Highway Weigh-In-Motion

Accurate Highway WIM System

- 3 rows of Quartz Sensors for high accuracy
- Maximum axle weight 30 tonnes
- Sensor overload capacity 45 tonnes per axle
- Gross Weight Accuracy + - 5%
- Vehicle Speed 3 to 130 km/hr
- Maximum Vehicle Speed 200 km/hr
- Licence Plate Recognition Camera
- Automatic Vehicle Classification
- Speed Monitoring
- Speed accuracy + - 1 km/hr
- Dual wheel sensor
- Induction Loop to recognise new vehicle
- Database to store results

Introduction

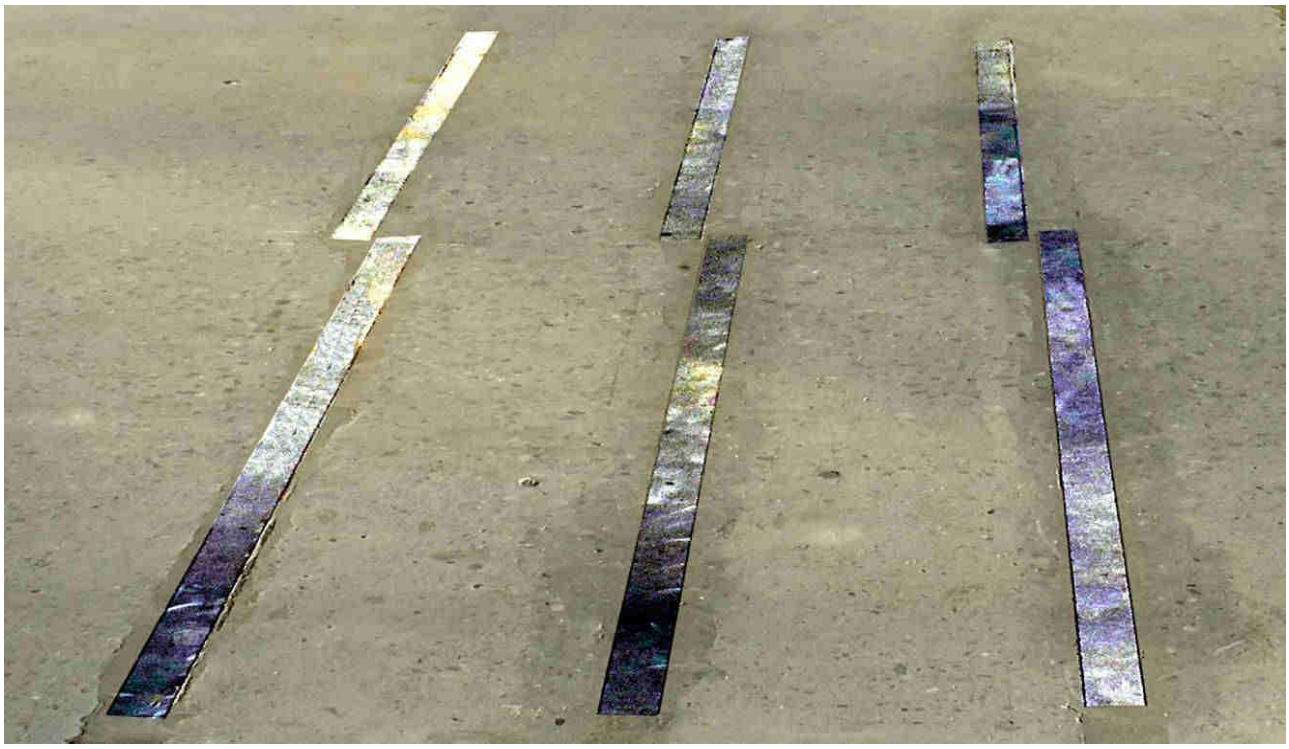
The Griffith Elder Highway Weigh-In-Motion system uses three rows of very high accuracy Quartz sensors to detect and weigh each axle of every vehicle. The axle weights are automatically added together to give axle group weights and gross vehicle weight.

A dual wheel sensor detects the width of the tyres and whether there is a dual wheel on an axle and an inductive loop ensures that each vehicle is recognised separately from the next one.

An automatic camera records the license plate which is held together with the weight information of the vehicle so that the classification of the vehicle can be determined automatically. The camera can have software for European, Arabic, Chinese or other language license plates.

If required, variable message signs can be used to tell vehicles what to do after being weighed.

Quartz Piezoelectric Weight Sensors



Quartz Weight Sensors installed in a concrete road

The Quartz Sensors are the heart of the High Speed Weigh-In-Motion system. Manufactured from the highest quality natural quartz, the sensors detect the weight of each wheel as it crosses them in the road. Three rows of sensors are used in each lane of the highway to give the most accurate weight of each axle as it passes. Times between sensors give the speed of the vehicle and distances between axles.

Length	1.5 metres, 1.75 metres and 2.0 metres
Cable length	40 metres up to 100 metres
Speed range	20 to 130 Km/Hr
Temperature Range	-45C to +80C
Temperature Coefficient	0.02%/^{0}C
Sensitivity	1750 – 1850 Pico-coulombs per Newton
Accuracy	+- 2% over length of sensor
Linearity	+- 0.2% Full Scale
Life Span	More than 100 million axles
IP Rating	IP68
Speed Accuracy	+- 1 Km/Hr

Maintenance of Quartz Sensors

No maintenance is required because the Quartz sensors are glued into the road surface. They are completely waterproof and have very high stability. One of the features of our sensors is that they each have a self diagnostic function and give out a fault signal if there is a problem. The system will continue working even when one sensor has a fault, allowing it to be changed before the whole station stops operating.

The Charge Amplifier

The Charge Amplifier is a current integrator that produces a voltage output proportional to the integrated value of the input current. It has six separate inputs from up to six quartz piezoelectric sensors and a single multi-core cable output which goes to the data-logger.

The charge amplifier is an integral component in the high speed weighing system.

Accuracy	Greater than 1%
Output	0V to +- 5Volts
	0 to +- 2mA
	100 Ohms
Frequency Range	3 db ~ 0.0016 – 10 KHz
Time Coefficient	100 seconds (if weight static on sensor)
Supply Voltage	12 Volts DC
Current Use	Less than 25 mA
Temperature Range	-45C to +80C
Accuracy	+- 10% per axle
	+- 7% per group of axles
	+- 5% Gross Weight of vehicle
Moisture Resistance	0 to 95% RH

There is one charge amplifier for each lane of the highway. They are housed in a roadside cabinet next to the data-logger. Up to five lanes can be run at the same time.

Data-logger and Local Indicator

The Data-logger analyses the Charge Amplifier inputs (up to 30 Quartz sensors), the dual wheel sensors, and induction loop readings to give readings of axle design (one or two tyre), width of tyres, axle speed, axle weight, and vehicle wheelbase length. It has an output on RS232 bus to computer. The data-logger/indicator is also used to trigger an automatic licence plate camera and to calibrate the quartz sensors.

Front View

Rear View

Voltage	AC 220 50Hz
Housing material	Aluminium
Display	Monochrome LCD 320 x 240 lattice
Keyboard	12 key thin-film membrane
Data Store	10,000 vehicle records
Data interface	RS232
Number of sensors	Up to 30 Quartz piezoelectric sensors (5 lane carriageway)
Number of road loops	Up to 10 induction loop sensors
Number of Tyre sensors	Up to 5 dual wheel sensors for tyre width and number of tyres per axle
Working Temperature	-20C to 60C
Camera Trigger Mode	Switch trigger
Length x width x height	483 x 225 x 133 mm

Induction Loop Sensor

Induction loop cut into a concrete road

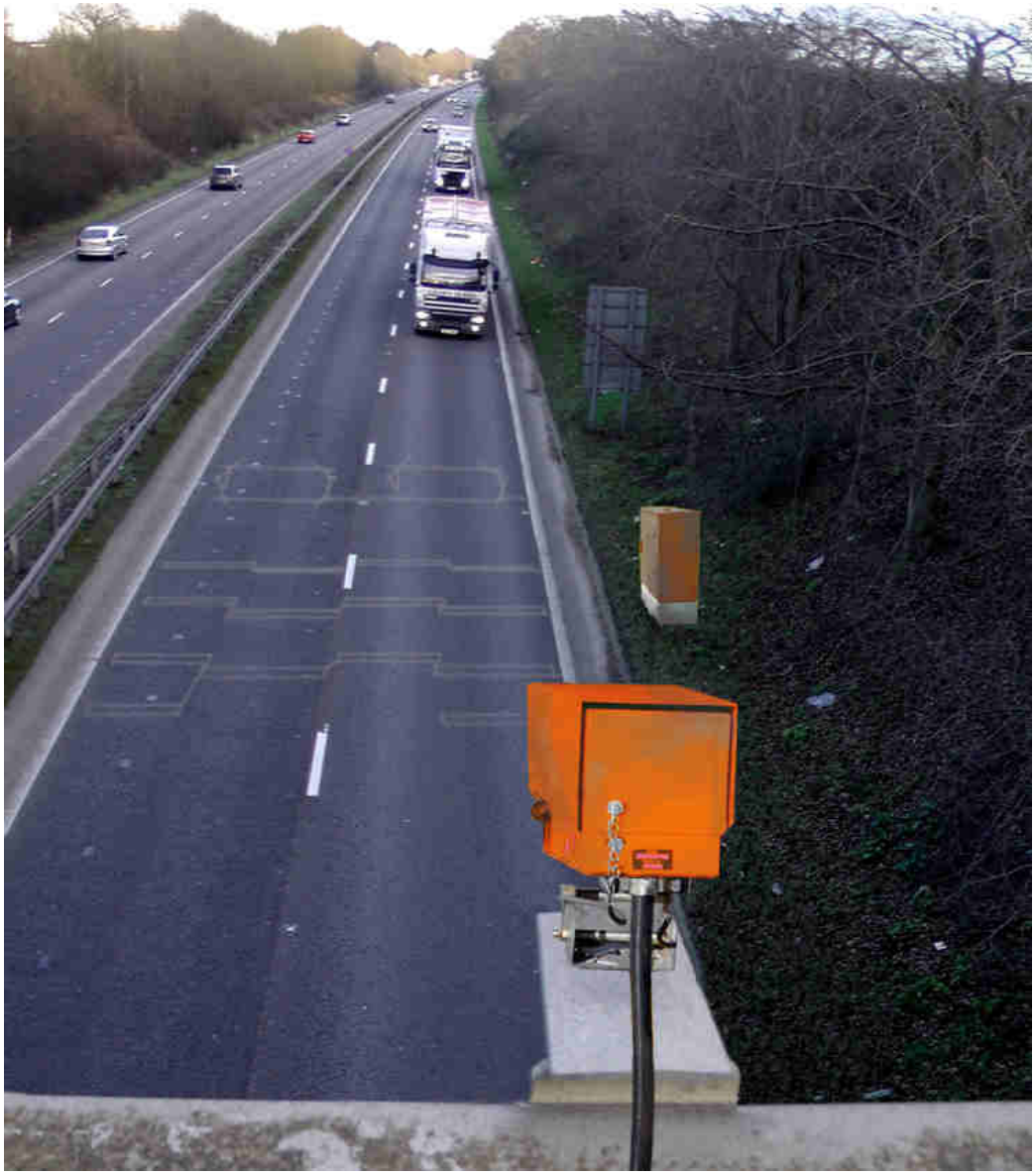
The induction loop has three major functions: Firstly to recognise that a vehicle is present, then to note the direction of travel of a vehicle, and finally to time the gap between vehicles to give traffic density. It is usual to only install one induction loop per lane of traffic, before the Quartz sensors.

Our inductive loops are made from 14-gauge 34 strand tinned copper inductive loop wire with a polyethylene insulation jacket impervious to water, oil, sunlight, gasoline, and mildew.

Dual Wheel Sensor

The Dual Wheel Sensor is made up of multiple quartz sensors so that the width of tyres can be measured and numbers of wheels on an axle can also be determined. It is normal to install one dual wheel sensor per lane, detecting one side of the vehicle only. Each axle is correctly identified whether it has one or two wheels, together with the overall width of the tyres. Normal width of a dual wheel sensor is 1.75 metres.

Automatic License Plate Recognition Camera



For complete automatic operation, a camera can be strategically placed to capture licence plates. This ensures that every vehicle that has weights logged in the computer database will also be identified by its license plate.

Each camera is full colour during the daylight and monochrome at night, using infrared illumination to catch the number plate. The cameras have built-in license plate recognition which is sent over Ethernet in ASCII format to the roadside industrial computer where it is stored in a local database.

The camera software can communicate with traffic signal software so that vehicle identification is coupled with the signal to instruct the vehicle to continue or to be diverted into an inspection lane.

Some installations also use a standard surveillance camera to take a photograph of the vehicle so that there is no doubt whether it turned into the inspection lane or not.

The camera can be equipped with software according to country so that number plate recognition is correct for the appropriate language.

An LED Variable Message sign is available to show the driver the number plate which lets them know that it has been caught.

High-Speed Weigh-In-Motion

Automatic recognition of over-weight vehicles

HSWIM

High speed weigh in motion operates between speeds of 3 and 130 kilometres per hour. Traffic travelling between these speeds will automatically be caught by the HSWIM system.

Sensors in the road are Quartz and compliment the inductive loop sensors, which recognise vehicle separation, to detect axle weights as a vehicle drives over them. Typically the Quartz Chrystal piezoelectric sensors are accurate to within 10% on a single axle and within 5% on the gross vehicle weight, and are generally acceptable for deciding which vehicles should be directed off the road to a weigh-station. However, in some countries they are accepted as being suitable to prosecute overweight vehicles because the tolerance is such that the 5% discrepancy works in favour of the vehicle owners.

Sensors are usually arranged in sets of six in each lane of the highway to give maximum accuracy.

In order to work with highest accuracy the road surface needs to be within certain tolerances which are detailed within the EU document “COST 323”. It should be noted that local installation conditions will influence accuracies.

A single Dual Wheel Sensor is normally also installed with the HSWIM sensors so that classification can be correctly determined, including double wheel axles.

Weigh-Station Pre-Screening

One of the major uses of High-Speed Weigh-in-Motion is to decide which vehicles should be pulled off the highway to be further examined. Normally this is due to infringement in weights allowable, however in recent times more interest has also been shown in taxation and insurance infringements and vehicle size (height and width) discrepancies. All these aspects of vehicles can be determined using In-Highway equipment to detect the vehicles fully. Each vehicle can be looked up in a national database and former infringements of the regulations can be noted in real time, so the personnel at the weigh-station will know, in advance of when a vehicle arrives, what they are looking for.

CCTV surveillance systems are often used in conjunction with the in-highway monitoring systems to give detailed video evidence of the presence and defects of a vehicle. This is usually stored separately from the national database of vehicles due the large size of files created at each weighing site. However, with appropriate software both systems can be viewed in synchronised time so that the video reinforces the data collected for each vehicle which is being investigated.

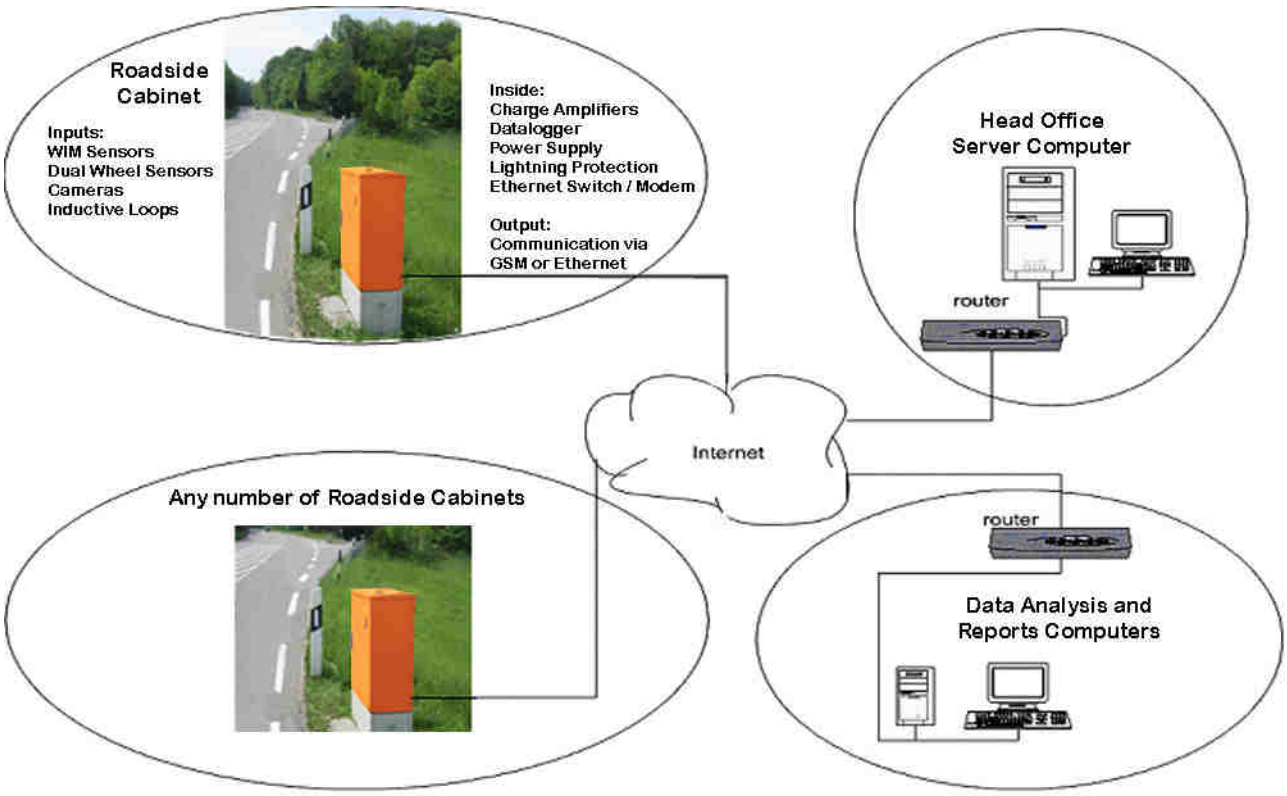
Information on the Single-Axle Low-Speed Weigh-in-Motion system can be found in the document named “Single Axle Overload Detection” document.

Vehicle Counting Function

Apart from weighing vehicles, the induction loop and the dual wheel sensor together can be used as a reasonably priced vehicle counting, vehicle speed, and classification system, with vehicle density and road use statistics easily developed from the data collected. The data is stored in a database at the road station and can be retrieved either at site using a laptop to plug into the data-logger, or via Ethernet using a remote connection.

Transmission of Data

Collating data from many stations



Data Transfer to Central Database

The Industrial Computer program sends all records to a central database, in real time, as they are completed from each WIM station. The data transfer program runs in the background and automatically tries to send a record as it is completed. In the event of no communication with the central database it will keep trying until a connection is made. It will then send all records that have been completed since the last good connection.

The normal method of data transfer is across the internet. To ensure the data cannot be intercepted or corrupted all data is encrypted between head office and the outlying stations.

The Central Database collates all the results from the individual roadside stations so that reports from the central database can include vehicles that have visited more than one station. For instance it is possible to report on a particular vehicle to see how often it is in contravention of the weight limit rules. Or, a report could be run to detect a particular company to check on what has been delivered.

Roadside Stations

Each roadside station has its own name and identification so that when a number of stations send information back to a central database the weighments are recognised by where they were taken. The weighbridge stations all have the same software and are completely compatible.