

Remote Control Weigh Station Implementation

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Abstract

Intelligent Transportation Systems are utilized worldwide to monitor vehicles, collect data, and enforce regulations. The Remote Control Weigh Station (RCWS) allows the implementation of these same techniques in locations where full time monitoring by on site personnel is not practical.

Remote Control Weigh Stations are used to monitor and manage vehicles at a remote location through an Internet connection to a centralized office.

A specific example of a global RCWS that will be examined in this article is the Thompson Remote Control Weigh Station. This system monitors commercial vehicle traffic on three roads that converge on a static scale site. Each monitoring site collects and displays information on each vehicle that passes by. These sites are each equipped with a Side Fire Camera and a License Plate Reader camera to capture both an overview and license plate image of each vehicle. Sensors at each monitoring site determine vehicle length and speed; vehicles are classified as commercial or non-commercial based on size. The system produces a vehicle record with the images and data for each commercial vehicle. When a vehicle is signaled to report to the inspection station, the central station operator can view and direct the vehicle through the weigh station and have the capability to view any documents or speak to the driver.

When a transportation agency has a shortage of resources, a Remote Control Weigh Station can be implemented so that commercial traffic can still be monitored with less staffing in place. Having the ability to monitor vehicles from a remote location makes the enforcement of overweight vehicles possible, which in turn reduces pavement damage on low volume roads.

Like other ITS implementations, the Remote Control Weigh Station helps alleviate the amount of emissions that are produced by commercial vehicles. With a Remote Control Weigh Station in place, vehicles are not required to cue up at the weigh station, but rather are able to bypass if appropriate weight and credentials are recorded at the Weigh-in-Motion locations near the weigh station.

The Remote Control Weigh Station is a viable solution for low traffic volume roadways in remote locations where there are limited resources to enforce non-compliant vehicles.

Introduction

As road agencies around the world grow in their awareness of the importance of utilizing Intelligent Transportation Systems (ITS) in transportation planning, ITS technologies are becoming increasingly innovative in ways to meet transportation needs. One of the innovations for monitoring and enforcement of commercial vehicles traveling on low volume roads is a system called a Remote Control Weigh Station (RCWS).

An RCWS is a system made up of sensors and network devices that allows monitoring and enforcement over an Internet connection, without the requirement of onsite personnel.

Many road agencies in North America are realizing that commercial vehicle monitoring and enforcement is important not only on primary highways, but also on low volume roads. The exponential relationship between wheel weights and damage to the road [1] reveals how an overweight vehicle has a major impact on road damage and reduction of the serviceability level, leading to increased preservation measures required to meet the road user expectation [2]. Monitoring commercial vehicles traveling on all road networks is very important in ensuring weight limits are being enforced and road structures are being protected.

As many existing roads are coming to the end of their service life, protecting road structures from any unnecessary overweight loads is very essential. An RCWS is an efficient way to monitor commercial vehicles and enforce weight limits.

System Overview

A typical RCWS system is depicted in the illustration below:

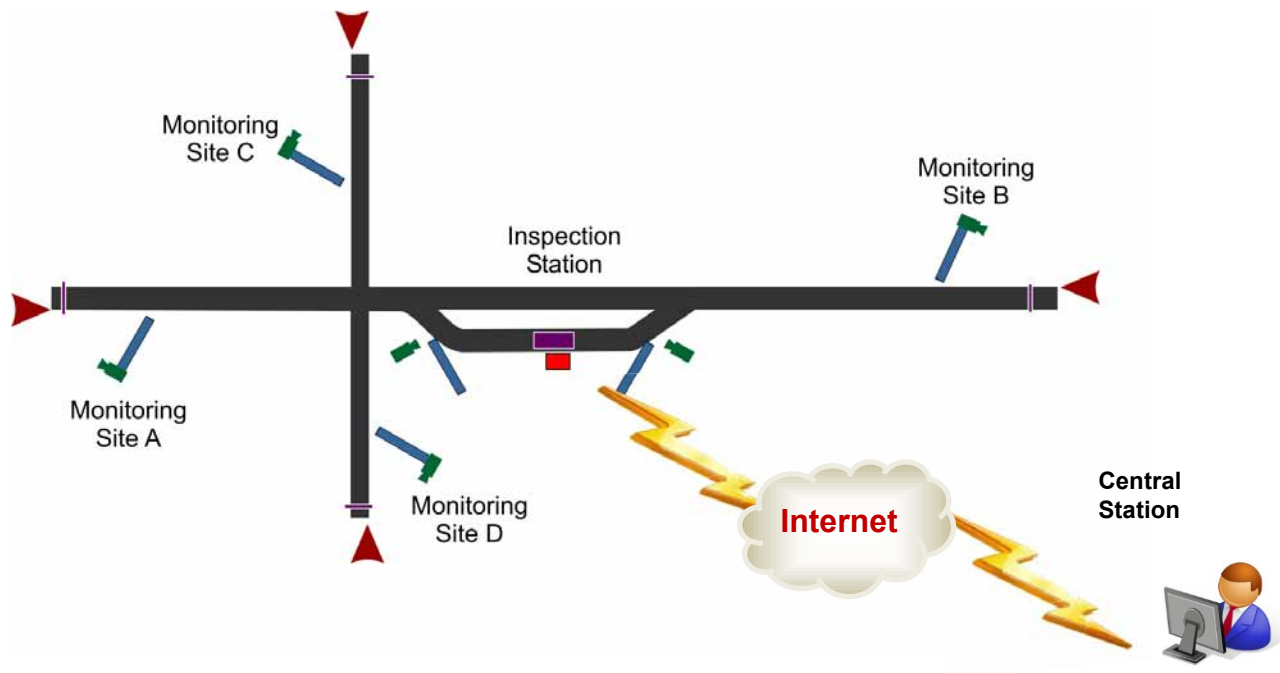


Figure 1 Typical System Layout

Each site is made up of monitoring sites, an inspection station, and a central station. Brief descriptions of the components that make up a remote control weigh station are:

- Monitoring sites
 - Vehicle sensors (presence detectors, loops, axle detectors, WIM sensors) – the sensors at the monitoring site provide the information that goes into the data record for each vehicle that passes through the system and is used to determine which vehicles should report to the inspection station.
 - Cameras – the monitoring sites utilize side image and license plate reader cameras to record images of each vehicle passing the site. These become part of the vehicle record and are used for vehicle identification.



Figure 2 Side Fire Camera System

- Signs and/or Signals – direct vehicles that are to be inspected at the inspection station.
- Controller – the system controller at each monitoring site receives the input from the sensors and cameras, determines whether or not the vehicle should report to the inspection station, assembles the information into a data record for the vehicle, and provides the network service to forward the vehicle record to the RCWS operator's browser.



Figure 3 Controller Electronics

The number of monitoring sites is determined by how many roadways in the vicinity of the inspection station location the agency feels need to be monitored. The monitoring sites capture commercial vehicle data and signal the vehicle whether to report to the inspection station or bypass it.

The monitoring sites are locations approaching the inspection station, that are able to collect commercial vehicle data prior to reaching the inspection station. At these sites, there are weigh-in-motion scales or sensors and a CMS sign, with the option of having cameras, license plate readers, and other additional ITS equipment. When a commercial vehicle is found to be overweight or otherwise non-compliant, an image of the vehicle will be captured along with the license plate, and the driver will be signalled through the CMS to report to the inspection station.

- Inspection Station
 - Static Scale – At the inspection station, commercial vehicles can be accurately weighed through the use of a static scale.



Figure 4 Commercial vehicle being weighed on Static Scale

- Site Overview Cameras – the site overview camera provides the RCWS operator with real time video of traffic through the inspection station. The operator can confirm that the commercial vehicle, which the monitoring sites have indicated should be reporting, has in fact turned into the inspection station. Pan, tilt and zoom controls provide the operator with the ability to inspect and verify specific details of a vehicle as required.
- Document Camera – if a commercial vehicle operator is required to show permits, credentials, log book, license, etc. they may be presented to the document camera in the inspection station building for the inspection station operator to view the documents remotely.
- Voice Communications Link – allows the RCWS operator to speak with the commercial vehicle driver.

The inspection station is the core location to the RCWS. At the inspection station, commercial vehicles are weighed on a static scale. Axle positioning sensors are used to notify the central station officer whether or not the commercial vehicle is weighing its axles correctly. If an axle is being missed the operator is able to pass on a message to the driver to either reverse or move forward so that all the axles are being weighed. Cameras provide the scale operator with images of the vehicles at the inspection station that can be matched with those from the monitoring sites to check that all signaled vehicles report. The driver may be asked to present his log book and other credential information to the officer who is viewing the site remotely.

An inspection booth is provided for the driver to present credentials and permit papers and speak to the central station operator. The booth is equipped with a Pan Tilt Zoom Camera that allows for the inspection station operator to view any documents presented verifying the vehicle's credentials and history. There is also a two way voice link in the booth so that the driver and remote operator can communicate.

At this location there is a static scale to weigh the vehicle. The central station operator can watch the commercial vehicle weigh each axle and signal the vehicle to re-weigh an axle if he sees an inaccurate reading. The driver is signaled through a Variable Message Sign (VMS) that the operator can control to display messages such as “STOP”, “REWEIGH AXLE”, “PROCEED”, “REPORT TO BOOTH”, etc. and through a red/green traffic light.



Figure 5 Changeable Message Sign and Red/Green Signal at Inspection Station

- Central Station
 - Monitoring Site Browser– the Internet interface on the RCWS operator’s workstation computer that allows the operator to view vehicle records and images from different monitoring sites.
 - Camera Display – the Internet interface on the RCWS operator’s computer that views the real time video display from the inspection station overview camera and document camera.

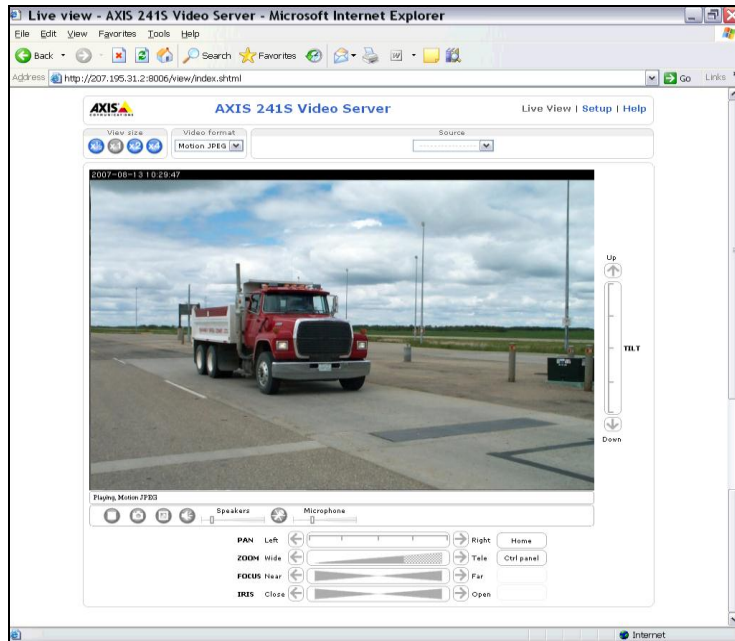


Figure 6 Camera Interface

- Monitoring Site Image Display – the operator can view detailed vehicle images from the monitoring site cameras.



Figure 7 Night Time License Plate Image



Figure 8 Day Time License Plate Image

- Scale Interface – the RCWS operator is able to view the static weight of a commercial vehicle through the scale interface.



Figure 9 RCWS Operator Workstation

From the RCWS operator's workstation, vehicle data is viewed through an internet connection to the remote site. There are multiple browser windows that allow the operator to view the monitoring sites, the live video camera display, and the static scale interface.

Enforcement Options

Citations may be issued either immediately at the remote site (via a printer in the booth) or from the central office through mail.

A citation at the booth can be given directly at the time of the incident. The weight of the vehicle is determined on the static scale and if non-compliant a citation may be given at the remote site via the internet link and printer at site. A citation can also be mailed from the central office directly to the commercial vehicle's business address.

The way a citation is handled is completely up to the agency that has implemented the RCWS.

Both the camera and the license plate reader help collect the necessary data to enforce vehicles.

Applications

Road systems with relatively low traffic volume are sometimes viewed as roadways where continuous enforcement is not economically feasible. However, no matter what type of roadway, overweight commercial vehicles will aggravate road deterioration. Low volume roads have fewer vehicles but not necessarily lower percentage of overweight traffic compared to a primary highway. Some low-volume roads see the same overloaded vehicle each day, as that road is part of a commercial vehicle route for an industrial business such as mining, forestry, petroleum, or farming. An RCWS gives agencies the ability to enforce on low volume roads without installing the amount of infrastructure a traditional weigh station requires.

An RCWS is also beneficial in locations where full time monitoring is not required. The inspection station can be opened and operated from a central station location rather than having personnel go to site. Therefore, in locations when only part time monitoring is desired, it is a lot easier to work with the drivers remotely than sending an operator to site for a short period of time to run the weigh station.

Roadways can benefit from an RCWS when there are remote hauling operations. When there is a determined haul route that has one road constantly being used for operations, that roadway is susceptible to damage due to heavy hauling. These roadways greatly benefit from an RCWS, which ensures that the commercial carriers are following the weight limits of those roadways. If traffic volumes or weight are seen to be increasing, the frequency and/or duration of RCWS operation can be increased to mitigate damage to the roadway.

When a jurisdiction is in control of a large network of roadways, many times the amount of enforcement that is required outstrips the resources available. By implementing a system utilizing multiple RCWS, the available resources have greatly expanded capability to monitor and enforce the entire area.

If a commercial carrier has been proven to be overweight or non-compliant with regards to safety or credentials at an inspection stations, then the operator can communicate and discuss the situation with the driver at the site via a voice communication link and video.

As well, an RCWS gives agencies the ability to utilize an existing weigh station that has been closed due to a shortage in resources. By adding a communication link and video camera, the site can be monitored from another location. Therefore, as traffic patterns shift and/or staffing priorities change, agencies can implement a remote control weigh station to ensure that enforcement is still occurring at an existing location.

Thompson Remote Control Weigh Station

Thompson is located in northern Manitoba, about 750 kilometers north of the Winnipeg. It has a population of approximately 15,000. Although the city has a low traffic volume, it is subjected to heavily overloaded commercial vehicle traffic, which aggravates damage to the road surfaces and structures of the city's road network. Weight enforcement is necessary to protect roads from further damage and reduce annual maintenance cost. Studies have shown that some commercial vehicle drivers will use secondary routes to avoid weigh stations when they are overloaded [3].

Thompson RCWS has many ITS technologies deployed at site. These technologies include non-intrusive vehicle sensors, inductive sensing loops, side view cameras, license plate readers, pan-tilt-zoom lot camera, document camera, variable message sign, system controller electronics, axle positioning sensors, an audio interface system and static scale.



Figure 10 Static Scale and Inspection Station

ITS Equipment Enhancements to Thompson RCWS

Thompson RCWS could be enhanced by adding Weigh-in-Motion (WIM) to the three monitoring sites surrounding the inspection station. The WIM would allow for the vehicle to be weighed prior to reaching the inspection station. This would allow the system to automatically sort between compliant and potentially non-compliant vehicles; compliant vehicles being signaled to bypass the inspection station and potential violators being signaled to report. A study in Oregon concluded that, “each bypass results in fuel savings and emission reduction, which can be very significant cumulatively [4].



Figure 11 IRD PAT Bending Plate Weigh-in-Motion Scale

WIM sorting at monitoring sites would require the addition of a Changeable Message Sign (CMS). A CMS gives the system the ability to show different messages to the drivers. The current static signs at Thompson state: “All trucks report when lights flashing”. The lights flash when the station is open and do not flash if the station is closed. The CMS would display “BYPASS” or “REPORT” depending on the WIM and/or credential data the system obtains.



Figure 12 Existing Static Sign at Thompson



Figure 13 Implementation of a Changeable Message Sign

Automatic Vehicle Identification (AVI) is used with a database to check that the vehicle, driver and carrier identity information, as well as their credentials and safety records are correct. The use of AVI would allow sorting of vehicles based on their credentials and safety record.

Thompson RCWS implemented a License Plate Reader to help identify the commercial vehicles that pass through the system. With the addition of Optical Character Recognition (OCR), a commercial vehicle's license plate could be read and the vehicle record looked up automatically without the RCWS operator having to visually read the plate number from the image and manually look up the vehicle information. This can make the enforcement and data collection process more efficient.

Conclusion

A Remote Control Weigh Station is an efficient and effective method of enforcement. This system includes Intelligent Transportation System products such as in-road sensors, Weigh-in-Motion, camera systems, signage, voice and video link, and a static scale. An RCWS provides a monitoring and enforcement solution for low volume roads. It leverages resources, utilizing sites where personnel cannot always be located, and where intermittent hauling operations such as oil and gas, logging or farming make up a major part of commercial traffic.

The RCWS is a web-based enforcement tool that can utilize existing personnel to monitor sites remotely. The operator has the ability to monitor multiple sites from one central location. Through the voice and video link, commercial vehicle drivers are easily able to communicate with the operator and receive any information or directions on how to proceed at the inspection station.

In summary the remote control weigh station has the ability to perform the following:

- Screen vehicles from one central location 24/7;
- Review documents and log books remotely;
- View and Communicate with drivers in real time;
- Remotely open & close the station, sort and bypass vehicles, and collect data;
- Screen multiple directions of travel;
- Ensure vehicles are not illegally bypassing the site when directed to report to the weigh station.

References

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