



I-5 retaining walls were monitored as a TBM drove through their foundations.



Multi-year monitoring was required for repair of this massive wall failure.



Monitoring was required during repairs to this MSE highway embankment.

## Purpose of Retaining Walls

Retaining walls support and stabilize excavations, foundations, slopes, and embankments.

## Retaining Wall Failures

Despite careful design and construction, wall failures can occur, usually due to one or more of the the conditions below:

- Insufficient drainage that allows water to accumulate behind the wall and results in deformation, cracks, tilting, erosion, and loss of backfill.
- Inadequate or degraded foundations that allow the wall to overturn or slide.
- Increased loading from traffic or new construction that exceeds the limits of the original design.
- Aging of the wall from weathering, erosion, freeze-thaw cycles, and corrosion of anchors.

## Visual Signs of Defective Walls

Periodic inspections are the first level of monitoring. Visible defects include:

**Wall face:** Increasing tilt, differential tilt of adjacent panels, vertical cracks, spalling, or bulging, misalignment or widening of joints, or blocked drainage channels.

**Soil & surfaces behind the wall:** Tension cracks or settlement, gap between soil and the backside of the wall, lateral cracks in pavement at the top of the wall, or excessive ponding of water on backfill.

**Soil & surfaces in front of the wall:** Deformation of the soil or surfaces at the base of the wall, including settlement, heave, or buckling.

## Instrumented Monitoring

The main parameters for instrumented monitoring include deformation and tilt of the wall face. Other parameters include anchor loads, pore-water pressure, and lateral displacements in the soil behind the wall.

## Automated Monitoring

Automated monitoring is deployed during construction, repair, or replacement of walls that protect or support highways, railways, and other infrastructure.

**AMTS systems** are capable of monitoring long spans of wall with high accuracy, revealing changes in tilt, lateral displacement, and settlement.

**Tiltmeters** are fixed to directly to the wall and are useful for detecting differential tilt of adjacent panels. Battery powered, wireless tiltmeters eliminate cabling.

**Crackmeters** connected to wireless loggers can monitor movement at joints.

**Shape arrays** are installed on the backside of the wall or on slopes above the wall to monitor lateral displacement and rotation.

**Load cells** monitor anchor performance.

**Piezometers** monitor pore-water pressure.

**GeoCloud** websites deliver visualized data, alerts, and reports.

