

Sink or SSWIM

Why is weigh-in-motion used at toll stations? **Rish Malhotra** has the answer

Commercial transport trucks derive their revenue by transporting goods on highways. Thus, if they are hauling heavy cargo they will maximize their return and load to the legal weight limit and in some cases may be overloaded. Modern highways and toll operators screen truck weights to avoid the damage caused by overweight trucks and the corresponding maintenance costs. Further, recognizing the economic benefit to the truckers, the highway operator, through the toll system, can charge trucks a toll based on their axle and vehicle weight.

International Road Dynamics Inc. (IRD) has developed a Weigh-In-Motion toll system (WIM@Toll) that allows highway operators and concessionaires to charge trucks based on truck weight. WIM@Toll facilitates a toll charge based on the economic value the highway provides to commercial vehicles, charging more for heavily loaded trucks and less for light or unloaded vehicles. In addition, it provides a means of screening for damaging overloaded vehicles.

The concept of WIM has a long history in data collection applications in transportation infrastructure planning. This has expanded to use in enforcement for sorting compliant from violating vehicles to increase the throughput and ease congestion at inspection stations. The wear and tear on pavements, bridge structures, and other components of the transportation infrastructure caused by an individual vehicle is related to the weight of that vehicle or axle. In fact, as gross vehicle and axle weights increase, the damage to highway and bridge infrastructure increases exponentially, as was concluded by the American Association of State Highway Officials (AASHTO) highway study. An increase in loading thus results in an exponential increase in the acceleration of road damage. WIM systems installed by



IRD's PAT Bending Plates installed in toll lanes at a toll plaza in Fujian province in China. IRD's WIM@Toll system is installed at this site before vehicles cross the Xinglin bridge in Xiamen

IRD combat road damage by providing accurate data for traffic planners and by identifying overloaded trucks.

WIM FOR TOLL STATIONS

IRD uses its Intelligent Sensor Interface and Network Controller (iSINC) to control WIM systems at tolls. The iSINC is a CE certified roadside electronic control unit with hardened electronics

suited to outdoor applications over a wide temperature range. While the iSINC is used for toll system operations, it also has applications in traffic monitoring and data collection, automated weigh station operations and traffic security systems. The iSINC controller is modular and can simultaneously connect with a variety of WIM sensors and toll system peripherals. The peripherals include lane >>>

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control signs, traffic lights, axle sensors, single and dual tire sensors, vehicle presence detectors, fare display signals, automatic vehicle identification (AVI) systems, camera systems, dimensioning sensors, toll barrier gates, communication systems and credential databases.

At toll stations IRD integrates its Slow Speed Weigh In Motion (SSWIM) scales or PAT Bending Plate WIM scales to the iSINC controller. IRD is a system integrator and is able to deploy various transponder based solutions including radio frequency identification transponders as well as passive and active microwave transponder solutions.

WEIGHING STRATEGIES

In order to change to a toll strategy that charges by weight and penalizes overloading, it is necessary to both weigh and classify vehicles. There are three main options for doing this.

The first is to have static weigh stations on the toll way. While being the most accurate, this method has a number of drawbacks. Vehicle throughput is very slow, resulting in delays and congestion. It requires an additional large infrastructure investment and staff to build and man the weigh station. The departure from the weigh station and merging of heavy vehicles with the main traffic stream poses a safety hazard. Thus, the GVW accuracy of the static weigh stations, though being the best, comes at a high initial investment and equipment cost to the buyer. The added cost to the user also includes the delay and slow down caused by the time taken by the traditional scales to calculate the GVW.

A second option is to have high-speed WIM lanes on the roads or toll way. This requires identifying all heavy vehicles at highway speeds with transponders or license plate recognition (LPR) cameras for vehicle tracking and recognition.

The third option is to have SSWIM lanes at toll plazas. This could be either



IRD's WIM@Toll system installed in Mongolia using IRD's slow speed WIM scales. IRD's system also includes automatic vehicle identification (AVI) using RFID transponders and readers

each lane of the toll plaza or a number of exterior lanes at a toll plaza depending on the traffic flow and usage. This method integrates the weighing operation into the normal toll collection process at the plaza. The WIM operation requires little additional delay. When combined with electronic toll collection (ETC), this system can process the majority of vehicles without stopping, while still allowing manual collection from vehicles that have not subscribed to the ETC program. The efficiency is significantly increased by having some WIM toll lanes reserved for ETC vehicles only.

WIM@TOLL PROJECTS USING ETC

In India, IRD has installed its SSWIM solution at toll plazas on the exterior extra wide lanes. Introducing low-speed WIM lanes at toll plazas assists the overall weighing operation by offering a significant reduction in delay in comparison to using static weigh stations on or before the toll ways, as well as in comparison to using high speed WIM on highways while attempting to identify all vehicles. While India does not have

an enforcement policy yet via legislation, IRD's SSWIM systems are being used for data collection and, in future, will provide tremendous benefit for concessionaires, users and stakeholders.

IRD's WIM@Toll systems in India are based on the ISO 18000-6C Radio-frequency identification (RFID) standard which has recently been adopted as the national standard in India for tolling on highways. ISO 18000-6C is a standard protocol for RFID devices operating in the UHF bands between 860 MHz to 960 MHz. The lower cost of 18000-6C tags, relative to other transponder technologies, has made 18000-6C an attractive ETC solution for the Indian market.

IRD has installed over 1500 WIM@Toll lanes at toll plazas in China. These systems have two Bending Plates installed in a staggered configuration on each lane of the toll plaza. Test results conducted on the Bending Plate systems in China have proven that it is possible to achieve accuracies of more than 97.5 per cent of the gross vehicle weight at over 90 per cent confidence levels. This means that over a sample size of vehicles that use IRD's WIM@Toll systems, over 90 per

cent of the vehicle population is able to be weighed with over 97.5 per cent accuracy over GVW's (i.e. the measured GVW via WIM for over 90 per cent of the vehicle population is within a ± 2.5 per cent variance of the vehicle's actual GVW).

In Mongolia, IRD is currently installing WIM@Toll at toll plazas along the Tavan Tolgoi – Gashuun Sukhait toll road, a crucial route being used to enhance mining development and expansion in the Gobi region bordering China. The toll road is built to transport coal to China from the Ukhaa Khudag coal deposit, a high quality coal deposit in Mongolia. The systems along this important strategic route will use IRD's SSWIM scales with RFID transponder and reader systems thereby monitoring and sorting the trucks which are overloaded from those that are in compliance with the maximum allowed GVW. This project combines a toll system with a SSWIM sorting system to keep overloaded trucks off the highway.

In summary, adding WIM to a toll system provides a means for highway operators, owners and concessionaires to effectively and fairly recoup the cost of infrastructure damage relative to the load carried by trucks. IRD's WIM@Toll systems help ensure effective toll road asset management by providing monitoring and screening to assist with the operation and management of toll ways. 📍

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