FLORIDA DEPARTMENT OF TRANSPORTATION | *Transportation Statistics Office*

Bicycle and Pedestrian Roadway Characteristics Inventory

final report

Mobility Performance Measures Program

February 2014

Florida Department of Transportation – Bicycle and Pedestrian Roadway Characteristics Inventory

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Transportation Statistics Office

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BACKGROUND

The Roadway Characteristics Inventory (RCI) is a database of various physical and administrative data related to the roadway networks that are either maintained by or are of special interest to the Florida Department of Transportation (FDOT). Every 3 to 5 years the features within RCI are updated, FDOT will inventory features related to bicyclists and pedestrian for the current year through this task. Included in this inventory is Feature 214 (outside shoulders), 216 (bike lanes, shared use paths, and sidewalks within urban areas), and 217 (sidewalks maintained by FDOT).

This data is extremely valuable as FDOT is often asked about the number of miles of pedestrian and bicycle facilities they have constructed and maintain. In addition, the effectiveness of various facility types for improving safety or mobility cannot be ascertained without data on the types of facilities that have been provided. While this data is valuable to FDOT, it has not been consistently collected throughout the state. Additionally, some data fields are only collected within one mile of an urban area. Thus, important information FDOT needs to evaluate and prioritize its efforts in providing for pedestrians and cyclists is unavailable. Consequently, this effort was undertaken to populate the RCI database with initial data for these bicycle and pedestrian related fields.

To minimize the amount of time needed to populate the desired fields in the RCI database, it was decided to use the FDOT videolog, straight line diagrams, and publicly available aerial photography to estimate the values for each field. It was understood that this would not be as accurate as field data collection. However, it was felt it would allow the fields to be populated quickly and they could be updated through the normal RCI field data collection process. Field validation of the data collection effort was planned to determine the accuracy of the computer-based data collection effort.

SUB-TASK 1. PHASE 1 - PILOT DATA COLLECTION

Prior to beginning statewide data collection, it was decided that Hillsborough County roadway data would be collected as a "Pilot Data Collection" effort. This would give the Consultants the opportunity to identify data or equipment needs and test data collection techniques. Additionally, it would allow for an initial data set to be reduced and batch loaded into RCI. This would ensure that all the data that needs to be collected is being collected in a format that can be efficiently uploaded to FDOT.

Data Sources

To begin this pilot data collection phase, the Consultant needed to obtain access to the videolog. After discussions with the FDOT Transportation Statistics Office, it was decided that rather than access the videolog over the internet, the District 7 videolog would be loaded onto a portable hard drive and sent to the Consultant. Straight Line Diagrams for Hillsborough County were obtained from District 7.

Field validation of the computer-based data was compared to actual measurements on approximately 10% of the Hillsborough County roadway mileage.

Data Collection

For data collection, the FDOT videolog was loaded onto a computer with dual monitors. This allowed the data collector to view the videolog or aerial photos on one screen while entering data on the other. Simple measuring scales were created for each monitor to aid in the estimation of feature widths.

It was originally envisioned that a single data collector would collect all the data for a roadway section. This was how this pilot was conducted. A data collection spreadsheet was developed for entering RCI values and information into the dataset. This spreadsheet was designed to allow a single data collector to collect all the desired data for a roadway section on a single pass through the videolog. The columns from the spreadsheet are listed in appendix A.

Each data collector was assigned a roadway and collected the data consistent with the directions provided in the *RCI Features and Characteristics Handbook* (published February 2013) as applicable. Data for other non-RCI features was collected as follows:

> **Shared Use Path Width** – There is not a field code for the width of a shared use path. However, this is entered just as sidewalk width would be entered.
>
> **Signalized Intersections** – Signalized intersections were coded at the mile point shown on the Straight Line Diagrams. Midblock crossing signals were not coded.
>
> **Outside Lane Width** – The width of the outside lane was coded for all roadways. One-way streets may have more than one outside lane.
>
> **Nominal Sidewalk Buffer Width** - Along some roadways the separation between sidewalks may change numerous times in a relatively short distance or may meander continuously. In these areas a nominal spacing between the sidewalk and roadway was selected and coded.
>
> **Shared Lane Markings** – The shared lane marking symbols were originally coded on an individual basis. This has been revised to note where the Shared Lane Markings begin and end along a roadway.
>
> **Colored Bike Lanes** – No colored bike lanes were present in Hillsborough County. These will be coded from the beginning of the colored bike lane treatment to the end.

The values for continuous features (shoulders, lane widths, sidewalk widths, etc.) were coded at the point the feature value began. Since a feature is continuous until in changes, no end point was noted for the continuous variables.

Data Reduction and Data Collection Modifications

Once data collection was completed, the data had to be put into a format that could be easily batch loaded into the FDOT's RCI system. This effort was more complex than originally envisioned for several reasons. These are described below:

- Because a new data line was added every time a feature changed, the data had to be sorted separately for each data field. This meant each section needed to be separated into a distinct spreadsheet and the data reduced separately.
- The occurrence of one-way roads, often only occurring as subsections of a major section, complicated the definitions of northbound/eastbound and southbound/westbound. This, in turn, complicated the programming to determine if something was on the right or left side of the roadway.
- When those responsible for batch loading the data reviewed the data, they identified the need for end mile point data for the continuous feature value. While it would seem that the endpoint of a feature value should be equal to either the begin point of the next feature value for a given data field, or the end of the section, this is not always the case. Occasionally there are gaps in a section resulting in discontinuity; thus a roadway section may "end" several times. These locations had to be identified and the end mile points manually coded.

The time required for reduction of data into a format that can be uploaded was much greater than anticipated. Additionally, each time data is manipulated to put it into the proper format (sorting, programming to determine endpoints, etc.) there is potential for errors to be introduced. Consequently, the data entry methods were changed for the rest of the data collection effort. Multiple data collectors were to be used. Each was assigned a particular variable and that data will be collected in a format that requires minimal reformatting prior to batch loading. In addition to reducing data reduction time and potential for induced errors, this also increased the efficiency of the data collectors as each data collector was dealing with one set of RCI data collection codes at a time.

OBSERVATIONS ON THE ACCURACY OF THE DATA

Two different accuracy checks were performed on the reduced data. First, the data was spot checked by an independent data collector. Additionally, field measurements were taken to determine the fidelity of the computer data to the field data.

Independent Data Checks

After initial data reduction a printout of the data was given to a data collector for office verification. While data collection accuracy varied with respect to the data being collected, overall the results were positive.

Bike lanes – When bike lane data was originally collected, undesignated bike slots had been coded as bike lanes. Once this was corrected, the entire data set was checked for accuracy. Of 174 lines of data, only three errors were found. Two were the result of coding errors, one was an error in the data reduction programming (a gap in the section created a not otherwise coded end mile point). The errors represented by the data reduction programming errors were fixed for the dataset.

Sidewalk Width – Of 159 lines of data checked, two errors in coding were identified. Again a problem with the data reduction programming was identified and fixed for the entire dataset.

Shoulder Type – One hundred fifty-five lines of data were checked. Three of these lines had the “wrong” shoulder type entered. It is possible these errors were the result of differing (or evolving) interpretations of the shoulder type codes. Endpoint data errors were more prevalent, seven, but again this was the result of programming and was fixed.

Shoulder Width – These were checked coincident with the shoulder type. Of the 155 lines checked, the checker noted two widths that he would have coded as a different width. Also, valley gutters were coded improperly, but fixed.

Buffer Widths (sidewalks and shared use paths) – This variable was hard for our data collector to check. As stated earlier a nominal width was recorded for many sidewalks. While he felt he may have coded some differently, he could not say he felt strongly enough to change the data.

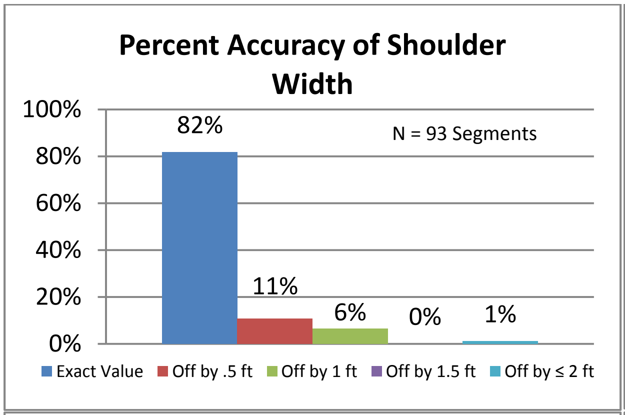
Bike Slots – The data was not coded as designated versus undesignated. This was corrected. Additionally, space provided between bus pull outs and travel lanes had been coded as bike slots. This also, was corrected.

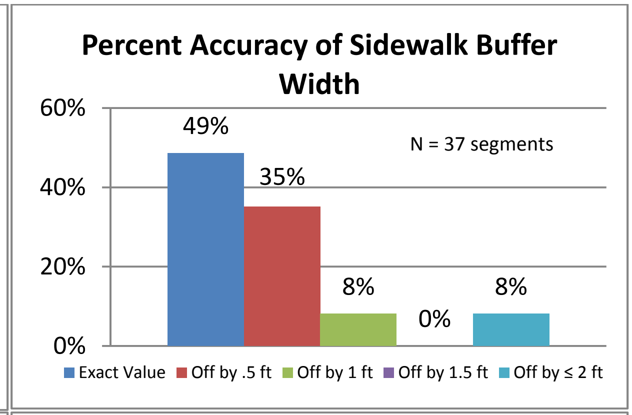
Outside lane widths, speed limits, and barrier codes – Fifty lines of data were checked. The checker found no widths or speed limits that were incorrect. Data reduction programming resulted in errors in endpoints but these, and the programming, were corrected.

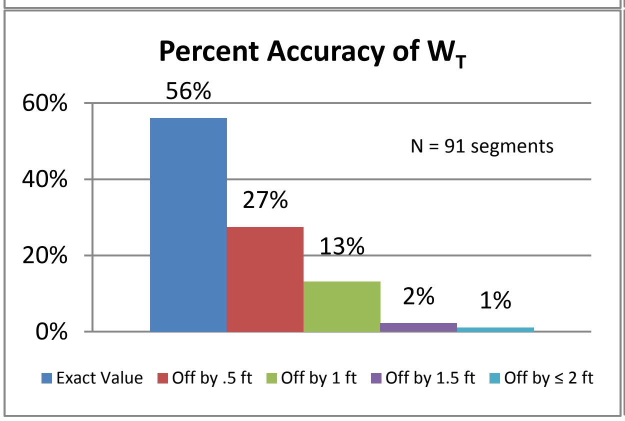
Field Data Validation

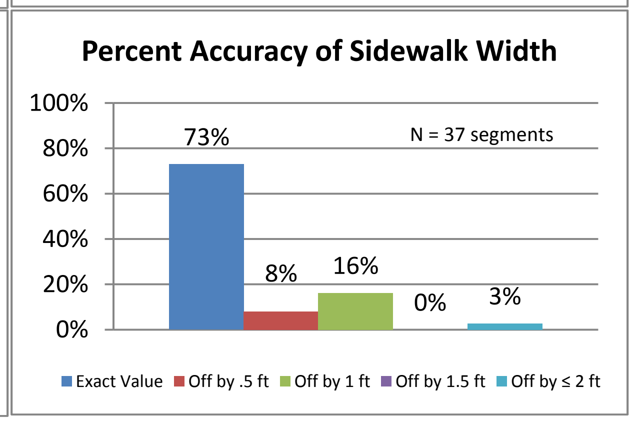
After initial data collection a printout of the data was checked via field verification. We randomly selected sections and field validated five mile segments from Hillsborough County. While data collection accuracy varied with respect to the data being collected, overall the results were positive. All fields have an 80% or higher accuracy with a margin or six inches and higher than 90% if you extend that range to one foot.

Below are the results from our field data validation.









Note: Sidewalk width was measured primarily via Google Earth as this measure was difficult to validate via the state video log. Sidewalks are mainly a whole number (example five feet) so that could explain the 16% inaccuracy of "off by one foot", as we thought it was a four foot sidewalk that was actually a five foot sidewalk.

Note: Sidewalk buffer width displayed a high amount of data off by more than two feet. This data could be explained as buffer widths are variable as many sidewalks meander; as well some roads have large distance between the sidewalk and the edge of pavement. This data was also measured primarily via Google Earth as this measure was difficult to validate via the state video log. Two of the three discrepancies for buffer width were at a lateral separation of nearly forty feet that meandered and the two segments were recorded at a distance of four feet off what the actual distance was measured in the field.

SUB-TASK 2. PHASE 2 – COMPLETING STATEWIDE DATA COLLECTION

On June 12, 2013 FDOT staff and the consultants participated in a meeting where FDOT gave approval to continue on with Phase 2 of the project. Thus continuing with the additional 65 counties of data in Florida.

Data Sources

For the remaining Districts data it was decided that FDOT Transportation Statistics Office continue loading the most current District Video Log Data onto a portable hard drive and send it to the

Consultant. It so happened that the Video Logs were in the process of being updated for several districts. Due to these updates we were able to (mid-project) use current 2013 video log data for entirety of District 6, and the majority of District 5. Straight Line Diagrams for the remaining counties were obtained from FDOT's website.

Data Collection
We continued to complete the statewide data collection with the data collection modifications agreed upon. This resulted in discontinuing the collecting of Feature 311 (MAXSPEED) and Signalized Intersections. It should also be noted that at times roadways data could not be collected due to a variety of reasons (Routes not on the route list at the time of last cycle, routes under construction at the time of last collection cycle, new routes, off-system routes, etc.). There were 22 roadways that were present in FDOT's Straight Line Diagrams that did not have a corresponding video log. If a short segment was identified where we could attempt to collect the data using only Aerial Photography and we perceived an accurate data set could be completed, we would attempt to collect the data.

OBSERVATIONS ON THE ACCURACY OF THE DATA
Independent accuracy checks were performed on the reduced data. When spot checking, 25 random segments where taken for each data field, where applicable (some fields might not be applicable as that field is not present or there are less than 25 segments), and checked for accuracy. This was done with an independent data collector who had not collected the data set, thus a new pair of eyes are reviewing the data for the first time. From all the counties independent spot checks (excluding pilot and field validated District 7) we reviewed 13,354 segments. Of those 13,354 we confirmed 13,162 were correct, yielding a comprehensive accuracy of 98.6%.

REVISED OR RECOMMENDED FIELDS

Revised Fields The research team identified several data fields that the FDOT should consider either adding descriptor codes or improving descriptions in the Department's data collection handbook. These modifications include the following:

Feature 214 (Outside Shoulders) – The existing codes do not include a separate value for on-street parking. It is currently coded as a "paved with or without hatching." However, as parking essentially eliminates the potential for using the paved shoulder as a bike facility and additional code is needed. -There is also no way to clearly note a bike lane next to on-street parking. Consequently a code for this condition is also recommended.

Feature 216 (Bicycle Lanes) – There is not currently a description of where a bike lane ends. The following method for determining the end of a bike lane is recommended:

- at a Bike Lane Ends sign (R3-17 with an R3-17b)
- at the first bike lane symbol in the opposing direction
- at a distance of either 660 feet beyond the last bike lane symbol in an urban area or 1320 feet beyond the last bike lane symbol in a suburban or rural area

Feature 216 (Bicycle Lanes) – Currently there is no field for a buffered bike lane. A buffered bike lane is a bike lane with extra separation, marked by a hatched pattern between two longitudinal stripes, similar to striping a neutral zone between two lanes. Adding this code would require two additional codes: buffer width and bike lane width. Alternatively, this could be addressed with the addition of a "hatched" and "non-hatched" code for the Outside Shoulder field.

Newly Developed Fields The research team also introduced several additional fields that have relevance to bicycle and pedestrian modes, including, outside lane width, shared lane markings, colored bike lanes. Fields for noting buffered bike lane applications are also being considered for development, but have not been implemented at the time of this writing. A comment field was also developed to note any relevant information that did not apply to a standard field entry.

Outside Lane Width The Bicycle Level of Service model uses the combined width of the outside lane and any paved shoulder to determine the operating space available to bicyclists and the separation they are afforded from motor vehicles. As shoulder width is already collected, outside lane width was added to the collection protocol, which could be converted to the W_t term used in calculating bicycle level of service. Independent lane widths are also a common descriptive data point for many roadway inventories.

Shared Lane Markings Shared Lane Markings are a relatively new type of pavement marking, first included in the 2009 Edition of the *Manual on Uniform Traffic Control Devices (3)*. Shared Lane Markings help position bicyclists in lanes that are not wide enough for a bicycle and motor vehicle to safely occupy side-by-side. The research team added the beginning and ending points of shared lane marking applications, also observed in the Video Log imagery or Google Earth imagery.

Colored Bike Lanes In 2011, the Federal Highway Administration granted Interim Approval for the optional use of green colored pavement in bike lanes. The research team added a field to note the use of colored pavement in a bike lane. While use of this facility treatment is rare, it will likely increase in the future and can now be documented in the RCI database.

Comments A Comment field has been added to note special considerations or reasons for adjusting data. For example, if a segment was found to be under construction at the time the imagery was generated in both image sources, no data was collected, but the reason is noted in the comment field. Also, shoulder width can sometimes be diminished by debris accumulation, pavement degradation, or vegetative encroachment. In such cases, the dimension entered into the field reflects the clear and usable width of the shoulder: The possibility that additional width could be realized with maintenance or repair is noted in the comment field. Additionally, buffer and sidewalk width can be variable at times. The protocol calls for the entry of a nominal typical width for these attributes of a segment; the comment field was used to describe the degree of variability of the actual width in such cases.

CONCLUSIONS

This project has shown that reliable geometric data relevant to bicycle and pedestrian accommodations can be collected from computer-based imagery, and that this reliable data collection can be conducted quickly in an office setting. The introduction of this data to the Roadway Characteristics Inventory will add significantly to the completeness of the database, well ahead of the long cycle associated with field data collection. This comprehensive statewide data allows for evaluation of the bicycle and pedestrian performance on the State Highway System. This new data will also facilitate comprehensive tracking of the mileage and types of various facility types for reporting to the public. The methodology developed here provides a template for other agencies to execute similar data collection efforts in their own jurisdictions, if they have similar information sources at their disposal.

APPENDIX

- Appendix A: Displays the data sets the consultant populated. This also contains fields not collected in the RCI, as well displays phase II partially collected data.
- Appendix B: Recommendations to the *RCI Features & Characteristics Handbook*. Recommended changes are highlighted.
- Appendix C: Statewide/Districts/Counties inventory summary reports.