Hillsborough County Florida
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TRANSPORTATION DESIGN MANUAL BULLETIN 23-03R

DATE: October 26, 2023

TO: County Director of Engineering & Operations Department,
County Director of Capital Programs Department,
County Manager of Construction Services,
County Director of Transportation Maintenance Division,
County Project Managers, and Project Engineers of Record

FROM: County Engineer,
County Director of Technical Services Division

COPIES: County Director of Performance Data and Analytics Department

SUBJECT: **MULTIMODAL SAFETY ANALYSIS GUIDANCE FOR TRANSPORTATION PROJECTS**

This bulletin revises Bulletin 23-03 Multimodal Safety Analysis for Hillsborough County Transportation Projects.

REVISIONS

Bulletin 23-03 Multimodal Safety Analysis for Hillsborough County Transportation Projects has been revised to include the following:

- Introduction of the Safe System Approach (SSA) language (page 3 and page 7)
- Updated dates of referenced documents (page 3)
- Requirement for the analysis to be signed and sealed by a Professional Engineer (page 3)
- Updated Crash Data Summary Table. Previously, the Crash Data Summary Table referred to a single table combining the analysis of roadway segments and intersections. It was necessary to split the crash data for analysis of roadway segments and intersections because the crash rate calculation for roadway segments and intersections are different (page 5)
- Addition of near-miss crashes for field observation (page 5)
- Condition Diagram requirement (page 7)

The Revised Multimodal Safety Analysis methodology is provided in pages 3 to 9.

IMPLEMENTATION

This bulletin will be utilized on all project types listed in Table 2 of this bulletin for new projects, projects that are in scope and staff hour negotiations, or projects that have a change in scope and/or design concept.

CONTACT

Please use the email link below to address any questions or comments in reference to this Design Bulletin:

PW-Standards_Inquiry

Recommended / Date:	Approved / Effective Date:
Leland Dicus — Digitally signed by Leland Dicus Date: 2023.11.03 11:05:07 -04'00'	Michael J. Williams — Digitally signed by Michael J. Williams Date: 2023.11.17 09:57:52 -05'00'
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MULTIMODAL SAFETY ANALYSIS

Hillsborough County has developed a Multimodal Safety Analysis methodology with the goal of reducing fatalities and serious injuries on County roads and at intersections for all transportation projects. The methodology provides a comprehensive and consistent multimodal safety approach that uses the most current safety practices.

In 2021, the US Department of Transportation (US DOT) developed the National Roadway Safety Strategy (NRSS) to address the growing issue of serious and fatal injury crashes on our roadways. As part of the NRSS, US DOT has committed to the Safe System Approach (SSA) which understands that humans make mistakes and humans can only withstand a certain level of kinetic energy before serious and fatal injuries occur. Hillsborough County is committed to the SSA and has introduced the pillars of Safe Roads, Safe Speeds, and Safe People, into the multimodal safety methodology. The remaining two pillars, Safe Vehicles and Post-Crash Care, are outside of the scope of the Multimodal Safety Analysis.

The Multimodal Safety Analysis methodology is based on the most recent (as September 2023) versions of:

- AASHTO Highway Safety Manual (HSM 1st Edition, 2013 with Errata),
- FHWA Signalized Intersections Informational Guide (2nd Edition, 2013),
- FDOT Design Manual (FDM 2023),
- FDOT Safety Analysis Guidebook for PD&E Studies (FSAG, 2019),
- FDOT Traffic Engineering Manual (2023), and
- FDOT Manual on Uniform Traffic Studies (MUTS, 2022).

The safety methodology will be based on the most recent versions of the aforementioned publications, should any updated versions of the above referenced manuals or guides be published.

The Multimodal Safety Analysis methodology provides for:

- Understanding of each crash by the examination of events before, during, and after the crash.
- Understanding of the road users and potential safety issues through the application of Context Based Classification, multimodal needs, and future community needs.
- Data-driven approach that provides quantitative differences in safety performance between alternatives.

A Multimodal Safety Analysis is required for all transportation projects, except for drainage retrofit and drainage enhancement projects, and must be signed and sealed by a Professional Engineer registered in the State of Florida.

PREVIOUS SAFETY ANALYSES

A Safety Analysis is typically required for all project development tasks including PD&E Reports and PERs. The most recent Safety Analysis should be reviewed to determine if an updated Safety Analysis is required based on changes of land use, adverse user behavior, increased crash rate, or increased fatal/serious injury rate. Recommendations to use the previous Safety Analysis must show that no significant changes have occurred with land use, behavior, crash rates or fatal/serious injury rates. The Safety Analysis procedure in Section 1.2.2.2 must be performed if significant changes have occurred. The Engineer of Record must submit a memorandum for review indicating why the previous Safety Analysis should be accepted or why a new Safety Analysis should be performed. Final approval to proceed must be obtained from the County's Technical Service Division.

MULTIMODAL SAFETY ANALYSIS OUTLINE

The Multimodal Safety Analysis procedure is outlined into four sections. The Multimodal Safety Analysis report should follow the outline as described below:

- Crash Data Collection and Review
    - i. Crash Data Collection
    - ii. Crash Data Summary
    - iii. Collision Diagram
- Multimodal Safety Diagnosis
    - i. Review of Supporting Documents
    - ii. Assessment of Field Conditions
    - iii. Crash Contributing Factors (Haddon Matrix) and Potential Safety Concerns
- Selection of Countermeasures
    - i. Develop Countermeasures
    - ii. Safety Effect Evaluation
    - iii. Benefit-Cost Analysis
- Recommendations
    - i. Recommended Countermeasures/Solutions
    - ii. Consideration of Innovative Solutions Beyond Countermeasure Selection
    - iii. Countermeasure Implementation Plan

CRASH DATA COLLECTION AND REVIEW

Crash Data Collection:

Crash data is the basis for the Multimodal Safety Analysis. Crash data should be collected following the requirements below:

1) <u>Analysis Area</u>:
The study limits of a Multimodal Safety Analysis should be the project limits and the adjacent areas of influence that may extend beyond the project limits. The adjacent area of influence should consider all users (for example: vehicles, bicyclists, pedestrians) and their exposure to the project. The influence area proposed by the Engineer of Record should be coordinated with the County PM to obtain documented approval from the County's Technical Services Division, Traffic Engineering Section.

2) <u>Analysis Period</u>:
Multimodal Safety Analysis will be performed by analyzing the most current five years of complete historical crash data.

3) <u>Crash Data Source</u>:
For facilities owned or maintained by the County, crash data should be obtained from CDMS. If other crash data sources are used, including University of Florida's Signal Four Analytics or FDOT's Safety Office CDMS Crash Analysis Record, the crash data must be coordinated with the County PM to obtain documented approval from the County's Technical Services Division, Traffic Engineering Section.

Documentation:

The results of Crash Data Collection and Review must include:

- A Crash Data Summary Table for Roadway Segments and a Crash Data Summary Table for Intersections. The Crash Data Summary Tables for Roadway Segments and Intersections can be found in Excel format at the following link: *Hillsborough County Public Work Crash Data Summary Table*.

- A collision diagram to provide a visual representation of crash patterns and help identify crash clusters by crash location. The collision diagram should follow the requirements in the current version of FDOT's MUTS. A historical aerial reflecting the conditions during the crash data analysis period is recommended to be used as the collision diagram background for correlating roadway conditions with crashes.

- A summary of identified crash patterns from the crash data summary table and the collision diagram.

MULTIMODAL SAFETY DIAGNOSIS

A Multimodal Safety Diagnosis must be performed to identify contributing factors and potential safety concerns. The diagnosis will involve reviewing supporting documentation and assessing field conditions, which provides an additional perspective to the Crash Data Collection and Review.

Supporting Documentation:

Reviewing supporting documentation can provide additional information that can explain the observed crash patterns from the Crash Data Collection and Review. Supporting documentation can also assist in identifying road user needs and safety concerns for newly planned developments near the project location. Supporting documentation includes, but is not limited to, Hillsborough County Context Based Classification, community plan needs as identified in the Comprehensive Plan's Livable Communities Element, recent transportation studies within the project limits, and current traffic data for all vehicular, pedestrian, bicycle and micromobility travel modes.

Assessment of Field Observation:

Field observations can serve to validate the safety concerns in the Crash Data Collection and Review and the supporting document assessment. Field observation should also identify potential safety concerns associated with driver behavior, roadway design, and field conditions (e.g. speeding at curves, near-miss crashes if any). The required field review should address how users of different modes travel through the project limits, particularly those more vulnerable in crashes. Vulnerable users within the project context should include the elderly, children, disabled populations, pedestrians, bicyclists, and motorcyclists. The criteria and conditions experienced within the decision sight distance limits must be identified. Field observations must be conducted for both daytime and nighttime conditions. An assessment of field conditions includes considerations of, but not limited to, traffic operations, geometric conditions, physical conditions, weather, traveler behavior, transit, pedestrian, bicycle and other vulnerable road user activity, and heavy vehicle activity. A form for the field assessment is provided on *Safety Analysis Field Assessment Form*.

Crash Contributing Factors (Haddon Matrix) and Potential Safety Concerns:

Crash contributing factors are distributed into three categories: human, vehicle, and roadway/environment, and they should be examined in three crash phases, including:

1) Before the Crash: Phase includes vehicle movements and dynamics between movements and roadway conditions and geometry, as well as the critical event immediately prior to a crash. (For example: motorist behavior, pavement condition, sight obstructions, weather and lighting conditions).

2) During the Crash: Phase includes the crash description about critical event (for example, vehicle direction, location), crash type, and road and weather physical conditions when each crash occurred (for example: crash time, pavement condition, sight obstructions, roadway geometry - horizontal and vertical, weather, and lighting condition).

3) After the Crash: Phase includes the results of a crash (for example: vehicle positions, crash severity, injuries, and fatalities).

The three-phase analysis of crash contributing factors, or commonly referred to as the Haddon Matrix, can be conducted for each crash by reviewing crash data, field assessment, and project historical aerials when the crash occurred (for example: Google Earth Historical Imagery or FDOT Aerial Photo Look Up System). The detailed evaluation factors for developing Haddon Matrix are included in Table 1 below. Due to data availability issue, vehicle factors for the phase of after the crash, such as integrity of fuel system, ease of access and fire risk, and roadway/environmental factors, such as distance from trauma center, incident management, roadway congestion, are not applicable for transportation improvement projects.

Table 1: Example Haddon Matrix for Identifying Contributing Factors

PHASES	HUMAN FACTORS	VEHICLE FACTORS	ROADWAY/ENVIRONMENTAL FACTORS
BEFORE THE CRASH	• Driver vision • Driver and non-motorist Impairment • Driver attention • Driver age	• Speed of vehicle	• Road design and markings • Intersection configuration • Roadway lighting • Speed limit
DURING THE CRASH			
AFTER THE CRASH	• Severity of injuries • Age of occupant	Not Applicable	Not Applicable

The key contributing factors should be identified in each crash and summarized for each crash pattern and safety concern. Examples of contributing factors are provided in the Section of 6.2.2 of HSM (1st Edition, 2010) and discussed in detail in NCHRP Report 500. If the three-phase crash data review (Haddon Matrix) is not conducted for all crashes, a justification should be submitted to the County PM to obtain documented approval from the County's Technical Services Division, Traffic Engineer Section.

Documentation:

The results of the Multimodal Safety Diagnosis should include:

- Summary of supporting documents and potential safety concerns.
- Summary of field observations and potential safety concerns. (*Safety Analysis Field Assessment Form*.)
- A condition diagram is required when an aerial cannot convey or capture the current safety concerns identified in the field review.
- Haddon Matrix development and key contributing factors for each crash.
- Crash contributing factors summary for identified crash patterns and for any safety concerns identified above.

SELECTION OF COUNTERMEASURES

Countermeasure selection must be conducted after completing the Data Collection and Review and Multimodal Safety Diagnosis.

Develop Countermeasures:

Countermeasures must be developed after identifying the contributing factors based on the crash data analysis results derived from the Data Collection and Review, and identification of existing and potential safety concerns from the Multimodal Safety Diagnosis. When evaluating the SSA elements of Safe Roads, Safe Speeds and Safe People, more than one countermeasure may be applied to address each of the identified contributing factors and safety concerns. Innovative countermeasures based on analyses of human behavior are encouraged but must be documented before application. Countermeasure resources include but are not limit to: AASHTO HSM, FHWA Proven Safety Countermeasures initiative, FHWA CMF Clearinghouse, FHWA technical publications and NCHRP reports for safety-related treatments.

Evaluate Crash Reduction Effectiveness:

The crash reduction effectiveness of all potential countermeasures should be evaluated quantitatively by calculating the potential changes of crash frequencies before selecting the final countermeasures to be incorporated into a project. Some countermeasures proposed may not have available or sufficient data to evaluate crash reduction effectiveness; thus, these recommended improvements must be coordinated with the County PM to obtain documented approval from the County's Technical Services Division, Traffic Engineering Section. The potential changes of crash frequencies can be calculated using either of the two methods discussed below:

1) Crash Modification Factors Method:

   CMFs can be obtained from the FHWA *CMF Clearinghouse* (star quality rating should be at least 3 stars). Details for selecting an appropriate CMF, applying multiple CMFs, and comparison of CMFs can be found in Section of 5 in the FSAG (FDOT, 2019).

2) HSM Predictive Method:

This method can be used to evaluate current and future safety performance of road projects. Details for applying the predictive method in Florida and available calculation tools can be found in Section of 6 in the FSAG (FDOT, 2019).

The appropriate method depends on many issues, including the type of project proposed, safety issues and availability of Safety Performance Functions (SPFs), calibration factors, and data. The suggested recommendation for selecting the appropriate method for different transportation projects is provided in Table 2. If the selected methodology differs from the table, coordinate with the County PM to obtain documented approval from the County's Technical Services Division, Traffic Engineering Section.

Table 2: Methodology Selection

PROJECT TYPE	CMF METHOD	HSM PREDICTIVE METHOD
New Construction		✓
Corridor Reconstruction		✓
Resurfacing, Restoration, and Rehabilitation (RRR)	✓	
Intersections[1]	✓	✓
Bridge Widening and Replacements	✓	
Complete Streets	✓	✓
Pedestrian/Bicycle Corridors	✓	✓
School Routes Safety Improvements	✓	
Trails and Shared Use Paths Crossings	✓	
Safety and Mobility Projects [2]	✓	✓

[1] For Intersections, the HSM Predictive Method will be required where there are major differences, including changes in: traffic control, number of thru lanes, number of turn lanes (dual or triple), right-of-way needs and future land use.

[2] Midblock Crossings, Access Management Improvements, Safety Lighting, Safe Route to Transit, Corridor Speed Management.

Benefit-Cost Analysis:

A Benefit-Cost Analysis must be performed to rank the selected countermeasure or combination of countermeasures by monetizing safety benefits associated with the projected reduction in crash frequencies. Ranking the societal costs is a summary of the construction, operation, maintenance, and other costs anticipated over the life of the project. Detailed BCA parameters, methods, and crash cost data are included in FDM, Chapter 122. Either Net Present Value or Benefit-Cost Ratio can be the measurement to compare benefits to costs and prioritize the countermeasures. Some consideration factors cannot be monetized, including community vision and environment, public demand, public perception and acceptance, road user needs, and other non-measurable community concerns. To determine the recommended countermeasure or combination of countermeasures, a benefit-cost analysis in monetary terms may serve as the primary decision-making tool, with secondary consideration of qualitative (non-monetized) factors.

Documentation:

The results of the countermeasure selection should include:

- List of countermeasures selected for the identified contributing factors and potential safety concerns.
- Evaluation method and results of crash reduction effectiveness for each countermeasure or combination of countermeasures.
- BCA results and qualitative factor considerations.

RECOMMENDATIONS

Recommendations of a countermeasure or a combination of countermeasures with supporting explanation of how it will improve safety must be provided based on the BCA and qualitative evaluation results. Innovative solutions beyond countermeasure selection are encouraged, but the effectiveness of reducing fatal/severe injury crashes and implementation concerns should be documented. The implementation plan for recommended countermeasures should be discussed and documented.