Additional measurements important to APT testing

Scope

- Temperature measurements
- Moisture measurements
- Density measurements
- Test pits
- Dynamic Cone Penetrometer (DCP)

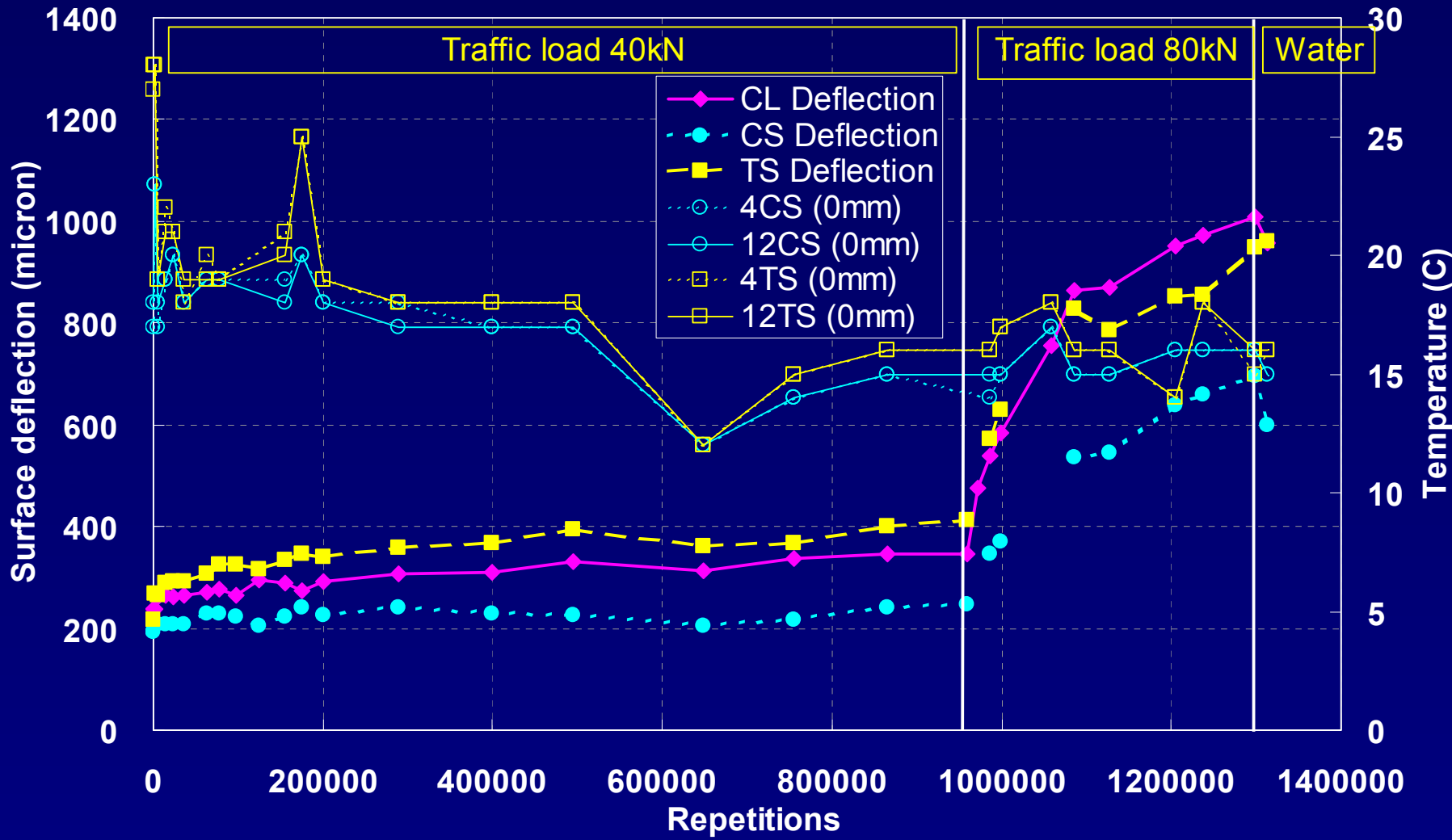
Temperature Measurements

- Thermocouples
- Temperature buttons
- Weather station

Thermocouples

- Both sides of test section
  - Traffic side
  - Caravan side
- Wires placed at several depths and surface
- Data recorded
  - Manually or electronically
    - » *Routinely*
    - » *When deflection data collected*
    - » *Can be used to control constant temperature tests*

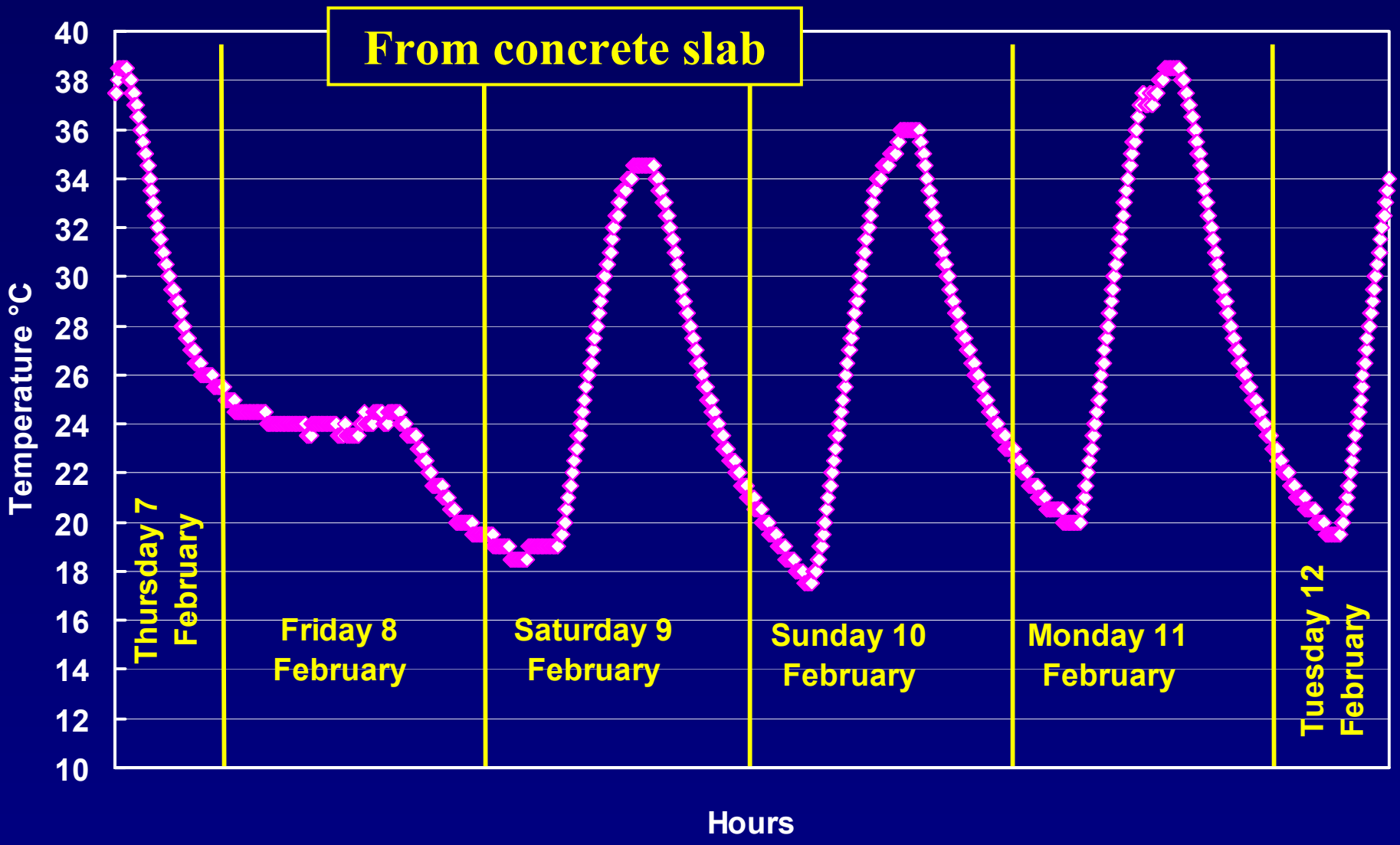
Thermocouple data (and RSD)



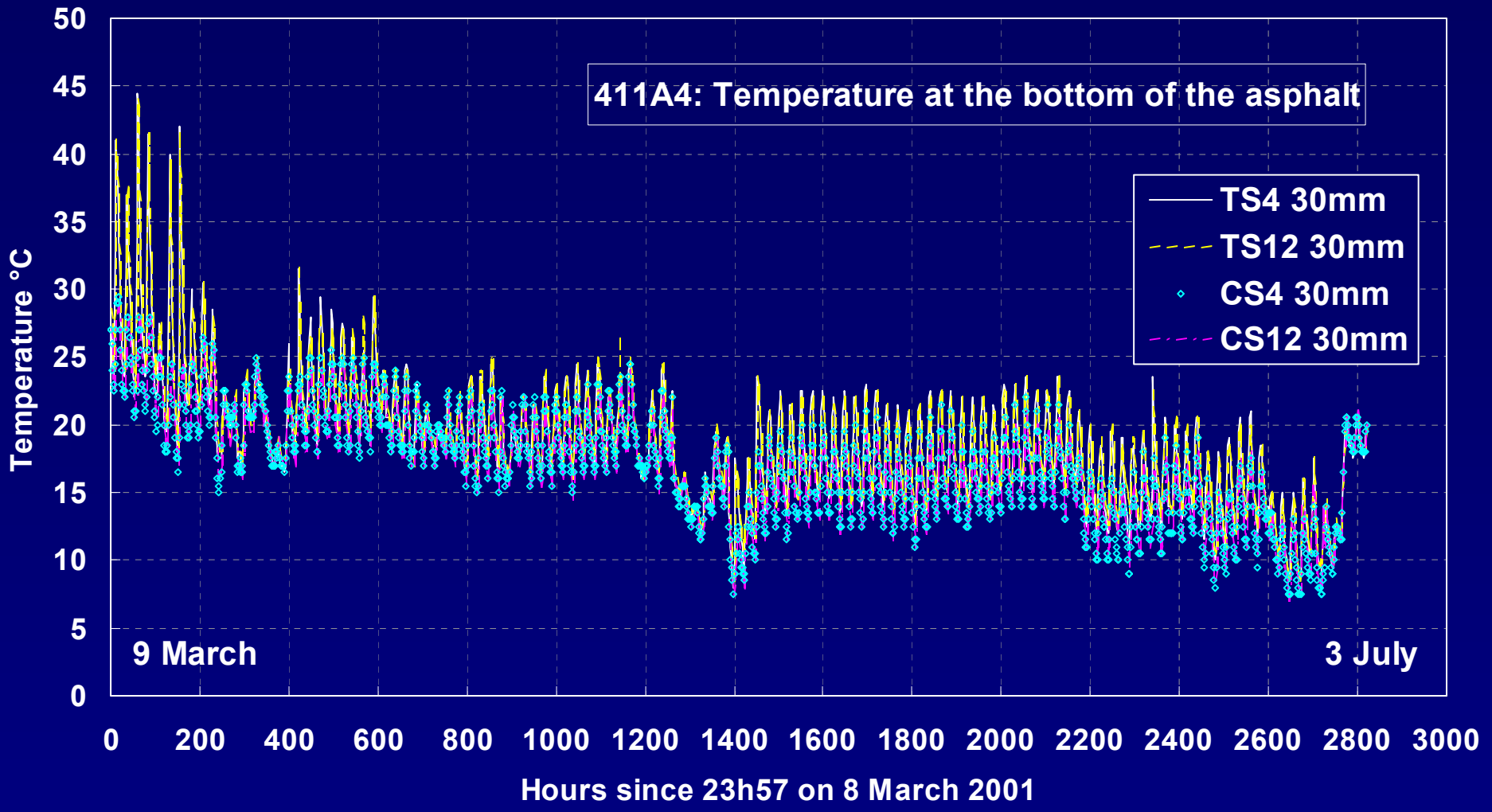
Temperature buttons

- Buried at depths in the pavement
  - Any depth
  - Can be installed during construction
  - Size (16mm diameter, 5 mm thick)
- Records ~2000 data points
  - Programmable intervals
    - » *5 minute intervals:* *7 days*
    - » *2 hour intervals:* *5.5 months*
- Remove button after test is complete to access data
  - Know where it is!

Temperature button data (5 minute intervals)

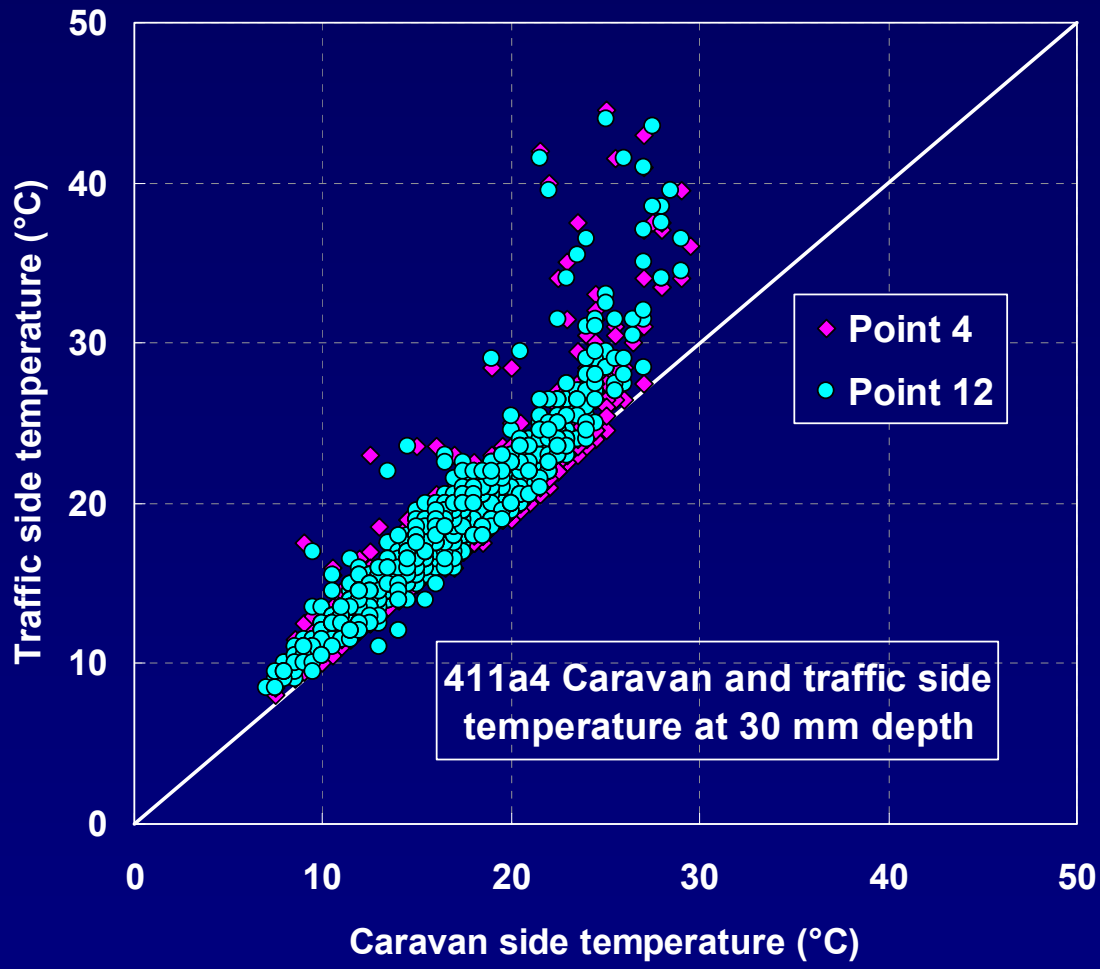


Temperature button data (2 hourly intervals)



Temperature button data

- Comparison of traffic and caravan side temperatures
  - Traffic side hotter
    - » *Less protection from the sun*



Moisture and density measurements

- Very important
  - Large influence on behaviour of untreated and stabilised materials
  - Changes in pavement response may be due to changes in moisture regime
  - Need to know moisture content and density to calibrate structural design models
- Two of the biggest challenges

Measurement techniques

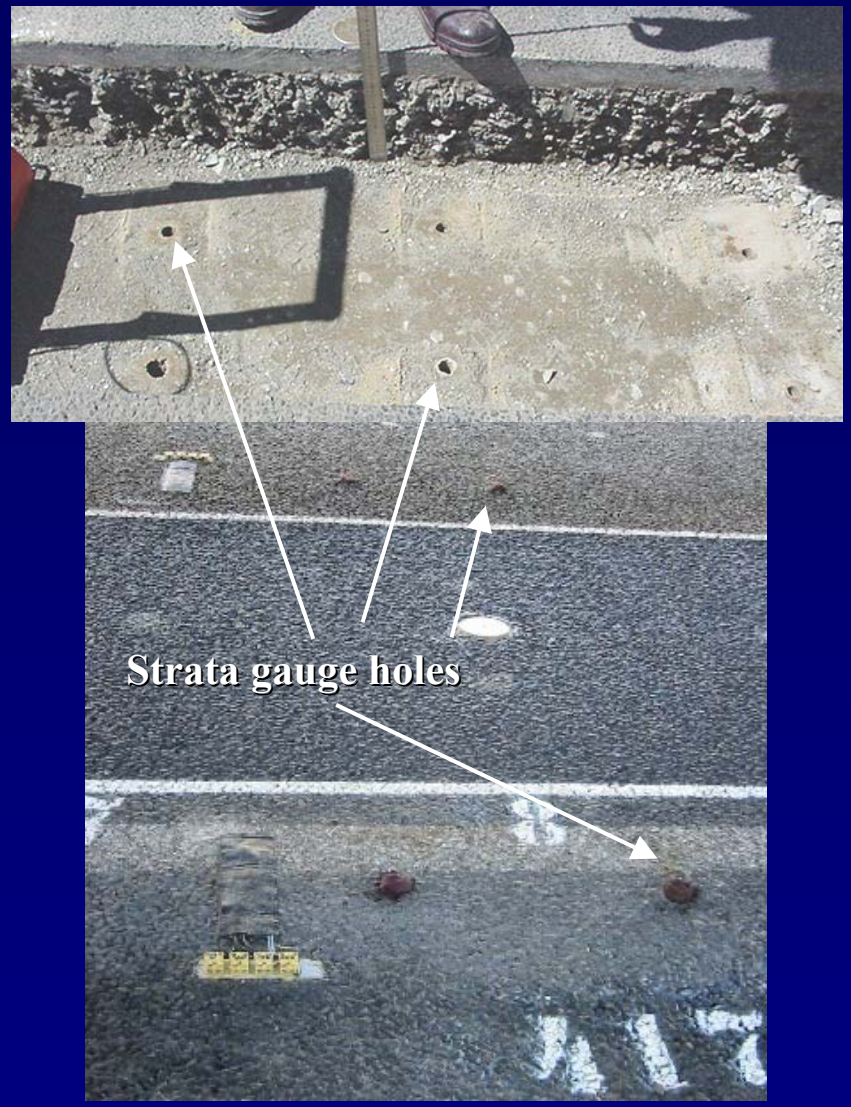
- Moisture content
  - Gravimetric
- Density
  - Sand replacement type tests
- Both density and moisture content
  - Strata gauge (nuclear)
  - Time domain reflectometry (TDR)
  - Ground penetrating radar (GPR)

Gravimetric measurements

- Oven-dried moisture content
- Destructive test
- Measure when testing is complete
  - Using material from the test pit
  - Use values to correct strata gauge density readings

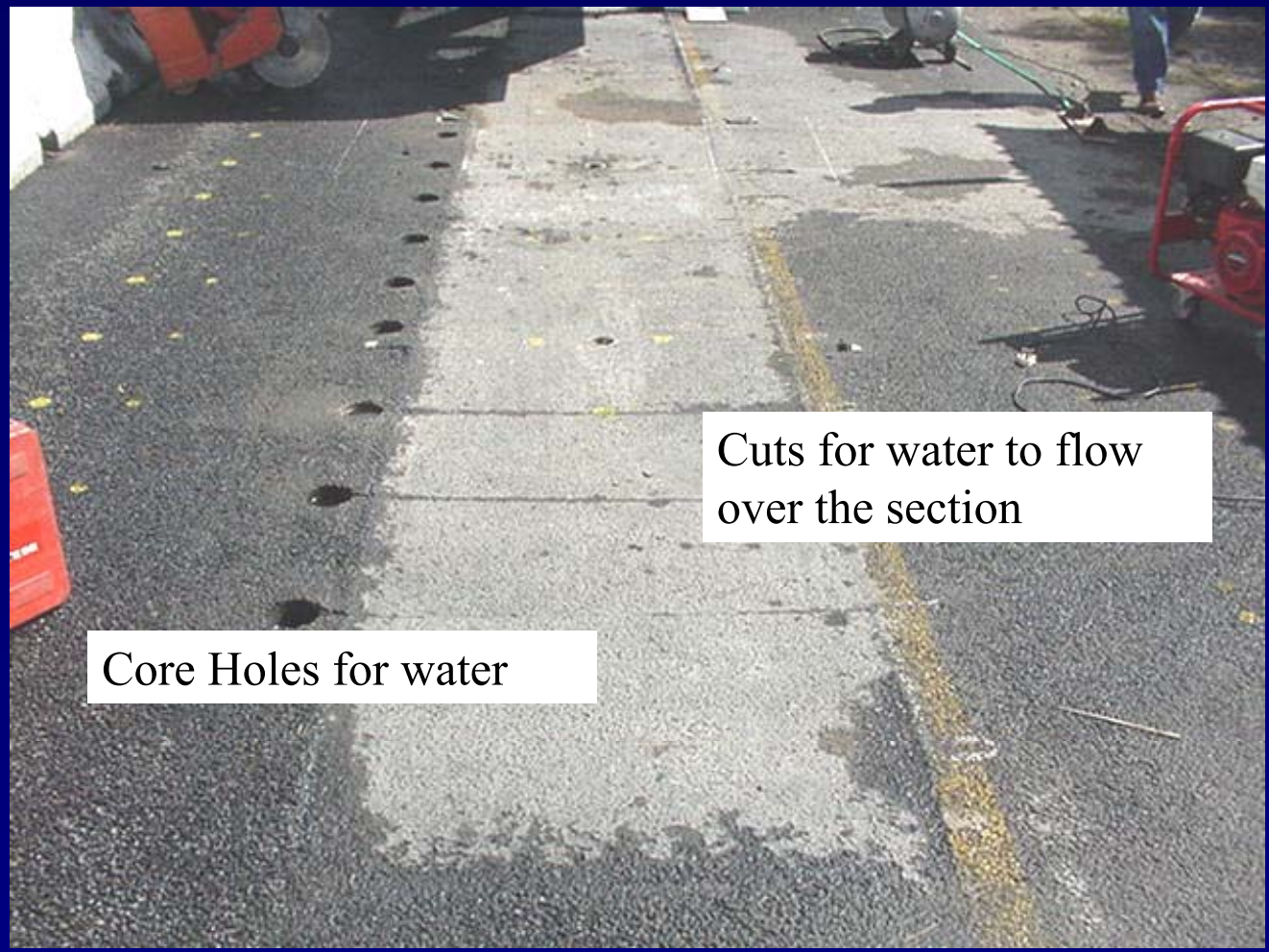
Strata gauge

- Nuclear device
  - Two probes placed in pavement
    - » *source and receiver*
  - Maximum depth of 600 mm
- Measurement intervals
  - Routinely during test
    - » *Both sides of test sections*
  - During opening of the test pit
- Scatter in data
  - But still observe trends



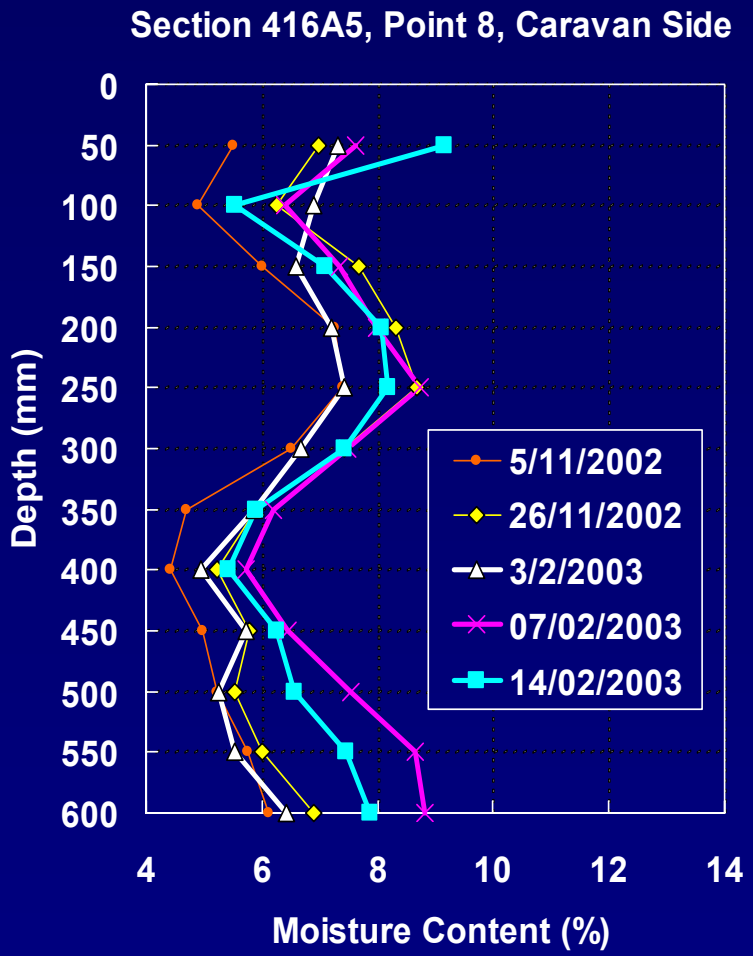
Strata gauge moisture content results

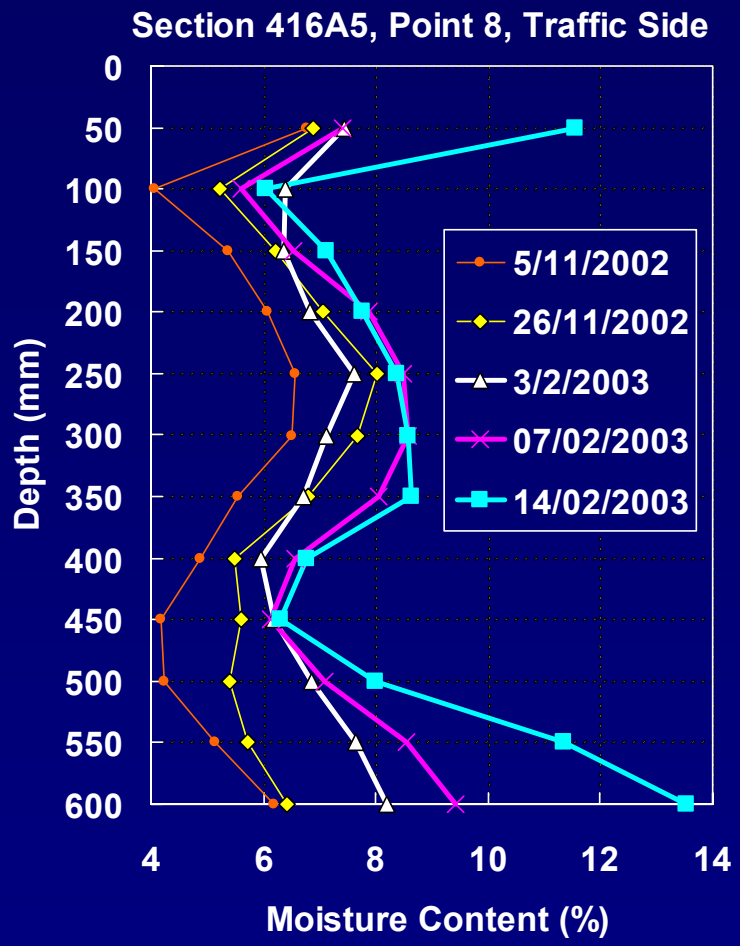
- Water added to test sections



Strata gauge moisture content results

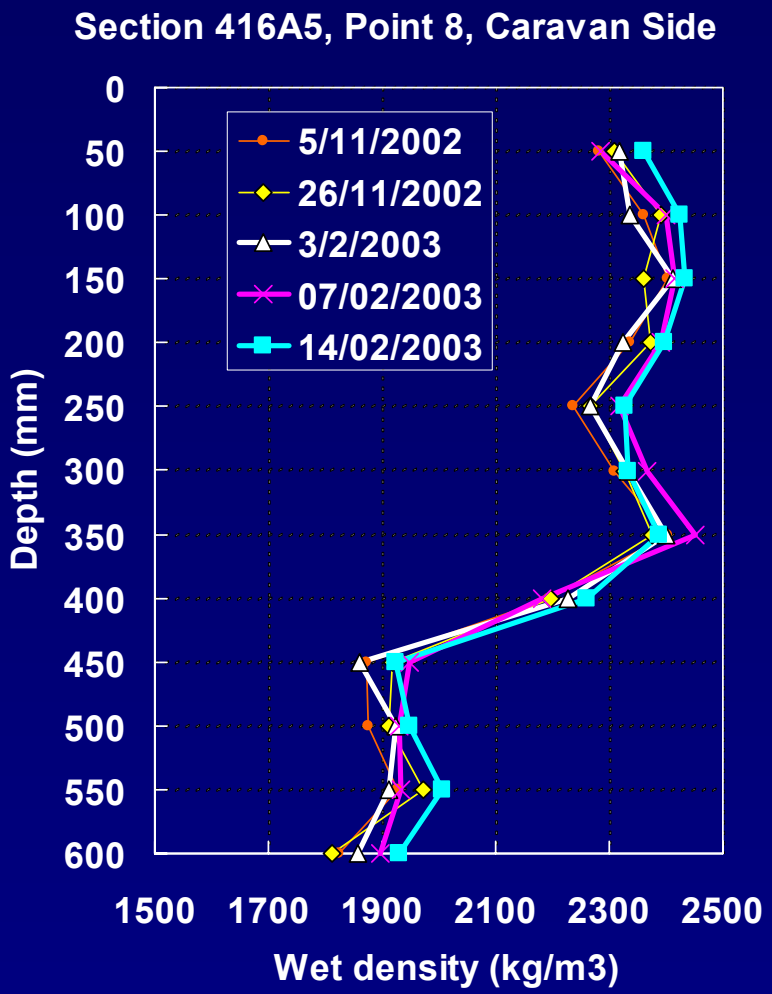
- Water added to traffic side on 03/02/2003

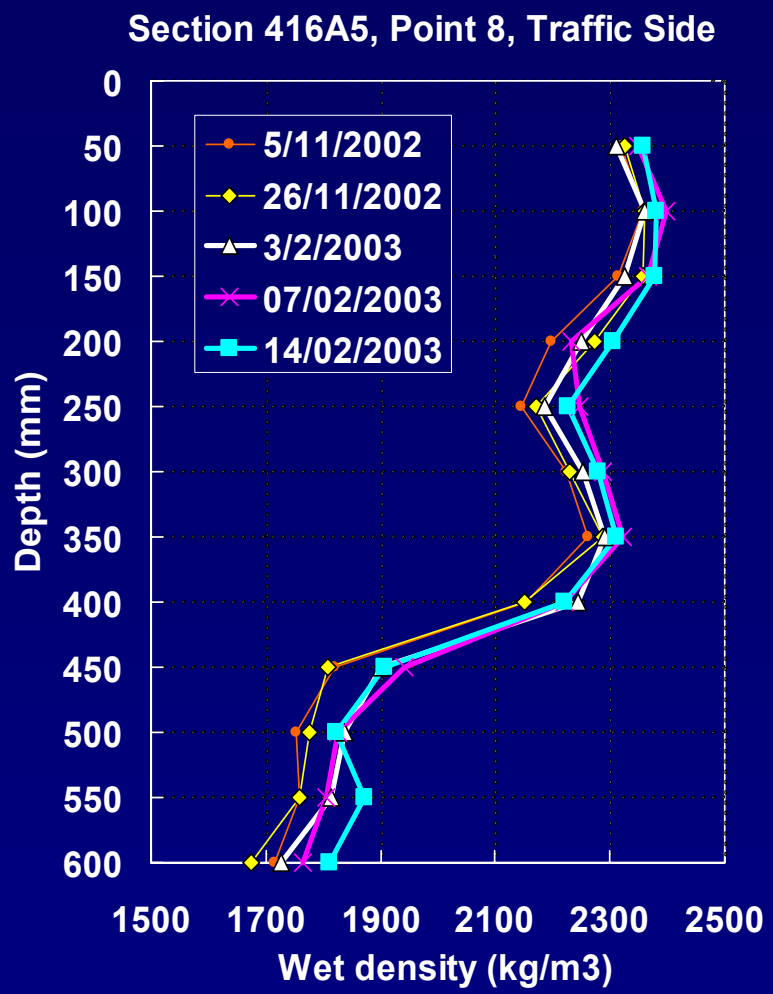




Strata gauge density results (wet)

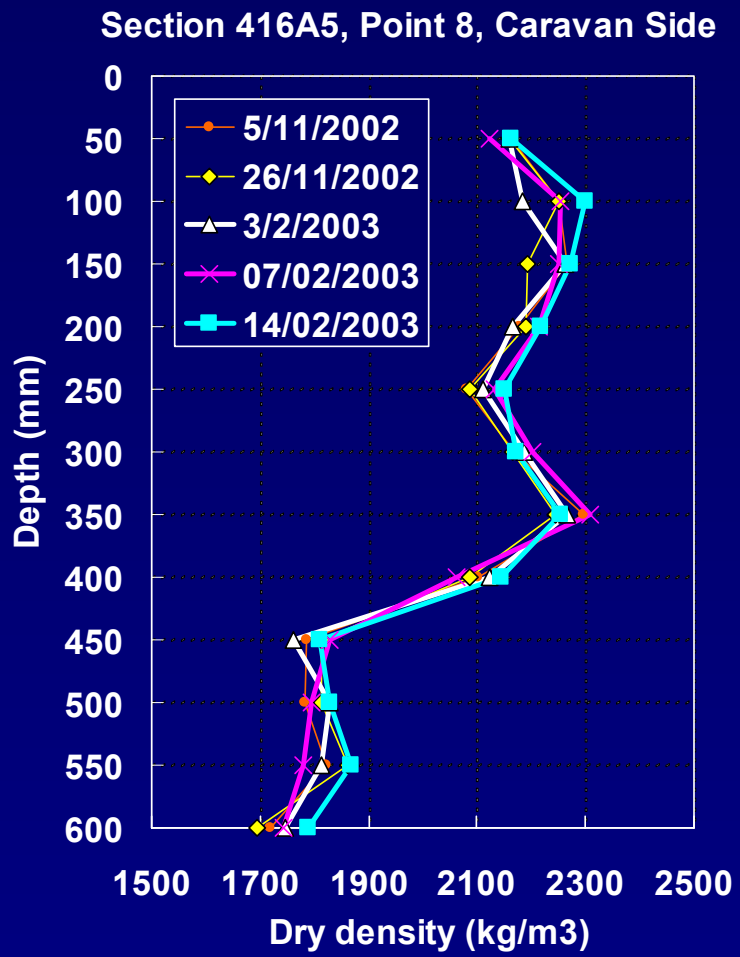
- Water added to traffic side on 03/02/2003

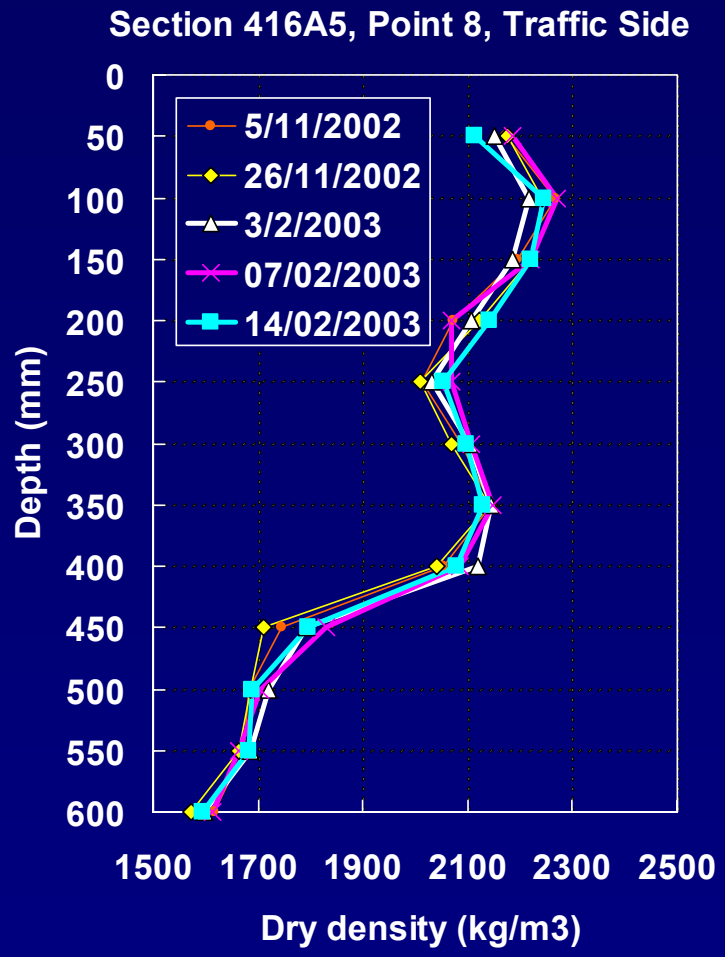




Strata gauge density results (dry)

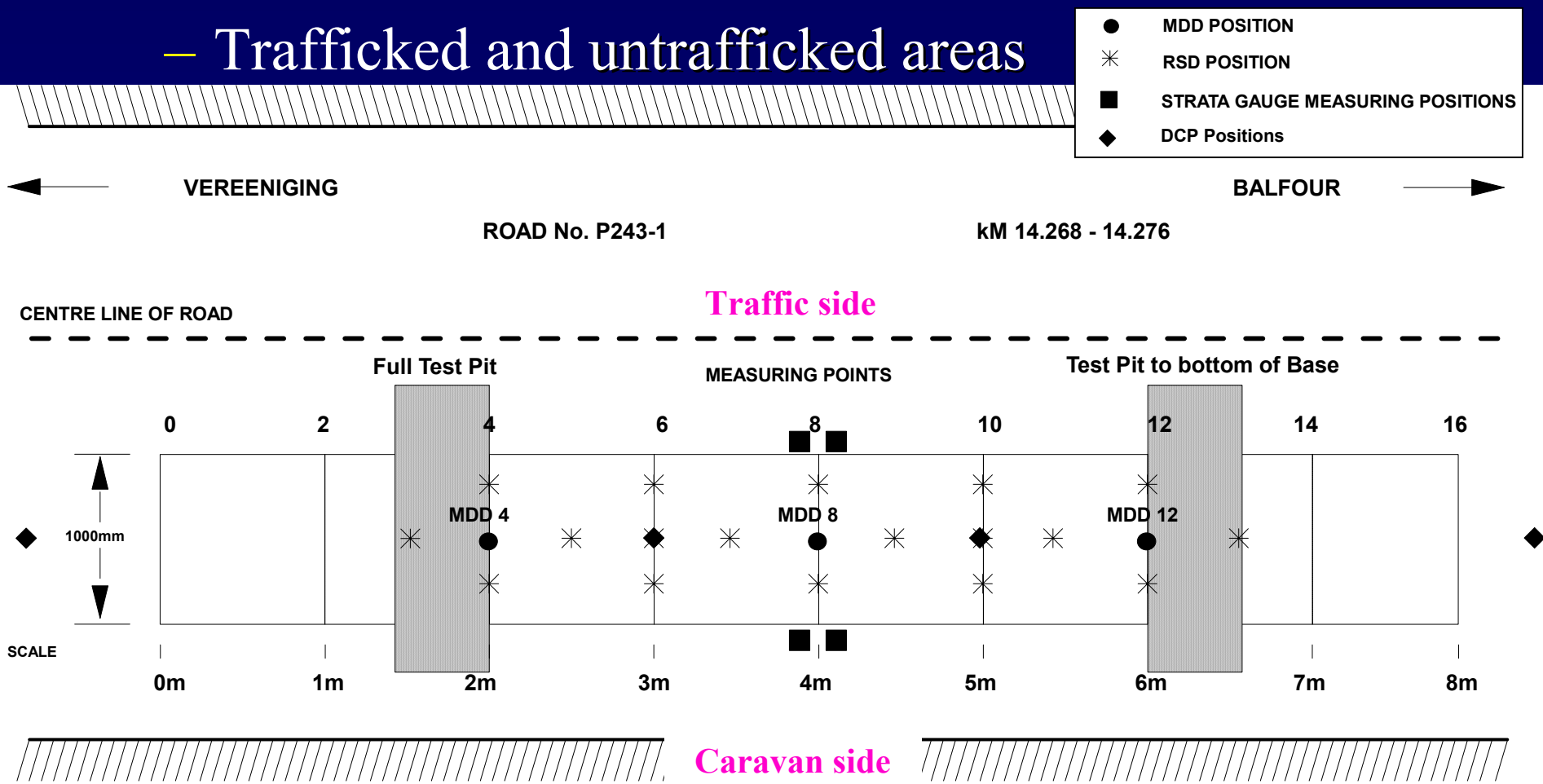
- Water added to traffic side on 03/02/2003





Testpits

- Opened at end of each test
  - Trafficked and untrafficked areas

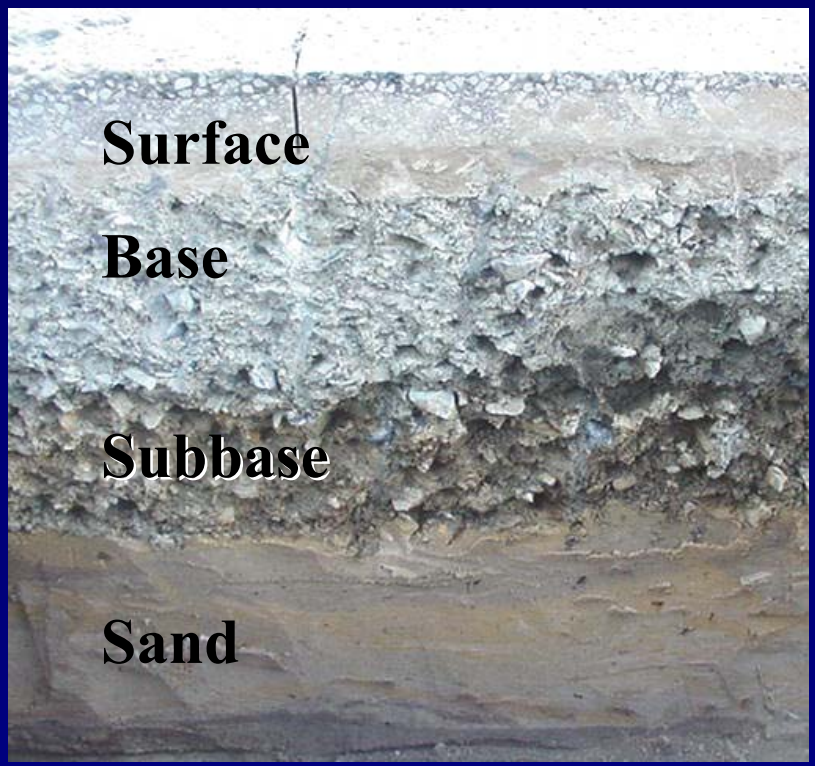


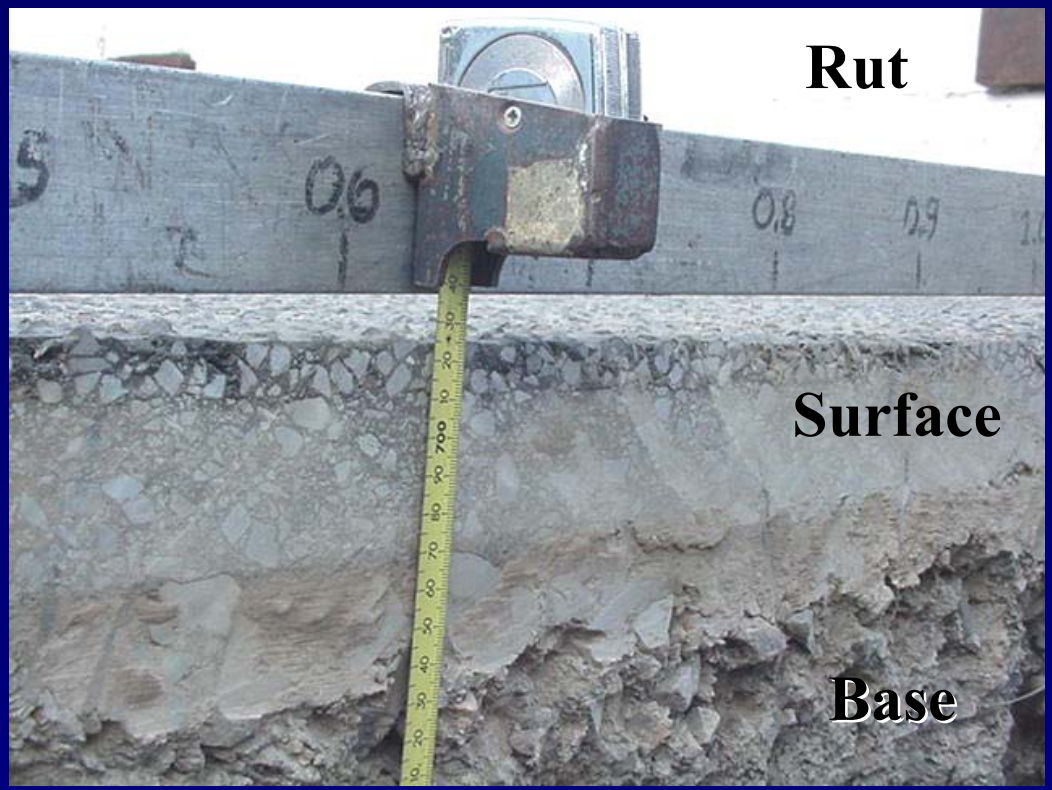
Testpits

- Measure
  - Layer profiles
  - Condition of materials
    - » *visible variability*
  - Observe material movement
    - » *if any*
  - Observe nature of cracks
  - Moisture content
  - Density

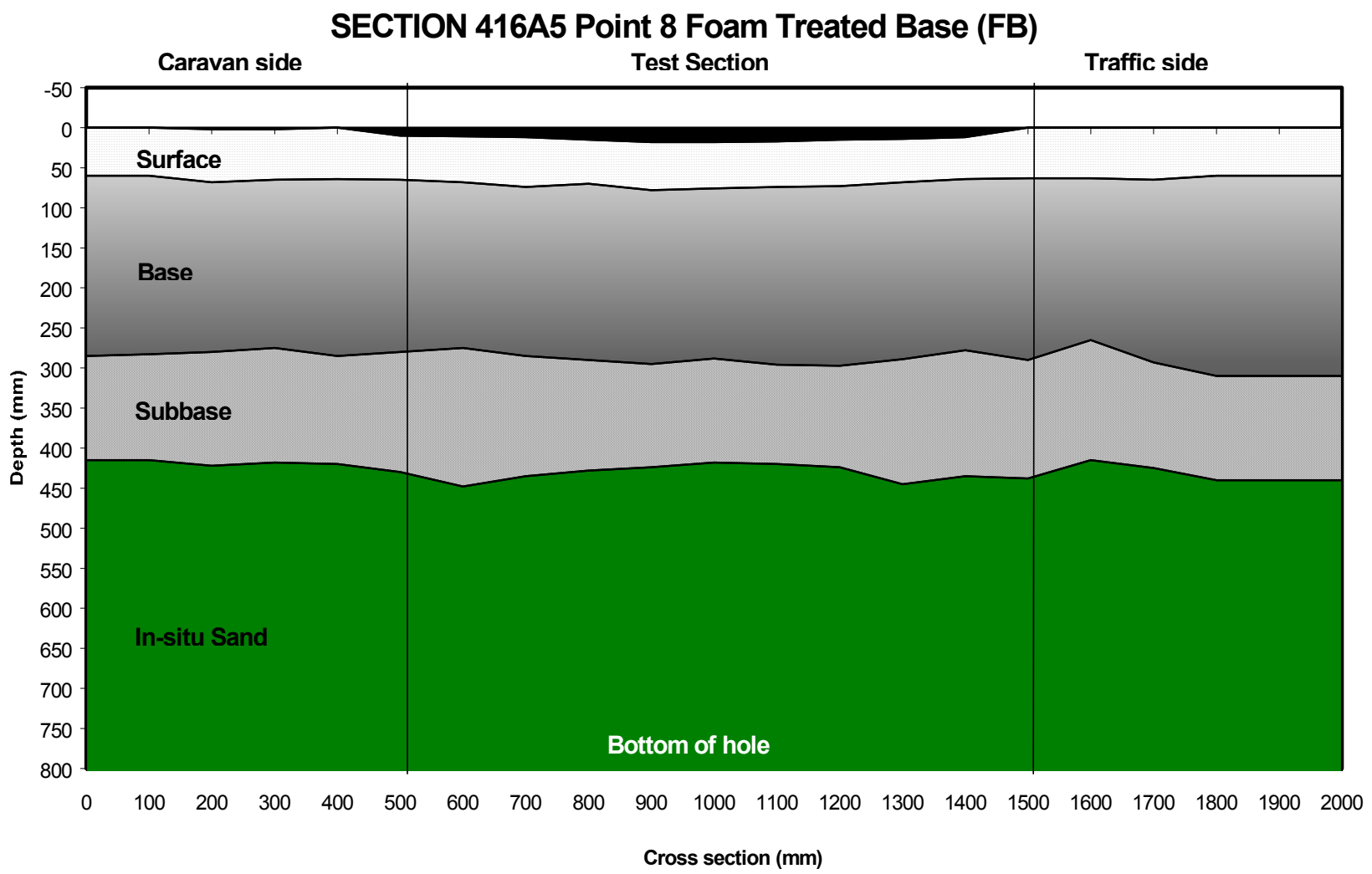
Test pits

- Layer profile
  - Actual layer thicknesses, variations in layer profiles





Test pits: Layer profile



Test pits

- Condition of materials

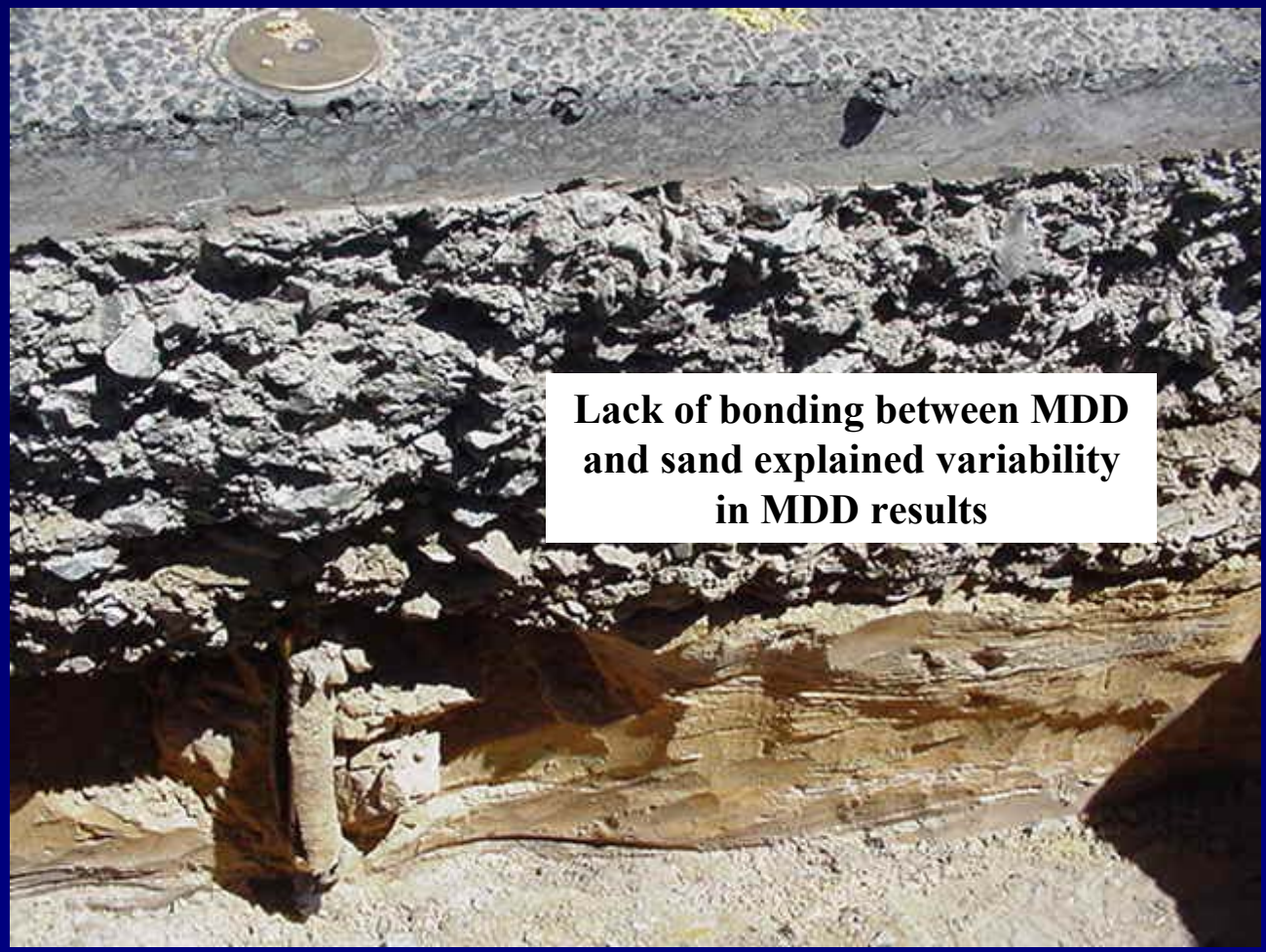
Underside of asphalt

Test pits

- Condition of materials

Test pits

- Condition of materials



Test pits

- Movement of materials

Test pits

- Movement of materials

Test pits

- Cracks

Conclusions

- Environmental measurements during HVS testing
  - Temperature (thermocouples, buttons, weather station)
  - Density (strata guage)
  - Moisture content (strata guage)
- Test pits
  - Crucial information about test section and material behaviour

And finally…

- Never underestimate the value of visual inspections!

Questions??