EFFECTS OF DIRECT ENFORCEMENT WIM

CASE STUDY | WEIGH-IN-MOTION

A traffic case study shows there is a significant difference between planning road maintenance with and without use of CAMEA WIM for direct enforcement. Fining results in a serious drop of violators, decreasing damage taken by the road up to five times. By eliminating overloaded vehicles, it is possible to reach the originally projected road lifespan, or even extend it.

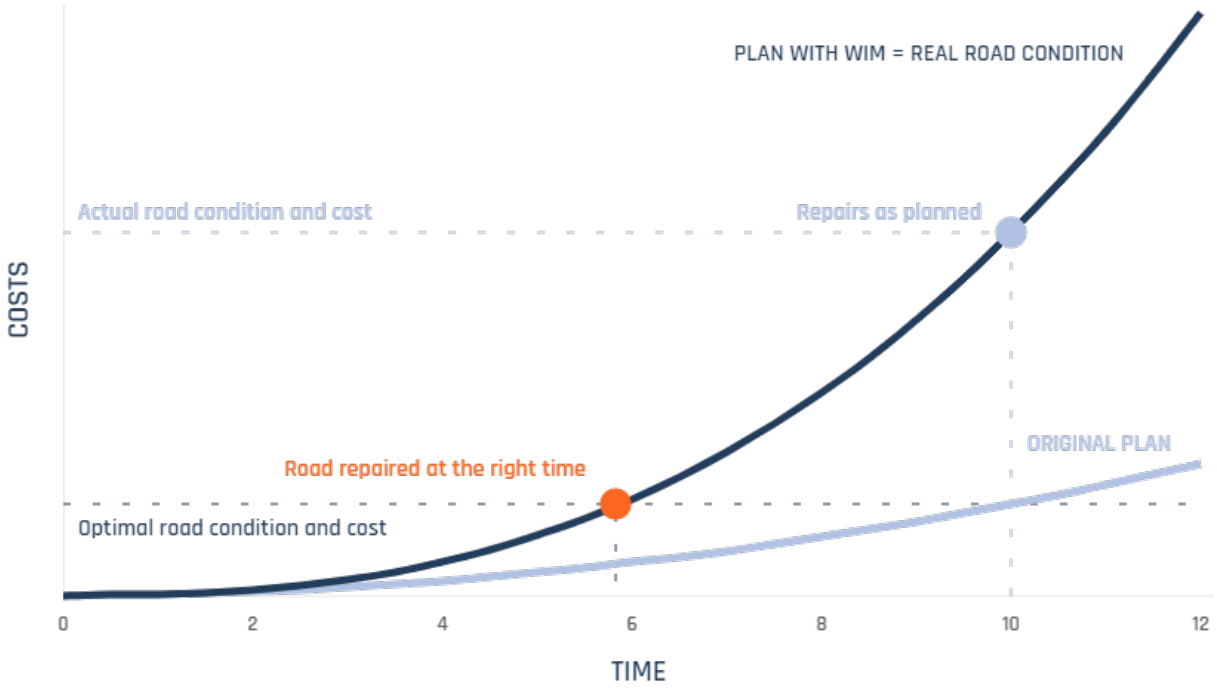
Introduction

Local authorities often face reality when comparing projected and true road lifetime. The projected lifetime is based on a qualified estimation of traffic intensity and structure. Yet it is very complicated to predict a number of overloaded trucks, just like it is very important, as these vehicles are the ones causing the most road damage.

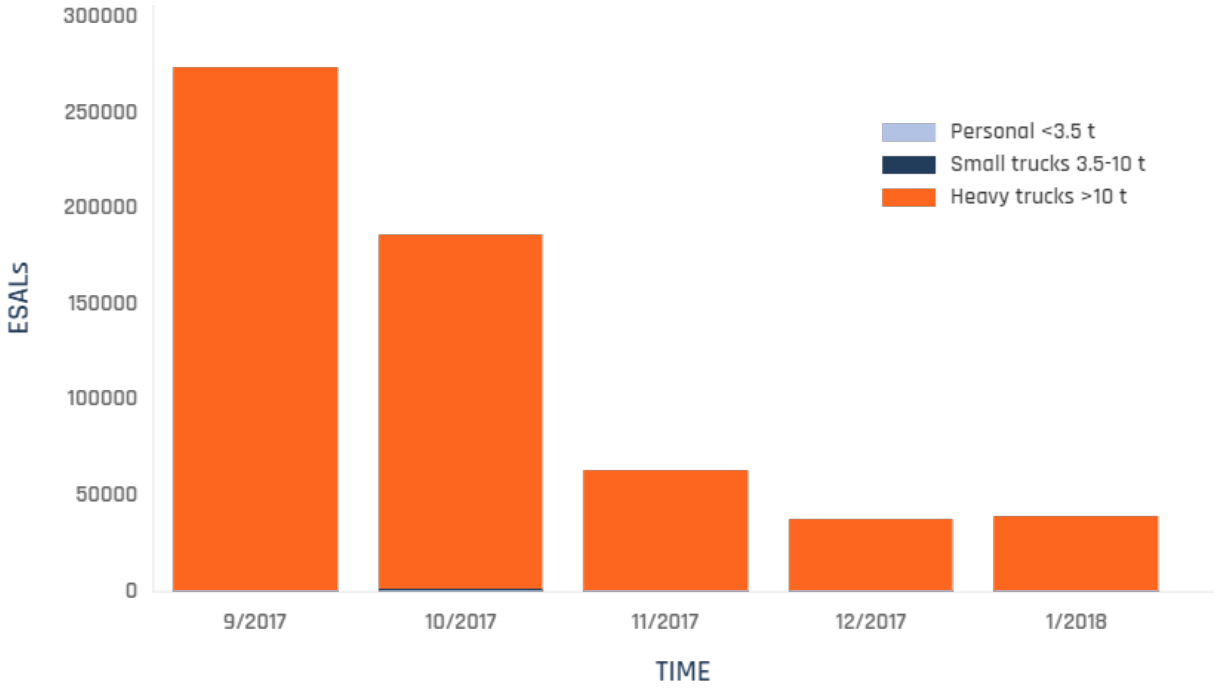
A Traffic study carried out in the Russian Federation aims to determine a level of road damage as accurately as possible. That is using WIM systems to measure Equivalent Single Axle Loads (ESALs) - the real cumulative road load.

Observations

From this example it is apparent the road condition according to an original plan differs from the real driveway condition. There are two conclusions. Firstly, the road has to be repaired much sooner if costs are demanded to reach the planned amount. Secondly, it has to be repaired in time. Otherwise, the costs will rise significantly. Weighing vehicles on axles provides data accurate enough to determine the actual road load, which enables the user to plan maintenance effectively.



Results in the Russian Federation show that installing the CAMEA WIM system for direct fining results in a significant drop of overloading violators. That decreases the road damage up to five times.



Conclusion

Once used for enforcing, the application extends the road lifespan significantly - the repairs can potentially be carried out at the optimal time and the original plan of costs and repairs can be met. It disables illegally heavy trucks from driving through the place. They are either loaded in accordance with the rules, or they use a different path. To prevent the second option, building a dense web of WIM stations is a desirable action.

MONITORING AND PROTECTING BRIDGES USING WIM

BLOG | WEIGH-IN-MOTION

In the context of the recent tragic incident in Genova, the topic of bridge conditions suddenly becomes widely discussed. How can anyone be sure the state of the bridge they drive on is good? The answer might be given by modern technology.

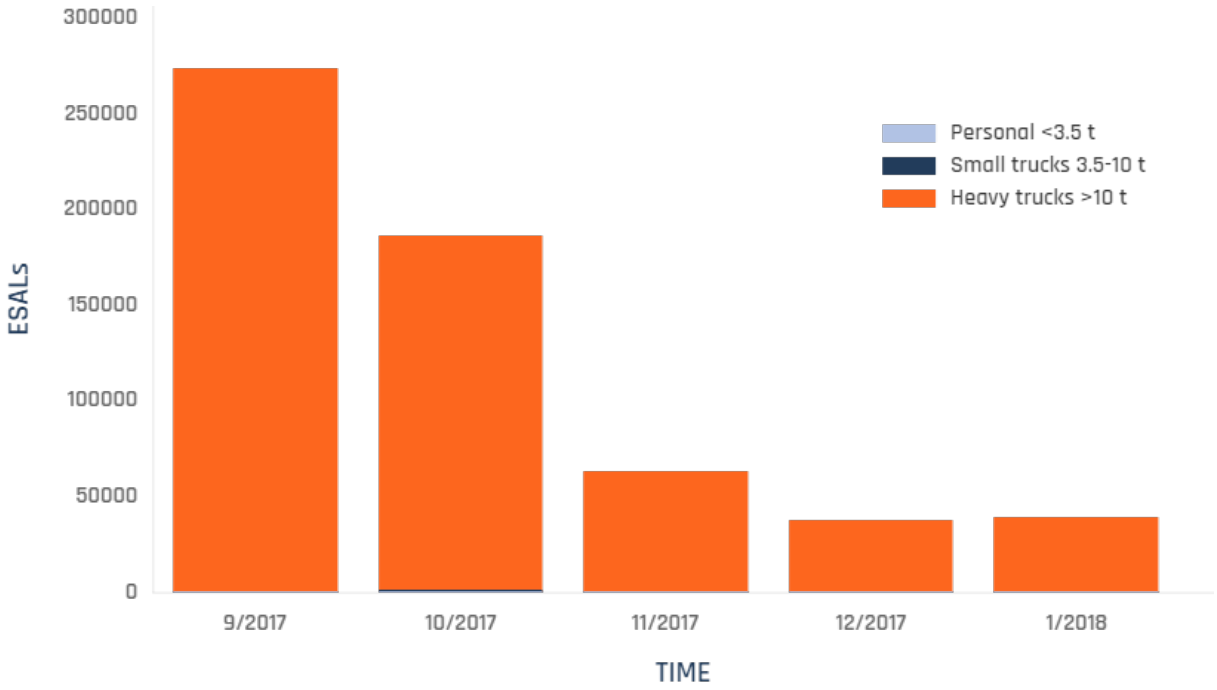
The Need for Data

Generally, the road infrastructure is damaged by the traffic intensity, yet much more by the weight of the separate vehicles. So, there are reasons to monitor how much vehicles use the road and which vehicle classes dominate. These can be done by traffic counters and classifiers. Based on the obtained information, the road stress load can be estimated and local authorities know what the bridge has gone through much better. That helps with maintenance planning and, in the end, cost saving.

It is estimated that one overloaded truck causes as much damage to the roads as almost 30,000 personal cars. In order to achieve more accurate and detailed information about the road damage, it is then appropriate to use a Weigh-In-Motion system.

Case Study

The graphs are based on collecting data from one of CAMEA WIM installations in Russia. They show how heavy trucks influence a cumulative load. Despite being the least frequent group of vehicles, they cause the most damage in total. It is also obvious the cumulative load decreases when enforcing. The reason is every overloaded vehicle eliminated means significant damage avoided. For instance, a common 5 axle semitrailer vehicle weighing 40 tons reaches 4.15 ESALs. Overloading this vehicle by 20 % means increasing the number more than twice, to 8.53 ESALs.



Providing Solution

Weigh-in-motion systems protect the roads. Protecting the bridges is particularly important as there is a greater danger involved. Applying weighing in motion at a spot near the bridge entering, not only do the local authorities have the best possible information about the stress the bridge has gone through, but the stress can be avoided by diverting overloaded vehicles. Using a pre-selection principle, they can be fined and ordered to unload. Until their weight is acceptable, they can't continue with the journey, nor with damaging the bridge and other infrastructure more than necessary.

Weigh-in-motion systems provide users with very accurate and complex information about the traffic. To a certain extent, the traffic determines the course of the bridge condition in time. It is possible to protect its state by enforcing the weight limits. That is most commonly done with a pre-selection method, allowing to prevent overloaded trucks from further travelling and enabling the not violating drivers to continue without interrupting their journey.

ACQUIRING WIM: LOCATING A SITE

BLOG | WEIGH-IN-MOTION

Weigh-In-Motion is the best solution for protecting roads. There are certain things to consider when planning a WIM station. Alongside location matters, very important and often underestimated ones are road and pavement characteristics.

Acquiring WIM

Supposing you have come to the conclusion that equipping the infrastructure with WIM is the best way to deal with overloaded trucks. Now you might think about approaching a practical matter of actualization. As the process of acquiring the WIM is much more complicated than shopping for groceries, there are some points to take into consideration. This article is presented to help you with some of them.

WIM Site Location

The WIM is usually placed on a highway or another important connection with a high traffic intensity and, most importantly, a high concentration of heavy vehicles. Such a road section is confronted with a lot of stress caused by the trucks, is easily damaged and therefore needs protection. Between important logistical centers, such as industrial zones and airports, ports etc., the chance of overloading occurrence is far from being insignificant. Take this into consideration. Within this section (typically 10 to 30 km monitored), the spot for a WIM site is selected. Remember not any spot can be chosen. Generally, it is advised not to install more than one system on one transport route. Concentrate more on building a network of stations to cover the whole region.

The users of the data provided by WIM are usually those determining the application of the system. It could be simply collecting data for the statistics purposes, pre-selection with a static or low speed scale (the station is usually already present, only later aided by WIM to raise efficiency) or direct enforcement. This fact influences the site locating as well.

Road and Pavement Characteristics

The basic purpose of all the WIM applications is to collect high-quality data. The road the sensors are installed into plays a significant role in reaching this goal. Any decision maker needs to pay attention to this matter as the system generally won't function as desired when the site is placed on a bad road.

Your WIM performance can only get as good as the road you are equipping.

According to COST323, it is strongly recommended that the road section between 50 m upstream and 25 m downstream of the system meets the following geometrical characteristics:

- **LONGITUDINAL SLOPE < 1 % FOR ACCURACY CLASS B+ (7) AND HIGHER OR 2 % FOR OTHER ACCURACY CLASSES**
- **TRANSVERSE SLOPE < 3 %**
- **RADIUS OF CURVATURE > 1000 M; STRAIGHT ROAD IS IDEAL**

The system weighs best when the traffic flow is maximally fluent. Therefore, the site should be installed away from any area of acceleration or deceleration, just as from a place where queuing is expected. Slip-roads or areas with changing number of lanes should also be avoided as maneuvering negatively influencing driving fluency occurs. The same applies for any infrastructure elements crossing of which results in extra vehicle dynamics.

Pavement quality significantly influences weighing accuracy and is just as important as selecting the site spot itself.

Pavement quality is just as important as selecting the site spot itself. WIM is commonly installed in a place where the road is new or has gone through a complete reconstruction. Simply, ruts are to be avoided. This way it also does not happen that the reconstruction is planned shortly after the system installation.

That would be a problem as it would either damage the sensors or result in a necessity of re-installation. COST323 specifies the pavement:

- NO HARD SPOTS IN THE UNDERLYING COURSES OR UNDER THE WEARING COURSE (TOLL SLABS, SERVICE TUNNELS, ETC.)
- THICKNESS OF BONDED LAYERS GREATER THAN 10 CM
- GOOD MECHANICAL BONDING BETWEEN COURSES, IN PARTICULAR OF BITUMINOUS CONCRETE ON GRANULAR MATERIALS STABILIZED BY HYDRAULIC BINDERS. THE SENSORS MUST BE INSTALLED IN HOMOGENEOUS LAYERS, NOT IN A JOINT
- SURFACING SHOULD BE DETERIORATION-FREE IN THE AREA OF SENSOR INSTALLATION
- PAVEMENT HOMOGENOUS ACROSS EACH TRAFFIC LANE, RULING OUT THE PRESENCE OF JOINTS OF COATED MATERIALS IN THE LENGTH OF A SENSOR

Specific road requirements differ across demanded accuracy classes. The most detailed information is found in specifications COST323, ASTM E1318 or NMi 2016.

For further consulting linked with your WIM project, contact CAMEA team.

IMPROVING INFRASTRUCTURE IN EAST AFRICA

SUCCESS STORY | WEIGH-IN-MOTION

Kenya leads the way in axle load control and management automation in East Africa, as it is the first country in the region to implement the Weigh-In-Motion technology countrywide; now observing positive impacts of the system deployment.

First Steps

Equipping the weighbridge management infrastructure with Weigh-In-Motion represents a step towards better roads, fluent traffic and improved road safety. Kenya National Highways Authority took up the onerous journey of automating and removing the human hand at the weighbridges from the year 2013. The authority started by installing high speed Weigh-In-Motion selection/filter at four of the weighbridges along the northern Corridor of Mombasa – Malaba. This involved the use of bending plate technology. In the year 2017, three of those were replaced by five CAMEA piezoelectric sensor and loop systems.

Owing to the expansive road network across the country, it was realized that it was never going to ever be possible to control overloading on Kenya road network through management at the existing ten static weighbridges. Therefore, a policy shift was made to develop a system of remote (virtual) weigh stations, also integrated to the existing static weigh station, utilizing CAMEA Weigh-In-Motion technology in partnership with AEA Limited. Ten of these virtual weigh stations integrated to the existing five static stations with CAMEA technology to form an integrated system of fifteen weigh bridges, complete with a dynamic 24-hour manned control centre were commissioned. Vehicles determined, through this system, to be overloaded above a critical threshold (initially 20% above permissible gross vehicle weight) are automatically tagged within and across the static weigh stations as well as the Axle Load Enforcement and Highway Unit (ALEHU) for possible impounding and prosecution whenever encountered. This system of fifteen integrated virtual and static weigh station has been in operation from October 2018.

This has seen a dramatic and unprecedented reduction in overloading incidences and elevated levels of compliance across the country.

When Theory meets Reality

Generally, the pre-selection is performed in order to eliminate long queues at the static scales as well facilitate trade, through faster and easier movement through the weighbridge system, as only those vehicles suspected to be overloaded are diverted, automatically, to the static scales for weight verification. The overall objective, from the foregoing above, is to reduce overloading, monitor the country's road network as well as collecting real time traffic data for design and planning purposes. According to Eng. Muita Ngatia (Deputy Director, Road Asset Management), all these are realized on Kenyan roads. With CAMEA technology, Kenyan road networks are much better off, and could easily last their designed economic lives.

"We are pleased to report the observed reality on Kenyan National roads. Queues at the static weigh stations are significantly shorter, compared to before implementing the Weigh-In-Motion. The Weigh-In-Motion solution, both at the static and virtual weigh stations, helps reduce overloading, facilitate trade and protects both infrastructure and people in the long run."

ENG. MUITA NGATIA, DEPUTY DIRECTOR, ROAD ASSET MANAGEMENT (KENHA)

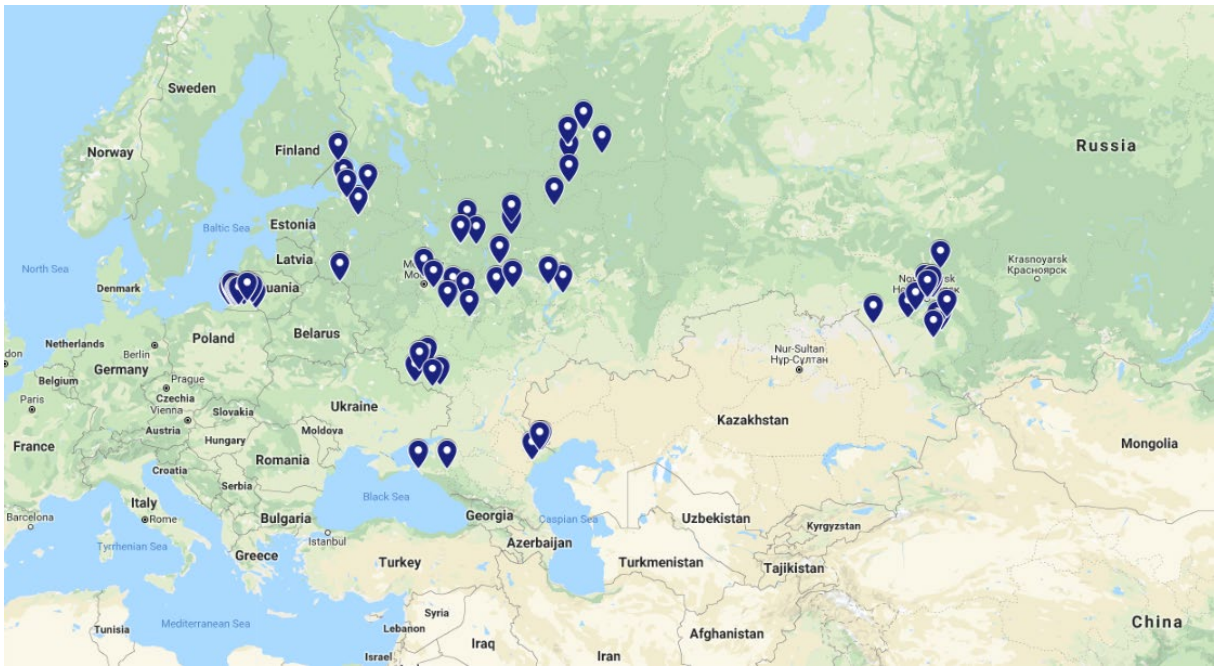
The Impact

Enforcing the weight limits using WIM technology could easily ensure safeguarding of road pavement integrity and cost-effective economic design life of the road networks. Considering the high cost of putting up road, it is clear that the solution saves serious amounts of money and results in a more efficient allocation of scarce resources, having a positive environmental impact.

Countrywide Direct Enforcement WIM Application in Russia

SUCCESS STORY | WEIGH-IN-MOTION

Russia has been implementing a unique combination of technologies for direct enforcement. CAMEA is a world leader in Direct Enforcement WIM, providing this solution to be a part of this project.



The Weigh-In-Motion for direct enforcement stands at the top of all intelligent transportation systems as the most sophisticated application of the most complex solution for traffic data management around. As such, it is a solution challenging in terms of development, implementation and maintenance. Also, deploying it means going through a complicated process including the legal authorization, public education and in-the-field operations.

A network of WIM stations is being built on a regional and national level. These major infrastructure projects are unique both in its extent and the combination of technologies. The enforcement is performed not only in vehicle weighing. The solution for enforcement in Russia enables fining speed and vehicle dimension violations as well.

CAMEA WIM solution was the first in the world to be certified for the direct enforcement. Now type-approved both in the Czech Republic and Russian Federation, the CAMEA WIM continues being successful on the Russian market with more than 60 stations used for direct enforcement out of almost 100 stations in operation today.

Reasons to Apply Section Speed Enforcement

BLOG | SPEED ENFORCEMENT

Section speed enforcement is efficient in keeping average speed in road sections down. Therefore, it has a potential of improving safety and environment in inhabited areas and leading to more fluent traffic.

Safety in Vulnerable Zones

At some places, there is a particular danger of vehicles colliding with pedestrians. A typical example is a school zone or different locality with high presence of children. The stopping distance which changes with vehicle speed is the main reason to control drivers within these areas. In some cases, it is sufficient to control speed for instance in front of a pedestrian crossing. Yet, the necessity to keep the speed down in a whole road section is very common.

The reason why spot speed enforcement using radars or similar technologies is not sufficient in some cases is the so called “Kangaroo effect”. It refers to drivers slowing down rapidly and increasing their speed again after passing the spot where speed is measured. There is no use for performing such maneuvers in a road stretch where the average vehicle speed is evaluated.

Between 30 and 40 km/h, the stopping distance increases by 50 percent!

(raisethehammer.org)

The importance of reducing speed in the areas lies in the relation of vehicle speed and its stopping distance. The higher the velocity, the more dominant the factor of the car braking possibilities as opposed to the reaction of the driver. Being cautious while driving fast therefore does not help as much as some would hope. The speed itself makes the situation dangerous.

According to the World Health Organization, speed contributes to 30 – 50 % of deaths on the road, depending on the country. It is obvious that monitoring speed can lower the number. The graph below shows impacts of enforcing the desired behavior using CAMEA section speed measurement technology. In the particular zone, number of daily violators decreased by approximately 80 % within a few months. As explained earlier in the text, this helps protecting traffic participants, especially the pedestrians.

Vehicle speed is a major cause of traffic accidents and enforcing the limits is generally considered one of the most effective tools for preserving road safety. Doing it in a whole road stretch prevents drivers from abrupt speed changes. By shortening the breaking distance, significantly dependent on the velocity, it protects vulnerable pedestrians, typically children, in areas where driving fast is particularly risky.

Traffic Fluency

Traffic density in some regions is getting enormous. At the same time, driver limitations such as speed measurement are often confronted with displeasure of citizens using the roads. But is enforcing in these situations really just bullying with a goal to collect money and to complicate getting to the final destination? Results from numerous applications show the impact on travel time is actually positive.

The elimination of the "kangaroo effect" contributes to traffic fluency. Together with speeding, avoiding this behavior also improves safety in specific places such as tunnels, roads where reconstruction is being performed etc. In the end, what is the worst thing for fluent driving? A highway full of queuing cars due to the accident in a constricted section with limited number of lanes.

Secondly, the speed reduction itself allows drivers to drive closer to the cars in front as the breaking distance is shorter and human brain can cope with it. Decreasing the vehicle gap then results in more vehicles situated in the section and more cars passing through the stretch within the same time period. Section speed enforcement therefore helps with getting to the final destination faster. Recognizing this function helps public acceptance.

Environmental Burden

Road traffic pollutes air and produces noise. Busy roads cutting through settlements are often responsible for respiratory issues, lack of sleep and many other major problems. In distant areas, wildlife suffers. Named impacts of traffic worsen with the speed of passing vehicles. That is why it is sometimes necessary to enforce keeping the velocity low.

The meaning of applying the section speed enforcement lies in fluent traffic, road safety and improved living in zones around the roadways. In order to achieve a decrease in average vehicle speed, it is necessary to properly inform drivers about the enforcement happening in the section.

Effects of Section Speed Enforcement

CASE STUDY | SPEED ENFORCEMENT

There is a typical course of number of speeding drivers after starting to enforce desired behavior through a section speed control installation. Shortly after the system application, the number drops significantly, just to rise marginally afterwards and to stabilize. This leads to reducing air pollution, noise pollution and improving pedestrian safety.

Background

In urban areas, a decision to apply a speed enforcement system comes from a necessity to protect pedestrians and to preserve or to restore a bearable ecological burden at the localities.

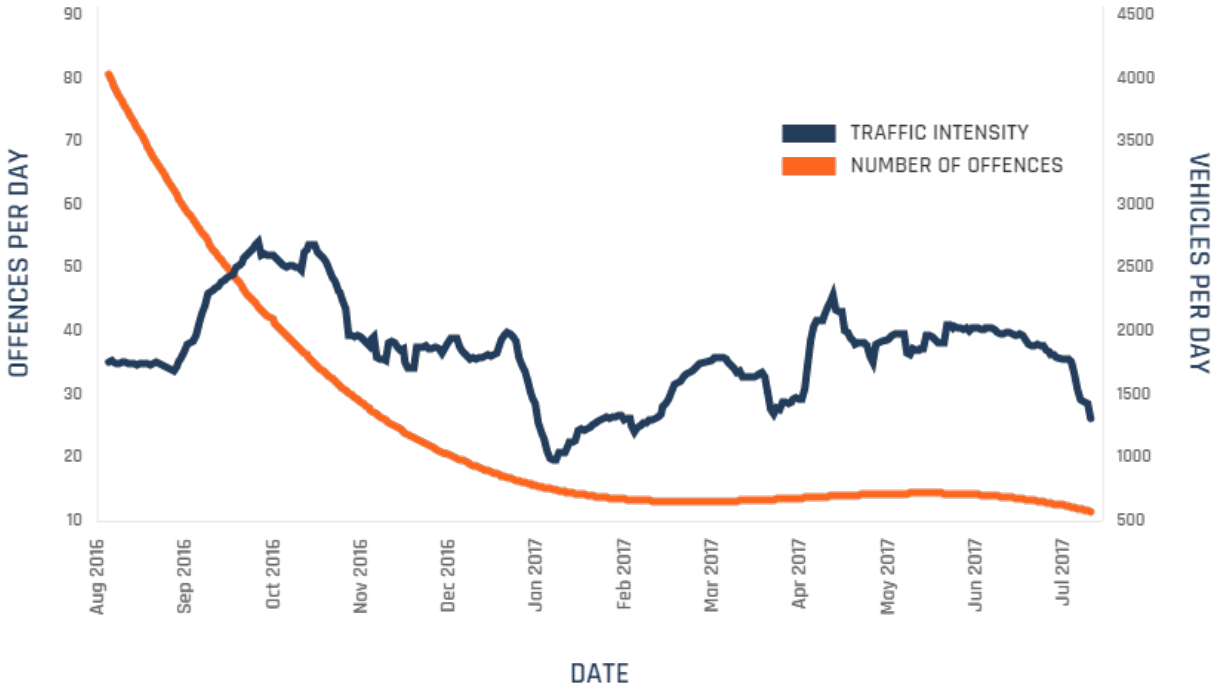
Comparing a number of speeding drivers shortly after applying a spot speed enforcement system and after some time, generally it is obvious there is a serious drop of the violators. However, it does not necessarily mean vehicles pass slowly through the whole area where following the speed limit is particularly important. Rapid slowing down approaching the radar or another device and accelerating again after passing the point often occurs and is referred to as a “kangaroo effect”. This phenomenon is possibly eliminated by a section speed enforcement.

Once the driver knows about his speed being monitored throughout the whole road section, it is irrational to perform the “kangaroo effect action” as he is not able to reduce the average speed significantly in a few meters. Therefore, section speed violation data seem to be more valuable when evaluating drivers’ behavior, since it is impossible to outsmart the system. Typical course of number of speeding drivers after the system installation testifies well enough.

The number of speeding drivers is typically reduced by around 80 % within a few months after the installation.

Observations

Usually, it can be observed the number of violators drops significantly from a certain figure right after starting to enforce. Following months are a period of drivers adapting their behavior to the fact their speed is monitored. Then the number of violators hits the bottom. After that, a marginal rise and a fluctuation might appear. Named effects are supported by the following chart.



The chart is a projection of the situation in Třebovice, a town in the Czech Republic. Other section speed system installations provide numbers testifying about a very similar course of the observed occurrence.

Applying section speed control in a particular area in order to protect pedestrians and an environment is efficient, as the number of speeding drivers is typically reduced by around 80 % within a few months after the installation.

Noisy Speeding: Impact of Speed on Noise Level

BLOG | SPEED ENFORCEMENT

The World Health Organization ranks traffic noise second among environmental threats to public health, trailing first air pollution. Alongside an endeavor to reduce speed in order to maximize safety or minimize air pollution, noise pollution calls for recognition as another important topic, since it grows significantly with vehicle speed.

Introduction

There are multiple side effects of road traffic. Two major ones are usually instantly recognized. Air and noise pollution greatly influence those spending a lot of time near the roads. Though, some suggest the noise is an underestimated factor in effecting human lives negatively. Is controlling speed a functional tool for dealing with this issue?

Reasons to Deal with Noise

Noise can be annoying and disturb various human activities. However, it had not been recognized widely as a negative health impact factor since recently. Nevertheless, the World Health Organization suggests noise exposure can cause health issues. According to the same institution, the noise exposure has a growing tendency, unlike other stressors the institution is concerned with, such as exposures to second hand smoke, dioxins and benzene.

Traffic noise is a major component of environmental noise and can be therefore responsible for stress, poor concentration and lack of sleep or for even more serious matters among which cardiovascular diseases, cognitive impairment and damaged hearing can be named. It has been recognized by WHO as the second among environmental threats to public health, as an estimated 30 % of European population is exposed to road traffic noise greater than 55 dB at night. Also, even remote natural areas are sometimes exposed to manmade noise, affecting the wildlife greatly, resulting in behavior changes and, in particular cases, possibly evolutionary changes (The Conversation).

Vehicle Speed and Produced Noise Relation

Instinctively, one would say the noise grows with the vehicle speed. But some went further and studied this occurrence with an intention to quantify it. In a distance of 7.5 m, it appears that 10 km/h speed difference results in the noise level increase by more than 1 dB for each vehicle passing. There is indeed a difference between a passenger car and larger vehicles. Not only do the trucks make more noise absolutely, the noise level growth is greater with the speed increase in comparison with the passenger cars (approximately 1.7 dB per 10 km/h for a truck, 1.2 dB per 10 km/h for a passenger car) (Deok-Soon An; Byung-Sik Ohm).

If aiming to reach as quiet traffic as possible, there are three main factors needed to be taken into consideration. Apart from speed It is an engine, tires and a road pavement type. At low speeds, engine type influences the total noise greatly. The significance of other two factors increases with growing speed. Road pavement becomes dominant particularly at high speeds.

Asphalt pavement is quieter than the joint concrete one, with slightly smaller influence of the noise level rising with vehicle speed (Deok-Soon An; Byung-Sik Ohm). It plays a significant role in producing traffic noise especially at higher speeds. At low speeds engine type is an inconsiderable factor too. There is also a significance of the tires which is growing with the speed.

Ways to Confront the Noise

Technological progress contributes to partial elimination of traffic noise sources. By some estimates, passenger cars are less than 20 percent as noisy and trucks even less than 10 percent as noisy as those produced 30 years ago. Nevertheless, the fight is not over. The trend of electric vehicles might seem to help solving the matter of noise. But is the effect really that significant? Engine type is a significant noise production factor at low speeds. In areas where speed does not exceed 40 km/h, the noise will be reduced to a serious extend by driving strictly electric vehicles. At higher speeds though, other factors, such as tires and pavement, become dominant and the electric engine doesn't make a big difference (Clean Technica).

Replacing current tires and treads with new technologies is most probably not happening any time soon. The most accessible approach then is to make sure cars don't exceed the permissible tolerance, as there is a positive relation between vehicle speed and produced noise. It is particularly important at populated streets with high traffic density and other specifics. The so called street canyons (streets flanked on either side with tall buildings creating a structure that's similar to a canyon) are a perfect example of vulnerable areas. Enforcing following speed limits is an efficient solution. For instance, applying CAMEA section speed measurement technology results in a serious drop of violators in a few months after the system installation. Experience from tens of installations testify about a similar course.

Conclusion

Road traffic noise can seriously damage human health. It grows significantly with the speed of the passing vehicles. The sound is created mainly by the engine, the tires and the road pavement. At low speeds, electric vehicle usage might be an answer as the engine is quiet. Nevertheless, at higher speeds, tire and pavement factors become dominant at making noise, while these are harder to influence. In order to preserve a bearable noise level, speed needs to be kept down. The best way to achieve it is by implementing and enforcing speed limits.