AIRFIELDS

High-speed measurement of airfield pavement condition

Alex Wright
Group Manager, Technology Development and Quality Assurance, TRL .

The last ten years has seen a significant growth in the application of high-speed techniques for the measurement of surface condition on the UK road network. This began with the development of the HARRIS1 survey vehicle at TRL, which took high-speed image collection equipment and applied this to the automated measurement of surface cracking. Laser systems were added to measure shape, and hence rutting and ride quality, to give a fully functional high-speed condition assessment system, see Figure 1. The developments demonstrated in HARRIS1 were used as the basis for the specification for the Highways Agency's TRACS survey of the motorway and trunk road network. This was later expanded to local roads under the SCANNER survey. Combined, these high-speed techniques now cover over 100,000km of the UK road network each year.

The introduction of high-speed survey techniques on the road network was stimulated by the need for an objective measurement of surface condition, which could be undertaken without the need for road closures. On the highway network the traffic-speed data is typically processed using standard algorithms to obtain parameters describing the surface condition in terms of the ride quality, cracking, rutting and texture. These parameters may be combined to obtain an overall condition for each 10m length, expressed as a defect index. Highway engineers can use this information in an initial sift of their network, including the identification of potential schemes, before targeted assessments are undertaken of those lengths short-listed for further attention. The data can also be used in the calculation of network performance indicators.

Whilst high-speed techniques are widely applied on the road network, these methods have only recently been introduced for the assessment of airfield pavements. Surveys of the visual condition of airport pavements are typically undertaken manually, by inspectors carrying out surveys on foot to record the presence, extent and severity of defects. Standard distress types assessed in these surveys include cracking, bleeding, erosion, patching, polishing, ravelling, rutting and shoving, on flexible pavements. On concrete pavements the survey includes common defects such as cracking, joint sealant defects, pumping, spalling, pop outs and faulting. Each defect is assessed in terms of area or number of occurrences, and severity of each occurrence. This quantitative information is typically combined in an airfield Pavement Condition Index (PCI).

In common with highways, manual surveys of airfield pavements are slow and intrusive. Carrying out such surveys is becoming increasingly difficult as access to operational areas can be limited. The surveys are also subjective and can suffer from poor repeatability. Comparability of survey results across different survey teams can be poor. These surveys also place the inspectors at risk if carried out during operational periods.

High-speed survey methods can be applied in the assessment of airfield pavements at two levels of intensity. A basic application of the high-speed technique can be made by direct transfer of the technology from the road network. Here surveys can be undertaken on lengths of airfield pavements to obtain the rutting, ride quality and cracking information in order to calculate a defects index that estimates the overall condition of particular lengths of pavement. This data can be used in the general assessment of condition to target lengths for further investigation. However, it must be accepted that this automated approach can only provide an estimate of condition. This approach can assist airfield engineers in obtaining a general level of information, but manual surveys would still be required to obtain detailed condition data or for critical areas – for example to plan maintenance, or where there is a need to minimise the risk of pavement defects causing FOD (Foreign Object Debris or Damage).

High-speed survey techniques can also be used to directly replace slow-speed manual surveys, by carrying out more detailed investigation of the data collected by the survey vehicle. In this application the image data is assessed manually after the survey, to record the area and severity of defects. The condition data is provided at a high level of detail for each defect, and can directly feed the quantitative assessment of the condition of the surveyed site. The capability of the method can be enhanced by using the newest generation of survey vehicles, such as

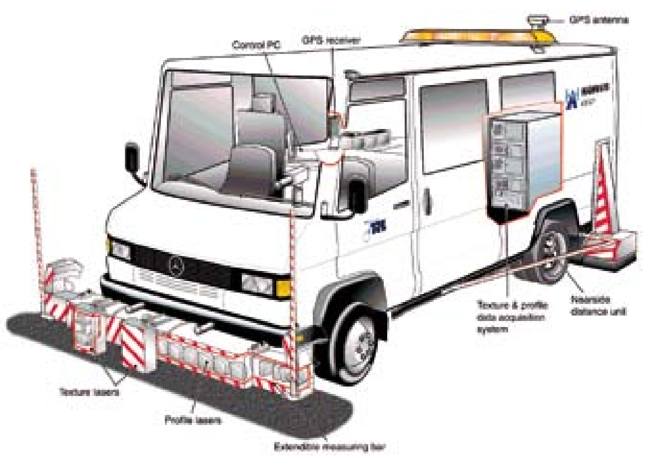

Figure 1: The HARRIS1 survey vehicle

Figure 2: The HARRIS2 survey vehicle

Figure 3: Surface images collected at traffic-speed

HARRIS2. This HARRIS2 employs the latest developments in high-speed data collection, providing high-resolution colour images of the pavement, linked to a scanning laser for the measurement of shape – see Figure 2. The example images shown in Figure 3 clearly show the defects such as joint failure, spalling, and surface loss, which are easily recorded in the manual assessment.

One of the limitations of high-speed image collection systems has been the inability of images to show depth. Although an assessment of the images can provide a report of the presence of defects such as spalling or potholes, the assessor is unable to quantify the depth, and hence the overall severity, of the defect. High-resolution laser measurements provide a three-dimensional picture of the pavement alongside the images, which can be used to assess depth and height. Tools can also be provided to assist the assessor by automatically highlighting severe features, as shown in Figure 4.

Clearly this technique can only be applied practically if the data can be accurately located in relation to the airfield. Developments in inertially aided Global Positioning Systems have simplified the achievement of highly accurate location referencing. The data collection has therefore become the simple process of driving over the areas to be assessed, ensuring that the survey is planned such that the vehicle covers the entire area (for example using several passes each covering a 4m width).

The potential of this approach has recently been demonstrated on the concrete taxi-ways of a major UK airport. Image, shape and location data was collected at high-speed (around 40km/h) and manually analysed following the survey. The defects identified in a 60m x 40m area are shown graphically, as a defect map, in Figure 5. The number and variety of defects identified can be structured to suit individual client needs. Because each defect is related to its Ordnance Survey Grid Co-ordinate it is a simple matter to transfer the defects to a GIS for further processing and, for example, calculation of a PCI.

Work on the highway network has shown that this approach to the assessment of high-speed survey data can provide a measurement of condition that compares directly with manual on-site surveys. However, the surveys are more consistent and less hazardous than the manual surveys, and they provide the additional benefit of delivering a permanent visual record that can be used later for auditing, assessing changes in condition, or determining treatments. With the increasing demand for airfield and runway space, combined with the need to achieve high levels of safety, there is significant potential for the application of this approach in the assessment of airfield pavements.

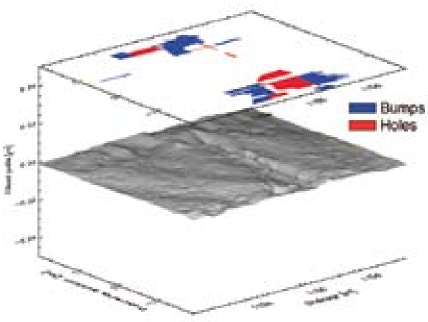

Figure 4: Surface shape measured at traffic-speed

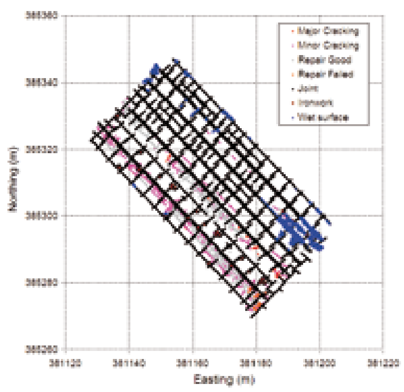

Figure 5: Map of defects identified in high-speed survey data

Cargo Stands Replacement Project at London Luton Airport

In partnership with Lagan Construction, WSP have recently completed a design and build airfield pavement project for London Luton Airport Operations Ltd. The project consisted of a total of 14,000m^2 of new Pavement Quality Concrete to accommodate concurrent operations of two A300-600 freighter aircraft and their associated ground service equipment.

The construction of the works, required to facilitate the move of part of the business aviation facility, had to be phased in order to maintain the continued operation of the adjacent cargo operation and was completed within the programmed 12 week construction period.

The replacement pavement areas, consisting of 335mm thick Pavement Quality Concrete on 150mm of wet lean concrete, was constructed by Lagan sub-contractor Gill Civil Engineering utilising an on-site batching plant with quality control assured by Lagan's on-site materials testing laboratory.