

**PREVENTION OF HIGHWAY INFRASTRUCTURE
DAMAGE THROUGH COMMERCIAL VEHICLE WEIGHT
ENFORCEMENT**

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ABSTRACT

In recent years, many Asian and other countries in transition have encouraged dramatic road infrastructure development in order to promote and sustain continued economic growth. India, for example, has seen demand for new highways achieve a level not previously experienced anywhere throughout the world. One of the main features of India's current fast-track economic development has been the equally rapid development of the inter-city and national highways.

Since transfer of the development, operation and maintenance of highways to the private sector is taking place at a rapid pace, the majority of the projects are being proposed on the Build-Operate-Transfer (BOT) concept. The financial success of these projects is based on effective maintenance of the infrastructure that is excessively and rapidly damaged due to overweight vehicles. The damage by over-loaded trucks to pavements is exponential. A 10% increase in weight results in a 40% increase in pavement damage.

A key focus of ITS (Intelligent Transportation Systems) has been to try to make better use of existing infrastructure, keep it in better condition, and utilize it in the most optimum way. This has led to innovative solutions for increasing capacity such as freeway management systems, incident response, and traveler information systems. With many competing demands for limited funding, it is imperative that the cost of highway maintenance and repair be minimized.

One way to reduce the cost of maintenance is to make it last longer by limiting the amount of load allowed on a particular roadway. Substantial pavement damage is due to overloaded trucks causing excessive damage to the roadway. Without active enforcement, the amount of overloading will increase, resulting in deteriorated pavement.

In addition to the economic impacts due to increased maintenance costs, there are also safety issues involved with a lack of enforcement. Worn, rutted, or potholed pavements can result in increased accident potential. Just as weight violations increase without enforcement, so will vehicle safety violations such as brake adjustment, tire condition, and load movement.

This paper describes why weight enforcement is imperative, how it benefits the authorities, and the new technologies that ensure effective enforcement without causing an effect on the regular traffic flow.

INTRODUCTION

Commercial vehicle weights and dimension laws are enforced by highway agencies to ensure that excessive damage (and hence reduced life) is not imposed on the highway infrastructure. Illegally overweight trucks rob the [highway] system of its life without reimbursing the public and compete unfairly with other trucking firms ⁽¹⁾. These same overweight trucks pose a safety hazard to the travelling public who share the road and create a substantial economic burden to taxpayers.

The purpose of this paper is to demonstrate the need for, and cost effectiveness of, enforcement of commercial vehicle weights and dimensions laws. Additionally, this paper will show that effective weight enforcement, in conjunction with a comprehensive data collection program form the foundation for a scientific based road asset management framework which is vital to make effective road asset management decisions.

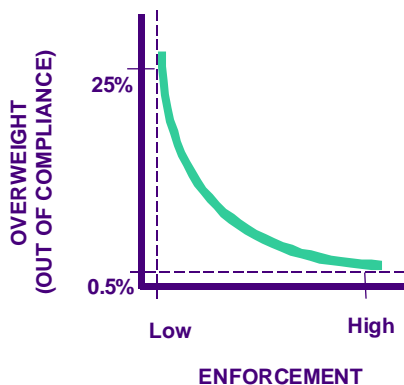
THE NEED FOR TRUCK WEIGHT MONITORING

A nation's transportation infrastructure is its lifeline. An efficient and safe road network allows goods to reach markets quickly and economically, thus stimulating economic activity and ensuring trade competitiveness. Four years ago, the Indian Government initiated a massive program to build the country's infrastructure, including roads. The Indian Government has initiated an enormous road development plan to the year 2020, involving an approximate Rs. 65,000 billion (US \$1,500 billion). Road transport accounts for 65 percent of goods traffic and 80 percent of passenger traffic. Each year, commercial vehicles transport goods valuing billions of rupees cross the country and this value is constantly growing.

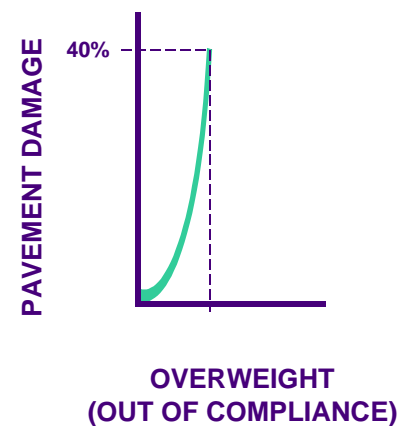
Why WIM?

Preserve the Infrastructure: Minimize the costly damage and deterioration to infrastructure from overweight trucks by monitoring and controlling truck weights. An increase in loading means an exponential increase in the acceleration of road wear. In other words, if pavement loading is miscalculated by as little as 10%, it can mean an acceleration of road wear by over 40%. When maintenance activities are timed incorrectly due to inaccurate traffic loading estimates, it can mean the premature destruction of a roadway. WIM systems combat road-wear by providing accurate data for traffic planners and by identifying overloaded trucks.

Commercial Vehicle Overloading and Safety



A 10% overload, increases pavement damage by 40%



Increase Safety: The efficient movement of goods via commercial vehicles must be balanced with concerns for safety of the motoring public. One aspect of safety is the condition of the road. With tighter maintenance budgets and increased highway usage, maintaining a high quality road is a challenge. Rutting, cracking, and potholes all decrease the level of safety on the road. Another aspect of safety is the operation and condition of the commercial vehicle. While many accidents involving commercial vehicles are the fault of others, the size and weight of the commercial vehicle often results in crashes of greater severity. It also means that the consequences of safety problems on a commercial vehicle are magnified many times over that of an automobile.

Save taxpayers' money: A WIM (Weigh-In-Motion) system helps to monitor and keep weights under control so that road wear is minimized. Implementation of WIM helps to protect the infrastructure, maximizes the efficiency of trucking and targets violators. This means savings to the taxpayer through better roads, cheaper goods and more efficient enforcement operations. When less funds are required for liability and to maintain and sustain the highway system, it means more funds for other areas fiscal or fewer taxes.

Prevent Overloading: It is well known amongst enforcement officials that visibility of enforcement programs cuts down on the frequency of overweight trucks. Numerous stations with WIM technology in North America have witnessed the number of overweight trucks increase by as much as 50% when the stations are closed. Implementing WIM systems on the mainline allows agencies to control the loads on the roads to prevent the acceleration of road wear. Thus, no overweight trucks will be allowed to bypass and create unacceptable amounts of wear to the road.

State	High Enforcement Level Violation Rate	Low Enforcement Level Violation Rate
Virginia (2)	0.5 to 2.0 %	12 to 27 %
Maryland (2)	1.0 %	34 %
Arizona (2)	1.5 %	30 %
Wisconsin (3)	1.0 %	20 %
Idaho (4)	11.9 %	32 %
Florida (5)	1.4 %	13 %
Montana(6)	1.0 %	29 %

Weigh All Trucks: In traditional weigh station operations, all trucks are required to report to the weigh station for visual inspection and/or weighing. At busier routes and during peak travel times, it is normal for trucks to fill the stations such that they must close temporarily until the queues diminish. The temporary closure of the stations is necessary to prevent traffic backups onto the highway and avoid the safety hazards of having immobile vehicles adjacent to vehicles traveling at high speeds. However, when the stations are closed, some trucks are able to bypass the weighing process even though

they may be overweight. By implementing WIM systems at weigh stations, all trucks are weighed and all overweight vehicles are identified.

Collect valuable data: Weighing trucks provides valuable data for future traffic planning and maintenance activities. WIM systems collect traffic data continuously, even while the weigh stations are closed. Information on peak times, traffic volumes, type of vehicles and weight of vehicles allows transportation planners to improve existing systems and design better future systems.

Prepare for increases in traffic volumes: There are already high volumes of trucks on Indian highways, with the number of trucks increasing by approximately 10% yearly. Weigh Stations with static scales operating in the traditional fashion cannot accommodate the future truck volumes. By implementing WIM systems at weigh station facilities, future volumes will be easily managed through pre-weighing, prescreening, and presorting.

Minimize delays to trucking industry: Traditional weigh stations with static scales require approximately 2 minutes per vehicle for weight compliance checks. This time increases with the traffic at the weigh stations. Loss of time results in loss of revenues. With the implementation of WIM systems, weighing takes place dynamically at normal highway or ramp speeds, without any interruption to truckers. The WIM system sorts all vehicles based on weight and, where applicable, credentials. The WIM system directs only out of compliance vehicles to report for further inspection. All other trucks are allowed to bypass without stopping at the station. With fewer delays at weigh stations, the good carriers are able to deliver goods on time without the disadvantage of competing against carriers who attempt to cheat the system to gain financially by overloading their trucks.

Protect the environment: Minimize truck emissions and maximize fuel efficiency by limiting the number of idling trucks at weigh stations.

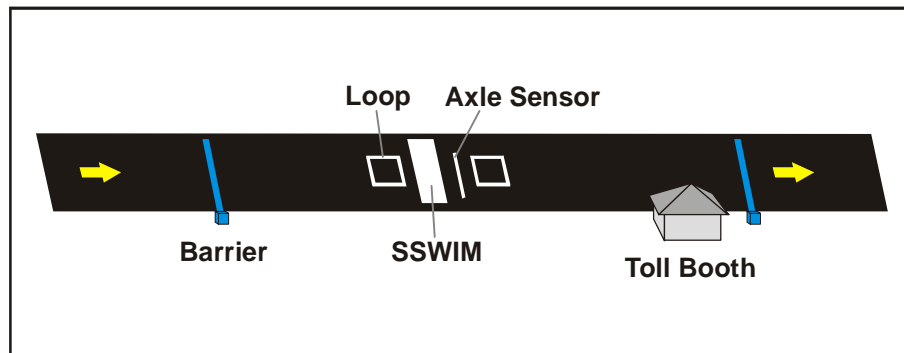
WEIGHT ENFORCEMENT STRATEGY TO PREVENT OVERLOADING

It is generally agreed that a combination of fixed and mobile facilities provides the best overall weight enforcement program. As noted earlier, visible weight enforcement presence is a key factor to a successful weight enforcement program. Past observations indicate that a relatively low probability of being caught for overweight infractions significantly discourages overloading. The equipment that is required to accommodate these facilities is available, and proven.

INTEGRATED Weigh-In-Motion (WIM) AT TOLL COLLECTION SITES

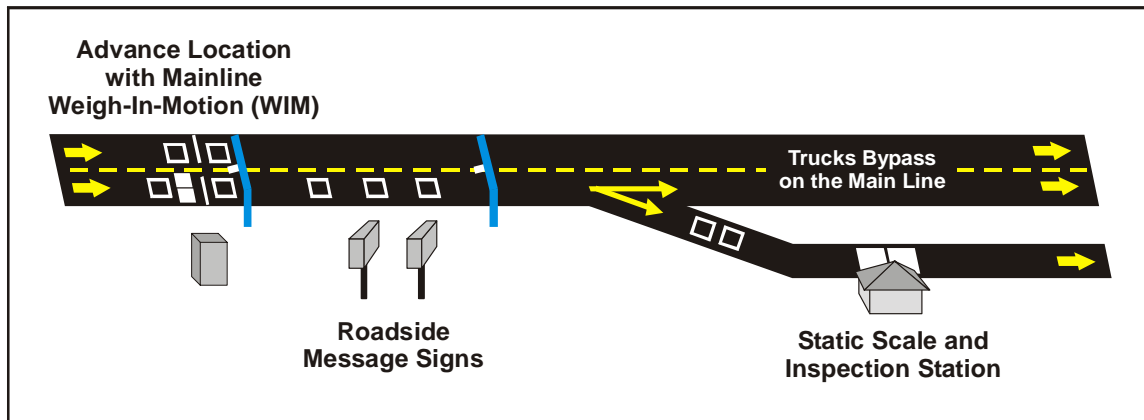
Highway authorities, road operators and owners need to protect their roads from unnecessary damage and premature wear. By regulating vehicle weights, a toll operator or owner can protect the investment in infrastructure. The toll operators can target heavier vehicles for higher tolls and collect the weight information for planning of future infrastructure and for maintenance activities. Operators may also target over-loaded trucks and place restrictions upon their entry.

A Weigh-In-Motion System may be integrated with the toll system for more effective operation. Weigh-In-Motion allows for a higher throughput and efficiency at toll operations. With static scales, long truck queues and lengthy delays may result. The addition of WIM to the toll system makes it possible to collect fares based on vehicle weight, as well as vehicle classification. Since heavier vehicles tend to cause greater wear and tear on roads, collecting fares based on weights ensures that the vehicles causing the most damage pay the higher fares.



INTEGRATED WIM AT TOLL SITE

The WIM systems can operate on the mainline or within the area of the weigh station. The system will have the ability to track the suspected violators using in-road inductive loops, and other optional road sensors, while on route to the static scales. An additional console alarm will be triggered for vehicles failing to follow the automated control signals. The systems can incorporate electronic identification of the vehicles for the automated verification of operating credentials. Along with this credential verification is the ability to evaluate safety history and risk.



MAINLINE WIM SYSTEM LAYOUT

Fully mobile crews can utilize portable wheel load weighing equipment and mobile communications systems to provide enforcement in remote areas and on secondary roads. These crews offer the ability to impose a certain amount of doubt in the truck operators mind as to the risk of being caught overloaded. Technology exists to streamline the task of weighing trucks on secondary roads. Portable WIM technology can offer quick roadside screening capabilities to focus on out of compliance drivers.



PORTABLE WEIGHING

CUSTOMIZED WIM SYSTEM OPERATION FOR INDIA

Vehicle approaches the toll plaza. Vehicle stops at the barrier gate. The barrier gate is opened by pressing a button on the operator console. The gate will automatically close once the vehicle proceeds past the gate. Driver proceeds over Slow Speed WIM (SSWIM) scale and the classification sensors driving vehicle at a constant speed. The vehicle can pass over the scales up to a speed of 20 Km/hr with being accurately weighed. The sensor information is processed and the vehicle is determined to be either within legal weight limits or exceeding the weight limit. The driver stops at the toll booth. The system automatically calculates the fine if the vehicle is over weight. The driver pays the fine if required, collects the receipt and proceeds on the highway. The barrier gate is opened for the next vehicle that goes through the same scenario.



SLOW SPEED WIM SCALE

The above approaches should not be considered in isolation for an effective enforcement program. The above approaches are complementary, and a planned approach will offer a cost-effective program. It is critical to study the unique aspects of the region and to design a system and method to best suit the circumstances. Issues that must be considered in this design include:

- **Specific State statutes on commercial vehicle enforcement:** This may include changes to statutes and could involve a review of fine structures and an education of judicial officials on the importance of the issues.
- **Specific State operating requirements and taxation issues:** In many States, there are several agencies involved in the enforcement of commercial vehicle law. In many cases, these agencies do not have consistent goals.
- **Geographic concerns and the relationship existing between primary and secondary highways:** There needs to be a coordinated approach in this regard.

- **Shipping patterns and goods movement patterns that exist in the State:** This may include issues concerning seasonal goods movements common in construction and agricultural based economies.

Interagency cooperation needs to ensure that all approaches and solutions fulfill a greater plan. For instance, police agencies enforcing weights and dimensions laws should cooperate with the agency involved in collecting traffic data. The police agencies can utilize permanently installed equipment to enhance the enforcement process and can use collected data to plan enforcement strategies. Highway design and planning groups should stay in constant touch with the data collection group in order to ensure that data collection supports planned rehabilitation.

CONCLUSION

An integral part of highway management activities must include the weighing of vehicles, both to manage existing infrastructure and plan for future investments in infrastructure.

Weighing vehicles serves two very important functions:

1. Protecting the infrastructure from premature wear and deterioration
2. Data collection for planning and management purposes

WIM technology weighs trucks dynamically and reduces the overloading of highways by targeting overweight vehicles. This helps to protect the public's investment in the infrastructure, reduces stress on highway budgets and makes vehicles safer by reducing rollovers, unbalanced loads, and various hazards associated with heavy loads. WIM technology also provides valuable information regarding vehicle configurations, weights, speeds, volumes, peak travel times, and a multitude of other information. This information can then be used by various state agencies for statistical analysis of road usage, road wear, truck overloading, and vehicle configurations both for the planning of new roadways and for the management of existing roadways. The data can be used to establish guidelines for building new highways and to plan maintenance activities.

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