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CALIBRATION NEEDS FOR LTPP TRAFFIC DATA

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The Long Term Pavement Performance (LTPP) traffic data collection effort represents the largest undertaking of its type ever attempted. Starting in 1990, monitored traffic data has been collected from most of the LTPP General Pavement Studies (GPS) and Specific Pavement Studies (SPS) test sections across the United States and Canada. This represents approximately 1,000 test locations. LTPP originally encouraged continuous data collection at all sites, using low cost Weigh-in-Motion (WIM) systems. Most states/provinces have instrumented their test sections and data are now available to the LTPP databases.

During the early years of the Strategic Highway Research Program (SHRP), Regional Coordination Offices (RCOs) representing LTPP requested a traffic data collection plan from the State Highway Agencies (SHAs). SHRP identified three potential levels of traffic data collection:

1. Preferred-Continuous WIM.
2. Desirable - Continuous AVC with seasonal sampled WIM.
3. Minimum - One-year continuous AVC with sampled WIM representing typical weekdays/weekends.

Little was said about calibration of the equipment early on. The states were asked to submit data which they felt was accurate and representative of the section being monitored. This data collection activity was made a SHA responsibility, primarily in recognition of the on-going SHA efforts at traffic data collection for their own and other federal needs. The states were asked to make ever effort to install equipment that would provide site-specific data. This made this data collection effort unique, in that the data would be associated with a discreet test section on the highway. This point-specific data collection effort, rather than the typical "network level" data collection effort, carried with it more stringent accuracy requirements than was normally encountered.

During the period from 1990 to present, most SHAs have instrumented the LTPP test sections with some type of traffic data collection equipment. The resulting data has been submitted to the LTPP RCOs, where it has been processed through quality control (QC) review software, and ultimately included as part of the LTPP database.

Using this resource, LTPP through it's Technical Assistance Contractors (TACs) endeavored to understand more about the nature of the traffic on our highways, and how best to monitor this traffic. Studies of the collected data found that while continuous data is not always required, it is **absolutely essential that site-specific, calibrated equipment be used** to collect the data if it is to be of use for performance monitoring research. To meet this need, LTPP developed a procedure for calibration of traffic data collection equipment to be used for monitoring of LTPP test sections. This new protocol will be distributed during state visits in the coming months.

The protocol for traffic data collection equipment calibration developed by LTPP provides recommendations for ensuring the traffic data collection equipment used for the LTPP traffic monitoring efforts operates correctly and collects valid data. It is subdivided into three areas. These include:

1. Steps for checking equipment calibration.
2. Quality control steps to be taken in the field.
3. Quality control steps to be taken in the office.

These recommendations follow from the research conducted by the TACs, indicating that **calibration of both AVC and WIM equipment with a known procedure on a routine basis is essential to provide accurate data.** In turn, accurate traffic data is essential for summarization into ESAL values for use in the pavement performance research studies.

Steps for checking equipment calibration are subdivided into sections for WIM and AVC equipment. For the WIM equipment, calibration of the equipment should occur prior to each use, or in the case of permanent scales, the calibration should be field-validated at least twice per year, and the data should be reviewed monthly to ensure that the scales remain calibrated.

Basically, where adjacent static weigh scales do not exist (anticipated for most locations), vehicles of known weight make multiple passes across the scales to calibrate the equipment within acceptable threshold limits. A minimum of two vehicles is required, with one of them being the standard 3S2 truck loaded between 72,000 lbs. and 80,000 lbs., preferably with an air-bag suspension system. The other truck should be of a different configuration, but not a three or four axle single unit dump-truck. Test runs are made at highway speeds, with a minimum of 20 passes per vehicle to achieve the necessary calibration. WIM system calibration tolerances for particular vehicle types are provided in Table 1 of the protocol, and generally require between ± 10 to ± 30 percent at a 95 percent confidence limit, depending on the site and vehicle types.

Once the calibration of the WIM system is confirmed, the data should be collected for a minimum of 100 3S2 vehicles to establish a gross vehicle weight (GVW) pattern. This pattern may be used to check future data collection efforts to identify calibration shifts. If it is recognized that the unloaded peak shifts greater than 4,000 lbs., or the loaded peak shifts greater than 8,000 lbs., the protocol requires that the calibration settings be validated. If it is found that these shifts are accurate and represent the vehicles actually crossing the scales, then a new GVW pattern can be established to help describe the expected patterns for the site.

Calibration of the AVC equipment was found to be as critical as calibration of the WIM equipment. This includes calibration of both stand-alone AVC equipment and the AVC component of WIM equipment. Basically, AVC calibration is conducted by comparing samples of classification vehicle counts to “truth” data, usually collected by visual or photographic methods. Checks are conducted for individual vehicle types, and a comparison of the aggregated classification device output with known control totals, to ensure that the classification equipment is operating properly. Many AVC counters have problems correctly differentiating specific vehicle types because the axle spacing characteristics of these vehicle types are similar. Therefore, the calibration effort needs to review how well specific types of vehicles are classified. These vehicles include the following:

1. Recreational vehicles.
2. Passenger vehicles pulling light trailers.
3. Long tractor/semi-trailer combinations.

Other vehicle classifications can also be tested, given a states experience with AVC equipment.

The second portion of the AVC calibration test involves comparing a minimum of 24 hours of vehicle classification output from the device with records known to correctly measure those same 24 hours. Comparison of these files include the percentage of unclassified vehicles and the presence of certain vehicle types, including a large number of motorcycles when few were actually present, or overly large numbers of Class 8 vehicles. Basically, the intent is to fine-tune the time-out and/or vehicle length threshold settings, to classify the vehicles as accurately as possible. Where both AVC and WIM equipment are placed in the same location, it is critically important that they be calibrated accurately, so that there are no large variations in values between the equipment types. This is very common, as algorithms for multiple vendors can provide large variations in classification results.

In addition to the calibration requirements, the protocol also makes recommendations for QC checks, both in the field and in the office. These QC checks are quick reviews to ensure that the properly calibrated piece of equipment is working as intended in a given field installation. The field QC check is based on a relatively short duration review of the data, observing vehicles as they pass to ensure that the AVC equipment is doing it's job properly. 3S2 drive axle and tandem axle spacings should be checked to see that they are within normal range, as specified in the protocol. Many of the same checks that are established for the calibration procedure are required in the field QC effort, only the duration of the activity is shorter.

For WIM equipment, the field QC procedure includes first checking that the equipment is correctly counting and classifying vehicles, following the procedure previously defined. Characteristics of 3S2 vehicles should be used to ensure that the calibration of the WIM equipment has not shifted. Front axle weights and spacings are used to accomplish this task.

In addition to QC in the field, QC steps are also required in the office, as the data is received. These require comparison of the manual counts and the AVC data to ensure that typically problematic vehicles and unclassified vehicles are within acceptable limits. Where historical values are available, comparison should be made with current truck percentages by class to determine whether unexpected changes in vehicle mix have occurred. For WIM data, the office QC check involves a review of the short-term data collection effort GVW plot for Class 9 vehicles, to that established when the equipment was calibrated as the typical for the site. For most sites, it has been found that the location of the peaks within the gross vehicle weight histogram will remain fairly constant, although the height of the peaks may change somewhat over time as the result of changing volumes and/or percentages of loaded or unloaded vehicles. The reviewers should examine the distribution and decide whether vehicle weights illustrated represent valid data, or whether the scale is either not correctly calibrated or is malfunctioning.

As a final note, flexibility is allowed in the implementation of this procedure. If a state has a system in place that can be shown to produce data of equal or greater accuracy, then that system may be used. This should be coordinated with the appropriate RCO.

This paper presents a very brief overview of the LTPP protocol for calibrating traffic data collection equipment. It is not intended as a replacement for the protocol, as there have been many details omitted due to space constraints. It is strongly recommended that the protocol be obtained from either the LTPP office or the RCOs for review.