Weigh-In-Motion Systems

Transport Roads & Maritime Services

Procedural Guideline | **ILC-ITS-TP0-002-G08**

Introduction

This guideline is intended to complement procedure ILC-ITS-TP0-002 which is a generic description of processes for installation of Intelligent Transport System devices and systems. When working on an installation of a Weigh-In-Motion (WIM) System it is advised to refer to both documents to provide the basic information required.

Description of how a WIM system operates

A WIM system consists of inroad sensor devices, a roadside data logger located in a cabinet, a power source and telephony connections (cellular or fixed line) for periodically downloading and monitoring the system.

The inroad sensors measure the dynamic axle mass of a moving vehicle to estimate the corresponding static axle mass. That is, the WIM device captures and records the axle or axle group mass, hence gross vehicle mass ("GVM") as the vehicle is moving. In addition the WIM system measures the spacing between each axle to enable classifying the vehicle, and tallies or counts all vehicles per hour. The vehicle speed plus date and time and tallies or counts all vehicles per hour.

The in-road WIM sensors record raw data and on reaching the data logger vehicle events and 24 hour tallies are generated from all vehicles passing over the WIM system. Typically vehicle events are generated only for Austroads classes 3 to 12, that is, the truck classes as trucks are of greater weight than cars.

A vehicle event is generated in the roadside data logger by recording the date, time, vehicle speed, inter-axle spacing and the weight of each axle or axle group load.

The tally table generated is simply a count per hour per Austroads class of all vehicles passing over the WIM system.

Other data such as GVM, freight, ESA and others is based on the above information.

A WIM system provides important data which assists with the following:

- Pavement design
- Freight analysis
- Bridge design and fatigue analysis
- Planning and designing road infrastructure
- Strategies for maintenance and modelling the road network

The WIM Data Quality is affected by several factors, such as:

- Pavement quality particularly flatness

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- Road geometry, preferably straight, flat gradient in direction of travel (< 2%) and deflection.
- Environmental factors, particularly pavement temperature

The WIM system type currently employed by Roads and Maritime Services are:

Culway WIM System

This system works by detecting vehicles with a pair of in-road piezoelectric sensors then recording the strains via strain gauges, imparted onto culvert roofs (or similar) via passing vehicles. These strain readings are later converted to axle group weights. In addition the system measures axle spacing speed and date and time. This system does not incorporate an inroad pavement temperature sensor consequently this system experiences drift throughout the year. The inroad sensor configuration Piezo Piezo with a 10 meter separation.

Plate-In-Road (PIR) WIM System

This system consists of various inroad sensors, that is weigh pads coupled with a set of vehicle detection induction loops to determine the mass of each axle, measure axle spacing, speed, date and time. From this data the axle group mass, gross vehicle mass, freight, tare weight and Equivalent Standard Axle (ESA) are calculated. The inroad sensor configuration Loop - Plate - Loop. Importantly this system includes an in pavement temperature sensor, the data from this is used to adjust the weights as these are highly variable with respect to pavement temperature.

Piezoelectric WIM System

This system relies on piezoelectric sensors and inductive loops to determine the presence of the vehicle, measure the mass of each axle, speed, date and time. Importantly this system includes an in pavement temperature sensor, the data from this is used to adjust the weights as these are highly variable with respect to pavement temperature. Inroad sensor configuration Piezo Loop Piezo or Loop Piezo Piezo Loop.

Kistler WIM System

This system uses a quartz piezoelectric solid state sensor which simply measures the strain when each vertical axle load is applied to it via the wheels of the passing vehicle. The quartz sensor is fully enclosed in an ‘I’ beam section and so is insensitive of temperature changes and protected from water (IP68). This system also includes two inductive loops one before the Kistler sensor and one after. Importantly the system includes an in pavement temperature sensor, the data from this is used to adjust the weights as these are variable with respect to pavement temperature. This system also measures axle spacing, speed, date and time. The inroad sensor configuration Loop-Kistler-Loop or Loop-Kistler-Kistle-Loop.

Operating and Maintenance Manual

Refer to the manufacturer's documentation.

Diagrams and Photos

A Kistler WIM site using piezoelectric sensors and road loops

References and Related Documents

Related Documents:	
Policies	• "Weigh-In-Motion Facilities Manual" obtained from RIS. • "WIM Network Planning" document obtained from RIS. • "Functional Specification on WIM Data Processing" document obtained from RIS. • "Functional Specification on WIM Field Hardware" document obtained from RIS.

Standards and Specifications	• Austroads AP-T171-10 - Weigh-in-motion Management and Operation Manual • ASTM E1318-02 - Standard Specification for WIM Systems with User Requirements and Test Methods. • The Conformal WIM Site - presentation by Kistler Instrument Corporation • COST 323 "Weigh-in-Motion of Road Vehicles standard
Procedure	• ILC-ITS-TP0-002 ITS Project Life Cycle
Technical Directions	• TDT 2011/07 - Attachment of Equipment to Traffic Facilities Assets • TDT 2012/10 - Energy Management for New Traffic Assets
Guidelines	• ITS-11ITS7 - APC Selection Guidelines – Alternative Power and Communications for ITS Installations.
Maintenance Specifications	• WIM monitored via WIMNET application, any anomalies to be investigated by the contractor. • For more information on WIMNET refer to "WIM Network Data Reporting" document obtained from JII.
Factory Acceptance Testing (FAT)	For Supplier-specific FAT documents, refer to those provided by Supplier(s).
Site Acceptance Testing (SAT)	• Pavement quality checks to be performed. • Calibration / Sensor test reports • ASTM E1318-02 / COST 323 Standards

Acronyms, Abbreviations and Definitions

Term	Definition
WIM	Weigh-In-Motion
ASTM	American Society for Testing and Materials
COST 323	European WIM standards
GVM	Gross Vehicle Mass
STATIC	To be stationary

PIR	Plate-in-Road
PLP	Piezo-Loop-Piezo
PLLP	Piezo-Loop-Loop-Piezo

About this release

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This document is published under the Infrastructure Life Cycle Management System and is subject to review and continual improvement. The current version of this procedure is that published on the Roads and Maritime Services intranet.

Note: The Infrastructure Lifecycle Management System complies with the requirements of the ISO9001 standard. This standard is revised every four years (2008, 2012, 2016). While system procedures within the ILC Management System are revised as necessary, to meet any changed requirements of the standard, references within the procedures refer only to ISO9001.

It should be confidently assumed by users that the term ISO9001 within a procedure refers to the most current version of the standard.

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