Jewell Instruments

Slope Monitoring of Reservoir

- **Objectives:** Measure critical movements in a shear zone
- **Solution:** Jewell Instruments **A906** Little Dipper
- **Benefits:** Durability and versatility
- **Results:** Extended project life and remote monitoring

Overview

Local officials became aware of an ongoing landslide near McKay's Point reservoir in California that went undetected until an estimated 450,000 cubic yards of ground had already been displaced. Due to the late detection of the landslide, previously installed sensor casings used for monitoring seismic activity beneath the resulting shear line had been damaged. This meant that the sensors already in the casing provided unreliable readings, and collecting readings in-person was dangerous. The Jewell Instruments A906 Little Dipper provided a solution to both of these problems.

Jewell Instruments A906 Little Dipper

Project

In 1996, cracks in a road bed above the McKay's Point Reservoir initially revealed the presence of a large and active landslide on the slope above the southeast shore of the reservoir. Subsequent investigation and monitoring by the Northern California Power revealed a landslide with a height of 480 ft and width of 450 ft with two distinct shear planes and a total estimated volume of 450,000 cubic yards. The outline of the slide mass is visible from across the reservoir. Monitoring since 1999 has included the installation of borehole tiltmeters. As the slide progresses at depth, damaged inclinometer casings are preventing measurements in some locations.

Purpose

In consideration of the time and effort required to manually collect inclinometer profiles – and the fact that damaged casings were preventing effective inclinometer measurements below the shears in many casings – A906 Little Dipper in-place tiltmeters were installed in five existing casings in October 2008. The 21 Little Dippers are connected to an automatic data collection system to provide automated monitoring of tiltmeter status, including beneath existing shears where possible. This system provides continuous information about subsurface displacements automatically at a safe client location.

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Project Considerations

The large amount of existing site and tiltmeter data alowed for the customization of the Little Dipper installations based on the historic profiles. By combining multiple-point and multiple-interval Little Dipper installations, it was possible to measure the critical movements in five different casings using 21 instruments. By using intervals to span known shear zones and a few points to verify common behavior between shears, it was possible to minimize the number of sensors needed.

One benefit of the Little Dipper in-place tiltmeter is that that only the instrument cable and connecting rods are present in most of the casing. Because of this feature, measurements across the shear zone or damaged casing and beneath it can continue much longer after the shear develops when Little Dippers are used than when making periodic readings using a traditional traversing tiltmeter probe.

During installation, workers discovered that several of the existing casings were damaged so badly that the instruments or pivots with guide fins used to anchor the instruments to the casings would not pass. Rather than abandon the deeper zones and in the interest of utilizing what remained of the existing casings, the guide fins were removed from several of the deepest instruments to allow them to pass the shears and some distances between sensors were shortened. By removing the guide fins, it became impossible to rely on the orientation of the instruments with respect to the casings or that they were even in contact with the casing at depth. The goal was that they would be pushed to one side of the casing and could be used to measure tilts though with greater uncertainty than with the positive connections provide by the guide fins. The ideal installation would have the instruments in newly installed casings before any shears developed but that option had long passed for these tiltmeters.

Results

21 Little Dippers were installed in five casings and successfully connected to an automated monitoring system. Despite the less than ideal instrument installations due to damaged casings preventing the installation of some of the deeper instruments as designed, system data correlates well with other data site information. The response of the deeper instruments that were installed without guide fins is remarkably evident even though they do not have a positive connection to the casing wall. This has extended the useful life of these casings and allows safe remote monitoring of this critical slide.

Conclusion

The multiple-interval installation of A906 Little Dippers across a shear zone will extend the useful life of an tiltmeter casing as long as the Little Dippers are installed before the shear is so severe as to prevent their installation.

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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