Introduction to Road Materials Engineering

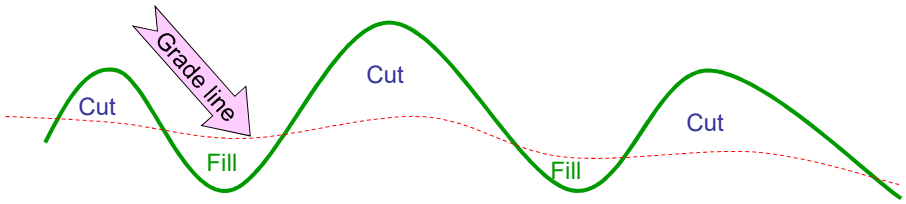
Part 6: Introduction to Materials Investigations

Presented by SARF

Presenter:
Ron Berkers

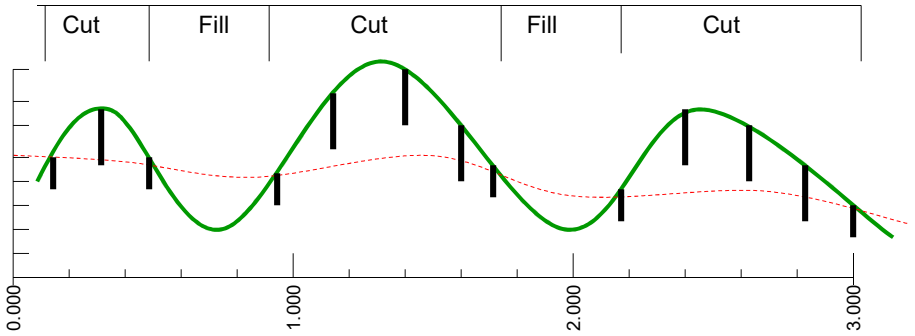
Investigations for construction of new roads

Cuts & Fills



Investigations for construction of new roads

Trial pits - excavation, profiling & sampling



Position trial pits in the ***CUTS*** at roughly 200m intervals. Include additional trial pits at "prick' of cut & fill. Aim to investigate to 1m below the gradeline or to max reach of the excavator

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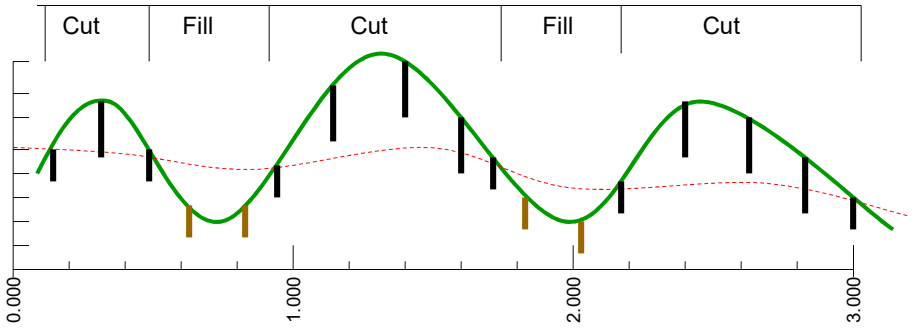
Investigations for construction of new roads

Trial pits - excavation, profiling & sampling



Position trial pits in the ***FILLS*** at roughly 200m intervals. Investigate to depth of 1m to 2m depending upon materials quality found in the trial pit

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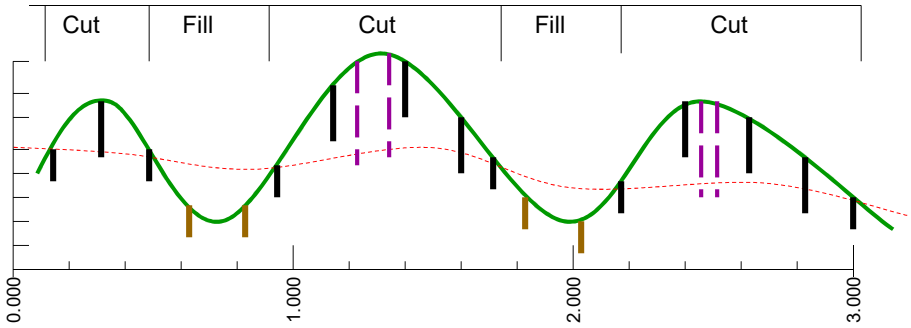
Investigations for construction of new roads

Deep cuts – seismic and core drilling



Consider deeper investigations in deep cuts beyond the reach of large excavators (± 5m) – seismic traverses, core drilling

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Trial pits - excavation, profiling & sampling

Using a large, min 20 ton track-mounted excavator to excavate the trial pits

Profiling and sampling

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Trial pits - excavation, profiling & sampling

Profiling

- Position a board showing the number and location of the trial pit
- Drop a broad measuring tape down the trial pit
- Take a photograph showing the full length of the profile – preferably use a SLR digital camera with a powerful remote flash

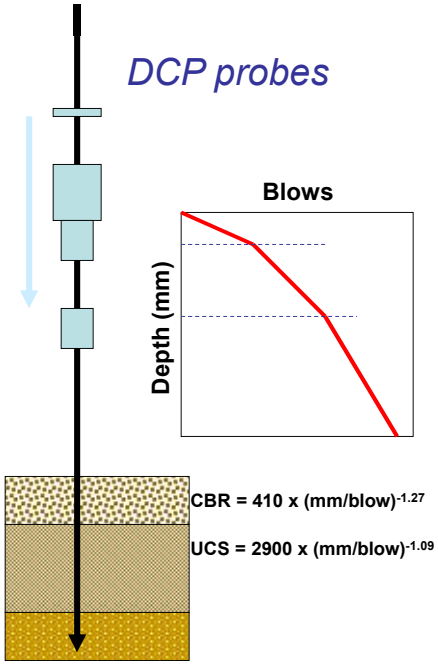
Sampling

- Generally take an Indicator sample from each soil horizon
- Take samples for moisture/density relationship and CBR tests on each different soils type – *USE YOUR DISCRETION*
- Consider whether the cut may be used to provide material for a stabilised layer – in this case take a larger sample so that stabiliser tests can be done in additional to the other tests

Trial pits - excavation, profiling & sampling

M	Moisture content
C	Colour
C	Consistency
S	Structure
S	Soil type
O	Origin

Overview of materials investigations



60° Cone mm/blow	CBR (%)	Safe Bearing Pressure (KPa)	Recommended safe bearing pressure (kPa)
3	+50	+350	325
4	50	350	
5	40	300	
6	33	265	230
6	28	240	
7	25	225	
8	22	210	
9	20	200	175
10	18	190	
10	17	185	
11	16	180	
12	15	175	150
12	14	170	
13	13	165	
14	12	160	
15	11	155	
16	10	150	120
18	9	145	
20	8	140	
22	7	135	
26	6	130	100
30	5	125	
36	4	120	
48-56	3	115	
64-72	2	110	
80	1	105	

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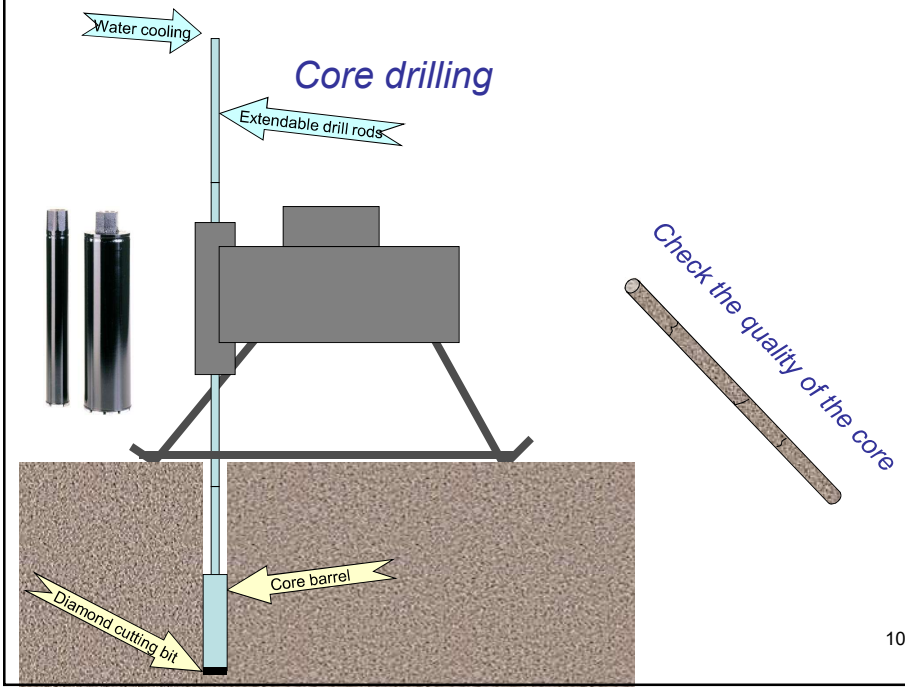
Overview of materials investigations



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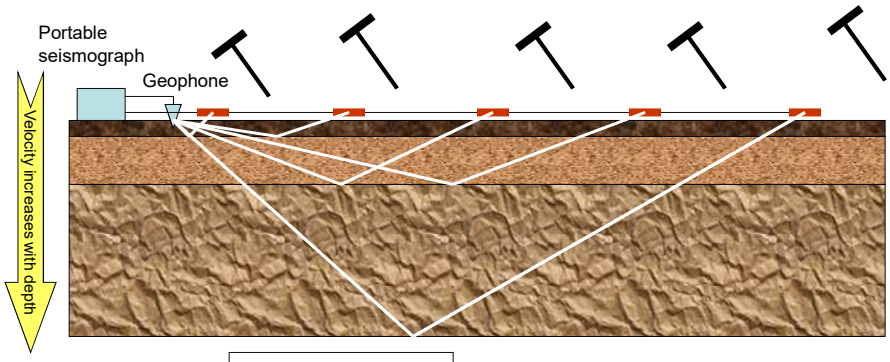
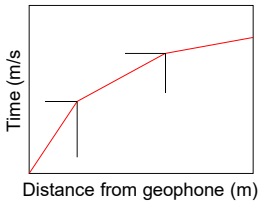
Seismic Traversing



Measures time taken for first arrival of the seismic wave



Calculate VELOCITY and LAYER THICKNESS

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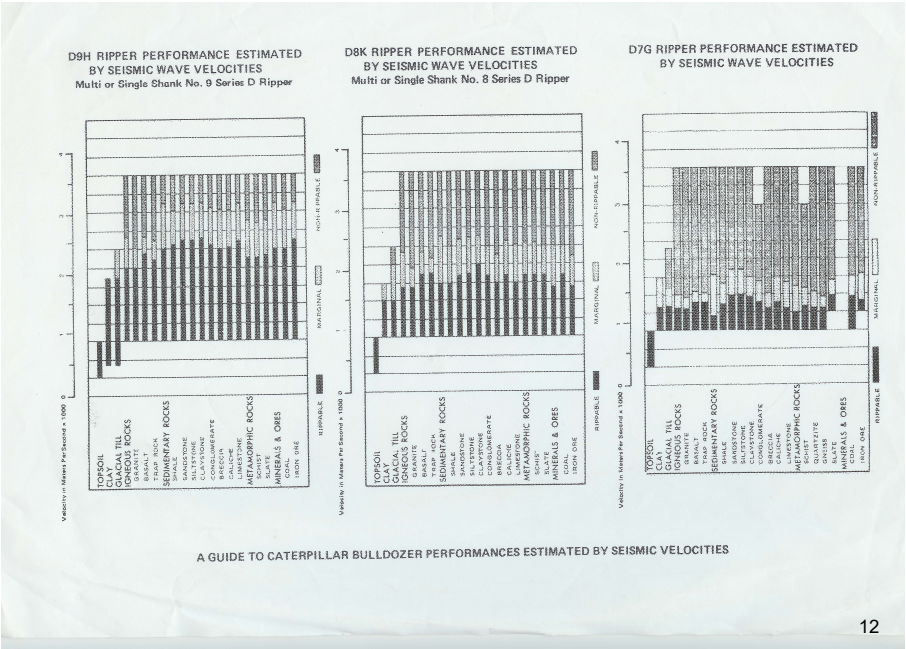

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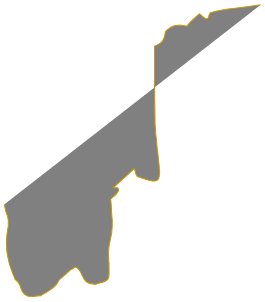
Borrowpit & Quarry Investigations

Borrowpits

Softer materials, limited blasting required. Remove material using excavators and dozers

Quarries



Hard material, rock. Usually required drilling and blasting before material can be removed

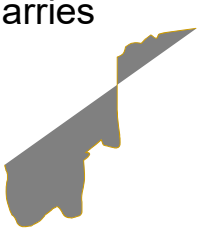
Borrowpit & Quarry Investigations

Borrowpits

Investigation tools

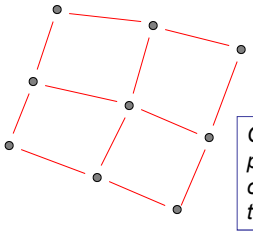
- trial pits
- seismic
- core drilling
- bulldozer slots

Quarries



Investigation tools

- seismic
- core drilling



Carry out the investigations in a grid pattern - the grid dimensions depend on quantity of material required and topography

Investigations for road rehabilitation

Investigation tools

- *Visual inspection*
- *Trial pits*
- *Core samples*
- *DCP probes*
- *Field density measurements*
- *Deflection measurements*
- *Rut measurements*
- *Riding quality measurements*

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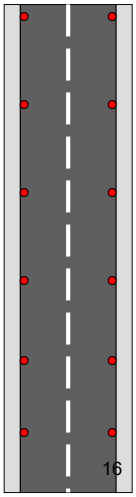
Visual assessments

Valuable tool for assessing the type, severity and cause of pavement distress !

Take adequate traffic safety precautions – flags, cones, safety vests, flagmen

Use a measuring wheel to mark the road at 20m intervals on both sides



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Visual assessments (TMH9)

MODE	TYPE	SEVERITY
Cracking	Crocodile Map Transverse Longitudinal	1 Least severe 2 3 4 5 Most severe
Deformation	Rutting Mounding	1 Least severe 2 3 4 5 Most severe
Surface disintegration	Potholing	1 Least severe 2 3 4 5 Most severe
Surface smoothing	Bleeding	1 Least severe 2 3 4 5 Most severe

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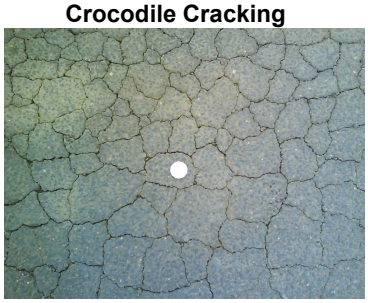
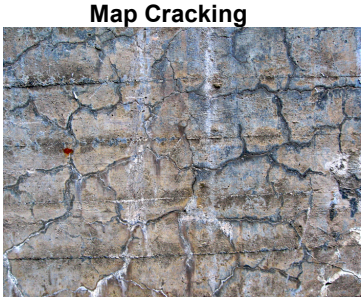
Crocodile Cracking



Map Cracking



Transverse Cracking

Longitudinal Cracking

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Overview of materials investigations

Rutting

Mounding

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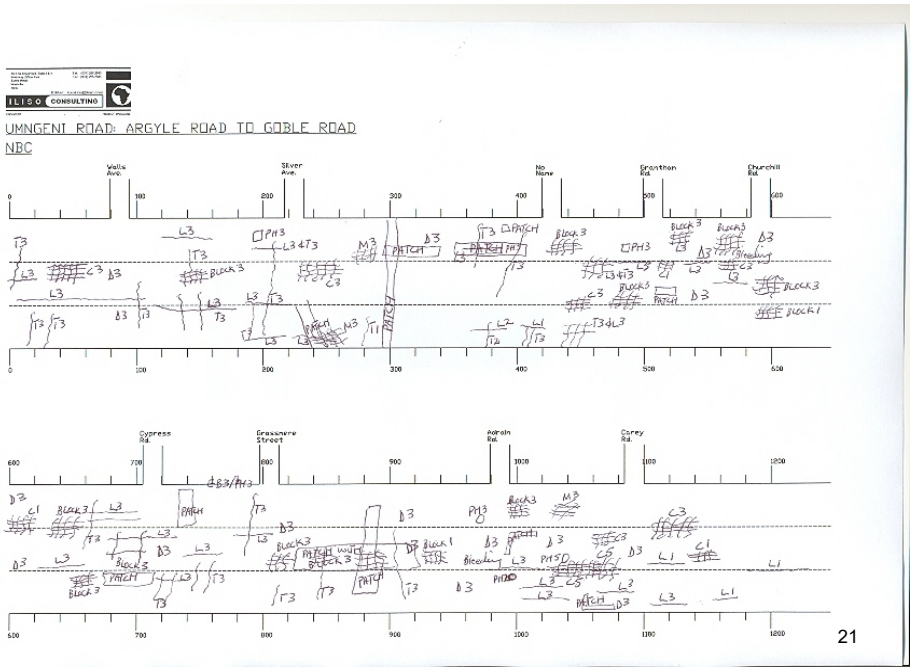
Overview of materials investigations

Pot holing

Bleeding

Overview of materials investigations



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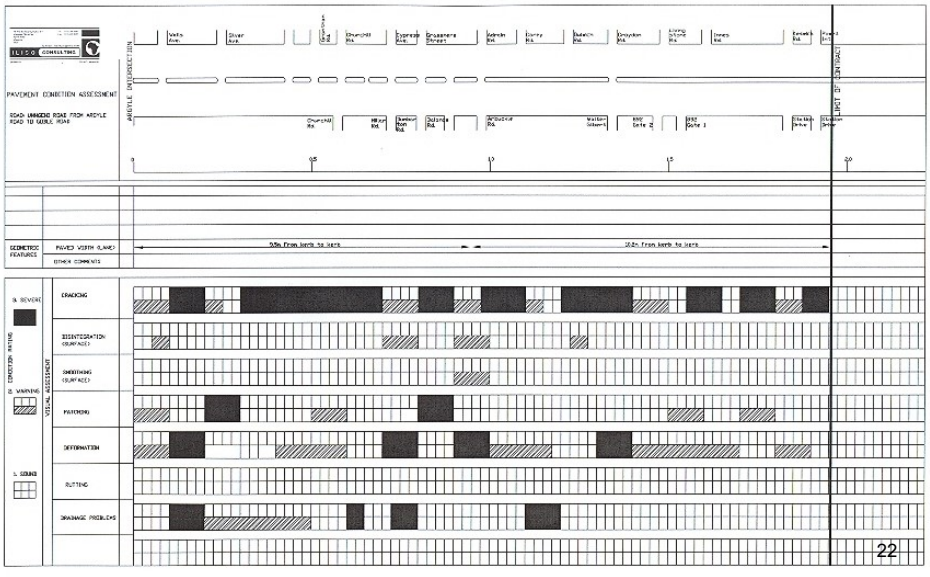
Overview of materials investigations



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Trial Pits

Trial pits provide accurate information on the thicknesses of the pavement layers, the moisture content and compaction of the layers

Trial pits should be excavated by hand using power tools so that the materials in the various layers, as well as layer thicknesses can be properly distinguished. The use of a TLB to excavate trial pits is NOT RECOMMENDED

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Trial Pits

Trial pits are normally excavated to a depth of 1m. The detailed profile of the trial pit is then recorded, the various layers are demarcated using string, and a photograph is taken to show the full length of the profile

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Trial Pits

Samples for Indicator and CBR tests are taken from material from each of the pavement layers.

The trial pit is then backfilled in layers not exceeding 150mm, with thorough compaction of each layer. Cold-mix asphalt is then laid as a surfacing.

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Core samples

Coring machine and newly extracted core

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Core samples

Cores provide an accurate means of checking layer thickness, and laboratory testing can be carried out to determine void content, bitumen content and grading

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Core samples

Thorough investigation using cores !

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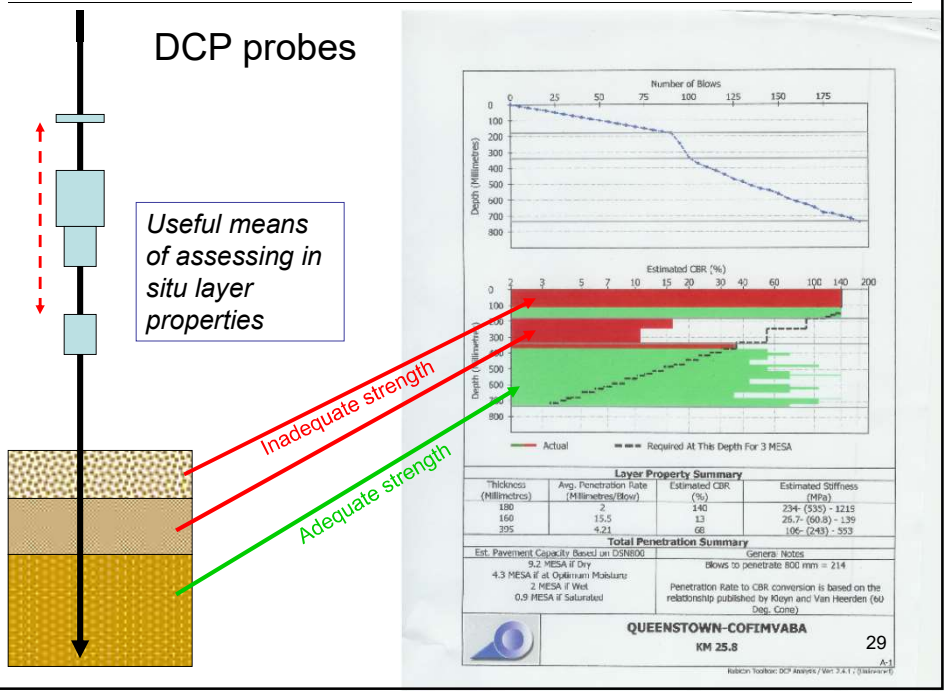
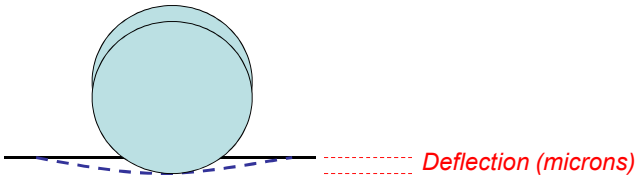
DCP probes



Deflection measurements

Methods:

- Benkelman Beam – maximum deflection
- La Croix Deflectograph – maximum deflection and deflection bowl
- Falling Weight Deflectometer (FWD) – max deflection and deflection bowl



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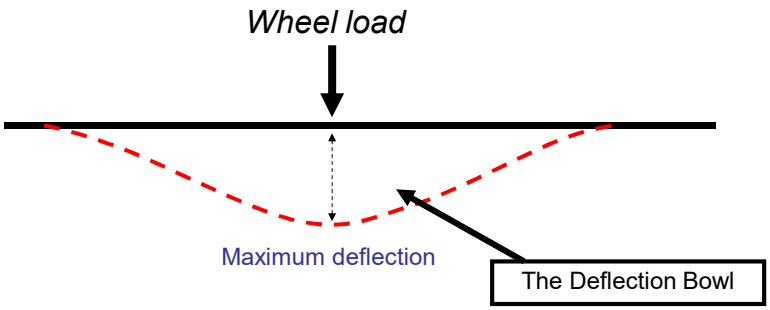
Deflection measurements



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Benkelman Beam

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Click Picture

La Croix Deflectograph

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Falling Weight Deflectometer

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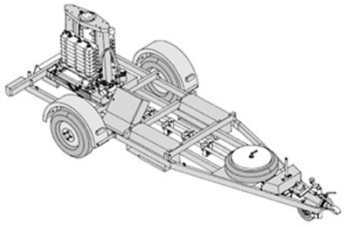
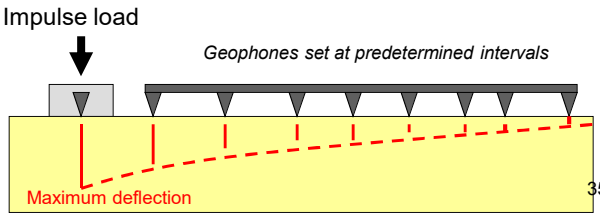
Click Picture

Deflection measurements

Falling weight deflectograph



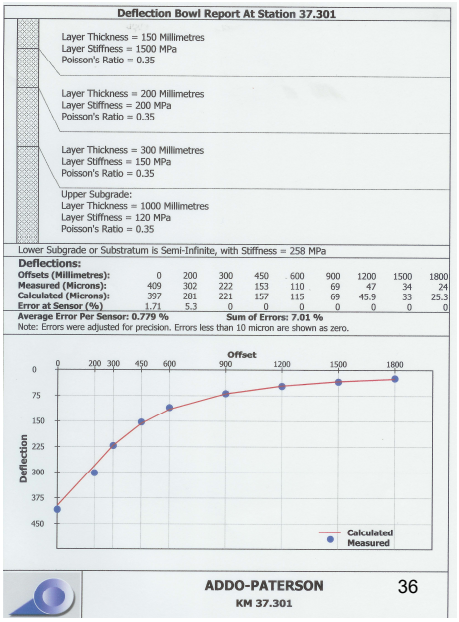


Deflection measurements

Deflection bowl analysis

The results of the deflection measurements can be processed to obtain the stiffness of the various layers in the pavement. This process is known as BACK CALCULATION

These results can then be used in a FORWARD CALCULATION process to estimate the structural design life of the pavement



Modern technology makes the job easy!

Laser bar takes rut depth measurements at frequent intervals

The road surface profiler enables rut depth and riding quality measurements to be taken along the project

A camera takes photos of the road in both directions at 10m intervals – the pavement condition can be reviewed in the office

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