GEOSOLVE

Multi-Speed Deflectometer

An innovative tool for local authority network asset management

And pavement structural testing at remote sites .

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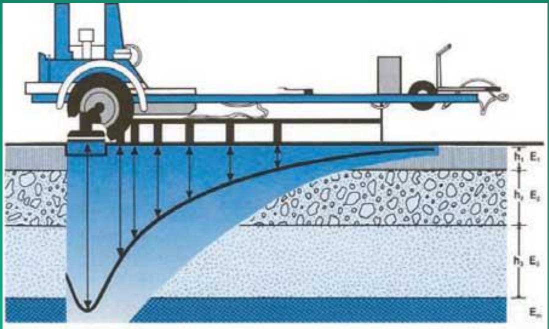
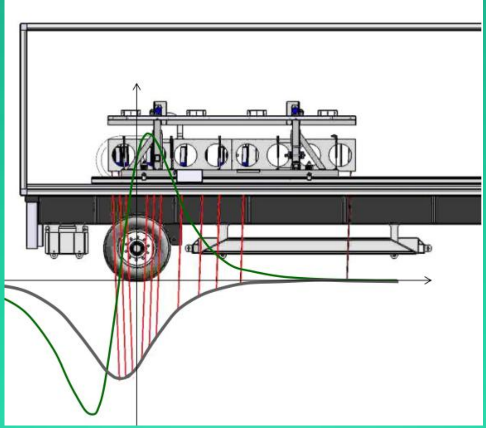


Falling Weight Deflectometer



Traffic Speed Deflectometer

What is the MSD?

The Multi-Speed Deflectometer (MSD) is a new, innovative technique for determining pavement structural capacity and remaining life, at normal traffic speeds. It combines the efficiency and continuity in relation to testing speed and test spacing of the Traffic Speed Deflectometer (TSD) with the compactness and reliability of the Falling Weight Deflectometer (FWD) or HWD

Like the TSD, the MSD is for high speed network screening (or project level at low speed). The MSD captures multiple images of the pavement surface during passage of a standard axle and also collects data from multiple sensors, averaging the results to 10 m or 20 m intervals, enabling a near-continuous profile of pavement structural life

Where to use it

The MSD is not normally intended for use on highways with high structural capacity (i.e. high-volume roads) because these require the greater resolution obtained from FWD or TSD. However, on occasions, the TSD can be affected by significant instability, in which case the MSD can be used to correct such anomalies. The MSD is ideal for most low volume roads with chipseal or thin AC, and can even be used on some types of unsealed roads and is therefore particularly useful for local authorities requiring effective asset management for a large network as it combines manoeuvrability, reliability and availability with collection of pavement structural data at minimal cost. Other applications are on grassed areas such as runway margins where the nature of the support requires characterisation.

For highways or heavy duty pavements at remote sites, the MSD used at slow speed, can provide a useful and much more cost effective alternative to mobilising FWD or HWD, provided a suitable heavy vehicle can be made available for equipping with the instrumentation. By using slower speeds, heavier loads and averaging multiple readings for each required HWD test point, suitable resolution for effective design of heavier duty flexible pavements can be achieved.

Testing

The testing vehicle can be readily equipped with sensors on each side, collecting structural data from both wheel paths of low volume roads. Additional sensors can be added for simultaneous high-speed surface condition data (rutting, roughness, cracking, macrotexture and skid resistance). Where roads are found to have more than 25 year's life, no further investigations are likely to be warranted. Where roads are found to have minimal life from the preliminary screening with MSD, more costly testing and analysis (eg traditional deflection testing) need be applied just to those sections of each road which are identified as critical. The outcomes are Forward Work Programmes using mechanistic methods for informed asset management without the inconvenience of traffic control and substantial cost savings for local authorities.

Background

The TSD provides a remarkable advance in pavement engineering, yet in some cases it has been made available only in mid summer when pavement conditions are usually at the wrong extreme as far as meaningful deflection characteristics are concerned. The length of the TSD vehicle is not practical for many minor roads, while the shortness of the MSD enables access almost anywhere and in any weather conditions. In some surveys, systematic anomalies in TSD data have been observed, and these tend to be for data collected over a limited time interval, but can include many tens of kilometres. The MSD can however provide an approximate indication of the likely change in characteristics between summer and winter conditions, or enable systematic anomalies to be corrected. MSD equipment is now based permanently in the country. Also, where TSD testing is usually carried out on the outer wheelpath, the MSD sensors can be adapted to estimate the relative structural capacity of the inner wheelpath relative to the outer, thus enabling improved characterisation of any route at minimal additional cost.

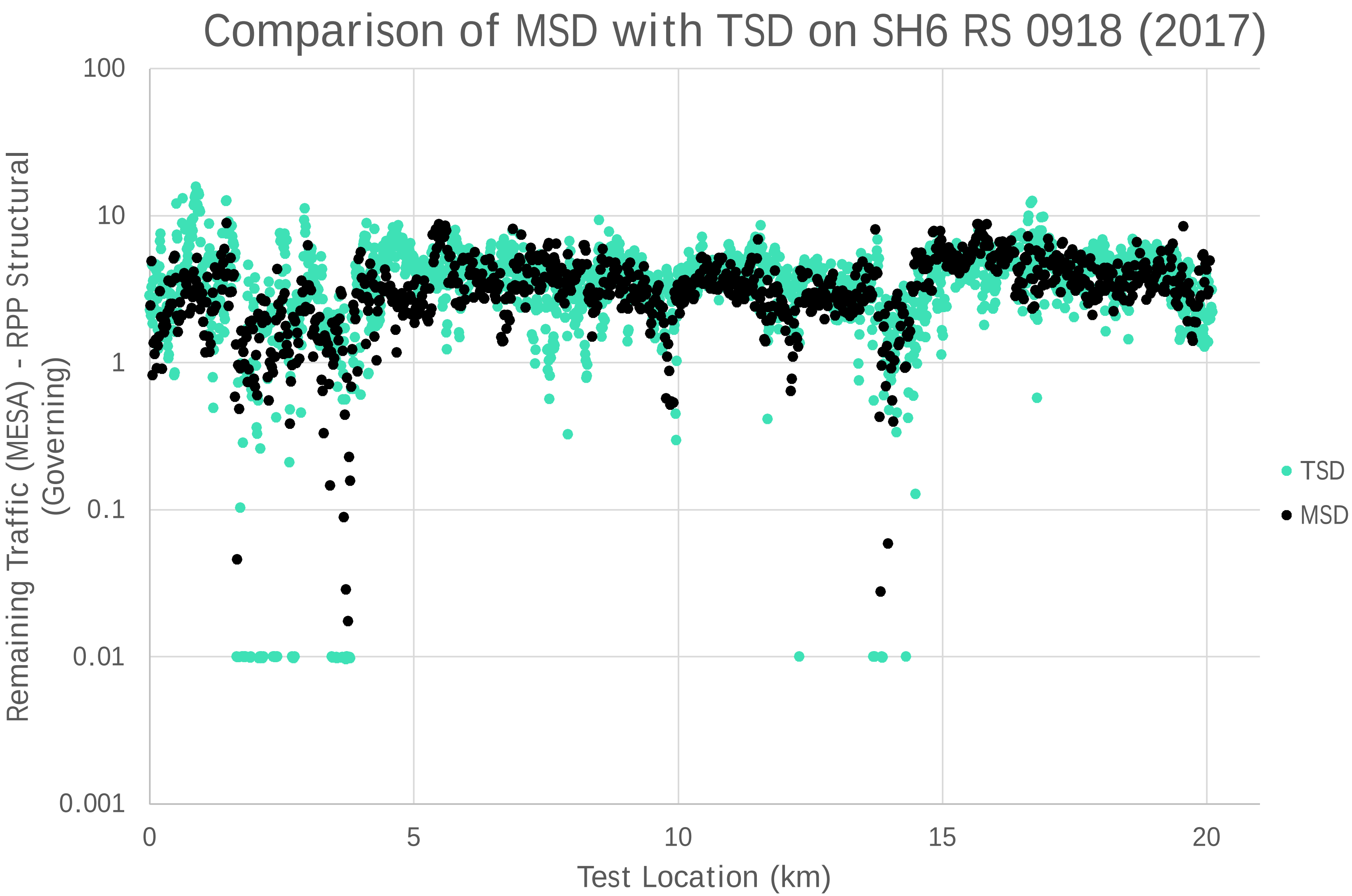
Loading

The MSD can be used with the loaded axle having either dual wheels or single wheels (including heavily loaded large singles, or super singles). By using different widths of the loaded area, the layer in which distress is likely to develop can be identified ie separating deformation in the pavement layers from that originating in the subgrade. The MSD sensors do not measure deflections in the manner of the FWD or the TSD. Effectively, the collective response to a given load and wheel assembly form a “signature” which is correlated either to FWD/TSD or directly to pavements where structure, traffic and performance (distress mode and severity) are known. Results are averaged over each 10 m section of pavement and directly correlated to remaining life (determined from TSD or FWD) in terms of Equivalent Standard Axles.

Correlation

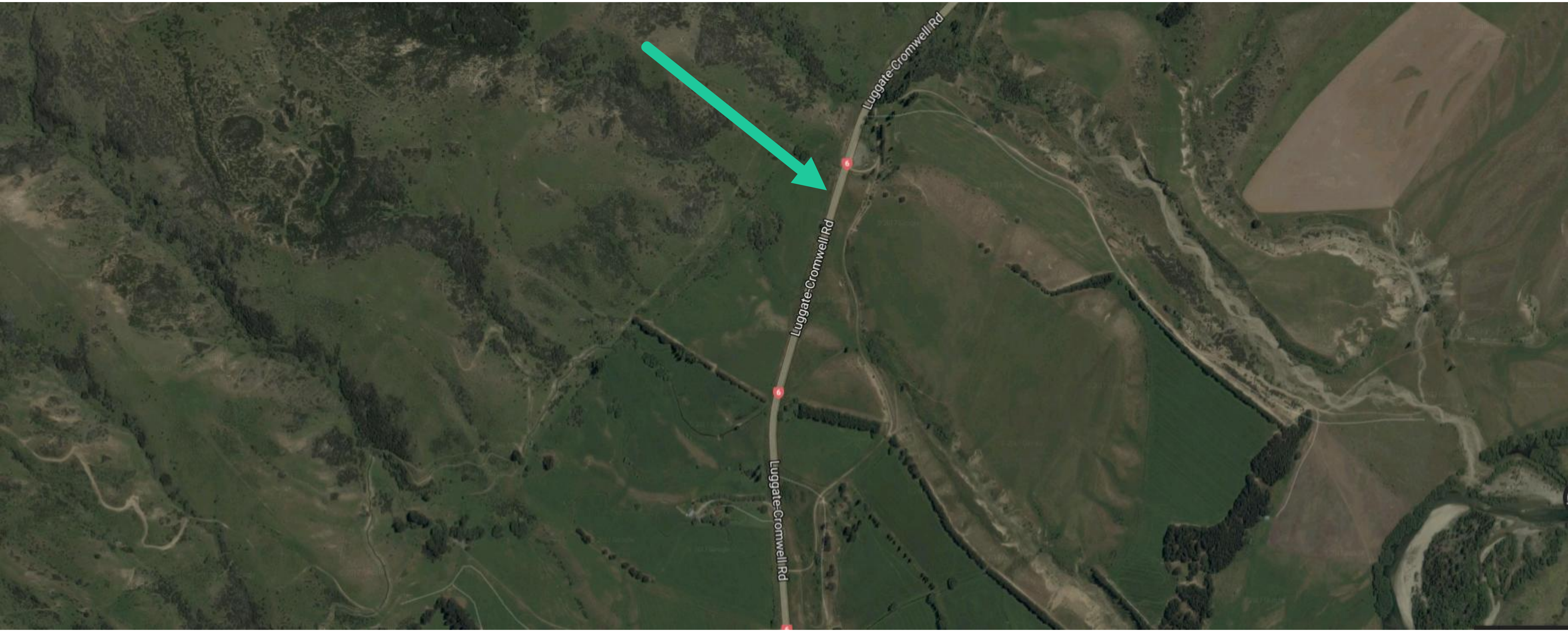
The correlation is obtained from a large database of FWD and TSD recordings which have previously been related to a wide variety of pavements inspected when in a terminal state (due for rehabilitation and analysed in terms of precedent performance in the region). Subsequently using the yearly heavy vehicle traffic volume, the remaining structural life (in terms of years) is generated, as well as likely overlay thickness to achieve 25 year's structural life. Alternatively correlations can be provided with any of the empirical parameters used in conventional deflection testing.

Another important benefit is that the closely spaced readings allow far superior sub-sectioning into homogenous structural treatment lengths than normally achieved with network level testing, hence a more meaningful forward work programme can be produced.



Comparison of MSD with TSD on SH6 RS 0918 (2017)
Remaining Traffic (MESA) - RPP Structural (Governing)
100
10
1
0.1
0.01
0.001
0
5
10
15
20
Test Location (km)
TSD
MSD

Most of the 20 km RS does have moderate remaining life, ie 2 million ESA. The first interval (Ch 4km) with limited capacity on the previous slide correlates with an area of increased irrigation which can hence be expected to deteriorate rapidly in the irrigation season.



The second interval (Ch 14km) with limited capacity also correlates with an area of increased irrigation. Both TSD and MSD highlight the same issue, but it may be that this is only a brief seasonal effect. Otherwise rehabilitation will be inevitable.