# CHARACTERISTIC FAILURES OF TUNNELS

*by*

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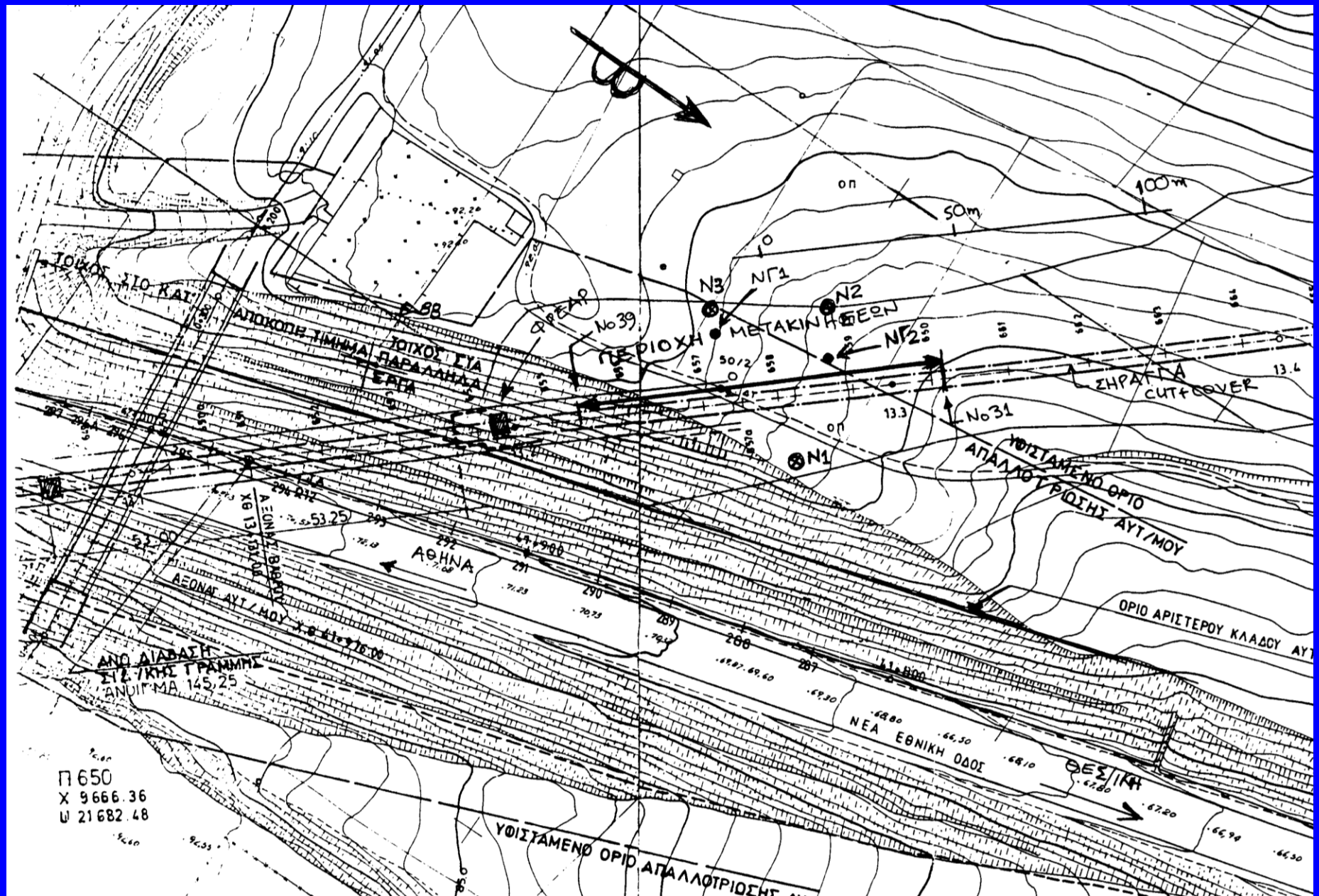
# Railroad cut+cover in Methoni Pierias
# Junction with the Athens-Thessaloniki highway



# Railroad cut+cover in Methoni. Construction in June 1994

Slope consists of a stiff calcareous clay and is stable (1:1)

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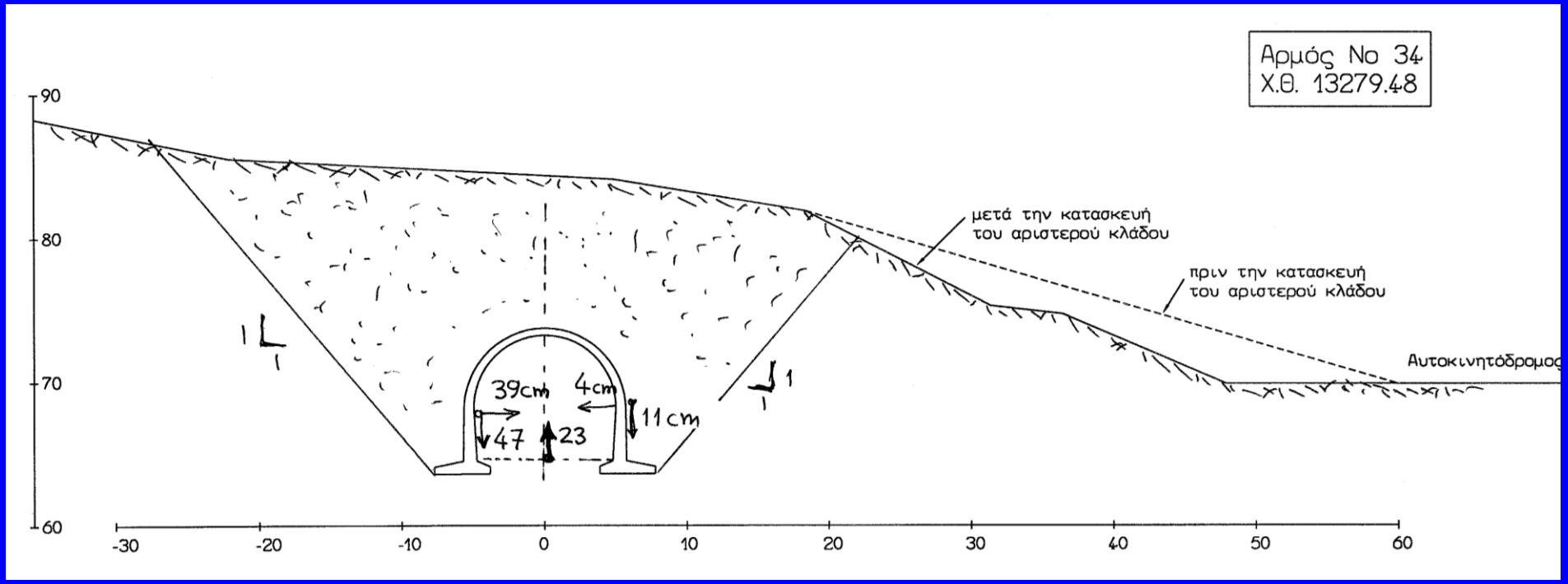
# Railroad cut+cover in Methoni

- Significant movements were observed in the winter of 1996-97.
- It is believed that they are associated with a creep-type deformation of the slope triggered by the widening of the highway (1994-95)
- The cut+cover has to be re-constructed



Patra by-pass road tunnel

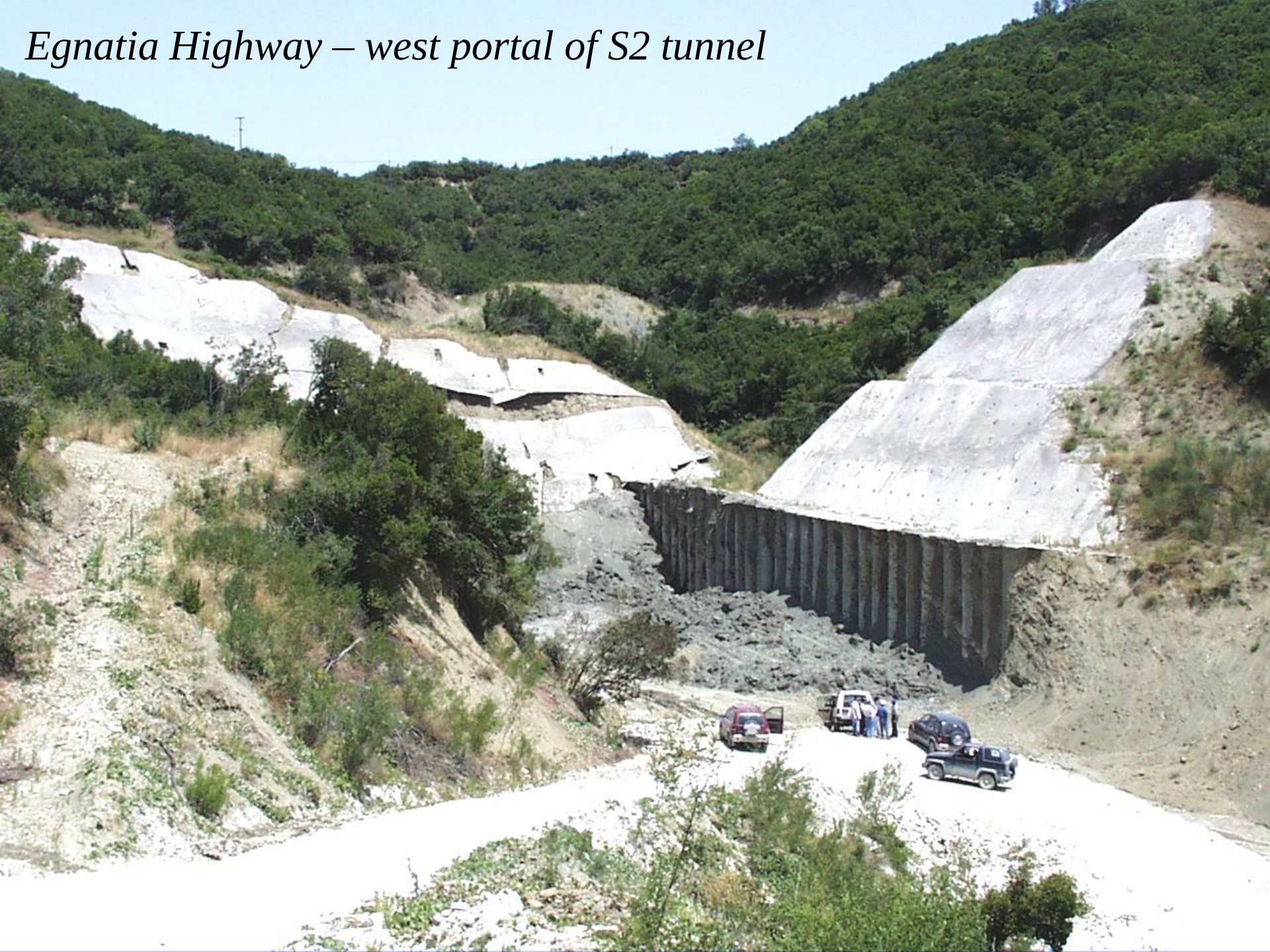
*South portal failure*

*August 1998*

- Failure of the tunnel portal was caused by slope instability induced by the boring of the tunnel.
- The tunnel axis runs practically parallel to the slope

# Patra by-pass road tunnel - *South portal before failure - August 1998*

# Patra by-pass road tunnel - *South portal failure - August 1998*


*Egnatia Highway – west portal of S2 tunnel*

# Egnatia Highway – Tunnel S2, west portal failure (summer 2000)

# Kallidromon railway tunnel. South portal in Pleistocene deposits.

Slump-type instability of the left slope, due to water seeping from a nearby stream

# Kallidromon railway tunnel. South portal in Pleistocene deposits

Slump-type instability of the left slope, due to water seeping from a nearby stream

Kallidromon railway tunnel
North portals in stiff Pliocene clay.

The inclination of the bedding planes causes instability of the left slope, while the right slope is stable

Kallidromon railway tunnel. North portal area

Slump-type slope failure (h=3m) in stiff Pliocene clay

*The design calls for a 15m cut with slope inclination 2:3 (v:h)*

Kallidromon railway tunnel. North portal area

Embankment slope failure (h=3m) in stiff Pliocene clay

*The design calls for a 15m cut with slope inclination 2:3 (v:h)*

Tymfristos road tunnel in flysch. Wall convergence reached 2 m.

# Tymfristos road tunnel in flysch

- Wall convergence reached 2 m, and the tunnel had to be re-mined
- Rock bolts were too short (4m) and were installed during the week-end, for scheduling reasons

# Failures in tunneling : Tymphristos highway tunnel in flysch

*Wall convergence reached 2 m and tunnel was re-mined*

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Re-mining of section with large wall convergence