

# A lighter load

The latest weigh-in-motion solutions are easing the burden on those involved with bridge protection and long-term maintenance

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Highway bridges are an important part of the transportation infrastructure and they represent a major investment for society. Overloaded vehicles inflict great stresses on the structural capacity of bridges. Furthermore, safety levels at bridges are expected to be higher than in other parts of the transport system, and failure of a bridge could have severe consequences in material damage and human lives. According to US Government Accountability Office data, more than 151,000 bridges in the USA – or 25% – were classified as structurally deficient or functionally obsolete in 2012. Implementing monitoring techniques in different forms can save costs by protecting and improving the understanding of the structure.

Weigh-in-motion (WIM) systems play a key role in bridge protection and monitoring by providing accurate vehicle weight data both in advance of a bridge and on the structure itself. This data is used by enforcement agencies for bridge overload detection. It is also used by bridge experts as traffic data for loading assessment.



IRD's WIM scales and sensors are designed to accurately capture and record vehicle classification, speed, axle weights and gross vehicle weights as vehicles travel across the WIM location. This makes the weighing process more efficient, and in the case of commercial vehicles, it also allows for the pre-screening of overloaded vehicles at bridges.

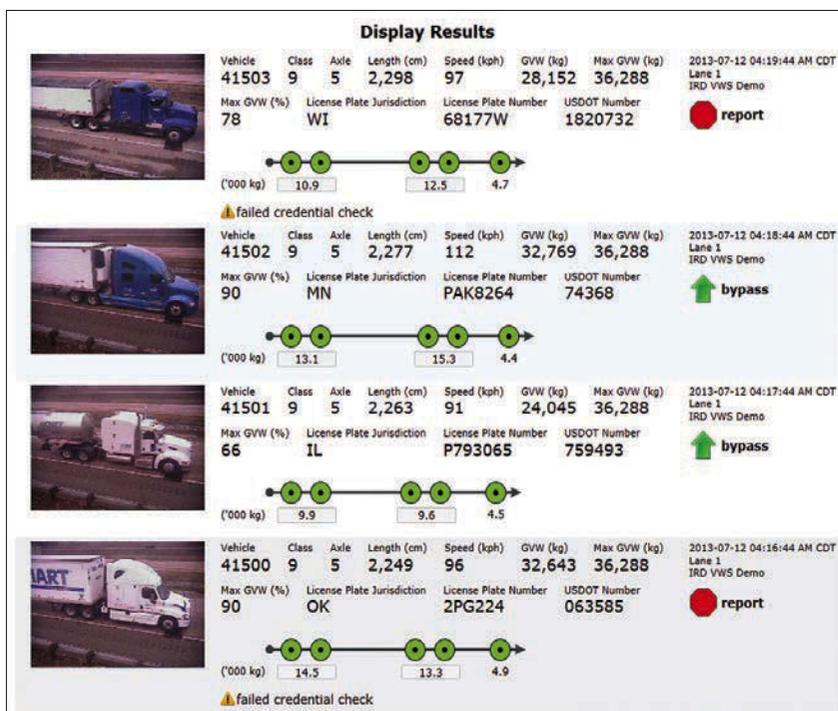
## Bridge overload detection

In the USA, the replacement of bridges costs transportation agencies billions of dollars. With ageing transportation infrastructure, decreased highway budgets and reduced resources, preservation and maintenance of roads and bridges is a top priority. Programmes for protecting road infrastructure are currently in place and these include the deployment of technologies to capture vehicle weight and identification for the purpose of screening non-compliant commercial vehicles.

The benefits of such an enforcement-based approach are numerous. The most obvious gain is the protection of road and bridge structures against premature damage due to overweight vehicles. Better identification of potential violators, leading to more efficient enforcement, is another key benefit. The knock-on effect is increased resources to focus on safety issues. Finally, better data collection enables improvements in road and bridge design.

Technologies such as WIM scales/sensors in combination with vehicle dimensioning detectors, overview cameras, numberplate readers, signs and gates assist enforcement agencies to automatically identify overloaded and over-dimension vehicles while they are approaching a bridge. These bridge overload systems provide vehicle records for enforcement, traffic surveillance and/or data collection in real time over a computer network connection to a laptop, tablet, mobile device or

(Below) **Real-time vehicle display for WIM system** (Above, right) **Vehicle identification via numberplate**





**Advisory signs rely on bridge overload data**

workstation computer. Such systems enable enforcement personnel to identify overweight and over-dimension vehicles and capture vehicle image and numberplate. Operators can then automatically divert overloaded vehicles by using message signs or activate a gate to deny them access onto the bridge. These systems continuously monitor commercial vehicles crossing a bridge and enable enforcement agencies to determine the non-compliant vehicles.

IRD's bridge overload systems collect vehicle records and allow authorised users to view the vehicle records via a web browser. In real-time display mode, the most recent vehicles to pass through the system are displayed. Each vehicle record displayed can include vehicle image, number of axles, vehicle classification, overall length, speed, individual axle weights, gross vehicle weights, date and time, and weight screening decision (compliant or overloaded). If the system is equipped with a numberplate reader, the plate number and jurisdiction will also be recorded and displayed on the WIM display.

Once a vehicle is identified as at risk of being overloaded, the bridge protection system will use advisory signs (flashing static signs or variable message signs) to automatically advise the targeted vehicle to make a detour. The message is communicated early enough that the driver has ample time to follow an alternate route.

**Traffic data for loading assessment**

WIM scales/sensors installed in advance of the bridge or on the bridge deck provide valuable data to assist in estimating the operational life of the bridge. The vehicle weight/load data along with structural health monitoring data (vibration and deflection) offer bridge inspectors and experts the ability to determine the load and response of a bridge. Instrumenting bridges with WIM and structural health monitoring devices provides an effective and reliable means of bridge health evaluation, which plays a key role in maintenance and rehabilitation.

The Shenzhen Western Corridor and Stonecutters Bridge in Hong Kong have incorporated IRD's WIM technology with a number of other bridge sensors for monitoring the condition and performance of the structures. The instrumentation allows for the monitoring of structural performance and applied loads and helps facilitate the planning of inspection and maintenance. It also validates design assumptions and is useful in updating and revising vehicle design manuals and standards.

IRD's WIM systems have provided valuable data for major bridge projects, and they play a role in the ongoing protection of bridge structures. Accurate traffic data allows for bridge inspectors and experts to determine changes in traffic volumes, classification and weights for future bridge design. ■

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