

Applications and Advantages of WIM

Weigh-In-Motion

In general Weigh-In-Motion (WIM) systems measure characteristics of vehicles when in motion. This includes: the gross vehicle weight, the axle loads, the number of axles, the axle distances, the total vehicle length, and the vehicle category. WIM systems are being used around the world by many different users for various applications:

Traffic Management

Real time monitoring of the actual traffic flow on a road network helps to optimize traffic management. WIM systems are able to deliver automatic and detailed real time traffic management information 24/7 without disrupting the traffic flow.

Detailed information on the traffic flow road also provides an important input for transportation studies that help transport authorities to optimize the planning and design of the future road network.



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Special Transports

Certain truck combinations are specially adapted to be able to carry excessively heavy and/or long loads e.g. through the addition of additional axles. Under the conditions stated in their permit these special transports are allowed to carry excessive loads on specific routes. Data from WIM systems can also be used to determine possible routes for special transports and to verify compliance with their permits. This will avoid unnecessary damages to bridges and pavements, reduce maintenance costs and increase road safety.

Tyre Management

Underinflated or overinflated tyres have the increased risk of a blowout, a negative effect on fuel consumption and will increase tyre wear. WIM measurements can be used to check the tyre pressure and temperature of passing trucks. In case a potential problem is detected the fleet manager of the truck will be notified and immediate action can be taken. This results in lower running costs, increased traffic safety and an extended tyre life.

Pavement Loading

The damage to road pavements by heavy vehicles has a - generally accepted - relation to the fourth power of the passing axle loads, see ESAL calculation. While the damage to bridges is more related to the total weights of the passing vehicles. Overloading by heavy goods vehicles will result in a disproportional increase in the damages to the road infrastructure, a reduction of its life span increased maintenance costs and additional traffic jams because of road works.

Organisations responsible for the construction and maintenance of roads and bridges need accurate and reliable information on the actual traffic loading on their roads. This loading information is an important input both for the design codes of the road infrastructure (new roads and bridges) and for the planning of the maintenance of the existing infrastructure.



The lack of accurate and reliable loading information will force pavement and bridge engineers to use larger uncertainty margins in their calculations. This will result in an increased maintenance frequency, thicker more expensive pavements and lower safety limits for bridges.

ESAL Calculation

Equivalent Single Axle Load (ESAL)

ESAL is a concept developed from data collected at the American Association of State Highway Officials (AASHTO) Road Test to establish a damage relationship for comparing the effects of axles carrying different loads.

ESAL calculation is used to quantify the damage caused by the passing traffic. The total damage of a vehicle is expressed relative to the damage of a standard reference axle load (often 10 tons is used).

$$ESAL = \sum_i (L_i / L_{ref})^4$$

With: L_i = the load of the i -th axle of the vehicle in tons,
 L_{ref} = the reference axle load.

Example

A 5 axle truck with 7.5 ton, 12.5 ton and 3 times 10 ton axles has an ESAL value of 5.6 that is more than 220,000 times larger of that of a normal car of 1,200 kg.

Only a WIM-system will measure the real traffic loading.

Bridge Safety Assessment

Safety verification of existing bridges requires periodical assessment of their bearing capacity and of traffic loads, above all in cases of structural deterioration or ageing. Applying traffic load models from bridge design codes almost always leads to over-conservative conclusion that the structure is not safe. The main reasons are: load effects that are based on generic load models not the true traffic loads, and, high safety margins to deal with many uncertainties over their lifetime

Reducing uncertainties through measured WIM data always optimises results of assessment. Often the severe remedial measures, like strengthening or replacement of a bridge, can be avoided. Even if measures are needed, they are less rigorous than if the design rules were used.

Other applications of WIM data for bridges includes fatigue lifetime assessment of steel bridges and design of non-standard bridges. In all cases, accurate knowledge of the current traffic loads by WIM is needed, and for fatigue re-assessment, the whole traffic load history is required.

Bridge Protection

Bridge protection a WIM system can detect an overloaded vehicle before it can cross a old protected bridge or can enter the historic centre of a city. This again will avoid unnecessary damages and reduce maintenance costs.



Tolling by Weight

The traditional approach to determine access fee for a toll road is based on the type of vehicle, mostly related to the number of its axles. In reality, the key damaging factors for the road infrastructure are the vehicle gross weights and their individual axle loads.

In line with the 'polluter pays' principle, the fee for using a toll road should be proportional to the wear caused by the vehicle. At weight-based toll roads the road users pay according to the actual weight of their vehicles.

A WIM system can be integrated into both types of existing toll collection systems: with manual toll collection at toll plazas and as a part of electronic toll collection under free traffic flow. In both cases the toll fees can be collected with greater efficiency. Finally, the WIM system can be used to detect overloaded vehicles.

ISWIM Vendors

More information on the ISWIM vendors can be found on their websites:

www.camea.cz

www.pesage-captels.com

www.cestel.eu

www.cross.cz

www.ecm-france.com

www.haenni-scales.com

www.intercompcompany.com

www.irdinc.com

www.kapsch.net

www.kistler.com

www.mikros.co.za

www.sterela.fr

www.traffic-data-systems.com

www.tdcsystems.co.uk

www.te.com/usa-en/home.htm

www.wheelright.co.uk

Weight Enforcement

WIM systems offer a range of applications that improve the efficiency and effectiveness of weight enforcement. This will result in a reduced overloading that has a number positive effects on society as a whole: less damages to the road infrastructure resulting in lower costs for maintenance and less disturbance because of road works, an increased road safety and a more fair competition between transport companies. Possible applications are:

Statistics

Using WIM data to generate statistical overviews on the traffic loading situation. Enforcement agencies can use these overviews in the planning of enforcement activities, when and where their control units are deployed. The statistics may also be used for the evaluation of the effects of enforcement activities.



Pre-Selection

Here a WIM system weighs all passing vehicles, when it detects an overloaded vehicle, an image of the vehicle is taken and the target vehicle is guided to the road side control area. Here the selected trucks are weighed by a static weighing scale or Low Speed WIM. This results in more efficient controls because of an increased hit-rate. It also gives an advantage to 'good' transport companies since almost no correctly loaded vehicles are stopped.

Company Profiling

All data measured by a network of WIM systems, including the pictures of the suspicious overloaded vehicles is stored in a database. Based on this information 'bad' transport companies are selected that qualify for further action by the enforcement agency like a company inspection. This way of enforcement is directly aimed at compliance of loading regulations instead of writing tickets only. Since the focus is only on "problem" transport companies a relatively low number of enforcement personnel is required.

Direct Enforcement

In this application the evidence for the prosecution of an overloaded vehicle is directly based on the measurement by the WIM system. The procedure from the WIM measurement to prosecution can be completely automated and is similar to that of automatic speed enforcement. This type of enforcement systems can be operational 24/7 without any enforcement personnel and is specifically suitable for highways with a high volume of trucks.

Our Society

ISWIM

The International Society for Weigh-In-Motion brings together users, researchers, and vendors of systems for dynamic weighing of vehicles. Membership of ISWIM is free of charge for individual members.

Purposes

The purposes of ISWIM are:

- To support advances in and the more widespread use of Weigh-In-Motion technologies and the applications of WIM data.
- To disseminate knowledge and understanding of WIM by organising conferences, seminars, training courses and other events.,
- To promote and support international research and development projects on WIM.
- To initiate or participate the development of standards relating to WIM and its applications
- To promote the use and application of WIM systems and data.

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