RESULTS

The vibration monitoring carried out at Station E-27 of Lima Metro's Line 2 confirmed that the dynamic excitation from surface traffic remains well within the permissible limits for sensitive structures as defined by DIN 4150-3 (Category III). During both observation windows (12:45–16:16 and 18:15–21:30), peak particle velocity (PPV) measurements across the vertical, longitudinal, and transverse axes, as well as the calculated vector sum, consistently stayed below the 3 mm/s threshold. Slight reductions in PPV values during the second monitoring slot were consistent with decreased vehicular activity. Analysis of vector sum and dominant frequency data indicated that the measured vibrations were outside the natural frequency range of the station's structural components, thereby reducing the potential for resonance-induced stress or cumulative fatigue. Data collected from both surface and concourse sensor locations validated the station's structural resilience and operational safety under existing traffic conditions.

CONCLUSION

- All records remained within the critical threshold of 3 mm/s defined by DIN 4150-3 (Category III).
- Slight variations in vibration levels were observed between the two monitoring periods, with lower values recorded during the second slot.
- Measurements taken both at the surface and in the concourse confirmed safe operating conditions against external dynamic loads.
- The validated data supports the station's vibrational stability under the current traffic scenario, without risk to sensitive structures.

Case Study Partner



CASE STUDY PARTNER



GEOTEKNIK
Calle Trinidad Morán 715
Lince 15073
San Martín
Peru
<https://geoteknik.com.pe/>

CLIENT

Oficina Técnica de Estudios y Control de Obras S.A. (OFITECO)
Lima, Peru

M7132 Geoteknik SAC Success Story Rev 01
© 2026 Xmark Corporation. All Rights Reserved. Design, features, and specifications are subject to change without notice.
INSTANTEL, INSTANTEL LOGO, MICROMATE, and MINIMATE PRO4 are trademarks of Xmark Corporation, or an affiliate thereof.