Equipment Selection and Site Installation for LTPP SPS WIM Sites

Background Material for the Presentation by Barbara K. Ostrom, LAW PCS

The Long-Term Pavement Performance Program (LTPP) has intensified its efforts to obtain sufficient quantities of research quality loading data at a number of Specific Pavement Studies (SPS) sites. As one part of this effort, the FHWA has consulted with the Transportation Research Board LTPP Traffic Expert Task Group for a recommendation for equipment with a significant field history of reliable, low variability, continuous operations. LTPP acknowledges that more than one technology may be capable of achieving the specified performance, however, as with all other LTPP equipment protocols, a single package of sensors, software and pavement performance requirements has been selected as the basis of a set of model specifications.

The model specifications are for high-speed bending plate WIM in a portland cement concrete slab 300 feet long. Installed equipment is expected to meet ASTM E-1318 tolerances for Type I equipment based on axle weights, gross vehicle weights, speeds and axle spacings. A separate smoothness specification has been developed which is partially referenced by incorporation in the grinding criteria for pavements. The details on the verification of scale performance are in a separate document.

The specifications are provided as if they were actual contract documents. They are divided into two parts: a hardware and software package, and installation procedures including two options for a portland cement concrete slab.

Individuals wishing to provide comments or obtain updates and any revisions with respect to this equipment and installation package should contact Larry Wiser, Traffic Lead for the FHWA LTPP Team, at 202-493-3079 or via e-mail at larry.wiser@fhwa.dot.gov.

LTPP Bending Plate Weigh-in-Motion System: Model Specifications for Equipment - Hardware and Software

Draft

U.S. Department of Transportation
Federal Highway Administration

Long-Term Pavement Performance
Serving your need for durable pavements

LTPP Bending Plate Weigh-in-Motion System Model Specifications

1.00   Introduction

It is the intent of these specifications to establish the minimum requirements and conditions for the procurement of high speed weigh-in-motion for the purpose of collecting traffic data at Long-Term Pavement Performance (LTPP) Specific Pavement Studies (SPS) sites.

2.00   Proposal Requirements and Conditions

(This section would include all special instructions and requirements in the preparation of proposal documents and bid. It would also include preferences.)

3.00   General

3.10 Plans and Working Drawings
(When plans or working drawings are required , this section will have instructions on who and where they are to be sent.)

3.11 Support
The vendor shall provide full-time on-site direction during weigh-in-motion system installation and system start-up.

3.12 Payments

4.00   High Speed Weigh-In-Motion Electrical System

4.10 Description
The Weigh-In-Motion System (hereafter WIM system) shall include equipment and software for collecting, processing, storing, transmitting and manipulating information related to the counting, classifying and speed monitoring of all vehicles and the weighing of trucks and buses at highway speeds.

4.11 WIM Controller Cabinet
The WIM controller cabinet shall be furnished as part of the WIM system. It shall be a Type 334 with 19" mounting cage. The cabinet shall be wired and have all mounting brackets installed at the WIM vendor's factory.

4.12 Detectors
Loop detector sensors shall be furnished by the WIM vendor and be of the WIM vendor's design. The loop wire shall consist of a conductor wire inside plastic tubing. The conductor shall be no. 14 stranded copper wire with Type THWN insulation. There will be no splices in the

roadway.. The tubing shall have a maximum outside diameter 0.27 inches and a minimum wall thickness of 0.028 inches. Loop detector lead-in cable shall be furnished by the WIM vendor. The loops shall be installed according to the Wim vendor's recommendation.

5.0   On-site Equipment

The WIM system shall provide for single threshold weighing, and operate over a speed range of 5 mph to 100 mph. Single threshold weighing shall consist of scales in each lane of measurement. The weigh sensors shall cover the entire lane width. The WIM system shall consist of the following components:

1. Wheel scales scale lead-in-cable, frames and mounting hardware for each lane to be instrumented. The scales shall report weigh data for each wheel track (right axle weight and left axle weight). Such wheel data shall be uniform across the total width of the scale. Scales installation shall conform to the details shown on the plans. A representative of the WIM manufacturer shall be on site during the installation of the WIM frames and scales.

   A. All fasteners used in mounting the wheel scales to the scale frames shall have a minimum diameter of 0.50 inches and have an 180,000-PSI rating or better rating. All fasteners shall be torqued to manufacturer's specifications. A minimum of twelve fasteners will be used.

2. Two inductive loop detectors per lane for measuring speed and vehicle length.

3. A central unit shall be installed in the controller cabinet. The central unit shall include all of the equipment and software to calculate, store and transmit to a host computer all data specified in these specifications. The central unit shall operate on AC power with a DC battery backup system to provide uninterrupted power to the central unit during AC poser outages for a minimum of one hour. The system shall be able to operate on solar power if AC power is unavailable. The modem to be installed in the controller cabinet shall be compatible with the host computer modems described elsewhere in these specifications. The user shall have the capability of entering a site designation code up to three characters.

4. All necessary interconnecting cables and miscellaneous materials to make an operational system.

5.10 Functional Requirements

   A. The WIM system shall be able to accommodate vehicles and vehicle combinations with up to nine axles and shall automatically determine for each vehicle, by lane of travel.

A. Weight of each axle:

Accuracy	MEAN	STD. DEV.
Single axle	±5%	8%
Tandem axle	±5%	6%
Gross weight	±5%	5%

B. Axle spacing, vehicle length and speed:

Accuracy:	MEAN	STD. DEV.
Axle spacing	±6"	12"
Vehicle length	±12"	18"
Speed	±1 mph	2 mph

The WIM system shall provide for calibration features such that the required accuracy required under LTPP standards for equipment performance verification can be met.

C. Vehicle classification:

The WIM system shall provide for a minimum of 15 vehicle classifications. Class I through Class 13 shall be used according to the classification scheme shown in Chapter 4, Appendix A, of the FHWA 3d edition of the Traffic Monitoring Guide, February 1995. Class 14 will identify special vehicles as determined by the user. Class 15 will identify any vehicle not conforming to the classification criteria for Classes 1 through 14. Classification criteria for Classes 1 through 14 shall be programmable by the user.

The WIM system shall provide sufficient flexibility in spacings and weights (gross, or axle and gross) for each of these classes so that accurate classifying is achievable.

D. Invalid measurements:

An "invalid measurement" code shall be assigned to any vehicle meeting the front axle weight threshold (discussed below) when (1) the left and right wheel weights of any axle have a difference of 40 percent or more; and (2) either of the wheel weights of such axle exceeds 2.0 kip. Both the 40 percent and 2.0 kip values shall be programmable by the operator. Any vehicle assigned an "invalid measurement" code shall not be considered a "Weighed Vehicle" but shall be classified and counted and all vehicle data shall be stored in the vehicle record.

E. Determination of weight violations:

For any vehicle meeting the front axle weight threshold (discussed below), the WIM system shall determine which, if any, axle(s) or axle grouping(s) exceed the weight limits set forth in the "Weight Violation Table" contained in these specifications. Any vehicle with one or more weight violations will be coded as to such a violation or combination of violations. The weight limitations set forth in the "Weight Violation Table" shall be the default settings. Such weights shall be programmable by the user.

1. The central unit of the WIM system shall calculate and store all specified data on a storage medium. The on-site data storage device shall have the capacity to store a minimum of seven days of vehicle count data and individual vehicle records. The storage device shall be completely solid state with no mechanical components and shall be a type not susceptible to loss of accumulated data should electrical power be interrupted. The central unit shall continue to calculate and store data for all vehicles passing through the system during periods of access, both on-site by portable PC and by the host computer for purposes of programming, real-time view and downloading of data.

The central unit shall store the following data:

A. Hourly vehicle counts by class and by speed range for each 24-hour period (Class/Count Summary).

B. Individual vehicle records for all vehicles with a front axle weight greater than 3.5 kip (hereafter referred to as "truck records"). The front axle weight threshold for truck records shall be programmable by the operator with 3.5 kip as default setting. Each truck record shall include, as a minimum, the following data:

   i.   Time and Date.
   ii.   Lane Number.
   iii. Vehicle Number.
   iv.   Speed.
   v.   Vehicle Classification.
   vi.   Weight in kips of each wheel or dual set of wheels by left and right side and by axle number.
   vii. Spacings in feet between each sequentially numbered axle.
   viii. Overall length of each vehicle or combination of vehicles in feet.
   ix.   Code for weight violation(s).
   x.   Code for invalid measurement(s).

3. Data shall be calculated and formatted such that all data can be accessed. All required reports can be generated by use of the WIM system application software.

4. All equipment with exception of the axle sensors and the central unit's modem shall operate properly within an atmospheric temperature range of –20°F and 122°F.

5. The central unit's modem shall be fully compatible with the host computer modem. The modem shall be specified by the WIM vendor.

6.0   High Speed WIM System Application Software

An application program, hereafter referred to as the "system program", which can be run on the host computer shall be furnished as part of the high speed WIM system. The host computer will be furnished by others and will consist of:

1. Personal computer using Windows 95 or most current version.
2. Dot matrix printer (parallel).
3. Universal Data Systems V.3229, or compatible, modem.

The system program shall provide communications between the host computer and the on-site central unit and shall process downloaded data to generate the specific ASCII files. Although referred to herein as a single software program, communications functions and data processing functions may be provided as two separate programs as long as all functional requirements are met. The system program shall be "user friendly", hierarchical menu driven and shall perform the following applications:

6.10   Communications

1. The communications portion of the system program shall include the following applications:

    A. Real time view:

    The real time view application shall provide for the on-line monitoring of traffic. The display on the host computer shall depict the axle configuration of each vehicle passing through the site. The contents and format for the real time display shall be similar to the sample display contained in these specifications. The user shall have the options of displaying either all traffic or only vehicle classifications 4 through 15 as well as the option of displaying a selected individual lane or all lanes.

    Printing of the real time data on the host computer printer shall be facilitated by means of an on/off toggle key from the keyboard.

B. System data programming:

The system data programming application shall provide for on-line modification to the central unit's software parameters, such as speed and weight calibration factors, vehicle classification parameters, weight violation table parameters, and front axle weight threshold.

C. Manual downloading:

The manual downloading application shall provide for the downloading of selected daily data files from the storage medium of the central unit to the storage medium of the host computer. The program shall provide for a listing of the daily data files stored in the central unit and shall provide for user selection of the file or files to be downloaded from such a listing. The program shall provide for the downloading of the current day's data stored as of the time of downloading.

D. Automatic downloading:

The automatic downloading applications shall provide for unattended downloading of daily data files stored in the central unit's storage medium to the storage medium of the host computer. The program shall provide the following:

  i.   User's input for the date and time that unattended downloading is to begin.
  ii. Downloading of all daily files not previously downloaded by the automatic downloading application.
  iii. At least three attempts to make telephone connection with the central unit.
  iv. At least three attempts to download files from the central unit before aborting download.
  v.   Discontinuation of telephone connection after downloading of files from the central unit (or after an abort)) and returning the host computer to a standby mode.

E. History file:

The history file application shall create a daily file, which chronologically records events occurring during manual and automatic downloading sessions. Such events shall include, but not be limited to, modem result messages, start and end time of each file download and any pertinent messages generated by the program. The program shall provide for either:

  i.   The history file shall be in the form of an ASCII text file which can be viewed or sent to the printer or,

ii.   A menu selection which shall provide for a listing of available history files and user selection of a file to be sent to the printer in the form of a report.

2.   The communications portion of the system program shall meet the following functional requirements:

A. Host computer's modem configuration:

The program shall initialize the host computer's modem so that all necessary operating characteristics are set.

B. Baud rate:

The program will provide for operation at a minimum rate of 9600 baud.

C. Error control:

The program shall not in any way disable the modems' error-checking features, which prevent phone-line noise from corrupting data during file downloading.

D. File downloading monitoring:

The program shall display a window that allows the user to monitor the progress of file downloading. The program shall also provide for the abort of a file download.

6.20 Report Preparation

The report preparation application shall generate specified reports using the downloaded data. Such reports shall be sent to the host computer printer or to file. The program shall prepare the following reports:

1. From vehicle class/count summary file:
    A. Distribution of class and speed counts by lane.
    B. Distribution of vehicle counts by hour of day by lane.
    C. Distribution of vehicle classifications by hour of day.
    D. Distribution of vehicle classifications by day of month.
    E. Distribution of vehicles by speed by hour of day.

2. From individual truck records file:
    A. Distribution of truck record data by lane.
    B. Distribution of weight violations and invalid measurements of vehicle classifications 4 through 15.

    C. Distribution of weight violations by hour of day for vehicle classifications 4 through 14.

    D. Distribution of overweight vehicles by hour of day for vehicle classifications 4 through 14.

    E. Distribution of gross weights for vehicle classifications 4 through 14.

    F. Distribution of 18 kip equivalent single axle loadings (ESALS) by hour of day for vehicle classifications 4 through 14.

    G. Distribution of axles by groups (single, tandem, tridem) by hour of day for vehicle classifications 4 through 14.

    H. Program provides for user input of:
        i. Pavement type:
           (1) flexible pavement and structural number; or,
           (2) rigid pavement and slab thickness.
        ii. Vehicle status:
           (1) "all " weighed vehicles (default); or,
           (2) "legal only" weighed vehicles; or,
           (3) "overweight only" weighed vehicles.

    I. Distribution of trucks by day of month for classifications 4 through 15.

The reports shall include all information contained in and formatted similarly to the sample reports contained in these specifications. The reports shall be printed in condensed print when necessary to fit on 8-½ inch x 11-inch sheets.

Determination of 18 kip equivalent single axle loads shall be in accordance with the methodology of the 1993 AASHTO Pavement Design Guide.

The program shall provide for the generation of reports in the following two modes:

    1. Manual Mode:

For daily reports the program shall provide for user selection of the date and the specific report. For monthly reports, the program shall provide for user selection of the month/year and the specific report. The selected month report shall include the data from all downloaded daily data files resident with the system program on a directory or subdirectory of the host computer's storage medium. The program shall also provide for user selection of the lane or lanes to be covered by the specific report (not applicable to the "Distribution of Class and Speed Counts by Lane", the:"Distribution of Vehicle Counts by Hour of Day by Lane" and the "Distribution of truck Record Data by Lane" reports").

The default shall be "all lanes." The printed report shall note which lanes are represented.

2.   Automatic Mode:

The program shall provide for user designation of one or a combination of the specific daily reports for automatic processing. User selection of lane or lanes is not required (the "all lanes" default may be used). User selection of vehicle status for the 18 kip ESAL report is not required (the "all" weighed vehicles default may be used). Such designations shall be effected by means of either:

A.   An ASCII text file, which can be revised with text editor or word processor, supplied with a "Sample" designation; or,
B.   A menu selection, which shall provide for user input designation.

Upon selection of automatic mode of report preparation by the user, the program shall send to the printer all per-designated reports for all downloaded daily data files resident with the system program on a directory or subdirectory of the host computer's storage medium.

The designated reports shall remain in effective for subsequent automatic mode sessions unless report designation, is revised by the user.

6.30 Truck Record Batch Print

The truck record batch print application shall provide for the display of, all on/off printer-toggle of, individual truck records. The program shall provide for a listing of the daily truck records files available on the storage medium of the host computer and the user's selection of one of those files. The program shall also provide for the user's selection of the vehicle class or classes for which individual truck records will be displayed or printed as well as the starting hour of day.

The user shall have the following options in viewing and printing the individual truck records.

1.   Scroll and print continuously all records for the selection of class(es); user has capability to stop/resume scrolling or terminates program.

2.   Scroll each record one at a time; user has capability to:
     1.   Print displayed record and display next record.
     2.   Display next record.
     3.   Terminate program.

An example of the truck record batch print is included in these specifications. (See Appendix A)

6.40 ASCII Export Utility

The ASCII export utility application shall allow the user to generate specified ASCII files using downloaded files. The user will have the choice of:

1. From vehicle class/count summary file:
   A. ASCII classification file.
   B. ASCII speed file.

2. From individual truck record file:
   A. ASCII truck record file

The file formats for these files are contained in Appendix A.

6.50 TRAFFIC MONITORING GUIDE Files Utility

The TMG files utility shall allow the user to generate ASCII files conforming to the instructions contained in Section 6 of the FHWA Traffic Monitoring Guide, 3rd edition using downloaded files.

6.60 Data Files

Notwithstanding the method of data manipulation and formatting used by the central unit, data files shall conform to the following:

1. Individual daily data files shall be created and stored in the storage medium of the central unit. Each daily data file shall include data for each 00:00 hour through a 24:00 hour period and shall have a file name which uniquely identifies the file as to site designation, date, and file contents (i.e., class/count summary data, individual truck record data, or both).

2. The daily data files shall be created at the start of each day. Data for each vehicle shall be filed within one-hour of the vehicle's passing through the site, and the current day's files shall be accommodative to efficient use of storage medium space and rapid downloading via modem to the host computers.

3. Daily files containing class/count summary data and individual truck records data may be created in the storage medium of the central unit as two separate daily files or as one daily file. However, if one daily file is created and downloaded as such, the system program shall create two separate daily files, each with a file name which uniquely identifies it as to site, date and whether it is a vehicle class/count summary file or an individual truck records file.

7.0 Acceptance Test

The WIM Vendor shall demonstrate that the WIM system is available for use by the Department of Transportation by successfully completing the acceptance test for each lane of data collection.

The acceptance test shall consist of the following:

1. Continuous operation of WIM system on-site equipment for 15 consecutive days. Failure of the system to record and store data meeting the requirements set forth in these specifications for an accumulated time exceeding 3 hours during the 15 day- period shall be cause for the acceptance test to be repeated.

2. Testing of the WIM system application software during the above noted 15 day-period and the full working day following the 15 day-period. Failure of the software to perform any application meeting the requirements set forth in these specifications shall be cause for the acceptance test to be repeated.

3. Unavailability shall be the failure of the system to pass the acceptance test. Failure of the host computer or its peripheral equipment or of a communication line not furnished by the WIM vendor to transmit data may be considered not to render the system unavailable, provided that the WIM vendor demonstrates to the satisfaction of the Engineer that the failure is not caused by any of the WIM vendor furnished equipment.

8.0 Maintenance and Operations Manuals

The WIM vendor shall furnish a maintenance manual for the central unit, including vehicle detector sensor units and an operation manual for the system. The maintenance manual and operation manual may be combined into one manual. The manual(s) shall include, but need not be limited to, the following items:

1. Specifications.
2. Design characteristics.
3. General operation theory.
4. Function of all controls.
5. Trouble shooting procedure (diagnostic routine).
6. Block circuit diagram.
7. Geographical layout of components.
8. Schematic diagrams, signal responses and acceptable thresholds.
9. List of component parts with stock numbers.
10. Documentation for application software.

9.0   Warranty

The wheel scales, lead-in cables, frames, and mounting hardware provided shall include the manufacturer or suppliers' 5-year warranty. All other equipment specified under on-site equipment of these specifications shall include the manufacturers or suppliers' 2-year warranty.

The warranty shall include all parts and installation costs necessary to make the repairs. Such warranty periods shall begin upon satisfactory completion of the acceptance test of the weight-in-motion system.

Appendix A

Sample Reports

```
DISTRIBUTION OF CLASS AND SPEED COUNTS BY LANE
====================================================================================================================
SITE DESIGNATION:
DATE:
====================================================================================================================

                                  LANE NUMBER   <number of lanes varies with contract requirements>
                                  -----------
                1             2             3             4             5             6           ALL LANES
           COUNT     %    COUNT     %    COUNT     %    COUNT     %    COUNT     %    COUNT     %    COUNT     %
           ------------   ------------   ------------   ------------   ------------   ------------   ------------
  CLASS

    1          0   0.0        0   0.0                                      0   0.0        6   0.0        6   0.0
    2      22521  82.4    24464  82.7                                  28540  90.6    23974  87.6    99499  85.9
    3       2687   9.8     2395   8.1    --------------------------    2324   7.4     1919   7.0     9325   8.1
    4         14   0.1       21   0.1    |                        |      16   0.1       13   0.0       64   0.1

    5       1152   4.2     1297   4.4    |  "COUNT" entries for   |     486   1.5       56   0.2     2991   2.6

    6         82   0.3      101   0.3    |  example only          |       9   0.0      917   3.3     1109   1.0
    7          1   0.0        3   0.0    |                        |       0   0.0       24   0.1       28   0.0
    8        280   1.0      402   1.4    |                        |       3   0.0       32   0.1      717   0.6
    9        340   1.2      544   1.8    --------------------------      4   0.0        0   0.0      888   0.8
   10         10   0.0        1   0.0                                      0   0.0        1   0.0        4   0.0
   11         84   0.3      104   0.4                                      0   0.0        0   0.0      188   0.2
   12          3   0.0        5   0.0                                      0   0.0        0   0.0        8   0.0
   13          1   0.0        0   0.0                                      0   0.0        0   0.0        1   0.0
   14         28   0.1       46   0.2                                      0   0.0        0   0.0       74   0.1
   15        142   0.5      206   0.7                                    127   0.4      434   1.6      909   0.8

  ------   ------------   ------------   ------------   ------------   ------------   ------------   -------------
  TOTAL    27337 100.0    29589 100.0                                  31509 100.0    27376 100.0   115811 100.0
====================================================================================================================
SPEED
(MPH)
   1- 5        2   0.0        6   0.0                                      2   0.0        4   0.0       14   0.0
   6-10        0   0.0        0   0.0                                      4   0.0       10   0.0       14   0.0
  11-15       10   0.0        5   0.0                                     32   0.1       28   0.1       75   0.1
  16-20       48   0.2       33   0.1                                     75   0.2       88   0.3      244   0.2
  21-25      271   1.0      280   0.9                                    269   0.9      179   0.7      999   0.9
  26-30      641   2.3      615   2.1                                    480   1.5      349   1.3     2085   1.8
  31-35     1047   3.8      838   2.8                                    731   2.3      606   2.2     3222   2.8
  36-40     1165   4.3     1073   3.6                                   1077   3.4      891   3.3     4206   3.6
  41-45     1645   6.0      913   3.1                                    927   2.9      997   3.6     4482   3.9
  46-50     5140  18.8     2063   7.0                                   1027   3.3      893   3.3     9123   7.9
  51-55     9487  34.7     5641  19.1                                   2508   8.0     1147   4.2    18783  16.2
  56-60     5613  20.5    13537  45.8                                  14134  44.9     3243  11.8    36527  31.5
  61-65     1872   6.8     3284  11.1                                   7211  22.9     9701  35.4    22068  19.1
  66-70      277   1.0     1170   4.0                                   2749   8.7     6614  24.2    10810   9.3
  71-75       79   0.3       90   0.3                                    234   0.7     2240   8.2     2643   2.3
  76-80       24   0.1       34   0.1                                     45   0.1      327   1.2      430   0.4
  81-85       13   0.0        7   0.0                                      4   0.0       51   0.2       75   0.1
  86-90        3   0.0        0   0.0                                      0   0.0        8   0.0       11   0.0
  91-95        0   0.0        0   0.0                                      0   0.0        0   0.0        0   0.0
  96-100       0   0.0        0   0.0                                      0   0.0        0   0.0        0   0.0
  > 100        0   0.0        0   0.0                                      0   0.0        0   0.0        0   0.0

  ------   ------------   ------------   ------------   ------------   ------------   ------------   -------------
  TOTAL    27337 100.0    29589 100.0                                  31509 100.0    27376 100.0   115811 100.0

  AVG.SPEED   51             55                                          57             61             56
====================================================================================================================
```

```
DISTRIBUTION OF VEHICLE COUNTS BY HOUR OF DAY BY LANE
==============================================================================================================
SITE DESIGNATION:
DATE:
==============================================================================================================

HOURLY SUMMARY                              LANE NUMBER  <number of lanes varies with contract requirements>

--------------                              -----------
                                                                                                     HOURLY
  HOUR              1           2           3           4           5           6                     TOTALS
 ------           -----       -----       -----       -----       -----       -----                  -------
00-01
01-02
02-03
03-04
04-05
05-06
------            -----       -----       -----       -----       -----       -----                  -------
QTR TOTALS
==============================================================================================================
06-07
07-08
08-09
09-10
10-11
11-12
------            -----       -----       -----       -----       -----       -----                  -------
QTR TOTALS
==============================================================================================================
12-13
13-14
14-15
15-16
16-17
17-18
------            -----       -----       -----       -----       -----       -----                  -------
QTR TOTALS
==============================================================================================================
18-19
19-20
20-21
21-22
22-23
23-24
------            -----       -----       -----       -----       -----       -----                  -------
QTR TOTALS

==============================================================================================================
==============================================================================================================

DAILY SUMMARY                               DAILY COUNTS BY LANE

--------------                              --------------------
                                                                                                     DAILY
                    1           2           3           4           5           6                     TOTALS
                  -----       -----       -----       -----       -----       -----                  ------


==============================================================================================================
==============================================================================================================
```

```
DISTRIBUTION OF VEHICLE CLASSIFICATIONS BY HOUR OF DAY
==================================================================================================
SITE DESIGNATION:               LANE NO's <display user's entry as to selected lane(s)>
DATE:
==================================================================================================

HOURLY SUMMARY                                      VEHICLE COUNTS

-------------                                       -------------

                                                                                          HOURLY
 HOUR      1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    TOTALS
------   ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------
00-01
01-02
02-03
03-04
04-05
05-06
------   ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------
QTR TOTALS
==================================================================================================
06-07
07-08
08-09
09-10
10-11
11-12
------   ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------
QTR TOTALS
==================================================================================================
12-13
13-14
14-15
15-16
16-17
17-18
------   ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------
QTR TOTALS
==================================================================================================
18-19
19-20
20-21
21-22
22-23
23-24
------   ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------
QTR TOTALS

==================================================================================================
==================================================================================================

DAILY SUMMARY                                       VEHICLE COUNTS

-------------                                       -------------

                                                                                          TOTAL
           1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    VEHICLES
         ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----   --------

COUNT

PERCENT


==================================================================================================
==================================================================================================
```

```
DISTRIBUTION OF VEHICLE CLASSIFICATIONS BY DAY OF MONTH
=================================================================================================================
SITE DESIGNATION:            LANE NO's <display user's entry as to selected lane(s)>
DATE: 01/92
=================================================================================================================
DAILY                                             VEHICLE COUNTS
SUMMARY      1     2      3      4     5      6     7     8     9     10    11    12    13    14    15      TOTALS
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
 1 WED
 2 THU
 3 FRI
 4 SAT
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
DAILY AVG
=================================================================================================================
 5 SUN
 6 MON
 7 TUE
 8 WED
 9 THU
10 FRI
11 SAT
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
DAILY AVG
=================================================================================================================
12 SUN
13 MON
14 TUE
15 WED
16 THU
17 FRI
18 SAT
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
DAILY AVG
=================================================================================================================
19 SUN
20 MON
21 TUE
22 WED
23 THU
24 FRI
25 SAT
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
DAILY AVG
=================================================================================================================
26 SUN
27 MON
28 TUE
29 WED
30 THU
31 FRI
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
DAILY AVG
=================================================================================================================
MONTHLY                                           VEHICLE COUNTS
SUMMARY      1     2      3      4     5      6     7     8     9     10    11    12    13    14    15      TOTALS
------      ---  ------- ------ ---- ------ ----- ---- ----- ------ ----- ----- ----- ---- ----- -----   --------
TOTALS
PERCENT
DAILY AVG
```

DISTRIBUTION OF VEHICLES BY SPEED BY HOUR

```
=====================================================================================================
SITE DESIGNATION:              LANE NO's <display user's entry as to selected lane(s)>

DATE:

=====================================================================================================

                                        SPEED RANGE, MPH

                                        ---------------

HOUR

RANGE          00-30   31-35   36-40   41-45   46-50   51-55   56-60   61-65   66-70   71-75   76-80    > 80
--------       -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----

00 - 01

01 - 02

02 - 03

03 - 04

04 - 05

05 - 06
--------       -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----
QTR TOTALS

==========

06 - 07

07 - 08

08 - 09

09 - 10

10 - 11

11 - 12
--------       -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----
QTR TOTALS

==========

12 - 13

13 - 14

14 - 15

15 - 16

16 - 17

17 - 18
--------       -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----
```

QTR TOTALS

==========

18 - 19

19 - 20

20 - 21

21 - 22

22 - 23

23 - 24

--------   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----   -----
QTR TOTALS

==========

DAILY SPEED SUMMARY

Total Vehicles   :   Total Vehicles > 55 MPH :   Percentage Vehicles > 55 MPH :

Average Speed   :   Total Vehicles > 60 MPH :   Percentage Vehicles > 60 MPH :

Median Speed   :   Total Vehicles > 65 MPH :   Percentage Vehicles > 65 MPH :

85th Percentile   :   Total Vehicles > 70 MPH :   Percentage Vehicles > 70 MPH :

==
==

DISTRIBUTION OF TRUCK RECORD DATA BY LANE <report to cover all records contained in truck records file>
==
SITE DESIGNATION:
DATE:
==

                                    LANE NUMBER <number of lanes varies with contract requirements>

CLASS	1		2		3		4		5		6		ALL LANES	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
1	0	0.0	0	0.0					0	0.0	0	0.0	0	0.0
2	0	0.0	0	0.0					0	0.0	0	0.0	0	0.0
3	152	3.7	342	14.7	---------------------------				87	4.0	74	1.9	655	5.2
4	18	0.4	13	0.6	|		|		3	0.1	5	0.1	39	0.3
5	560	13.6	354	15.2	| "COUNT" entries for		|		306	14.2	574	14.7	1794	14.3
6	129	3.1	67	2.9	| example only		|		66	3.1	104	2.7	366	2.9
7	3	0.1	0	0.0	|		|		0	0.0	27	0.7	30	0.2
8	350	8.5	134	8.8	|		|		278	12.9	357	9.1	1119	8.9
9	1775	43.1	918	39.4	---------------------------				961	44.4	1698	43.5	5352	42.7
10	3	0.1	1	0.0					4	0.2	4	0.1	12	0.1
11	783	19.0	332	14.2					302	14.0	754	19.3	2171	17.3
12	56	1.4	30	1.3					32	1.5	68	1.7	186	1.5
13	5	0.1	2	0.1					0	0.0	7	0.2	14	0.1
14	122	3.0	34	1.5					37	1.7	104	2.7	297	2.4
15	158	3.8	66	2.8					78	3.6	128	3.3	430	3.4
TOTAL	4121	100.0	2330	100.0					2161	100.0	3907	100.0	12520	100.0

==

                                    LANE NUMBER

STATUS	1		2		3		4		5		6		ALL LANES	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
LEGAL	3353	81.4	1866	80.1					1976	91.4	3076	78.7	10271	82.0
OVR'WT	662	16.0	384	16.5					127	5.9	715	18.3	2249	18.0
INVALID	106	2.6	80	3.4					59	2.7	116	3.0	361	2.9

    | |
    | Note: |
    | The line items under "STATUS" are to be based upon the Contractor's coding scheme for weight |
    | violation and invalid measurements. If the coding system identifies invalid measurements other |
    | than imbalance (such as "out-of-range" values, system errors, etc.), each unique type of invalid |
    | measurement should be broken down as a "STATUS" line item. |
    | |

| TOTAL | 4121 | 100.0 | 2330 | 100.0 | | | | | 2162 | 100.0 | 3907 | 100.0 | 12520 | 100.0 |

==

```
DISTRIBUTION OF WEIGHT VIOLATIONS AND INVALID MEASUREMENTS FOR VEHICLE CLASSIFICATIONS 4 THROUGH 15
========================================================================================================
SITE DESIGNATION:                 LANE NO's <display user's entry as to selected lane(s)>

DATE:
========================================================================================================
                     VEHICLES                                    ********    NUMBER OF    ********

            TOTAL        WITH         TOTAL        TOTAL      PERCENT     ********  WEIGHT VIOLATIONS ********
            VEHICLES     INVALID      VEHICLES     VEHICLES   VEHICLES
 CLASS      COUNTED      MEASUREMENTS WEIGHED      OVERWEIGHT OVERWEIGHT  AXLE      TANDEM   GROSS    BRIDGE
 ------     -------      ------------ -------      ---------- ----------  ----      ------   -----    ------

    4
    5
    6
    7
    8
    9
   10
   11
   12
   13
   14
   15

 ------     -------      ------------ -------      ---------- ----------  ----      ------   -----    ------
 TOTALS



      PERCENT VEHICLES NOT CLASSIFIED (CLASS 15)  : _____

      PERCENT VEHICLES WITH INVALID MEASUREMENTS  : _____


  -------------------------------------------------------------------------------------------------------
 |
 |  Notes:
 |
 |  "Percent Vehicles Not Classified"  =  Class 15 Total Vehicle Count / Total Vehicles Counted
 |  "Percent Vehicles With Invalid Measurements"  =  Total Vehicles With Invalid Measurements / Total Vehicles Counted
 |  "Vehicles Counted" - "Vehicles With Invalid Measurements"  =  "Vehicles Weighed"
 |
 |  All weight and weight violation reporting and calculations based on data for "weighed vehicles"
 |
  -------------------------------------------------------------------------------------------------------
```

```
DISTRIBUTION OF WEIGHT VIOLATIONS BY HOUR OF DAY FOR VEHICLE CLASSIFICATIONS 4 THROUGH 14
=================================================================================================
SITE DESIGNATION:              LANE NO's <display user's entry as to selected lane(s)>

DATE:
=================================================================================================

HOURLY SUMMARY
--------------                                        ************    NUMBER OF     *************

            TOTAL         TOTAL        PERCENT        ************ WEIGHT VIOLATIONS **************
            VEHICLES      VEHICLES     VEHICLES
  HOUR      WEIGHED       OVERWEIGHT   OVERWEIGHT     AXLE        TANDEM        GROSS       BRIDGE
-------     -------       ----------   ----------     ----        ------        -----       ------
00-01
01-02
02-03
03-04
04-05
05-06
------      -----         -----        -----          -----       -----         -----       -----
QTR TOTALS
=================================================================================================
06-07
07-08
08-09
09-10
10-11
11-12
------      -----         -----        -----          -----       -----         -----       -----
QTR TOTALS
=================================================================================================
12-13
13-14
14-15
15-16
16-17
17-18
------      -----         -----        -----          -----       -----         -----       -----
QTR TOTALS
=================================================================================================
18-19
19-20
20-21
21-22
22-23
23-24
------      -----         -----        -----          -----       -----         -----       -----
QTR TOTALS

=================================================================================================
=================================================================================================

DAILY SUMMARY
-------------                                         ************    NUMBER OF     *************

            TOTAL         TOTAL        PERCENT        ************ WEIGHT VIOLATIONS **************
            VEHICLES      VEHICLES     VEHICLES
            WEIGHED       OVERWEIGHT   OVERWEIGHT     AXLE        TANDEM        GROSS       BRIDGE
            -------       ----------   ----------     ----        ------        -----       ------


=================================================================================================
=================================================================================================
```

```
DISTRIBUTION OF OVERWEIGHT VEHICLES BY HOUR OF DAY FOR VEHICLE CLASSIFICATIONS 4 THROUGH 14
=========================================================================================================
SITE DESIGNATION:              LANE NO's <display user's entry as to selected lane(s)>

DATE:
=========================================================================================================
HOURLY SUMMARY                                          NUMBER OVERWEIGHT VEHICLES

-------------                                           -------------------------

          TOTAL    TOTAL    PERCENT
          VEH'S    VEH'S    VEH'S
HOUR      WEIGHED  OVERWT   OVERWT     4     5     6     7     8     9    10    11    12    13    14
-----     -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----

00-01
01-02
02-03
03-04
04-05
05-06
-----     -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
=========================================================================================================
06-07
07-08
08-09
09-10
10-11
11-12
-----     -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
=========================================================================================================
12-13
13-14
14-15
15-16
16-17
17-18
-----     -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTRTOTALS
=========================================================================================================
18-19
19-20
20-21
21-22
22-23
23-24
-----     -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
=========================================================================================================
=========================================================================================================
DAILY SUMMARY                                           NUMBER OVERWEIGHT VEHICLES

-------------                                           -------------------------

          TOTAL    TOTAL    PERCENT
          VEH'S    VEH'S    VEH'S
          WEIGHED  OVERWT   OVERWT     4     5     6     7     8     9    10    11    12    13    14
          -------- -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----


=========================================================================================================
=========================================================================================================
```

```
DISTRIBUTION OF GROSS WEIGHTS FOR VEHICLE CLASSIFICATIONS 4 THROUGH 14
=====================================================================================================================
SITE DESIGNATION:              LANE NO's <display user's entry as to selected lane(s)>

DATE:
=====================================================================================================================
                                                    VEHICLE COUNTS
                                                    --------------
GROSS WT
  KIPS           4     5     6     7     8     9    10    11    12    13    14      TOTALS
 -------        ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----     ------

   0-  5
   5- 10
  10- 15
  15- 20
  20- 25
  25- 30
  30- 35
  35- 40
  40- 45
  45- 50
  50- 55
  55- 60
  60- 65
  65- 70
  70- 75
  75- 80
  80- 85
  85- 90
  90- 95
  95-100
 100-105
 105-110
 110-115
 115-120
   > 120
 ------        ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----     ------

TOTALS

=====================================================================================================================
=====================================================================================================================
```

```
DISTRIBUTION OF 18 KIP ESALS BY HOUR OF DAY FOR VEHICLE CLASSIFICATIONS 4 THROUGH 14
FOR _____ <display user's entries as to pavement type and str. no. or slab thickness>

================================================================================================
SITE DESIGNATION:              LANE NO's   <display user's entry as to selected lane(s)>

DATE:                          VEH STATUS  <display user's entry as to "LEGAL ONLY", "OVWT ONLY" or "ALL" (default)

================================================================================================
HOURLY SUMMARY

--------------
                                                    ESALS BY HOUR BY CLASS
                    TOTAL                           ----------------------
                    VEH'S    TOTAL
HOUR                WEIGHED  ESALS     4     5     6     7     8     9     10    11    12    13    14
-----               -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
00-01
01-02
02-03
03-04
04-05
05-06
-----               -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
================================================================================================
06-07
07-08
08-09
09-10
10-11
11-12
-----               -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
================================================================================================
12-13
13-14
14-15
15-16
16-17
17-18
-----               -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS
================================================================================================
18-19
19-20
20-21
21-22
22-23
23-24
-----               -------- -------- ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
QTR TOTALS

================================================================================================
================================================================================================
DAILY SUMMARY
-------------
                             TOTALS    4     5     6     7     8     9     10    11    12    13    14
                             ------ ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----
VEH'S WEIGHED :
18 KIP ESALS  :
AVERAGE ESAL  :

================================================================================================
================================================================================================
```

```
DISTRIBUTION OF TRUCKS BY DAY OF MONTH FOR CLASSIFICATIONS 4 THROUGH 15
=================================================================================================================
SITE DESIGNATION:            LANE NO's <display user's entry as to selected lane(s)>
DATE:
=================================================================================================================

DAILY SUMMARY
-------------
          TOTAL   TOTAL   TOTAL   PCT    ----------------------------- COUNTED VEHICLES -----------------------------
          VEHS    VEHS    VEHS    VEHS
DAY       CNTD    WGHD    OVWT    OVWT     4      5      6      7      8      9      10     11     12     13     14     15
------    ------  ------  -----   ----    ----  ------  -----  ----  -----  ------  -----  -----  -----  ----  -----  -----
  1 WED
  2 THU
  3 FRI
  4 SAT
=================================================================================================================
  5 SUN
  6 MON
  7 TUE
  8 WED
  9 THU
 10 FRI
 11 SAT
=================================================================================================================
 12 SUN
 13 MON
 14 TUE
 15 WED
 16 THU
 17 FRI
 18 SAT
=================================================================================================================
 19 SUN
 20 MON
 21 TUE
 22 WED
 23 THU
 24 FRI
 25 SAT
=================================================================================================================
 26 SUN
 27 MON
 28 TUE
 29 WED
 30 THU
 31 FRI
=================================================================================================================

MONTHLY SUMMARY
---------------

          TOTAL   TOTAL   TOTAL   PCT    ----------------------------- COUNTED VEHICLES -----------------------------
          VEHS    VEHS    VEHS    VEHS
          CNTD    WGHD    OVWT    OVWT     4      5      6      7      8      9      10     11     12     13     14     15
          ------  ------  ------  ----    ----  ------  -----  ----  -----  ------  -----  -----  -----  ----  -----  -----
TOTALS
PERCENT
```

ASCII SPEED FILE FORMAT

FIELD	LENGTH	STARTS IN COLUMN
Lane	2	1
Hour	2	4
Count, 0-35 MPH	4	7
Count, 36-40 MPH	4	12
Count, 41-45 MPH	4	17
Count, 46-50 MPH	4	22
Count, 51-55 MPH	4	27
Count, 56-60 MPH	4	32
Count, 61-65 MPH	4	37
Count, 66-70 MPH	4	42
Count, 71-75 MPH	4	47
Count, 76-80 MPH	4	52
Count, 81-85 MPH	4	57
Count, >85 MPH	4	62

ASCII CLASSIFICATION FILE FORMAT

FIELD	LENGTH	STARTS IN COLUMN
Lane	2	1
Hour	2	4
Count, Class 1	4	7
Count, Class 2	4	12
Count, Class 3	4	17
Count, Class 4	4	22
Count, Class 5	4	27
Count, Class 6	4	32
Count, Class 7	4	37
Count, Class 8	4	42
Count, Class 9	4	47
Count, Class 10	4	52
Count, Class 11	4	57
Count, Class 12	4	62
Count, Class 13	4	67
Count, Class 14	4	72
Count, Class 15	4	77

For the above two files :

    Each field shall be comma delimited.
    For each day's file, there is one record
    for each lane for each hourly period.

ASCII TRUCK RECORD FILE FORMAT

FIELD	LENGTH	DECIMAL PLACES	STARTS IN COLUMN
LANE	1		1
MONTH	2		3
DAY	2		6
YEAR	2		9
HOUR	2		12
MINUTE	2		15
SECOND	2		18
VEHICLE NO.	5		21
CLASS	2		27
GROSS WEIGHT	6	1	30
LENGTH	6	1	37
SPEED	5	1	44
VIOLATION CODE	3		50
AXLE 1 RT. WEIGHT	4	1	54
AXLE 1 LT. WEIGHT	4	1	59
AXLE 2 RT. WEIGHT	4	1	64
AXLE 2 LT. WEIGHT	4	1	69
AXLE 1-2 SPACING	4	1	74
AXLE 3 RT. WEIGHT	4	1	79
AXLE 3 LT. WEIGHT	4	1	84
AXLE 2-3 SPACING	4	1	89
AXLE 4 RT. WEIGHT	4	1	94
AXLE 4 LT. WEIGHT	4	1	99
AXLE 3-4 SPACING	4	1	104
AXLE 5 RT. WEIGHT	4	1	109
AXLE 5 LT. WEIGHT	4	1	114
AXLE 4-5 SPACING	4	1	119
AXLE 6 RT. WEIGHT	4	1	124
AXLE 6 LT. WEIGHT	4	1	129
AXLE 5-6 SPACING	4	1	134
AXLE 7 RT. WEIGHT	4	1	139
AXLE 7 LT. WEIGHT	4	1	144
AXLE 6-7 SPACING	4	1	149
AXLE 8 RT. WEIGHT	4	1	154
AXLE 8 LT. WEIGHT	4	1	159
AXLE 7-8 SPACING	4	1	164
AXLE 9 RT. WEIGHT	4	1	169
AXLE 9 LT. WEIGHT	4	1	174
AXLE 8-9 SPACING	4	1	179
VENDOR SPECIFIC OPTIONAL FIELDS			184

This file shall include every "truck record" contained in the daily data file. Each field shall be comma delimited and padded with blanks to complete the fixed logical record length.

For axle weight only weighing (in lieu of right and left wheel weighing), either the "AXLE n RT. WEIGHT" or the "AXLE n LT. WEIGHT" field may be used for the "AXLE n WEIGHT".

```
                              REAL TIME VIEW
                              ===============

*********************************************************************************

     Veh No.: _____        Class: _____      Lane: _____      Speed: _____

     Time: _____      Date: _____          Vehicle Length: _____

     Invalid Measurement Code:_____      Wt. Violation(s):_____

                                               AXLE NO.
          TOTALS         1        2        3        4        5        6        7        8        9

Ax. Wt. 76.1        10.9    15.0    16.2    17.2    16.8
(kip)
Ax. Sp. 56.9             11.8     4.5    36.4     4.2
(ft)

*********************************************************************************


Note:   Entries following Axle Wt. and Axle Space are for example
        purposes only.
```

```
                                    TRUCK RECORD BATCH PRINT

                                    ==========================

****************************************************************************************************

     Site Designation: _____       Lane: _____       Time: _____       Date: _____       Speed: _____

     Vehicle No.: _____      Class: _____    Invalid Code: _____      Veh. Wheelbase: _____       Veh. Length: _____

     Gross Wt.(kips): _____       Weight Violation(s): _____

     Axle No.                   1          2          3          4          5          6          7          8          9

     Rt. Wheel Wt.(kip)        5.4        7.3        8.0        8.5        8.3
     Lt. Wheel Wt.(kip)        5.5        7.7        8.2        8.7        8.5
                          --------------------------------------------------------------------------------------------
     Axle Wt.(kips)           10.9       15.0       16.2       17.2       16.8
     Axle Space (feet)             11.8       4.5       36.4       4.2

****************************************************************************************************


     Note:   Entries following Axle Wt. and Axle Space are for example purposes only.
```

```
WEIGHT VIOLATION TABLE
=======================================================

(All weights in pounds)


AXLE WEIGHT

        Axle No. 1   -----------------------  12500

        All other axles --------------------  20000


TANDEM AXLE WEIGHT

        Two consecutive axles with an axle
        spacing not exceeding 8.4 feet  ------  34000


GROSS VEHICLE WEIGHT

        All vehicles  -----------------------  80000


BRIDGE WEIGHT

        See page following ----
```

BRIDGE WEIGHT

Distance in nearest whole foot between the extremes of any group of 2 or more consecutive axles	2 Axles	3 Axles	4 Axles	5 Axles	6 Axles	7 Axles	8 Axles	9 Axles
< 8	34000	34000	34000	34000	34000	-----	-----	-----
8	34000	34000	34000	34000	34000	-----	-----	-----
9	39000	42500	42500	42500	42500	-----	-----	-----
10	40000	43500	43500	43500	43500	-----	-----	-----
11	40000	44000	44000	44000	44000	-----	-----	-----
12	40000	45000	50000	50000	50000	-----	-----	-----
13	40000	45500	50500	50500	50500	-----	-----	-----
14	40000	46500	51500	51500	51500	-----	-----	-----
15	40000	47000	52000	52000	52000	-----	-----	-----
16	40000	48000	52500	52500	52500	-----	-----	-----
17	40000	48500	53500	53500	53500	-----	-----	-----
18	40000	49500	54000	54000	54000	-----	-----	-----
19	40000	50000	54500	54500	54500	-----	-----	-----
20	40000	51000	55500	55500	55500	-----	-----	-----
21	40000	51500	56000	56000	56000	-----	-----	-----
22	40000	52500	56500	56500	56500	-----	-----	-----
23	40000	53000	57500	57500	57500	-----	-----	-----
24	40000	54000	58000	58000	58000	74000	-----	-----
25	40000	54500	58500	58500	58500	74500	80000	-----
26	40000	55500	59500	59500	59500	75000	80000	-----
27	40000	56000	60000	60000	60000	76000	80000	80000
28	40000	57000	60500	60500	60500	76500	80000	80000
29	40000	57500	61500	61500	61500	77000	80000	80000
30	40000	58500	62000	62000	62000	77500	80000	80000
31	40000	59000	62500	62500	62500	78000	80000	80000
32	40000	60000	63500	63500	63500	78500	80000	80000
33	40000	60000	64000	64000	64000	79500	80000	80000
34	40000	60000	64500	64500	64500	80000	80000	80000
35	40000	60000	65500	65500	65500	80000	80000	80000
36	40000	60000	68000	66000	66000	80000	80000	80000
37	40000	60000	68000	66500	66500	80000	80000	80000
38	40000	60000	68000	67500	67500	80000	80000	80000
39	40000	60000	68000	68000	68000	80000	80000	80000
40	40000	60000	68500	70000	70000	80000	80000	80000
41	40000	60000	69500	72000	72000	80000	80000	80000
42	40000	60000	70000	73280	73280	80000	80000	80000
43	40000	60000	70500	73280	73280	80000	80000	80000
44	40000	60000	71500	73280	73280	80000	80000	80000
45	40000	60000	72000	76000	80000	80000	80000	80000
46	40000	60000	72500	76500	80000	80000	80000	80000
47	40000	60000	73500	77500	80000	80000	80000	80000
48	40000	60000	74000	78000	80000	80000	80000	80000
49	40000	60000	74500	78500	80000	80000	80000	80000
50	40000	60000	75500	79000	80000	80000	80000	80000
51	40000	60000	76000	80000	80000	80000	80000	80000
52	40000	60000	76500	80000	80000	80000	80000	80000
53	40000	60000	77500	80000	80000	80000	80000	80000
54	40000	60000	78000	80000	80000	80000	80000	80000
55	40000	60000	78500	80000	80000	80000	80000	80000
56	40000	60000	79500	80000	80000	80000	80000	80000
57	40000	60000	80000	80000	80000	80000	80000	80000
58	40000	60000	80000	80000	80000	80000	80000	80000
>58	40000	60000	80000	80000	80000	80000	80000	80000

LTPP Bending Plate Weigh-in-Motion System:
Model Specifications for Pavement and Installation

Draft

Federal Highway Administration
Office of Infrastructure Research, Development and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike, HRDI-13
McLean, Virginia 22101-2296

August 22, 2000

U.S. Department of Transportation
Federal Highway Administration

Long-Term Pavement Performance
Serving your need for durable pavements

WEIGH-IN-MOTION SYSTEM MODEL SPECIFICATIONS FOR SYSTEM INSTALLATION

1.00   Introduction

It is the intent of these specifications to establish the minimum requirements and conditions for the successful installation of high speed weigh-in-motion for the purpose of collecting traffic data at Long-Term Pavement Performance (LTPP) Specific Pavement Studies (SPS) sites.

2.00   Proposal Requirements and Conditions

(This section would include all special instructions and requirements in the preparation of proposal documents and bid. It would also include preferences.)

3.00   Award of Contract

4.00   Beginning of Work

4.10   Time of Completion and Liquidated Damages

5.00   General

5.10   Plans and Working Drawings

The WIM scale will be installed in a concrete pavement 300 feet long, a minimum of the depth of the frame or the depth of the pavement in thickness and the full width of the lane. The scale will be installed 225 feet from the upstream edge of the section.

Working drawings, installation details and on-site support during the weigh-in-motion system installation will be provided by the system vendor.

5.11   Labor Code Requirements

5.12   Public Safety

5.13   Subcontracting

5.14   Payments

6.0   Approved Traffic Products

6.10   Pavement Markers, Permanent Type

6.20   Pavement Markers, Temporary Type

6.30   Striping and Pavement Marking Materials

7.00   Concrete

7.10   Concrete Pavement and Pavement Preparation (Weigh-in-Motion) 4 Hour Cure

The exact limits of existing pavement removal and replacement with concrete pavement will be determined by the Engineer.

Pavement and underlying base material removal shall be replaced with concrete pavement which shall be cured for at least 4 hours prior to the time the lane is to be opened to public traffic.

The outlines of excavations in the pavement shall be cut on a neat line with a power-driven concrete saw before any material is removed. The depth of such cuts shall be no less than the total thickness of the pavement section or section to be removed. Residue resulting from cutting operations shall not be permitted to flow across shoulders or lanes occupied by public traffic. Residue shall be removed from the pavement surface before any such material flows off said surface.

The material remaining in place, after removing pavement and base to the required depth, shall be graded to a plane, watered, and compacted. The finished surface of the remaining material shall not extend above the grade established by the Engineer.

Portland cement concrete pavement for the WIM System shall conform to the provisions for concrete pavement, as per _____.

The thickness of concrete pavement for the WIM System shall be a minimum of 1.0 – foot or as shown on the plans.

Calcium chloride shall be added to the concrete mix at a rate not to exceed 2 percent of the dry weight of the cement, the exact rate shall be as recommended by the concrete supplier and subject to Engineer approval.

Chemical admixtures and mineral admixtures shall not be used to replace Portland cement.

Prior to placing concrete, a ¼-inch thick commercial quality polyethylene flexible foam expansion joint filler shall be placed across the original transverse joint faces and extend the full depth of the excavation with the top of the joint filler flush with top of pavement. The joint filler shall be secured to the existing pavement joint by any method that will hold the joint filler in place during placement of concrete.

The penetration of concrete mixes shall conform to _____. The maximum penetration shall not exceed 2 ½ inches.

Concrete shall not be placed when the atmospheric temperature is 40E F, or lower.

Concrete shall not be spread, compacted, and shaped using stationary side forms.

Wood side forms not less than 2-inch nominal thickness may be used.

Upon written request by the Contractor, the Engineer may allow use of the shoulders in lieu of stationary side forms if such shoulders are suitable. Such approval of the Engineer shall in no way relieve the contractor of meeting all other requirements.

Transverse weakened plane joints shall be constructed using the sawing method where directed by the engineer. The exact time of sawing shall be the Contractor's responsibility, but in any event, the joints shall be sawed prior to opening the pavement to traffic. The minimum depth of cuts for the sawed weakened plan joints on either side of each WIM scale frame location shall be ½ of the pavement depth.

Concrete pavement shall be cured by the curing compound method. The curing compound shall be Pigmented Curing Compound.

The Portland cement concrete pavement for the WIM system shall be ground.

7.20   Concrete Pavement and Pavement Preparation (Weigh-in-Motion) 7 Day Cure

The exact limits of existing pavement removal and replacement with concrete pavement will be determined by the Engineer.

Pavement and underlying base material removal shall be replaced with concrete pavement which shall be cured for at least 7 days prior to the time the lane is to be opened to public traffic.

The outlines of excavations in the pavement shall be cut on a neat line with a power-driven concrete saw before any material is removed. The depth of such cuts shall be no less than the total thickness of the pavement section or section to be removed. Residue resulting from cutting operations shall not be permitted to flow across shoulders or lanes occupied by public traffic. Residue shall be removed from the pavement surface before any such material flows off said surface.

The material remaining in place, after removing pavement and base to the required depth, shall be graded to a plane, watered, and compacted. The finished surface of the remaining material shall not extend above the grade established by the Engineer.

Portland cement concrete pavement for the WIM System shall conform to the provisions for concrete pavement, as per _____.

The thickness of concrete pavement for the WIM System shall be a minimum of 1.0 – foot or as shown on the plans.

Prior to placing concrete, a ¼-inch thick commercial quality polyethylene flexible foam expansion joint filler shall be placed across the original transverse joint faces and extend the full depth of the excavation with the top of the joint filler flush with top of pavement. The joint filler shall be secured to the existing pavement joint by any method that will hold the joint filler in place during placement of concrete.

The penetration of concrete mixes shall conform to _____. The maximum penetration shall not exceed 2 ½ inches.

Concrete shall not be placed when the atmospheric temperature is 40E F, or lower.

Concrete shall not be spread, compacted, and shaped using stationary side forms.

Wood side forms not less than 2-inch nominal thickness may be used.

Upon written request by the Contractor, the Engineer may allow use of the shoulders in lieu of stationary side forms if such shoulders are suitable. Such approval of the Engineer shall in no way relieve the contractor of meeting all other requirements.

Transverse weakened plane joints shall be constructed using the sawing method where directed by the engineer. The exact time of sawing shall be the Contractor's responsibility, but in any event, the joints shall be sawed prior to opening the pavement to traffic. The minimum depth of cuts for the sawed weakened plan joints on either side of each WIM scale frame location shall be ½ of the pavement depth.

Concrete pavement shall be cured by the curing compound method. The curing compound shall be Pigmented Curing Compound.

7.30   Grinding

The Portland cement concrete pavement for the WIM system shall be ground.

The surface ground will be straight-edged at locations to be determined by the Engineer with a straightedge 12 feet long. When the straightedge is laid on finished pavement in a direction parallel with centerline or normal to centerline, the surface shall not vary more than 0.01-foot from the lower edge.

Fog seal coat shall be applied to all ground asphalt concrete pavement.

7.31   Grinding Procedure

Spot bump grinding should not be allowed.

All grinding should be done in the direction of travel, starting on the left lane line (This would normally be the high side of super elevation). The grinder should make a continuous cut.

After the grinder has completed a cut over the WIM concrete pad, the profile should be checked, using a 12-foot straight edge. If there are areas still out side of specifications, the WIM pad should have a total regrind.

7.32   Equipment Requirements

The wheelbase of the grinder shall be a minimum of 13 feet, with the cutting head located 3.5 feet ahead of the trailing wheel center.

The cutting head shall provide a minimum cutting width of 36 inches. The cutting head shall consist of stacked diamond saw blades.

The cutting head shall be cooled and the concrete dust generated by the grinding operation shall contained by a spray of clean unpolluted water.

The concrete grinder shall be equipped with a vacuum system to pick up the water used to cool the cutting head and the concrete tailings from the grinding operation. The collected water and concrete tailings shall be pumped into a container for proper disposal.

8.00   Construction Details

8.10   Water Pollution Control

8.20   Construction Area Signs

8.30   Maintaining Traffic

8.40   Closure Requirements and Conditions

8.41 Closure Schedule

8.42 Contingency Plan

8.50   Traffic Control for Lane Closure

9.00   High Speed Weigh-In-Motion Electrical System

9.10   Description

The Weigh-In-Motion Equipment shall be furnished by others.

The Weigh-In-Motion System (hereafter WIM system) shall include equipment and software for collecting, processing, storing, transmitting and manipulating information related to the counting, classifying and speed monitoring of all vehicles and the weighing of trucks and buses.

9.11   Conduit

Conduit to be installed underground shall be grounded IMC.

9.12   Trenching Installation of Conduit

The installation of all conduits between WIM scales and the outside edge of shoulder shall be done by trenching. No boring will be allowed.

9.13   Pull Boxes (Junction Boxes)

9.14   Traffic Pull Boxes

9.15   Conductors and wiring

9.16   Telephone Cable

9.17   Service and Service Cabinet

9.18   High Speed WIM Controller Cabinet

The controller cabinet will be provided by the WIM vendor as part of the WIM system. The contractor will provided the concrete cabinet foundation, cabinet mounting fasteners and conduits. The contractor will install the controller cabinet on the foundation.

9.19   Detectors

Loop detector sensors shall be furnished and installed by the WIM vendor.

Loop wire shall be furnished by the WIM vendor.

Loop detector lead-in cable shall be furnished by the WIM vendor.

Slot cutting for inductive detector loops shall not be performed until after the concrete pavement has been ground, straight-edged and brought into tolerance.

Slots in Portland cement concrete shall be filled with elastomeric sealant.

9.20   Concrete Removal (WIM Scale Frame)

Neither saw cutting nor the removal of concrete for WIM scales shall be performed until after the concrete pavement has been ground, straight-edged and brought into tolerance.

9.21   On-site Equipment

The WIM system shall be provided by others and installed by the contractor according to contract plans, WIM vendor shop drawings and WIM vendor requirements..

10.00 Payment

The contract price paid per cubic yard for concrete pavement (weigh-in-motion) shall include full-compensation for furnishing all labor, materials, tools equipment and incidentals, and for doing all the work involved in constructing concrete pavement complete in place. This includes sawing, grinding new WIM PCC pavement and the existing AC pavement, applying fog seal, removing and disposing of existing pavement and base material, as shown on the plans and as directed by the Engineer.