GBG Australia

SUB SURFACE PROFILING

RTA - 2100km Sydney Metropolitan Network

Vic Roads - 260km Prince Hwy, Melbourne to Geelong

Vic Roads - Approach Ramps to Westgate Bridge

Newcastle City Council - 380km Council Pavement Network

Redland Shire Council (QLD) - 280km Council Network

City Link Consortium - Detailed Investigation of Tullamarine and South Eastern Arterial Highways

Sydney Airports Corporation Limited - Sydney Airport Runway and Taxiway Pavements Construction Profiling

FAC Brisbane Airport - Void Location Under Taxiways

Airplan - Tamworth Regional Airport Runway and Taxiway investigations

Moree Council - Moree Regional Airport Runway Pavement Investigation

P&O Botany - Container Terminal Pavements Investigation

Brisbane Ports Authority - Container Terminal Pavements Investigation

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applications for

SUB SURFACE PROFILING

Summary

Traffic speed radar investigations can enable the highway engineer to make better informed decisions by providing a better overview of the construction of the networks pavements and highlighting parts of a network requiring further investigation. The method has the following principle benefits and limitations:

Benefits

- Non Destructive.
- No or limited disruption to traffic.
- Can locate construction changes.
- Can resolve construction layers as thin as 40mm.
- Flexible reporting format.

Limitations

- Calibration needed for accurate depth measurement and determine of material type (generally required for base and sub base layers).
- Small scale features may not be resolved – therefore inappropriate to assess joints, map small voids or locate services at high speed.
- Effective penetration depth 800mm.
- Resolution of detail decreases with increasing depth.

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Non Destructive Techniques for

SUB SURFACE PROFILING OF PAVEMENT STRUCTURES

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GBG Australia is a specialist in applying non-destructive investigative techniques for assessment of buildings. We offer our clients innovative methods of revealing structural and condition information whilst minimizing both costs and disturbances of the site.

Company Expertise

GBG Australia is linked with one of the United Kingdoms foremost non destructive investigation companies – GBG UK Ltd. The UK partner has pioneered the application of shallow geophysical techniques to the precision investigation environmental sites and engineered structures in UK and Europe since 1982. Having been part of CMP-GBG with CMPS&F and GHD in the last 10 years, GBG Australia is now an Independent consultant company and the Australian office of GBG UK.

applications for

SUB SURFACE INVESTIGATIONS OF PAVEMENT

Faced with shrinking budgets and longer term 'ownership' of responsibility for maintenance, today's pavement engineer requires more information on the construction and condition of pavement structures than ever before. At the same time a premium has been placed on road access and the engineer must consider the impact of lane closures and traffic management schemes causing delays, incurring possible political and financial penalties.

Traditionally, subsurface construction information from pavements has been derived from cores or dips in the pavements. This is both costly in terms of traffic control and associated costs and it also only provides a point reference with what may be a 100m – 500m gap between data points. A lot can change in both construction and condition of a pavement in the distance between data points.

Within Europe and the USA, R & D in the application of Ground Penetrating Radar (GPR) for pavement investigation has been undertaken by the Highways Agency, TRRL and the SHRP programme. GPR is now an established method for pavement investigations carried out in both UK, USA and most of Europe.

The investigations and trials carried out by these bodies has established that GPR profiling can provide the following information:

- Pavement construction layer thickness
- Changes in pavement construction.
- Generic identification of construction materials,
- Location of buried utilities
- Condition information:
- Delamination between asphalt layers
- Failure of lower pavement layers
- Voids / areas of poor support.

Principles

Radar works by transmitting bursts of radio frequency pulses into the pavement. As each wave or signal passes through different layers its velocity changes and part of the signal is reflected back to the surface. The strength of the reflection mainly depends on the difference in propagation characteristics (dielectric constant) of the adjacent layers. The greater the difference the stronger the reflection.

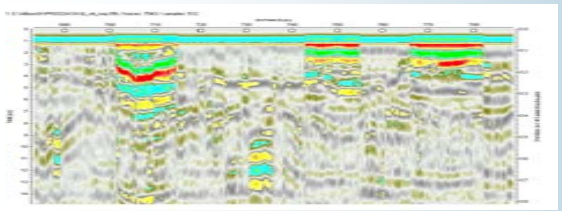
The radar fires pulses at fixed intervals as it passes over the road surface and records the strength, amplitude, frequency and travel time of the reflected signals. To convert this data into a cross sectional image of the pavement a calculation is made to convert the travel time of the reflected signal into depth, and interpretation is required to relate the changes in the data to actual material layers. This requires the use of powerful processing software by experienced personnel.

Detailed pavement investigations

Typically Data collection for detailed investigations is carried out at between 2-5Kph from a slow moving vehicle converted for specific pavement collection. The antenna are housed under the vehicle with the equipment and staff within the vehicle. The data is recorded digitally along with chainage reference information that is automatically logged from a digital trip system.

Methodology

Data is normally collected from both wheel paths and centre line although any combination can be undertaken. The subsurface profiles are normally collected using a mobile traffic control system in order to limit road user inconvenience and costs for investigation. Data can be collected according to specific road loc information from any Pavement Management System. Data may also be collected from multiple antenna frequencies in the one pass to provide overlapping information for cross correlation.



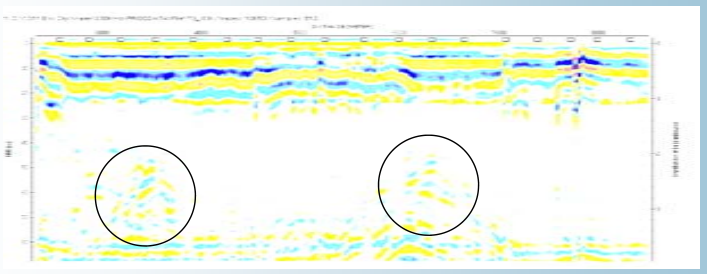
Radar profile showing amplitude variation from full depth asphalt patch repairs indicative of delamination of asphalt layers.

Core taken at location referenced from radar data showing clear delamination between asphalt layers.

Detailed investigations provide high resolution subsurface imaging with scan samples at 10-20mm intervals. This degree of resolution is required to supply the following information.

- Construction layer thickness and construction changes
- Asphalt condition
  - Delamination/raveling
  - Changes in dielectric properties (variations in void content)
  - Failure of base layers
  - Cracking within the base layers
- Void location, Areas or poor support
- Unbound layer thickness, base or sub-base layers.
- Variations in the moisture content within unbound layers
- Location of "floaters" large rock boulders within the sub-grade close to pavement construction layers.
- Location of utilities

Data is normally supplied as either; longitudinal or transverse sections or plan views in a CAD format either as hard copy drawings or as electronic files.



Radar profile showing voids / swallow holes 1.2m below pavement

Scheme or Network Traffic Speed Pavement Surveys

Logistics

Investigations are typically conducted from an appropriately marked vehicle using digital radar systems with the ability for multiple antenna configurations. The antenna are mounted in front or under the vehicle and maybe air coupled for ease or use at high speed or ground coupled for better resolution at depth. The ground coupled system is mounted within 25mm of the pavement surface (less than one tenth of a pulse length). This enables working speeds of up to 50 kph to be achieved.

The resolution of pavement features depends on the sampling rate of the system, which is controlled by the scan rate of the radar and the travel speed of the vehicle. At 50-60 kph the typical sample rate is 1 san every 0.2m. A minimum of 6 scans are required to resolve a subsurface feature. Therefore, features smaller then 1.2m lateral extent may be missed.

The radar data may be referenced to standard section lengths provided by the client. The use of automated distance measuring and sampling rate adjustment systems enables a high level of relocation accuracy, typically to within +/-1m at 50 kph.

Careful preparation is essential in order to simplify data collection and get it right first time. GBG Australia follows a standard quality process to ensure that sufficient location information is available prior to the investigation. Wherever possible, the client should clearly indicate sections to be investigated with start and end points on either maps or in tabular format (i.e., output from asset management database).

GBG Australia is committed to the principle of presenting the results of an investigation in the format most suited to the clients needs. Generally high speed network data is presented in a tabular, database format for inclusion in an asset register. Data can also be presented in a graphical format as longitudinal sections can provide a better combination for detail and perspective. All formats can generally be provided in hard copy and/ or electronically.

Because of the lower subsurface resolution from high speed surveys the amount of information available from this type of service is limited to the following:

- Bound construction layer thicknesses (partial unbound thicknesses can be achieved in certain pavement and soil types).
- Construction Changes
- Overview information of variations in condition (can be used to target more detailed investigation work)