Abridgment

Weighing in Motion in California

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Since the California Department of Highway Patrol commenced enforcing vehicle weight laws, the primary method of detecting overweight vehicles has been to stop the vehicles and weigh them on platform scales. To improve efficiency of vehicle weight enforcement and highway operation and to minimize delay and inconvenience to the trucking industry, the California Transportation Laboratory in cooperation with the Federal Highway Administration has designed and placed into operation a trial high-speed truck screening system. This installation is located on westbound Interstate 80 at the Cordelia weighing facility, about 80 km (50 miles) west of Sacramento. Using strain-gauge, load-cell weighing bridges, the system is capable of weighing trucks at speeds up to 56.3 km/h (35 mph). Initial tests indicate average errors of 2 or 3 percent and no more than 10 percent.

The high-speed scales are located approximately 243.8 m (800 ft) upstream from a 3.05 by 3.66-m (10 by 12-ft) platform scale, static weighing station at Cordelia. Maximum truck volume is approximately 2100 vehicles/d in August and decreases to 1100 vehicles/d in December.

The truck screening project has been in operation intermittently since November 1974. A statistical experiment was designed and performed in May 1975 with a loaded five-axle truck. Unfortunately a scale failed during the test and the results were not accurate. Six of the scales failed between November 1974 and June 1975. These were returned to the manufacturer, repaired, and reinstalled.

DESCRIPTION OF TRUCK SCREENING INSTALLATION

Power is furnished to the electronic scale chassis from 12 separate strain gauges so that scale calibration is easy. The force exerted by the tire on the transducer assembly produces an output signal voltage proportional to that force; each 44.5-kN (10 000-lbf) increment produces a 10-mV signal. The excitation voltage and the output signal voltage are brought to each transducer in 1.27-cm (0.5-in) diameter copper tubing that also supplies a protective envelope of dry nitrogen gas at a slight positive pressure of 13.8 kPa (2 lbf/in^2). The nitrogen gas is used to impede moisture from entering the strain-gauge load cells.

The output signal voltage (proportional to the vertical force) is connected to the multiplexer-analog to digital converter (DC). This device sequentially scans the transducers at a rate of 13 900 samples/s, amplifies the signal to an acceptable level, and then converts the magnitude of the DC signal to a corresponding binary code acceptable for transfer to the computer.

In the computer the vertical forces exerted by the wheel on the transducer assembly are averaged over the four successive samples that have values higher than a preselected cutoff value and that have the least deviation from their mean. This average force is then added to the average force obtained for the wheel on the other five scales as that wheel goes over each scale. This sum is then divided by six to obtain an overall average weight for that wheel. This average force is added to the average force obtained for the wheel on the other end of the axle to obtain an average axle weight. This process is repeated for each axle of the vehicle as it crosses each of the six pairs of transducers.

During the time the truck is dynamically weighed, the space between axles is also determined to the nearest 30.5 cm (1 ft). The axle weight and spacing are compared with those set forth in the vehicle code. If a violation is detected, the system prints the type of violation on the teletype and by overhead signals directs the truck driver to the platform scales to have the truck reweighed. If the truck is determined to be in violation of the weight laws, the driver is cited and must correct the violation before he can move the vehicle from the weighing station. Vehicle speed is also calculated, and, if a change in speed of more than 25 percent is detected, the truck driver is directed to the platform scales to have the truck weighed. If the truck is not in violation, the driver is directed by overhead signals to use a bypass

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lane to return to the freeway without stopping at the platform scales.

Violations are indicated to the weighmaster by a small display mounted in front of him. The weighmaster has control of the overhead signals and can direct any vehicle to come to the platform scale. This procedure permits him to determine whether a vehicle has some obvious safety deficiency and whether it needs a mechanical inspection.

CONCLUSIONS AND RECOMMENDATIONS

1. Weighing in motion on a day-to-day basis has proved to be practical.
2. Typical errors between the motion and static vehicle weights are 2 to 3 percent although some errors exceed 10 percent.
3. Additional work is required to improve the reliability of equipment.
4. Further developmental work is recommended to provide more reliable operational weighing transducers.

In the future, similar installations at major weighing facilities in California will serve to speed truck traffic and provide greater safety by reducing queues of trucks backed up onto the freeway waiting to be weighed.