Ball Bank Indicator Guide – Iowa LTAP

Overview

The following is a step by step explanation for different aspects of use for the Rieker RDI digital inclinometer (referred to here as the digital ball bank). It is intended to walk the user through use of the device to determine the advisory speed for a curve. In this capacity, the digital ball bank can aid in determining an advisory speed where one is not presently known, or in determining whether an existing/posted advisory speed is correct or needs to be changed.

Disclaimer

Note that the digital ball bank is a tool to assist in the determination of advisory speeds in curves. All resulting calculations related to determining the advisory speed for a curve should be performed by or under the supervision of a licensed engineer. The final decision on whether to add, revise or remove advisory speed signing at a curve remains with the engineer of the jurisdiction overseeing the roadway.

Questions

It there are any questions regarding the digital ball bank or its use, please contact David Veneziano at 515-294-5480 or dvenez@iastate.edu.

Pre-Data Collection

1) Identify the curves that will have data collected.
2) Arrange for a second person to assist in data collection in the field. One person will handle the driving at the site, while the second will be responsible for operating the digital ball bank and recording data readings.
3) Prior to field data collection, maps should be printed out for each site. Notes can be taken both before and during data collection related to site conditions.
4) Curve length should be measured on-site by a distance measuring instrument in-vehicle or a distance wheel, or in the office via Google Maps' distance measurement tool. In addition, the length between curves should be measured for sites with multiple curves. As per the MUTCD, Section 2C.07, a distance between successive curves (i.e. a reverse curve) of less than 600 feet is treated as one location and signed accordingly (using a reverse turn sign, W1-3). A distance of 600 feet or greater is considered a separate curve, and each curve receives its own set of signing.
5) Print curve study sheets to record data for each trip (both directions) through a curve. A total of three passes through each curve in both directions during the field study. A sample data recording sheet has been provided by LTAP.

In Vehicle Set-Up

1.) Connect the 15 pin power/data cable to the digital ball bank unit. The screw connections should be lightly tightened if a flathead screwdriver is available. Plug the 12 volt connection into a vehicle power port. Note that real-time data collection/download is not needed for the data collection application described here, so the data collection cable does not need to be connected to a laptop.
2.) The ball bank must be mounted to a flat surface that is less than 10° out of level. Ideally, a portion of the dashboard in the vehicle that will be used in data collection will have a relatively flat surface. To determine if the dashboard surface is within ±10° of level, plug in the digital ball bank and turn it on via the "On-Off" switch on the right side of the unit. If the screen reads within ±10°, the surface is acceptable. If the reading falls outside of this range, then the digital ball bank will need to be placed on a flatter surface.
3.) The digital ball bank needs to remain stable and affixed to the level location identified in Step 1. To accomplish this, it should be secured to the dashboard using a Velcro strip. Velcro strips have been supplied with the digital ball bank equipment for this purpose. (The dashboard surface should be cleaned prior to securing the Velcro strip by using a cleaner that will not leave a residue (i.e. window cleaner or similar).
4.) Before leaving for the study site(s), the digital ball bank device will need to be relevelled out. This needs to be done while the vehicle is parked on a level pad. Ideally this will be a parking lot, although these are not always level. A quick check for a relatively level parking area can be made using a traditional carpenter's level.
5.) To relevel the ball bank, press the "REL" button on the face of the unit. Once pushed, the unit should return to a value of approximately 0°. The value displayed on the screen of the unit may fluctuate around 0° because of the vibrations of the vehicle. Once relevelled, the unit should remain on until all data collection is completed.
6.) When levelling the device, all occupants of the vehicle that will be visiting the study sites need to be in the vehicle and remain in their seating position until data collection is finished. If occupants shift seating locations, it can throw off the weight and balance of the vehicle, affecting the levelling of the ball bank.

On-Site Data Collection

1) Proceed to the first study site. Drive through the curve and become familiar with conditions prior to beginning data collection runs. Note that the data collection runs made through a curve will be made three times in both directions at the advisory (or posted/lower speed if an advisory speed is not present).
2) When approaching the study curve, the driver will maintain a uniform speed that will be kept while travelling through the curve itself. This should be accomplished by setting the cruise control whenever it is available in a vehicle. Steering should remain smooth, avoiding any jerky types of movements.
3) When approaching the study curve on a tangent section, the data recorder will press the "Min-Max" button on the ball bank to start the device. Note that the Min_Max button may need to be pressed a few times to pass through the "Left" and "Right" readings before resetting.
4) Once the curve has been exited and the vehicle is on a tangent section, the "Min-Max" button will be pressed again to obtain the degree of bank measurements collected when passing through the curve. The device produces two readings, a value for the "Left" and a value for the "Right". The larger of these two values is what should be recorded on the study sheet in the corresponding cell for the speed driven on the respective pass.
5) The negative and positive values produced by the ball bank on a particular pass correspond to whether the vehicle is moving to the left or to the right (negative values for left curves, positive values for right curves). If a negative value is produced, the absolute value is recorded on the study sheet (e.g. if a reading is -12.1, a value of 12.1 should be recorded).
6) Once the Min-Max button has selected the "Right" reading, leave this reading displayed until approaching the curve on another data collection run. Once approaching the curve for another collection run, then press the Min-Max button to reset the device and begin data collection readings.
7) Once a total of six passes have been made through the site (three in each direction) data collection for that particular speed is complete.
8) In order to determine a safe advisory speed, it may be necessary to perform multiple data collection runs through a curve at different set speeds. For example, one set of passes may be collected at 40 mph, another at 35 mph and a third at 30 mph. The collection of data at these different speeds would be done to assist in determining the correct advisory speed for a curve where it is unknown or where it may need to be revised.

Post Data Collection

1) Using the measurements recorded from different collection passes on the study sheet, calculate the average value for the pass and round that result to the nearest whole number. (Note when multiple passes have been collected, for example at 30 mph, 35 mph, and 40 mph, separate averages need to be developed for each collection speed.)
2) The degree of ball bank specified by the MUTCD for a particular speed limit are present in the provided study sheet and are also specified in Paragraph 7 of MUTCD Section 2C.08.
3) For a given speed, the average measured degree of bank in each direction should not exceed the degree listed for that particular speed on the study sheet. In cases where the degree of bank in each direction might result in two different advisory speeds posted in two different directions, the lowest safe advisory speed of the two should be selected for use.
4) Refer to MUTCD Table 2C-5 to determine what signs are required or recommended based on site characteristics (speed limit on tangent, traffic volume, etc.). (Note: See Section 2C.06 for roadways with less than 1,000 ADT.)
5) Refer to MUTCD Section 2C.08 for specific information on Advisory Speed Plaques as needed.