RUTTING - ALPS

General Description

The Automated Laser Profile System (ALPS) is used to collect rutting traces every ¼" for each lane at 50-foot intervals. The traces are stored and a macro program written in Visual Basic determines the maximum rut depth and location, along with the volume of water potentially stored in the rut. The ALPS is also used to measure transverse crack cupping. The ALPS is the most current device used to measure rutting.

A more detailed description of how the ALPS was developed can be found at:
http://www.mrr.dot.state.mn.us/research/pdf/2003MRRDOC005.pdf

COLLECTION FREQUENCY

An initial reading is taken immediately after the pavement has been laid. Subsequently, rutting data is collected three times per year (April, July and October).

The following table lists the MnROAD cells to be tested with the ALPS in 2009.

HMA Test Cells Measured for Rutting
Mainline: 1 , 2, 3, 4, 6, 70 (future), 15, 16, 17, 18, 19, 20, 21, 22, 23
LVR: 24, 86, 87, 88, 27, 28, 77, 78, 79, 31, 33, 34, 35
Farm Loop: 83, 84

Operation

RUTTING MEASUREMENTS

1. Start the tractor engine.
2. Turn on the auxiliary power, the inclinometer power, the unit power, and the enable switch as shown in Figure 1 and Figure 2.

Figure 1


Figure 2

3. Use the left lever on the tractor to raise the unit and the right lever to bring the unit perpendicular to the tractor as in Figure 3.


Figure 3

4. Drive the tractor to the cell to be tested. To obtain the correct data, one must collect data in the westbound/driving lane first then the eastbound lane or passing lane depending if testing the Low Volume Road or the Mainline.
5. Place the unit on the first correct paint markings to be tested within the cell. There are two different markings systems: a double dot where one must line up each foot on each dot, and a single dot where one must put the indicator rod in the center of the dot.
6. Line up the unit to the dots as closely as possible and if needed use the left and right lateral button to make the position more accurate as in Figure 1.
7. Press the home button to bring the sensor to the start position.
8. Level the beam using the up and down button. Level must read 0.00. (Number should be close to –0.00 but on 0.00.)
9. Follow the Using the Computer instructions below.

CRACKING MEASUREMENTS

1. Start the tractor engine.
2. Turn on the auxiliary power, the inclinometer power, the unit power, and the enable switch (as shown in Figures 1 and 2 above).
3. Use the left lever on the tractor to raise the unit and the right lever to bring the unit perpendicular to the tractor.
4. Drive the tractor to the cell to be tested. To obtain the correct data one must collect data going from west to east. There are typically three cracking lines per cell to be tested.
5. The tractor must be facing south. Line the feet of the unit on the fog line to square the machine. There is a line on the unit that must be lined up on the crack. Keep as straight as possible and set the unit down on the designated paint mark.
6. Press the home button to bring the sensor to the start position.
7. Lower the unit until the green bar on the right touches the ground.
8. Follow the Using the Computer instructions below.

USING THE COMPUTER

1. Plug in the computer to the unit. There are two cords: a power cord and the cord that transfers the data (COM1).
2. Turn on computer.
3. Press Ctrl, Alt, Delete, and then enter when the next screen comes up.
4. Click advanced button.
5. In the windows menu, use the pull down menu to change AD to MRLXPW713.
6. Type in the password and click ok.
7. Go to the start menu and right click.
8. Click on the explore button.
9. Under the local disk (C:), on the left side of the screen, click on the ALPS Tests.
10. Pick the correct cell to be tested and double click. Cells that say curl and warp are concrete and cells that say cracking or rutting are asphalt cells.
11. A warning screen will come up, click Enable macros.
12. At the bottom left of the screen, make sure the screen is opened to the settings page.
13. Then click the start button in the window.
14. A screen will come up saying," Successfully opened serial port COM1 at 9600 baud", click ok. The sensor will move down the beam.
15. A screen will appear saying, "Successfully set sample rate to 100 samples/sec", click ok.
16. A ready to collect data screen will then come up, click yes. The sensor will move again this time collecting the appropriate data.
17. When the sensor is done collecting data, a screen will appear saying, "Read 616 data points from sensor. Display data", click ok.
18. The data will then be displayed and a screen will come up for the next data set. The sensor will return to start position.
19. Raise the unit up and move to the next set of points and level to 0.00.
20. Repeat steps 16 through 19.
21. When you have completed the 20 test points on the cell a screen will come up saying, "Done data collection, Cleaning up", click ok.
22. Another screen will appear saying, "Successfully closed the serial port to sensor", click ok.
23. The screen will close.
24. Click save data button, data saves to the raw data folder.

25. Close the page and the screen will ask to save changes to the Excel file, click no. Move to the next cell.

Data Processing

PROGRAM USED

ALPS_RUT_MACROS_v04.xls

STEP BY STEP PROCESS

After the data is collected and downloaded to the working computer, the program processes the data for insertion into the database as follows. The raw data file is separated into each data collection point within the cell. The resulting file (xxxxx_Sheets.xls) is then saved for possible future use. The ruts are calculated by adjusting the readings to eliminate extreme outlying data points and a digital straight edge is inserted over each wheel path. A graph depicting this information is produced. This file (xxxxx_Charts.xls) is also saved for possible future use. The final rutting data is then derived from this file. The rutting data is calculated from the "Charts" file by measuring the area between the digital straight-edge and the actual road profile, and a third file (xxxxx_Data.xls) is saved. The "Sheets" and "Charts" files are then deleted and only the final "Data" file and the raw data file are stored at a common point.

The next step is to compile all the "Data" files into one database ready file for insertion into the database. This file is stored on the R drive at:
R:\MnROAD\Data - Collection\Rutting (ALPS)\Data\ALPS Data\ALPS Measurements\Database Ready Files.

The MnROAD Monitoring Engineer will add the DATE_UPDATED and COMMENTS fields to the file and populate the data accordingly. He will then email the excel file to the database administrator to load the data to the database. At the same time he moves this file to the directory marked:
R:\MnROAD\Data - Collection\Rutting (ALPS)\Data\ALPS Data\distress_alps_results_rut (loaded).

Finally, the raw data files are moved to a final storage location for future reference.

Database Tables

The ALPS data is stored in two database tables. DISTRESS_ALPS_DATA stores the raw values collected in the field. DISTRESS_APLS_RESULTS_RUT stores the processed rut depth measurements. See the descriptions of each table below.

DATABASE TABLE – DISTRESS_ALPS_DATA

Name	Null?	Type
CELL		NUMBER(2,0)
STATION		NUMBER(8,1)
LANE		VARCHAR2(15)
MEASUREMENT_TYPE		VARCHAR2(30)
DAY		DATE
HOUR_MIN_SEC		VARCHAR2(10)
RECORD_NO		NUMBER(22,0)
Z_DATA_IN		NUMBER(10,4)
Y_STA_FT		NUMBER(14,4)
X_OFFSET_FT		NUMBER(14,4)
COMMENTS		VARCHAR2(60)
DATE_UPDATED		DATE

DATABASE TABLE – DISTRESS_ALPS_RESULTS_RUT

Name	**Null?**	**Type**
CELL		NUMBER(2)
STATION		NUMBER(8,1)
LANE		VARCHAR2(15)
MEASUREMENT_TYPE		VARCHAR2(30)
DAY		DATE
HOUR_MIN_SEC		VARCHAR2(10)
WHEELPATH		VARCHAR2(10)
RUT_IN		NUMBER(6,4)
WATER_IN		NUMBER(6,4)
RUT_VOL_CFPF		NUMBER(6,4)
WATER_VOL_CFPF		NUMBER(6,4)
X_RUT_FT		NUMBER(6,4)
X_WATER_FT		NUMBER(6,4)
DATE_UPDATED		DATE
COMMENTS		VARCHAR2(60)

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