GBG Australia

SUB SURFACE PROFILING

2100km Sydney Metropolitan Network. RTA.

260km Prince Hwy, Melbourne to Geelong. VIC Roads.

Approach Ramps to Westgate Bridge. VIC Roads.

380km Council Pavement Network. Newcastle City Council, NSW.

280km Council Network. Redland Shire Council, QLD.

Sydney Airport Runway and Taxiway Pavements Construction Profiling. Sydney Airports Corporation Limited (2005).

Western Distributor NSW, pavement condition and location of reinforcement. RTA (2005).

Windsor Road Upgrade, pavement investigation. Northwest Connect Alliance (2005).

Townsville Airport, QLD, bitumen pavement condition investigation. Connell Wagner (2006).

Detailed Investigation of Tullamarine and South Eastern Arterial Highways, VIC. Citylink Consortium (2007).

Location of layer changes and depth of asphalt on the Monash Freeway, Victoria. Geopave (2007).

Subsurface investigation of dipping structures on sections of Ryde Road, Sydney, NSW. Transfield Services (2007).

Eastern Distributor NSW, pavement condition of southbound carriageway. Maunsell (2008).

Mackay Airport QLD, bitumen pavement condition investigation of main runway . SKM (2008).

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Applications for

SUB SURFACE INVESTIGATIONS OF PAVEMENT STRUCTURES

Information available from sub surface profiling

Construction layer thicknesses

Construction layer changes

Asphalt delamination and condition

Failure of base layers

Cracking within base layers

Variations in void content

Void location or areas of deconsolidation

Unbound layer thickness, base or sub-base layers

Variations in moisture content within bound and unbound layers

Location of floaters or large boulders within the sub-grade

Location of utilities

GBG Australia

Non Destructive Techniques for

SUB SURFACE INVESTIGATIONS OF PAVEMENT STRUCTURES

GBG Australia

GBG Australia is a specialist in applying non-destructive investigative techniques to a wide range of environmental and engineering applications. Employing engineers and geophysicists of considerable experience, GBG provides advanced subsurface solutions using a variety of non-destructive and geophysical techniques. The non-destructive profiling of pavement structures using Ground Penetrating Radar (GPR) has been successfully undertaken by GBG for over fifteen years.

Company Expertise

GBG Australia is a subsidiary of the GBG Group, a multi-national company specialising in the application of geophysical and advanced applied physics for precision investigations of geotechnical, environmental sites and engineered structures in UK and Europe since 1982. GBG has had a presence in Australia since 1993 originally through a joint venture with CMPS&F and GHD before becoming a stand alone company in 2003, operating in three main areas of business; geotechnical and environmental investigations and non destructive investigation of structures and contracting of staff and / or equipment for data collection or processing and interpretation of data.

GBG Australia is an independent provider of non destructive and shallow geophysical investigation services with applications ranging from the location of a single pre-stressing strand in a concrete slab to mine scale exploration geophysics. With clients ranging from Local to Federal Government, and from developers and engineering companies to private individuals, we can provide tailored solutions to your particular subsurface investigation requirements.

Applications for

SUB SURFACE INVESTIGATIONS OF PAVEMENT STRUCTURES

Traditionally, subsurface construction information from pavements has been derived from cores or dips. This is both costly in terms of traffic control and associated costs but also only provides a point reference with what may be sometimes a considerable 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, research and development in the application of Ground Penetrating Radar (GPR) for pavement investigation has been undertaken by the Highways Agency, TRRL and the SHRP program. GPR is now an established worldwide method for pavement investigations.

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 emits 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

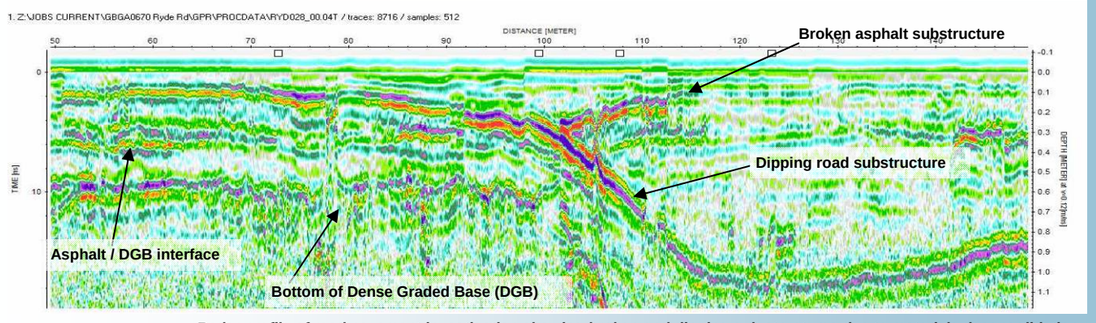
Typically, data collection for detailed investigations is carried out between 2 and 5 km/h from a slow moving vehicle converted for specific pavement collection. The antennae are housed behind the vehicle with the equipment and staff within the vehicle for safety and quality control purposes. The data is recorded digitally along with chainage reference information automatically logged from a digital trip system.

Methodology

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

Results

Data is normally supplied showing selected longitudinal or transverse sections, plan views in a CAD format and a detailed formal report presented in either hard copy or electronic files.



Radar profile of road pavement investigation showing broken and dipping sub structures due to materials deconsolidation

GPR INVESTIGATION OF PAVEMENT CONDITION OF THE MAIN RUNWAY AT MACKAY AIRPORT, QLD.

Aim

The aim of this investigation was to determine bitumen pavement construction, layer thicknesses and condition information and in particular, the extent of delamination and stripping of the upper layers of Main Runway 14/32 at Mackay Airport, Mackay, Queensland. The information gathered was to be used for the future planning and maintenance works of the main runway.

Methodology

Three antennae were used to achieve a combination of shallow high resolution and deep depth of penetration. The new GSSI 2.0 GHz horn antenna provides the highest layer resolution available for pavement assessment, and was supplemented by a 1.6GHz and 900Mhz conventional ground coupled antennae to provide information about deeper layers. The depth of penetration for these antennae were 0.3, 0.4 and 1.5 m respectively. The 2.0 GHz antenna was mounted at the front of the vehicle whilst the 1.6 GHz and 900 MHz ground coupled antennae were deployed inside a wheeled trailer at the rear of the vehicle.

The total length of the 3 km long runway was investigated at 2.5m spacings resulting in a total investigation distance of over 57 km.

4WD with GPR system, ground coupled antennae are towed in the trolley behind, whilst the airhorn antenna is mounted at the front.

Results

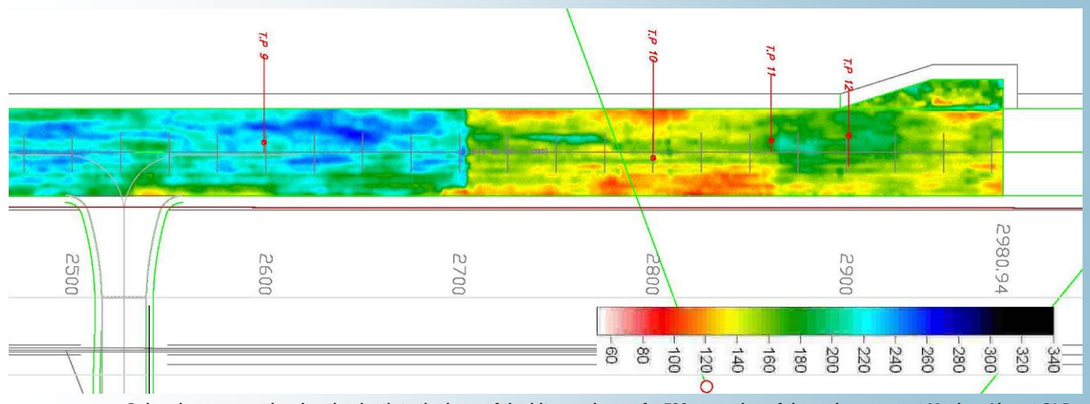
Core hole drilling was conducted along the runway prior to the GPR investigation. These core holes provided correlation between real time depths and the estimated depth domain as well as gaining a physical insight into the runway's construction.

Construction profile drawings together with an in-depth report were supplied to the client as they conveyed the radar data and layer properties with greatest ease and functionality. Along with construction profile drawings and the report, a contour plan of the entire runway was supplied which showed total Bitumen-Concrete (BC) depth.

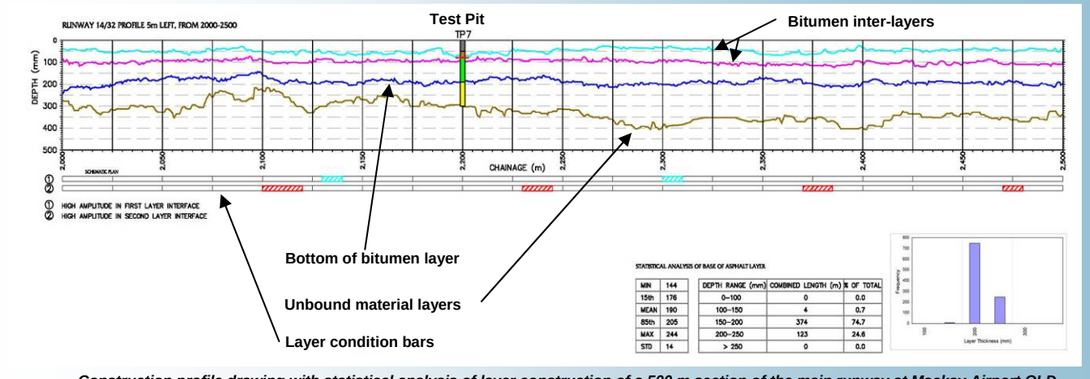
Conclusions

From this investigation, GBG Australia was able to plot the construction profile across the entire runway. It was found that most of the runway bitumen pavement is approximately 200mm thick and the ends of the runway are significantly thinner at approximately 150mm thick.

The GPR results found areas of high signal amplitude reflected from the top bitumen interface. The extent of the area affected is approximately 10% of the total area of the runway. The southern half and the outer edges of the runway appear to contain a greater extent of high signal amplitude. The conditions leading to a high amplitude response in the top layer may be extremely variable and dependant on the interaction between surface cracking, delamination and stripping.



Colour image map showing the depth to the base of the bitumen layer of a 500 m section of the main runway at Mackay Airport QLD.



Construction profile drawing with statistical analysis of layer construction of a 500 m section of the main runway at Mackay Airport QLD.