



## Geotechnical Applications Of Tiltmeters



- **Objectives:** Actionable and essential geotechnical data
- **Solution:** Jewell Instruments Tiltmeters
- **Benefits:** High-precision and exceptional repeatability
- **Results:** Reliable and precise measurements

### Case Study

#### Alameda Corridor, Los Angeles, California

The Alameda Corridor streamlines the freight rail connection from the ports of Los Angeles and Long Beach to an interstate rail hub near downtown Los Angeles. The 10-mile long midsection of the corridor consists of a 37-foot deep, 51-foot wide open trench, which accommodates two rail tracks and a service road. In order to safeguard against unforeseen

soil conditions, the wall's kick-out stability was monitored in real time using [Jewell Instruments' Little Dipper](#) in-place inclinometers. The system measured pile tip displacements every minute and compared the readings with programmed alarm thresholds. A contingency plan provided for installing intermittent struts within 24 hours of reaching 0.2 inches of "kick-out" displacement.

The Little Dipper is an in-place inclinometer system for monitoring slopes, embankments, deep excavations, tunnels, tank foundations, retaining walls, and other types of ground movement. Installed as a string of vertical or horizontal sensors inside inclinometer casing, or by direct burial, this instrument provides a continuous record of ground displacement. Fiberglass rods connect the sensors inside the casing, and fins – or universal pivots – couple the sensors to the casing walls. [Little Dipper's](#) on-board electronics accept a wide input voltage range and drive long cables without signal loss. The waterproof and non-corrodible ABS sensor housing also makes the [Little Dipper](#) a popular tool for underwater tilt measurements in shallow marine application.



[Jewell Instruments Little Dipper Inclinometer](#)



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## Dane County Coliseum, Madison, Wisconsin

The Dane County Coliseum is home to a wide variety of sporting events, concerts, and public exhibits. A structural steel dome that is 100 meters in diameter covers the circular building. Deep layers of snow and high loads hung from the roof threatened to cause structural damage and create a hazardous condition for visitors.

A total of 17 uniaxial and biaxial tiltmeters, in addition to four displacement transducers, were installed in the roof at various locations. The tiltmeters measure rotations caused by beam bending in response to the applied loads. The displacement transducers measure sliding on bearings where the steel roof joins the concrete piers that support the perimeter walls.



## Ground Subsidence, Belle Isle Salt Mine , Louisiana

This underground room-and-pillar salt mine was opened in the mid-1960s, and it had salt extraction from the 1200 ft (365 meter) level. The mine was located beneath a gas processing plant about 1 mile (1.6 km) from the Gulf of Mexico. Pillar collapse had resulted in several meters of ground subsidence by the time Jewell Instruments became involved in the project. The gas processing plant above the mine was threatened with flooding and the plant operator feared a sudden catastrophic ground collapse. The mine's insurance company specified installation of an automated tiltmeter system to warn of imminent ground collapse. Jewell Instruments provided equipment, installation, and maintenance services. The plant was subsequently moved, and the mine flooded and was abandoned.

## Asco II Nuclear Power Plant, Catalonia, Spain

This plant was constructed in the early 1980s on a deep (55 meter) cut in expansive claystone. After construction began, it was noted that the foundation began heaving upward, moving the plant with it. The designer concluded that the foundation would move rigidly, preventing damaging shear stresses in the critical elements of the cooling system and reactor. To verify this conclusion, the Spanish Nuclear Regulatory Agency specified monitoring of foundation tilts throughout the plant. Jewell Instruments installed a system comprised of 40 tiltmeters in 1987. Data are continuously recorded by computer and by manual sampling. Monitoring will continue over the 40-year design life of the plant. Selected tiltmeters are replaced during each refueling outage as part of a regularly scheduled maintenance program.



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## Laurel Street Bridge, Santa Cruz, California

Jewell Instruments was retained by Hayward Baker to monitor the Laurel Street Bridge in Santa Cruz during compaction grouting of the ground beneath the bridge footings. Hayward Baker recognized that tiltmeters were one of the few instruments that could measure movements small enough to satisfy the specifications. However, the threshold alarming was complicated by the fact that the normal diurnal movement of the bridge due to thermal expansion and contraction is of the same order of magnitude. Therefore, the normal daily movement of the bridge was modeled with a sine wave, and the alarm thresholds were based on the difference between the model and the recorded data.

The [Model 801 "Tuff Tilt" Tiltmeter](#) series com-

bines high precision and durability in an economical instrument package. Using an absolute gravity referenced electrolytic sensor, the [801](#) series delivers superior measurement accuracy with virtually no long-term drift.

The model [A711](#) (floor or wall-mount) can bolt or clamp to any surface and is well suited for areas with heavy traffic or vibration. [D711](#) units also include onboard memory with a storage capacity of up to 22,000 samples. Units include two switchable gains and two low-pass filter settings and are sensitive to  $<0.1 \mu\text{rad}$ . Applications include volcano monitoring, high-precision geotechnical engineering, bridge deflection monitoring, precision metrology, radar platform leveling, and high-accuracy tilt monitoring applications where bolt-on installations are required.



[Jewell Instruments 801 "Tuff Tilt" tiltmeter](#)



[Jewell Instruments A711 tiltmeter](#)

## Green Valley Road Landslide, Watsonville, California

When grading for a subdivision that undercut a fill embankment, the road above began to fail. Jewell Instruments' borehole tiltmeters were installed beneath the roadway, and it was confirmed that buttressing repairs had stabilized the landslide. The tiltmeter evidence allowed construction of the subdivision to resume.

## About Jewell Instruments

Jewell Instruments is a world leader in the design, manufacture, and distribution of high-precision products. Our expertise includes acceleration and tilt sensors, electronic compasses, avionics components, solenoids, and panel meters. The extensive application knowledge we have obtained through decades of experience allows us to provide custom solutions for a diverse group of industries. In fact, customers from all over the globe contact us for solutions to aerospace, medical, industrial, and telecommunications applications - to name a few.

To find out more, visit our website!



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