PBCAT Pedestrian and Bicycle Crash Analysis Tool Version 3.0 User Guide

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FOREWORD

Pedestrian and bicycle safety continue to be a focus area under the Federal Highway Administration's Focused Approach to Safety. Based upon the FARS and FHWA Roadway Departure Definition/Attributes, pedestrian and bicycle crashes consistently comprise around 20 percent of U.S. traffic fatalities. The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) is a long-standing resource developed by FHWA that allows users to take information from crash reports, categorize their non-motorist crashes, and create a data set for analysis. PBCAT version 3 is now a web-based application with updated logic, crash typologies, and user interface.

PBCAT is designed to help State and local transportation safety practitioners and researchers develop new variables to describe collisions between motorists and non-motorists on trafficway or non-trafficway locations. PBCAT users can apply PBCAT crash types and contextual factors to help identify preventable crash scenarios and make informed selections of a variety of strategies and solutions to improve non-motorist safety. The data can be used to help improve the infrastructure, vehicle and interactive technologies, behaviors, and policies to reduce non-motorist crashes and injuries.

This document serves as a user guide to the assist state and local safety professionals applying PBCAT version 3 to their crash reports. This document also presents the modernized crash-typing framework, which is significantly different from former versions of PBCAT. Additionally, this document presents expanded typologies that enable typing crashes involving new and different types of non-motorists, such as persons on motorized personal conveyances or persons on non-motorized personal conveyances, as well as crashes involving cyclists and pedestrians.

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16. Abstract
Pedestrians, bicyclists, and other non-motorist road users account for a disproportionate and growing share of U.S. traffic fatalities and injuries in recent decades. Crash types are a way to describe immediate precrash events or conflict types associated with crashes involving different road users. This information can help safety professionals determine the myriad ways crashes might be prevented through a system of effective road safety measures; improvements to policies, community, and roadway design guidance; and other strategies such as enhanced crash-prevention technologies. Yet, crash data are often not as complete or descriptive of precrash events and circumstances for crashes involving nonmotorists compared with crash data for motor vehicle-only crashes.
The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) version 3.0 (PBCAT 3) is a web-based application developed to help agencies generate unique crash types from a nonmotorized road user safety perspective. PBCAT 3 helps agencies generate objective descriptors of nonmotorist crash types, location context, and other crash circumstances, which in turn can be used to inform crash and injury prevention strategies. The PBCAT 3 crash-typing framework is significantly different from former versions of PBCAT and is detailed in this User Guide. In addition, PBCAT 3 expanded to enable typing crashes involving new and different types of non-motorists in addition to crashes involving cyclists and pedestrians—all in one streamlined, accessible crash typing system. This User Guide is a companion resource to assist those using PBCAT 3.

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Unclassified	Unclassified	133	

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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LIST OF ABBREVIATIONS

B	backing
B	bicyclist crash types
CO	Colorado
CR	crossing path from motorist's right
CSV	comma separated values
CL	crossing path from motorist's left
CU	crossing path, unknown direction
E	entering traffic lane
EB	Eastbound
FC	non-motorist fall or crash
FHWA	Federal Highway Administration
HSIS	Highway Safety Information System
IIHS	Insurance Institute for Highway Safety
JPEGs	Joint Photographic Experts Group
KY	Kentucky
L	turning left
MMUCC	Model Minimum Uniform Crash Criteria
MU	moving in unknown path/direction
N	non-collision
NA and n/a	not applicable
N	neither
NC	North Carolina
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration

NB	Northbound
NW	North West
O	other maneuver
OU	other/unusual
P	pedestrian crash types
P	parked
PB	both pedestrian and bicyclist crash types
PBCAT	Pedestrian and Bicycle Crash Analysis Tool
PO	parallel path opposite direction
PS	parallel path same direction
PU	parallel path unknown direction
PVA	public vehicular area
R	turning right
S	going straight
STEP	Safe Transportation for Every Pedestrian
SB	Southbound
ST	stationary
U	unknown maneuver
UN	unknown
USDOT	U.S. Department of Transportation
VA	Virginia
WB	Westbound

Introduction to PBCAT 3

Pedestrians, bicyclists, and other non-motorist road users account for a growing share of all U.S. traffic fatalities. The increase in fatalities for non-motorist road users is a trend that spans two decades. Annually, an even larger number of non-motorists are seriously injured in collisions involving motor vehicles. Halting the growing number of non-motorists killed or injured by motor vehicles requires a national, collaborative, and comprehensive approach to road user safety for non-motorists. The first step toward that approach is gathering high-quality, objective data on non-motorized road user safety risks. Crash data serve as a primary data source for analyzing and understanding road user crash risks. However, the crash data involving non-motorists are incomplete and less descriptive than the crash data involving only motorists. The Federal Highway Administration (FHWA) developed the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) to help road safety professionals improve crash data about non-motorist crashes (FHWA, n.d.). The enhanced data from PBCAT can be used to better characterize safety problems and help prevent these crashes.

NEED FOR CRASH TYPING

Crash types are a way to characterize immediate precrash events or conflict types for crashes involving different road users. This information can help safety professionals determine the myriad ways to prevent crashes. The methods at their disposal include: utilizing a system of effective road safety measures, making improvements to policies, offering community and roadway design guidance, or other strategies like investing in enhanced crash-prevention technologies. When bicyclists, pedestrians, and other nonmotorized road users are involved in collisions with motorists, crash types are frequently missing from the existing crash databases or not well-defined. In addition, the variables being captured for crashes involving nonmotorized road users are more reflective of conditions relevant to motor vehicle-only collisions. Crash typing serves as a tool to assist State and local practitioners, researchers, and other stakeholders in developing new data elements to improve the usefulness of crash data for crash and injury prevention.

BENEFITS OF CRASH TYPING WITH PBCAT 3

The PBCAT version 3 (PBCAT 3) is a web-based application that agencies can use to help generate unique crash types through a nonmotorized road user safety perspective. PBCAT 3 helps agencies generate objective descriptors of non-motorist crash types. In turn, the descriptors can be used for improving non-motorist safety and access by informing prevention strategies and solutions. PBCAT 3 turns crash report information into variables on the precrash maneuvers of the motorist and non-motorist involved in a crash. The PBCAT 3 application also helps users generate other variables about crash events and the location context of the crash through a non-motorist safety lens. The variables developed using PBCAT 3 can complement existing crash data to help inform varied and holistic approaches to non-motorist safety.

With the expanding use of diverse types of personal conveyances for travel and recreation, there is also an expanding need to capture crash events for safety analysis for crashes involving more types of non-motor vehicle road users. PBCAT 3 expanded to enable typing crashes involving new and different types of non-motorists in addition to other crashes involving cyclists and pedestrians. PBCAT 3 can be used to type crashes involving persons using power-enhanced pedalcycles and varied types of personal conveyances—with and without supplemental power, along with those involving more traditional pedestrians and pedalcyclists. PBCAT 3 also offers the ability to capture a single crash type for non-motorist falls or crashes that do not involve a motor vehicle.

PBCAT 3 can be used for typing crashes that occur on trafficways (roads plus associated facilities and rights-of-way) and crashes that occur off the trafficways network (e.g., in parking lots and driveways). While trafficways are usually under the purview of State and local transportation agencies, local and regional planning organizations may be able to influence site designs to help reduce off-trafficway crashes as well. Furthermore, as vehicle technologies are developed to keep crashes from occurring, they will need to operate in all kinds of environments.

PBCAT 3 is a unique crash typing system developed with extensive stakeholder input on the needs and uses for the data. PBCAT 3 enables users to enhance and complement existing non-motorist crash data with variables that will improve the utility of the data for use in analyzing non-motorist safety performance and safety needs. A diverse range of potential PBCAT 3 users, including planners, engineers, road designers, traffic operations experts, vehicle designers, safety researchers, and policymakers, may find that PBCAT 3-derived data improves their safety efforts. Historically, a well-defined crash type variable has been missing in crash databases for crashes involving non-motorists. PBCAT 3 can help develop variables that will provide valuable information about crash events. That information can then be used for analysis and the development of safety prevention strategies of many types.

Background and Development of PBCAT 3

PBCAT versions 1 and 2 (PBCAT 2, released in 2006) served for many years as a national resource for pedestrian and bicyclist crash typing and data enhancement (FHWA, n.d.). However, previous versions of the software were no longer compatible with a large proportion of current computer operating systems. The PBCAT software had been designed for desktop computers. An update was necessary. In addition to the issue of functionality, there were other reasons to consider an overhaul of the crash-typing logic.

With prior versions of PBCAT, crash types were derived from the *results* of detailed analyses of samples of pedestrian and bicyclist crash data collected in the 1970s (Cross and Fisher 1977; Snyder and Knoblauch 1971). Data collection included detailed on-scene investigations. The crash types described intricate crash relationships identified in those samples. While the studies provided important and useful knowledge to help identify treatment targets of common crash scenarios, the multivariable categorization systems that emerged—with no single definition of a crash type—resulted in a complex and hierarchical coding system. The coding system could lead to overlap among crash types and require subjective judgment (Harkey and Blomberg 2001). Determining a crash type in PBCAT 2 could require coders to make up to 11 choices to get to the ‘correct’ crash type; an error in any one step could lead to an incorrect type (Jodan 2019).

Different laws in different jurisdictions could also affect validity. These situations led to issues for achieving objective and consistent crash typing results. In addition, PBCAT 2 users were presented with a large number of distinct crash types—56 for pedestrian crashes and 79 for bicyclist crashes for a total of 135 types (Harkey et al. 2006). This situation could make it difficult to identify priority types for safety focus and countermeasures applications.

PBCAT 3 was developed with assistance from stakeholder groups who provided input on potential improvements. The PBCAT 3 development team also reviewed prior crash typing studies to identify various ways pedestrian and bicyclist crash types have been previously defined. An advisory group of selected personnel from State DOTs and municipalities—with expertise in crash typing, data analysis, and safety treatment implementation—convened in December 2019. The advisory group helped prioritize the crash typing framework and most desirable improvements for PBCAT 3. A second group of stakeholders tested and reviewed a beta version of the application.

Pedestrian and bicyclist crash typing studies—released since the late 1990s—and stakeholder input were helpful in defining new, more objective crash types. These studies included descriptions of intersection pedestrian crash scenarios. The scenarios were described as separate variables in PBCAT 2 (Harkey et al. 2006), the Location-Movement-Classification Method described by Schneider and Stefanich (Schneider and Stefanich 2016), and crash types described in studies by the Insurance Institute for Highway Safety (IIHS) for pedestrian-motor vehicle crashes (Jermakian and Zuby 2011) and bicyclist-motor vehicle crashes (MacAlister and Zuby 2015).

The two IIHS studies used national data from the Fatality Analysis Reporting System and the National Automotive Sampling System-General Estimates System and available variables in these datasets. The data were used to characterize prevalent crash types (and other factors such as lighting conditions) for use in identifying potential crash and fatality reductions that could result if pedestrian and cyclist detection technologies were able to 'recognize' pedestrians and cyclists in enough time to avoid a crash. All three of the research studies and the pedestrian intersection crash scenarios described in PBCAT version 2 shared a common reliance on motorist maneuvers and relative paths and approach directions of the bicyclist or pedestrian.

Motorist maneuvers (e.g., going straight, turning right, and turning left) are typically coded in crash reports or are at least diagramed and described in crash narratives. Another primary element of these crash types included whether the non-motorist was on a parallel or crossing path to the motorist before the collision. Schneider and Stefanich also included location/position characteristics and the approach direction (same or opposite for parallel paths, and from the right, or from the left for crossing paths) in their crash type definitions. In all of the research studies cited in the previous part of this section, other variables such as injury severity, traffic control, lighting conditions, speed, weather, view obstructions, etc., were derived from the crash databases or reports used in the studies, and therefore could be analyzed in association with, and independently as contributors to the different crash types (Harkey et al. 2006; Schneider and Stefanich 2016; Jermakin and Zuby 2011; McAllister and Zuby 2015).

The determination of crash type definitions for PBCAT 3 built on these prior studies and stakeholder preferences for reduced subjectivity and confounding among crash types (compared

to earlier PBCAT versions); crash types consistent with current data collection practices to the extent feasible; and fewer different distinct crash types (to make it easier to identify prevalent crash types for treatment opportunities). However, stakeholders were also interested in the ability to use the data to help identify various types of safety issues for subsequent diverse safety treatment targeting. This desire ultimately led to retaining more distinct types that may relate to countermeasures development. Finally, stakeholders also preferred a streamlined coding process, but one that also incorporates the ability to type crashes involving more types of road users in addition to pedestrians and bicyclists. Fisher notes that since 2010, 207 million trips have been taken on shared bikes (pedal and electric-powered) and e-scooters in the United States (Fisher 2020). There is a need to develop data to be able to track and measure the safety of these newer types of road users. According to this same report by the Governors Highway Safety Association, use of e-scooters, e-bikes, power-assisted cycles, and shared rides is expanding. Power-assisted bike sales to individuals are also soaring and use of these modes is expected to continue growing (Fisher 2020).

Main Features of PBCAT 3

The information generated by PBCAT is intended to make a unique contribution in improving crash data for crashes involving non-motorists. PBCAT 3 is specific to its purpose and streamlined to generate new variables that may be otherwise unavailable or of limited accuracy in other sources. Because PBCAT 3 is intended for developing new objective descriptors of crashes to complement existing crash data, there are no places to enter variables. The variables include non-motorist or motorist age, weather, lighting conditions, injury severity, and other factors that are typically available from State crash databases. In addition, the user is not required to design a database or upload any data.

PBCAT 3 is a browser-based, easy-to-use application for developing new variables useful for non-motorized safety analysis. Users of prior versions of PBCAT will notice major differences in platform, crash typing logic, and dataset in this version. PBCAT 3 has significant improvements in the functionality and features of the application that make it easier to use for generating data. Some of the features include:

- Online Open-Access Format: PBCAT 3 operates as an online, browser-based tool. The tool is available to anyone coding crash reports or specific variables related to a crash.

- Improved Adaptability: PBCAT 3 can complement States' crash data systems, and PBCAT 3 variable outputs can be linked with other datasets using the jurisdiction's unique crash identifier.

- Updated Road User Options: PBCAT 3 allows users to choose from a wide array of non-motorist road users, including pedestrians, bicyclists, and non-motorists using varied types of personal conveyances, with or without supplemental power.

- Simplified Crash Types: In PBCAT 3, crash type is solely derived from a combination of Motorist and Non-motorist Maneuvers. The crash type that results is distinct from other variables or location context of the crash, improving the objectivity of crash types. Additionally, the logic framework results in only one crash type possibility per crash.

- Streamlined Logic: Users have a set number of questions and category options, with the ability to skip certain questions. The same system is applied to all non-motorist modes, which enhances the ability of analysts to identify the common and distinct crash risk patterns across the nonmotorized modes.

- New Illustrations: Graphic illustrations help users confirm location context variables and depict the resulting crash types based on selected motorist and non-motorist maneuvers. The illustrations are available for users to download on the Images page.

- User-friendly data output: Data are output in user-friendly comma-separated values (CSV) format, which enables convenient importing into various data analysis and management platforms, linking of multiple files, and compiling with data from other sources.

A major difference in PBCAT 3, compared to the earlier versions of PBCAT, is that the new crash types were defined using a similar, consistent framework. The framework is akin to those used in earlier studies, and it is built upon existing crash data practices. Crash types rely solely on the movements and relative paths of the motorist and non-motorist involved in a crash. Other characteristics of the crash (including location characteristics) or special circumstances are coded as separate variables (if necessary). FHWA also created these variables with non-motorist safety issues in mind. Crash types in the updated PBCAT are a *starting point* for analysis, using data for crash type and other variables that can be objectively and consistently determined from crash reports.

One module allows crash typing for most non-motorist modes. A notable feature of the streamlined crash typing system is the ability to type crashes involving pedestrians, cyclists, and other non-motorist road users within one system.

Types of transport that are covered by PBCAT 3 include:

- Bicyclists, other pedalcyclists, and power-assisted pedalcycles (typically assistance is capped at speeds of 30 mph (SAE International, 2019).

- Pedestrians, wheelchair/mobility chair users, and persons moving under their own power using devices that are not pedalcycles (skates, kick-scooters, etc.).

- Persons using personal conveyance devices that are powered but are designed for low-speed use (also typically capped at 28–30 mph) on trafficways and paved surfaces (SAE 2019).

Types of road users involved in crashes with motorists that are *not* readily covered by PBCAT 3 crash typing include:

- Conveyances involving animals or riders of animals.

- People in railway cars, trams, or trolleys.

- Mopeds and motorized scooters or motorcycles.

Detailed definitions of the types (or Modes, as referred to in PBCAT 3) of non-motorist users covered are provided in the chapter on the PBCAT 3 Crash Typing System and Variables. Because personal transportation is evolving rapidly, there is a need for better information about the characteristics, operations, and safety of these new types of transport. While categorizing these types of road users is challenging, the definitions and inclusion of these modes of travel in PBCAT 3 will hopefully contribute new data and insights to the crash data collection discussion about these road user types.

Users can easily merge data with other crash variables. Because PBCAT 3 is designed to provide new variables to link to existing data, once crash type and other data elements are coded, users can compile the downloaded PBCAT data with other related crash data. Some variables are commonly available in crash databases already, including injury severity, demographic characteristics of those involved, environment, contributing factors, and some roadway characteristics. If spatial coordinates are linked to the source crash data, then users also have the option of linking many other data types as well. The CSV data format provides flexibility for importing and linking the data to other data types.

With the database compiled, analysts can identify prevalent crash types and associated factors that can be targeted with engineering countermeasures, changes in policies or design guidance, and other safety measures. More uses of PBCAT 3 data are discussed in the next section. Readers can reference the Getting Started Chapter section on Linking PBCAT Data with Other Data for more information.

Audience and Uses for PBCAT 3 Data

Crash Type and the other PBCAT 3-coded variables can be used to enhance crash data to help detect emerging safety issues or changing trends with respect to new types of road users, identify crash conflict patterns to target with potential roadway improvements, define crash scenarios and circumstances that may be useful for crash avoidance technologies research, and for other safety purposes. Given the range of data elements generated through PBCAT 3, the application is intended for a diverse audience of State, local, and national transportation safety practitioners and researchers that work to support many types of safety stakeholders in advancing safety for nonmotorized road users. Some potential applications of PBCAT 3 data are described next.

Identify common and distinct crash types and related factors across nonmotorized modes. PBCAT 3 applies the same system for typing crashes for all types of non-motorist road users. This single-system approach allows analysts to identify shared or dissimilar conflict patterns across different types of road users. PBCAT 3's ability to identify conflict patterns among road users could help prioritize safety improvements.

A study by Shah et al. used a pilot version of the PBCAT 3 crash typing logic to type and compare crashes involving powered scooter users and bicyclists (Shah et al., 2021). The researchers found both similarities and differences in the patterns observed in a relatively small crash sample. At the same time, the system provides flexibility to code additional factors that may be more prevalent among crashes involving some non-motorist types (e.g., bicyclists, joggers, or powered scooters) than others (e.g., people walking).

Hotspot, systemic, and policy approaches to improve road safety. State and local road and transit safety planners, engineers, and their partners in land use planning can use PBCAT 3 data to better understand crash patterns, including the risks and relationships of these patterns or crash types with other factors. The data can help users identify and diagnose safety problems in crash hotspots and risk-based, systemic treatment approaches and may help to influence policies and system-level changes that can influence common collision patterns (Thomas et al., 2018).

Vehicle and other technologies research. Given the PBCAT 3 focus on road user maneuvers and paths (with secondary variables available for location types and facility types), data related to real crash scenarios also has the potential to inform vehicle detection and crash avoidance technologies research similar to earlier studies cited in the Background section.

Comparing and validating conflict studies. Because of the relative infrequency of pedestrian, cyclist, and other non-motorist crashes overall (although fatality rates can be high), it can be difficult to perform pedestrian and bicycle safety studies or evaluate the safety effects of specific treatments based on crash data alone. For these reasons, studies are increasingly using video-collected data to analyze near-crash conflicts to better understand safety risks and the potential safety effects of treatments. The new PBCAT 3 crash types may better correspond with types of conflicts identified in such studies and may therefore improve the ability of researchers to compare the results of conflict studies to actual crash data.

Holistic and Safe Systems approaches. Non-motorist crashes are the result of diverse types of road users and vehicles interacting within a complex transportation and land use system. In a 'Safe Systems' approach, efforts are applied at many leverage points in the transportation system. These leverage points include providing safer road networks for all types of road users (appropriate to location contexts) and working toward safer vehicles, safer speeds, safer road users, and better postcrash care to prevent crashes and minimize serious injuries (FHWA, n.d.). PBCAT 3 crash types capture only the most proximal events and conflict types that led to the crash. However, identification of these patterns may be useful for agencies to identify and alter upstream policies and design practices across these interacting systems to better prevent crashes (Bailey and Woolley, 2017).

Data improvement. Besides directly enhancing the crash data available for analysis through generation of new objective data elements, the results of crash typing studies using PBCAT 3 can help to inform those involved in defining and developing procedures and forms for collecting crash data. This User Guide provides detailed descriptions of each variable and maps those that relate to current national practice-suggested crash data elements. One element in particular is the *Model Minimum Uniform Crash Criteria* (NHTSA, 2017). In the future, improvements to non-motorist crash data collection may lessen the need for add-on non-motorist crash typing.

CONSIDERATIONS FOR USING PBCAT

Although there are clear benefits to typing crashes with PBCAT 3, there are also considerations to be aware of when crash typing, using the application, and analyzing the resulting data. PBCAT 3 developers considered the diverse roles (and constraints) of those involved in the process of generating and using crash data, from the complexity of accurately gathering data at a

crash scene to the varied needs of end-users of the data for accurate, objective, and timely data for different types of safety studies and crash prevention efforts:

- Users are not required to re-enter data that is captured in other datasets. Instead, the intent is that PBCAT data should be linked to other crash variables (if these crash variables are needed for safety analysis purposes). Such procedures are discussed further in the Getting Started chapter.

- PBCAT 3 crash typing logic offers the ability to easily code specific elements related to non-motorist crashes and provides flexibility on many of the elements that may be coded.

- Data elements are clearly named, and text descriptors are used for variable values in the CSV data output; these elements and values are therefore more easily interpreted by end-users of the data.

Data elements in PBCAT 3 are not exhaustive and are dependent on the quality of the crash reports. As mentioned in the previous description of Safe System applications, there are many upstream system factors that contribute to a crash event, and many of these factors are not typically well-represented by what is reported in crash data. For example, crash data are unlikely to document important nearby attractors, distance to the nearest controlled crossing, or traffic conditions at the time of the crash. In some instances, linking other datasets such as indepth crash reviews, roadway inventory, land use, and census data with PBCAT 3 data may help to provide more insight. Collecting information and experiences directly from non-motorists and motorists may also add important insights that cannot be gleaned from existing data.
Users should therefore consider that PBCAT 3 data have the following characteristics:

- Are intended to supplement existing crash and other data (not recreate variables that already exist).

- Cannot compensate for insufficiently described crashes (including lack of detail in narratives and diagrams that otherwise often compensate for variable inadequacies), *nor* for types of data that crash reports overlook. These types of data include traffic conditions, distance to nearest controlled crossing, signal phasing, lighting adequacy, built environment and population characteristics, attractors, etc.

- Describe only the most proximal events leading up to a collision as reported in traffic crash reports.

Although important as one piece of information, crash types must be complemented with other sources of knowledge—including from users of the system—to improve safety managers' and other safety stakeholders' holistic understanding of what may be needed to reduce non-motorist crashes and injuries. The Analysis Notes chapter provides a few basic tips on analyzing PBCAT 3 data.

Next Steps for Using PBCAT 3

The first step in using PBCAT 3 is to finish reviewing this document. Although the crash typing application and website are intended to be user-friendly, reviewing this guide before using the crash typing tool is advised. The guide may provide a better understanding of how the application works, the data that will be generated (and what is not generated), and how best to use the system.

The remaining chapters of the *User Guide* will discuss:

- Getting Started: This chapter covers the basic needs and steps to begin crash typing, including user responsibilities for data entry, tool functionality, recommended protocols for use, and data management. Users, including project managers and data specialists considering using PBCAT, may want to review this chapter to learn how the system works.

- PBCAT 3 Crash Typing System and Variables: This chapter covers the crash typing system in detail, including the questions that require inputs to generate crash types and key variables. It will also be helpful for users who want to understand the information that can be developed from PBCAT coding. The information will help users determine which optional PBCAT variables may be most useful to complement pre-existing crash data.

- Variable Mapping: This chapter provides information on the relationships of PBCAT 3 variables to data elements that States may already be collecting based on national guidance (NHTSA, 2017). This chapter also highlights information on mapping PBCAT 2 to PBCAT 3 crash types for those that may want to analyze longitudinal crash type or location type trends using data developed with both systems.

- Analysis Notes: This chapter provides basic tips for analysis using PBCAT 3 variables, as well as uses of PBCAT data for crash hot spot and systemic, risk-based safety analysis.

- Four appendices (which are referenced in the remaining chapters): The appendices contain more details on available variables, data file contents, and detailed mapping for PBCAT version 2 and PBCAT 3 crash type.

GETTING STARTED

This chapter identifies needed types of information for using PBCAT 3 and covers managing the data and accessing the typing system and code crash information. The chapter also provides important information on how PBCAT 3 functions. This information is followed by sections that outline good practice protocols.

HOW TO USE PBCAT 3

To crash type using PBCAT 3, the user needs access to crash information, especially information that is typically available on crash report forms, including crash diagrams and narrative summaries. Crash diagrams and narratives are the most important elements for typing crashes. Diagrams and narratives may be available in electronic crash databases but often have to be obtained from images of crash reports. Users might also find street-level online map views of the crash location that help answer some questions. Objective coding is important, however, and users should minimize inferring information that is not clear from a crash report.

The main purpose of PBCAT 3 is to generate new or redefined safety-related variables that are not already captured in crash databases. It is not possible to enter crash variables other than those described in the bulleted list below (type of non-motorists involved in the crash, crash location context variables, and motorist and non-motorists movements prior to the crash) and more fully in the next chapter in PBCAT.

There are two ways for users to create new variables. First, users create new variables by responding to a series of questions in the crash typing application. Second, users create new variables by choosing among categorical options.

The most important information users will need to extract from crash information and enter into PBCAT 3 are the following:

- Type of non-motorist involved in the crash (which may be defined somewhat differently in PBCAT 3 than in existing crash report variables).
- Crash location context variables.
- Motorist and non-motorist movements and actions just prior to the crash.

The crash typing application uses the motorist and non-motorist movements to generate the *Crash Type* variables. Users have the option to code additional information on the types of facilities being used by the non-motorist, and other events or circumstances that may have been involved in the crash. Users can review details of the variables that may be coded using PBCAT 3 in the next chapter.

Illustrations as Crash Typing Aid

Within the PBCAT 3 application, many of the variable options and their descriptions are combined with illustrations to help users in the coding process. The illustrations are available for

select variables and for depicting the *Crash Types* based on motorist and non-motorist maneuvers. The illustrations are intended to help users confirm variable selections. The illustrations are not intended to represent the spectrum of features or events for every crash.

The supporting images are:

- High-contrast, 508-compliant images.
- Simple, diagrammatic illustrations (to avoid distracting details).

Users should primarily rely on the descriptions of each category option, secondarily using the images as an aid for finding and selecting the correct category for each crash. The images are not intended as a literal representation of the location and facility type. Nor do the images represent the only way that a type of crash can occur.

In the *Crash Type* images, symbols are used to universally represent all nonmotorized modes. A generic motor vehicle image is used to represent all motorized road users. Generic symbols allow representation of a variety of road users and changing technologies among both non-motorist modes and motor vehicles. Arrows are used to represent motorist and non-motorist movements. A universal symbol is also used to represent the area of the crash. *Crash Types* are illustrated without location context because crash types are defined solely based on maneuvers. Separate crash location and facility type illustrations are provided to support those independent variable selections.

The images used within PBCAT 3 are available for the user to download as JPEGs via the image link on the website. The images may be useful in summary reports and presentations of analysis results. Multiple illustrations are provided in the download package for a few crash types. However, only one image is used to represent each type within the crash typing application.

Design files of the supporting images are available upon request (Adobe 2022). While the images within PBCAT 3 do not individually provide a fully rendered visual—that represents a crash as it occurred at a specific location—the package of illustrations allows users and designers to overlay and adapt the images to fit their data and illustration needs for crash scenarios.

The next sections describe the crash typing flow and each of the variables in more detail.

Entering Data

This section describes the basic process of entering data through the application and how certain features work. Coding crashes in PBCAT 3 is intended to be intuitive, and much of the information in this section is provided within the application. However, some users may wish to have a preview or more details of how data entry is completed.

After clicking the “Begin Crash Typing” button on the home page of the website, and before entering information on crashes, users are required to share their contact information, including name, organization, and email. This contact information is collected for tracking use of PBCAT 3, and so developers of the application may share information regarding important

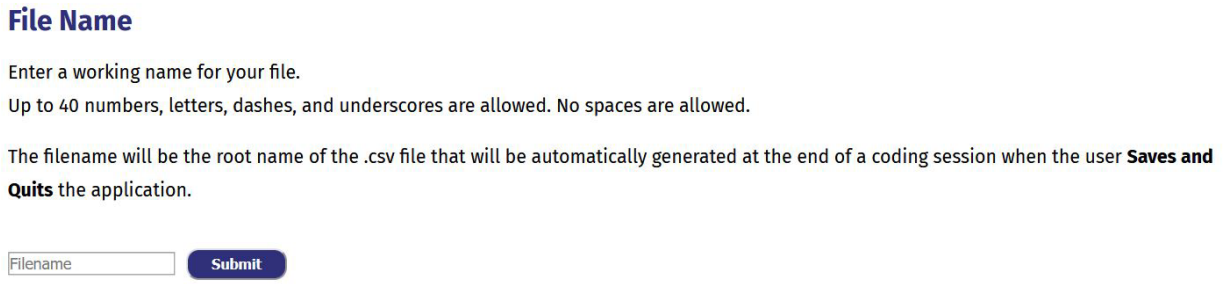
updates with users. User information will not be shared with other entities besides the funding agency for PBCAT 3 and the FHWA. All information is stored on a secure server.

Contact information is the only information that is retained through PBCAT 3. All other data being coded through the tool is passed through the application to generate variables that are downloaded directly to the user's computer as CSV files.

The next sections describe the basic procedures for coding crashes using PBCAT 3.

Enter File Name

Figure 1 shows the first screen after signing in requires the user to enter a file name. This name will be the name of the CSV file that will be automatically generated at the end of a coding session when the user quits the application. This name will also form the root name for automatic backup files (figure 1).



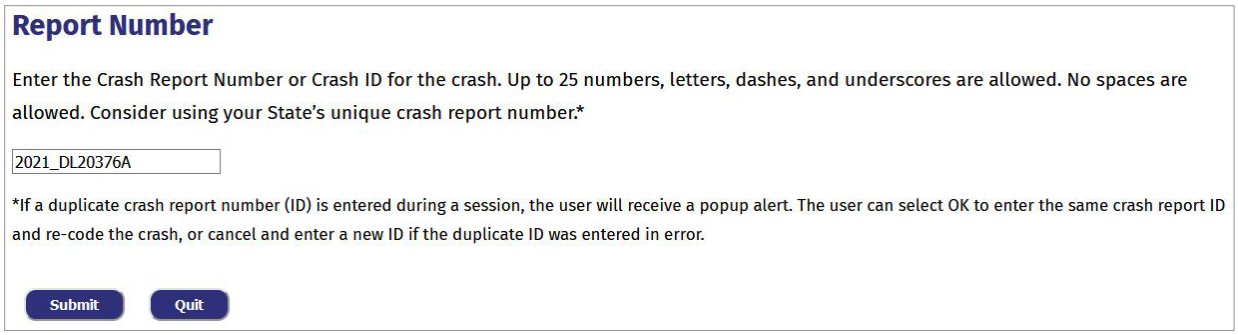
Source: FHWA.

Figure 1. Screenshot. PBCAT 3 filename screen.

Enter Crash Report Number

Once the user enters a filename, the next step is to enter a crash report identifier. The crash report identifier is often the State's unique crash report number, which, as mentioned in *Enter File Name*, may enable the user to easily link the PBCAT 3 data to other variables collected in other crash data datasets (figure 2).

PBCAT 3 allows the report number (or other unique crash identifier) to be a combination of letters, numbers, dashes, and underscores, up to 25 characters long. No spaces can be used. The example in figure 2 shows an underscore rather than a space.



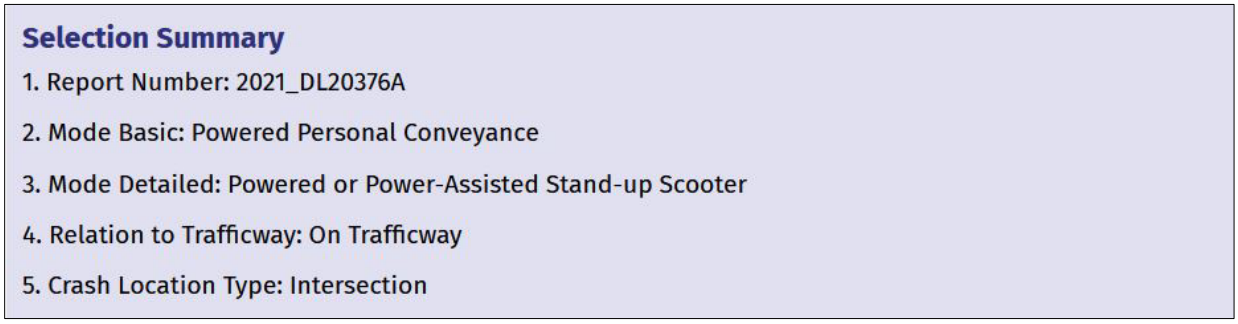
Source: FHWA.

Figure 2. Screenshot. PBCAT 3 report number screen.

Code Crash Types and other Variables

The user will then proceed through the crash typing screens and enter information for specific questions, as explained further in the next chapter. One question and categorical options for the answer are presented on each screen. The user can move "**Back**" (button at the bottom of each screen) through the logic to make changes until each specific crash record is "Saved." **Clicking any radio button next to the appropriate category moves the page forward again.**

After the crash identifier is entered, the crash typing screens begin with item 2, selecting the type of non-motorist involved in the crash for the *Mode Basic* variable. The top of each screen includes a Selection Summary window (figure 3) which provides an ongoing list of the selections made for the previous questions.



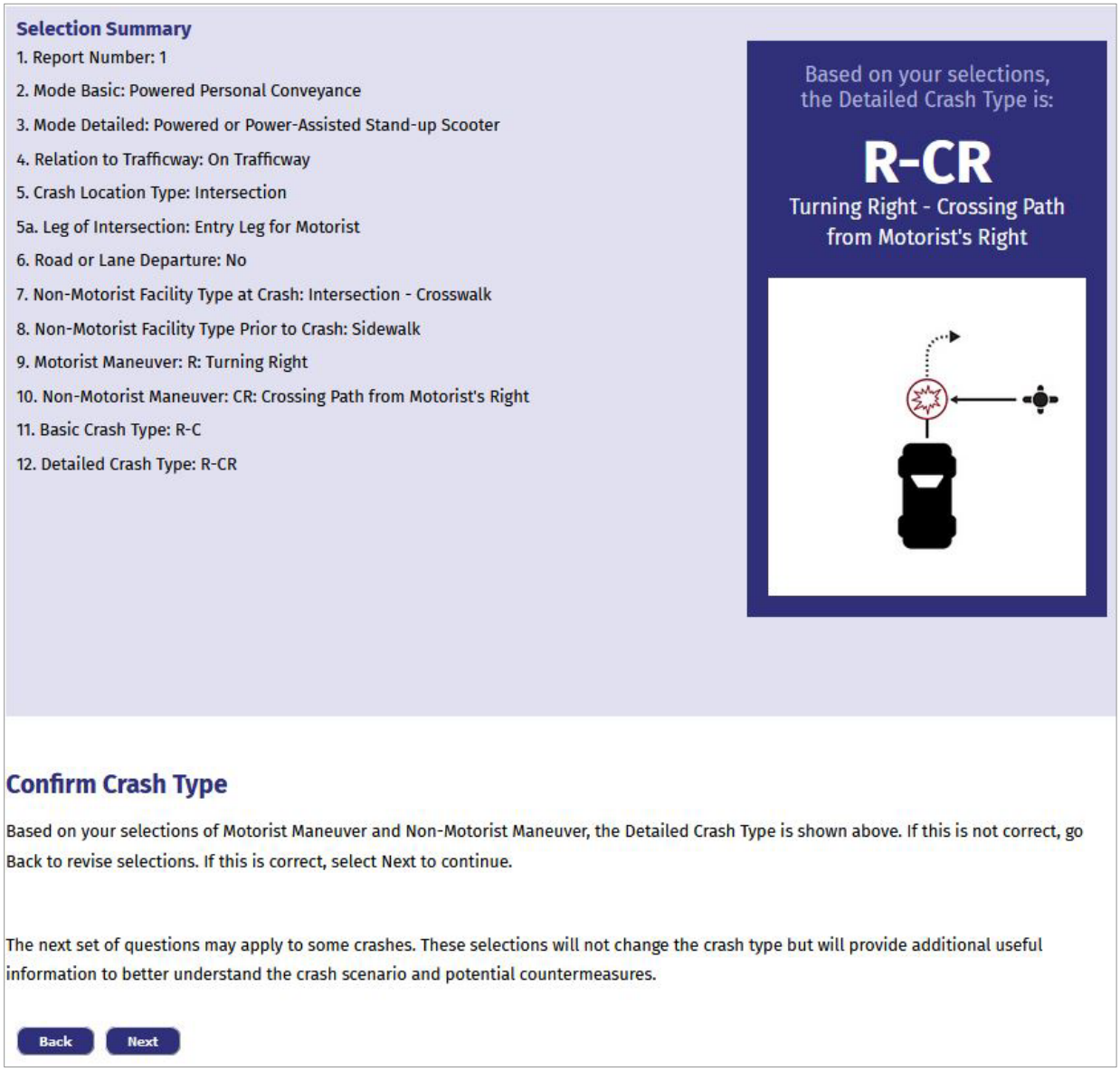
Source: FHWA.

Figure 3. Screenshot. Example (through step 5) of how PBCAT tracks prior selections made during coding in the Selection Summary window at the top of each crash typing page.

Confirm Crash Type

After each crash is typed (which means that the *Motorist* and *Non-motorist Maneuvers* are coded), users are also offered the opportunity to view the resulting crash type and associated illustration to verify the *Crash Type* is correct before proceeding with other optional variables. An example of this opportunity to review and confirm is shown in figure 4. If the user notes any

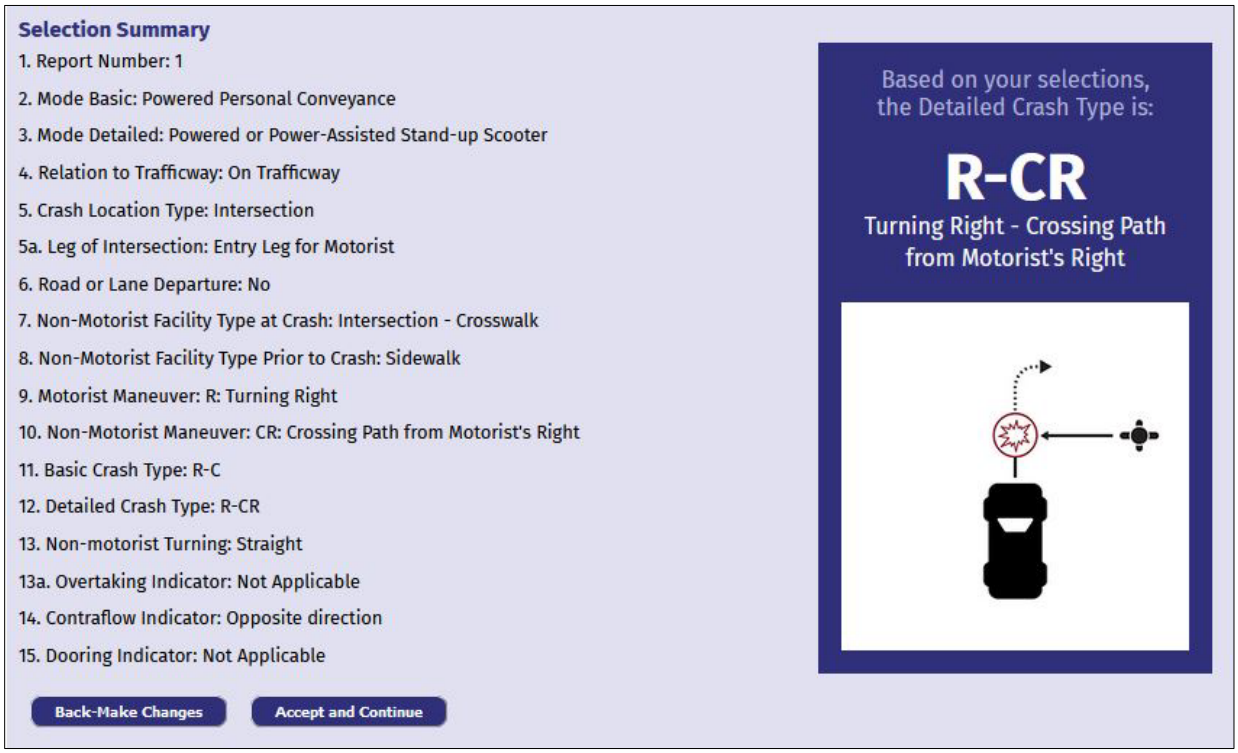
errors in the crash type or other prior selections, they may go back and make changes. If the user selects "Next," the user is presented with options to code more information about the crash.



Source: FHWA.

Figure 4. Screenshot. Selection Summary showing prior selections and Crash Type for user confirmation before proceeding.

After up to four additional, optional variables are coded—which do not change the *Crash Type*—users again have the opportunity to go back and make further changes to the variable selections or to accept and move forward (see figure 6). Accepting and moving forward ends the main crash coding sequence. **Once "Accept and Continue" is selected on this screen, the user does not have a further opportunity to go back to edit the previous selections.** (There *is* an option to recode the crash after it is saved, if needed; see the Recoding Cases with Errors section.)



Source: FHWA.

Figure 5. Screenshot. Last opportunity to revise selections in main crash typing sequence.

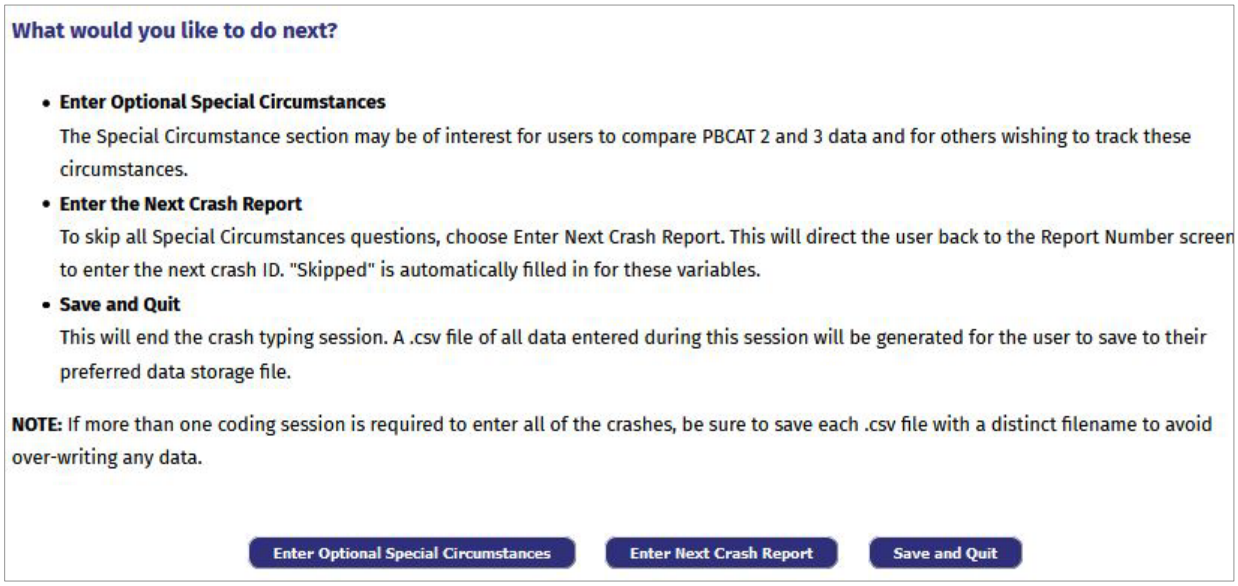
After "Accept and Continue" is selected, users are presented with a "What would you like to do next?" screen (figure 6), which presents a choice to code optional ***Special Circumstance*** factors that may have been associated with the crash, "Enter Next Crash Report," or "Save and Quit." **When either "Enter Next Crash Report" or "Save and Quit" are selected, that crash record is saved to the CSV file being built.**

If the user opts to code Special Circumstance factors, they will proceed to a new set of four screens that contain 44 questions. See the next section for more information on the Special Circumstance coding process and information that may be coded.

The user may also opt not to code any Special Circumstance factors (i.e., skip this entire section) by selecting "Enter Next Crash Report" or by selecting "Save and Quit" if the user is finished coding crashes for the active session. If the user opts to code the Special Circumstances, the prior selections have already been recorded, although the record is not yet saved to the active file. The "Enter Next Crash Report" and "Save and Quit" options are again presented after the Special Circumstance questions are reviewed and coded, and the crash record is saved to the CSV file along with any additional Special Circumstance indicators that were selected. (Note that every variable is either populated with a value or skipped).

When "Save and Quit" is selected, the data download for all records coded in that session is initiated. Note that it is best to "Save and Quit" to download the current crash records if the user

is taking a break or will be leaving the computer idle for a length of time, during which the computer may enter sleep mode or other disruptions may occur. There are more tips for data entry in the Functionality and Protocols sections.



Source: FHWA.

Figure 6. Screenshot. End of main crash typing sequence in application and options for next steps.

Special Circumstances

Because users have the option to skip this entire section, the typing process and functionality change at this point. As previously mentioned, users cannot go back to the earlier crash typing questions, and the Selection Summary window is no longer presented. This situation happened because the variable selections for the previous questions have been recorded (but not yet saved) to allow the functionality for users to skip the section entirely if they choose to.

The coding screens also look different than previous screens since previous screens only included one question per screen. When the user chooses to enter optional Special Circumstance factors, 44 different questions, categorized by topic, are presented on four screens. The user only selects 'Yes' if the situation applies to that crash; otherwise, the user is supposed to skip the question. (Users can go back and forth within the four Special Circumstance screens.)

At the end of Special Circumstance questions, the user is again prompted with the option to "Enter the Next Crash Report" to begin coding the next crash or "Save and Quit." As previously noted, "Save and Quit" initiates the data download. Users can review codable information in the Special Circumstance section in the next chapter and appendix B.

Recoding Cases with Errors

The ability to track selections as the user proceeds through coding the main variables (figure 3) and then go back if an error was made should reduce the need for recoding. However, once the

user makes a selection on the "What would you like to do next?" screen (figure 6), the user no longer can go back to change earlier selections, as the data entered previously has been recorded already for that crash.

If, however, the user thinks they made a mistake and wants to correct the coding for a specific crash, then the user can do so. The coding must already be completed for that crash, to do so, and the record must also be saved. To recode a crash, simply reenter the same crash *Report Number*. The user will then receive a prompt to confirm that they wish to recode that crash (or cancel). The recoded variable selections will replace the original selections. Users cannot view the original variable choices as the earlier data must be cleared to recode the crash.

The recoded variable selections will replace the original selections in the data file. If the error is only noticed after the user quits a coding session, and the data are downloaded, then the crash can simply be reentered during a new coding session. Reentering the crash information deletes the old record from the CSV file.

PBCAT 3 Functionality

PBCAT 3 is a browser-based application that operates without a database. The PBCAT 3 tool was designed to be streamlined and allow users to easily begin coding data to generate new variables. Users are not required to design a database that fits their data, and the application does not require users to upload any data, either from preexisting crash data or from earlier PBCAT 3 crash typing. Users may simply start typing crashes upon accessing the needed crash reports and information.

These application features also mean that crash records are only tracked and 'retained' by the system when the user is actively coding and the browser is open. When the user quits a session, all entered records from that active coding session are automatically downloaded for the user to save locally. Therefore, users are responsible for storing, merging multiple files or variables, and managing the data downloaded.

User selections within PBCAT are output in a delimited (CSV) file when the user quits the application. The user can rename the file at this point (if desired) and choose where to save the data, if not saved in an automatic Download folder. To enhance data protection, since there is no stored database, **backup data files are also automatically generated** for the user. PCBAT adds a number to the root file name for each backup file. This automatic backup occurs after every 5 records for the first 20 entries and then at a decreasing frequency of up to 200 records per session. This precaution is intended to help prevent accidental data loss. When the user quits a coding session, all records are outputted into the session CSV file, and the user may discard any unneeded backup data files.

Good Protocols for PBCAT 3 Data Entry

Since data are not stored by PBCAT 3, the user maintains control of all data and data security. However, this system simplicity requires users to practice good data entry, management, and control.

Guidance for Using the PBCAT 3 application:

1. Use modern, up-to-date internet browsers. PBCAT 3 is not supported by Internet Explorer®.
2. Do not use internet browsers in incognito or private mode. Check that cookies are enabled.
3. Do not clear the internet browser cache during coding sessions without submitting a "save and quit." The browser cache retains selections within the current session.
4. Use the directional "Back" button within the application to go back and change prior entries. Do not use the "Back" feature within the browser.
5. Do not abandon a coding session without saving and quitting. The computer should not be allowed to enter sleep mode while in a session.

If a user inadvertently navigates away from the site, or closes the window, but has other browser windows open, there is potential for recovering any non-backed-up data from the current session; however, the current unsaved record that was in the process of being entered may be lost. Users in this situation should not close the browser and should instead try navigating back to the PBCAT 3 webpage with the browser's navigation. The user should reach the "Enter Report Number" screen and enter the report that was being coded at the time of the disruption. The session data should still be available, excepting any unsaved record.

Good Protocols for File Management

The data generated by using PBCAT 3 are automatically downloaded to the user's computer (designated Download folder) when the user quits a session. If multiple sessions (or personnel) are needed to code the crashes that the user intends to code, then multiple CSV files will be created. These files will need to be stored, tracked, and, when data entry is complete, merged by the users.

Good data management protocols include developing a file naming and storage convention to guard against inadvertently over-writing any previous data files (for example, that may have been created by other users using the same file name). Users will also want to check for completion of records intended to be coded, as well as check for duplicate records. Again, the CSV format provides for the convenient merging of multiple files.

Compiling PBCAT 3 Data with Other Data

As mentioned in the Main Features section of the first chapter, PBCAT 3 is intended to create supplemental variables and is not intended for entering data elements commonly available in crash databases, including the ages of those involved, injury outcomes, traffic control, lighting conditions, and other factors. If these types of variables (or others not included in PBCAT 3) are important for the analysis purpose, users will want to be able to merge PBCAT 3-derived data with crash data variables. Users will want to enter a unique crash Report Number that can be used to match each typed crash record from PBCAT 3 with existing crash data. **Linking data is performed by the user outside of PBCAT 3.** This step should be straightforward to perform by data management specialists since the data generated by PBCAT 3 are outputted into a user-friendly CSV format.

PBCAT 3 CRASH TYPING SYSTEM AND VARIABLES

This chapter presents the PBCAT 3 crash typing framework, types of information generated by using the application, flow of the typing tool, and detailed information about each variable. There are seven key types of information that may be coded in PBCAT 3. Users are guided to code these information types through 15 questions, yielding data for 17 variables. These variables are intended to provide information on the type of non-motorist involved in the collision, characteristics of the crash location, the basic type of conflict or *Crash Type*, and other events and circumstances that are involved in some crashes. PBCAT 3 distinctly defines each data element coded within the system to enhance the objectivity and utility of the data for analyzing crashes.

Types of Information Generated

The seven key types of information for users to code, with the 17 variables that capture the relevant information, are as follows:

- Type of non-motorist involved in the collision—*Mode Basic* and *Mode Detailed* variables.

- Crash location context—*Relation to Trafficway, Crash Location Type,* (Motorist) *Road or Lane Departure* indicator, *Leg of Intersection* (if relevant) variables.

- Type of facility the non-motorist was using at or just prior to the time of the crash—*Non-motorist Facility Type at Crash,* (Non-motorist) *Travel Lane Type* (if relevant), and *Non-motorist Facility Type Prior to Crash* variables.

- Controlled movement of the motorist prior to the crash—*Motorist Maneuver* variable.

- Precrash maneuver of the non-motorist, relative to the motorist movement—*Non-motorist Maneuver* variable.

- Crash type—*Detailed Crash Type* and *Basic Crash Type* variables. The crash type variables are both generated by the application when the user selects the *Motorist* and *Non-motorist Maneuvers*.

- Other maneuvers or circumstances that add detail on precrash events for some crashes—*Non-motorist Turning, Overtaking Indicator, Dooring Indicator, Contraflow Indicator* variables. These variables do not alter the crash type; they may, however, be important for a fuller description of some crashes.

Users also have the option to answer 44 *Special Considerations* questions to indicate the presence of other factors, behaviors, or conditions that may have been present in some crashes.

Most users will likely code PBCAT 3 crashes by reviewing crash reports or crash diagrams and narratives available from the study State's or local jurisdiction's crash data system. Each State has its own crash report format and data collection system (whether entirely electronic or hard

copy) and makes these data available to safety stakeholders. When using PBCAT 3, a version of the report or data that includes the narrative and diagram is essential. PBCAT 3 users will need to familiarize themselves with the placement of variables, narratives, and diagrams on their State's crash report form or within the database and understand the definitions of these elements and their categories for crash typing purposes. The most important features of the crash report for PBCAT 3 are the diagram and narrative, which are used to characterize the motorist and non-motorist maneuvers used to generate the crash type variables.

In addition, jurisdictions may consider how their crash data system and collected data elements relate to the recommended PBCAT 3 variables. As mentioned in the section "Considerations for Crash Typing Using PBCAT 3," the variables in PBCAT 3 are intended to complement or enhance data elements already available in most crash databases. For some jurisdictions, it may also be possible to algorithmically program a close approximation of PBCAT 3 variables using existing crash variables. Users may find more information on the PBCAT 3 variables in the Variable Mapping chapter.

Key Variables

Users are asked to code five key variables to identify the type of non-motorist, crash location context, and the maneuvers used to generate the two crash type variables. These variables are:

- *Mode Basic*: This variable allows the user to indicate what type of person (non-motorist) was involved in the crash.

- *Relation to Trafficway*: This variable indicates whether the crash occurred on or off a trafficway.

- *Crash Location Type:* This variable indicates where the crash occurred (allows both on-trafficway and non-trafficway locations).

- *Motorist Maneuver*: This variable indicates the motorist's controlled maneuver just before the crash.

- *Non-motorist Maneuver*: This variable indicates the non-motorist maneuver, in relation to the motorist heading, just before the crash (and before any turns).

The precrash maneuvers of the motorist and non-motorist ***are the only two variables that influence the Crash Type.*** The application uses the selections for the *Motorist* and *Non-motorist Maneuvers* to generate the two crash type variables:

- *Crash Type: Detailed*: This variable defines a detailed crash type based on the interaction of *Motorist Maneuver* and *Non-motorist Maneuver* selections.

- *Crash Type: Basic:* This variable defines a basic crash type based on the interaction of *Motorist Maneuver* and *Non-motorist Maneuver* selections but automatically combines some categories.

Optional Variables

Users have the option to code information for up to 10 additional variables. These variables provide more detail about circumstances and events leading up to the crash. The optional variables will give a fuller picture of the crash sequence for some crashes but will not apply to all crashes. Users may opt to skip coding any of these variables for several reasons:

- If there is insufficient information in the crash report to make an accurate selection.
- If the user does not need the additional details.
- If the variable is not applicable to the crash circumstances.

To maintain objective data, users should avoid guessing when there is insufficient information to choose an option and instead select Unknown. If users decide to code these variables, they may want to code them each time and select **Unknown** or **Not Applicable**, when necessary, instead of skipping. This manner of coding can help to promote data completeness. The optional variables include:

- *Mode Detailed*: This variable captures more detail on the type of pedalcycle or other device used by the person in the crash, depending on the answer to Mode Basic.
- *Leg of Intersection*: This variable captures where in the intersection the crash occurred. The question is asked if the user indicated the crash occurred at an intersection, providing more information that may be useful for understanding the crash with respect to whether the motorist was entering the intersection, somewhere in the center, or exiting the intersection when the collision occurred. The answer could also be helpful for analyzing crashes at intersections that allow diagonal crossings as well as potential risks of more severe injuries.
- *Road or Lane Departure*: This variable aims to ascertain whether or not the motorist unintentionally departed the roadway or the motorist's travel lane prior to the crash (for on-trafficway crashes only).
- *Non-motorist Facility Type at Crash:* This variable captures the type of facility the non-motorist was on at the point of impact.
- *Travel Lane Type*: If the non-motorist was struck in a travel lane without other facility designations, this variable allows the user to code the type of travel lane.
- *Non-motorist Precrash Facility Type*: This variable captures the type of facility the non-motorist was using just before the crash. For faster modes, the variable may be different from that of the *Facility Type at Crash*.
- *Non-motorist Turning*: This variable captures whether the non-motorist may have turned, merged, or changed trajectories before the crash (regardless of mode, initial paths, or location type, or whether the motorist also turned).

- *Overtaking Indicator:* For parallel path, the same direction crashes involving motorists going straight, the *Overtaking Indicator* variable captures whether the motorist or non-motorist was overtaking the other at the time of the crash.

- *Non-motorist Contraflow Indicator:* This variable provides an opportunity to independently establish whether the non-motorist was traveling in the same or opposite direction as adjacent motorized traffic (if relevant). This factor may be represented regularly in certain crash types, and regardless of mode or location type, may be of interest in investigating detection technologies and potential for reducing crashes. [Note that 'contraflow' walking is typically recommended for pedestrians traveling where there is no walkway; in contrast, contraflow cycling in traffic lanes or on-road bike lanes *may* adversely affect safety].

- *Dooring Indicator:* For crashes involving parked motor vehicles, this variable provides an opportunity to indicate whether the crash resulted from a dooring situation (non-motorist striking an open or opening vehicle door).

Special Circumstances

Another aspect of the crash typing system flow relates to the optional Special Circumstance questions. As mentioned in the Getting Started chapter, users have the option to code any Special Circumstance factors that may apply to some crashes. However, users may also skip this Special Circumstance section entirely. Users cannot review or go back to the prior variables entered once they opt to code *Special Circumstances*.

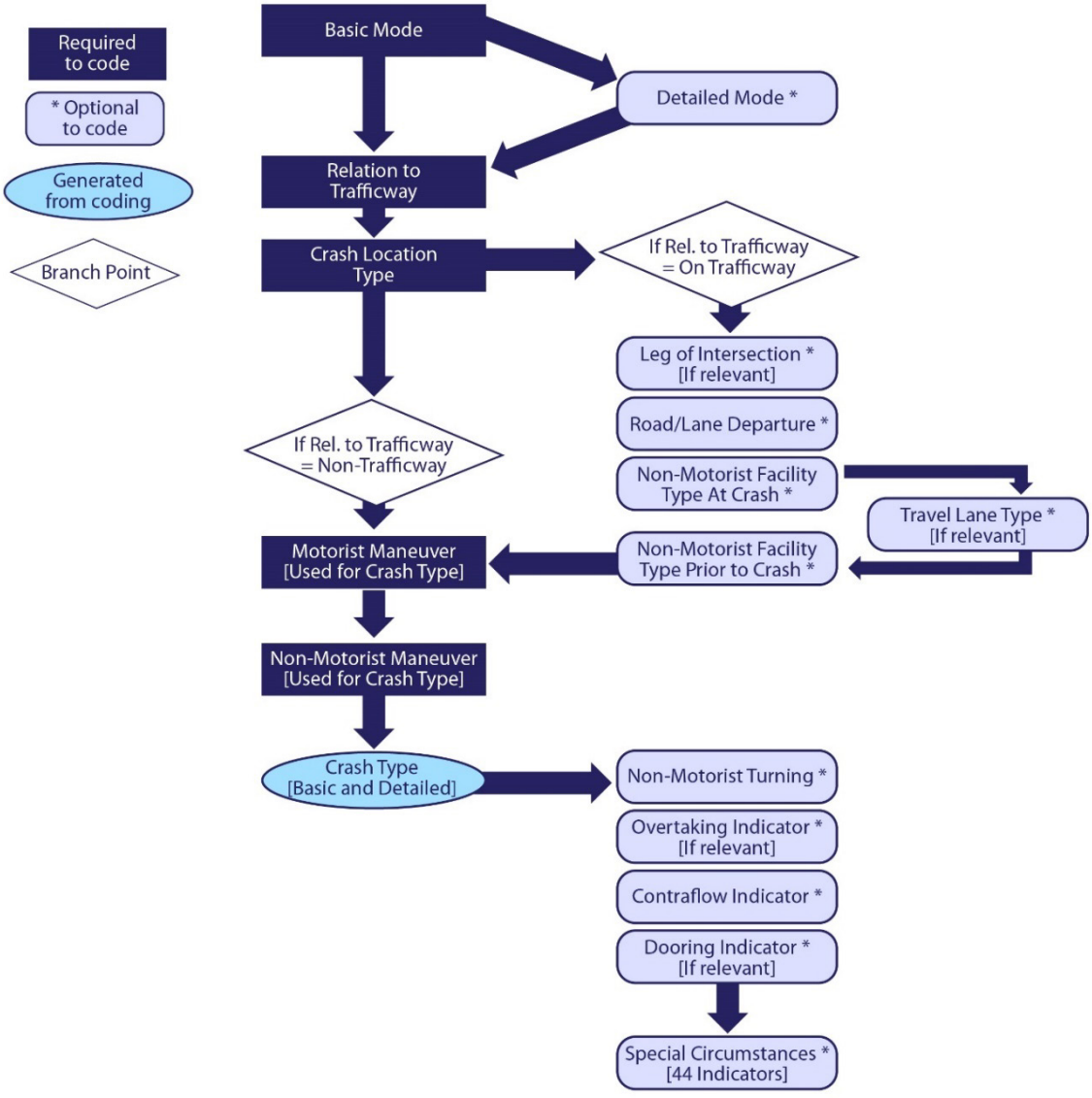
Thirty-nine of the questions provide indicators that correspond to special situations used to identify specific pedestrian or bicyclist crash types in earlier versions of PBCAT. These variables may therefore be of special interest to those who have data from crash typing using PBCAT 2 and wish to make longitudinal comparisons of detailed crash type trends. Comparing and analyzing data derived from PBCAT 3 with data derived from using the PBCAT 2 methodology is discussed in more detail in the Variable Mapping chapter.

The next section provides an overview of the crash typing flow and detailed descriptions of the crash typing logic and variables that can be coded using PBCAT.

Crash Typing Logic

Figure 7 illustrates the basic flow of crash typing within the application. Depending on selections, not all questions will be presented for each crash. For example, for crashes that did not occur on a trafficway, the *Non-motorist Facility Type* questions are not presented, as these questions are most relevant for **On Trafficway** crashes. In general, relatively few restrictions were imposed on questions presented based on prior variable selections to maintain flexible options for coders, recognizing that unexpected combinations of factors may occur. Any restrictions are described for each variable in the Detailed Variable Descriptions section following the next section on the use of illustrations in the crash typing application.

Each variable, except for the *Detailed* and *Basic Crash Type* variables, is coded by users by reviewing information from crash reports and making selections in the application. As mentioned previously, the crash type variables are derived by the application from *Motorist* and *Non-motorist Maneuvers* selections. Users are presented with the *Detailed Crash Type* and an illustration of the crash type (if available) following those two selections. Users can then review and confirm the crash type before proceeding to the next questions, as described in the Data Entry and Management section of this guide. Other data related to the crash scenario (such as the location context) and other actions (e.g., *Non-motorist Turning* indicator) are captured in other variables. Choices for those variables do not alter the *Crash Type* but instead provide supplemental variables that can be analyzed with respect to all crash types.



Source: FHWA.

Figure 7. Flowchart. Variable presentation within the crash typing flow in PBCAT 3.

Type of Non-motorist

There are two variables that assist the user in describing the nonmotorized road user type: *Mode Basic*, which users must code to differentiate among the basic types of non-motorists, and *Mode Detailed*, which is optional to code. There were several considerations for defining the basic and detailed modes for pedalcyclists, pedestrians, and users of varied personal conveyance devices. These considerations include current practices in crash reporting, the ability of law enforcement officers to recognize and distinguish different modes in reporting on crashes, rapidly evolving types of personal conveyances and power-assisted pedalcycles, and safety and operational characteristics. Mode Detailed offers an opportunity to distinguish more specific types of devices, if sufficient information is available in the crash report and existing variables to do so.

Mode Basic (modeBasic in CSV file)

Users may first select from three basic categories of non-motorist. The question, category options, and descriptions for *Mode Basic* are as follows:

Question:

What type of person was involved in the crash?

Category options (No illustrations):

Pedalcyclist or Power-Assisted Pedalcyclist—Cyclist using a wheeled vehicle with operable pedals or hand cranks. Motor-power assistance may be present.

Powered Personal Conveyance—A person using a powered or power-assisted personal conveyance device that is NOT pedal-powered. Examples include electric-powered stand-up and sit-down scooters, electric skates, powered boards, and others.

Pedestrian/Other Pedestrian—A person on foot, sitting, lying, using a self-propelled conveyance (e.g., stroller, skateboard, skates, kick-scooter, skis), or using a wheelchair that is motorized or non-motorized.

In Mode Basic, all types of pedalcycles were grouped together. Power-assisted pedalcyclists were combined with traditional pedalcyclists because these bikes seem to operate similarly to other pedalcycles (except they may go faster up hills). With designs that may hide the power source and motor, it is also unknown whether those reporting on crashes are always able to distinguish power-assisted pedalcycles from other pedalcycles. Note that the *MMUCC Guideline* includes motorized bikes with motor vehicles (combining with mopeds – refer to table 3 in the Variable Mapping chapter for more information) (NHTSA 2017).

Mode Detailed (modeDetailed in CSV file) (Optional)

PBCAT 3 provides the option for users to consider more specific types of personal conveyance devices and pedalcycles by coding *Mode Detailed*.

Question:

What type of pedalcycle/device was used by the cyclist/person in the crash?

[If unable to determine from the crash report, Skip the question.]

Category options for when Mode Basic = Pedalcyclist or Power-Assisted Pedalcyclist (no illustrations):

Bicycle—Two-wheeled vehicle that is human propelled by pedaling or hand-driven cranks. Includes handlebars for steering and a seat for the operator.

Other (Non-motorized) Pedalcyclist—Non-motorized, pedal-powered vehicle other than a bicycle, such as a unicycle, adult tricycle, tandem bicycle, bicycle plus trailer, etc.

Powered or Power-Assisted Pedalcyclist—Bicycle or other pedalcycle with a motor that provides supplemental power to the human operator.

A variety of powered personal conveyance devices, described as those "primarily designed to be used on paved roadways and paths" and designed for human transport, were defined in the SAE report on the taxonomy of powered personal micromobility vehicles (SAE 2019). The *MMUCC Guideline* does not provide as much detail on personal conveyance types (NHTSA 2017). PBCAT 3 followed the SAE categories for powered and power-assisted personal conveyances other than pedalcycles (SAE 2019). For pedalcycles, the SAE report distinguished three classes (and various sub-classes) of cycles that provide supplemental power to operators. However, the level and type of assistance may not always be apparent to those responding to and reporting on crashes, and different combinations of these characteristics may occur (SAE 2019). These varied levels of powered or power-assisted pedalcycles were therefore not split out in *Mode Detailed* in PBCAT 3.

The more detailed information from this optional variable could be useful in safety studies to better understand how different operational characteristics and profiles (such as different types of powered versus non-powered devices) might affect safety. If, however, there is inadequate information available in the crash report to make a choice, users should avoid making a subjective judgment and skip coding this variable to maintain objective data. If the user decides not to code *Mode Detailed* for any specific crash or for all crashes, they may select the Skip button provided below the category options. The options offered for *Mode Detailed* are a subset of categories that relate to the selection made for *Mode Basic.* No illustrations are provided for the Mode variables as devices are varied and evolving.

Category options for when Mode Basic = Powered Personal Conveyance (no illustrations):

Powered or Power-Assisted Stand-up Scooter—Small, longitudinally-wheeled stand-up scooter powered fully or partially by a motor, controlled by a throttle, with a handlebar for steering.

Powered or Power-Assisted Seated Scooter—Small, longitudinal wheeled scooter with a seat for the operator, powered fully or partially by a motor, typically controlled by a throttle with a handlebar for steering [Includes powered scooters that may be used for mobility assistance].

Powered Non-Self-Balancing, Standup Board—Board/skateboard powered fully or partially by a motor; has no column or handlebars.

Power-Assisted Skates—Skates powered fully or partially by a motor.

Powered Board with Self-Balancing Mechanism—Fully motorized vehicle with horizontally-arranged wheels, a foot platform, and center column with handlebar. These devices are controlled by the operators distributing their weight.

Other Powered/Assisted Personal Conveyance—Other type of active transport device or conveyance with power assistance not described in the other options.

Category options for when Mode Basic = Pedestrian/Other Pedestrian (no illustrations):

Non-powered or Powered Wheelchair

Other Self-propelled, Personal Conveyance or Toy—Personal conveyance other than a pedalcycle or wheelchair but powered solely by human effort. [Includes devices such strollers, kick scooters, sleds, skis, stilts, child's tricycle, or other non-motorized pedestrian conveyance.]

Pedestrian—No recreational or conveyance device was used.

Crash Location Context

After completing selections for the *Mode* variables, PBCAT 3 users are presented with questions about crash location context: *Relation to Trafficway* and *Crash Location Type.* Optional variables relating to location of the crash include A *Road or Lane Departure* indicator, as well as *Leg of Intersection*, when appropriate. Finally, users have the options to code specific facility types the non-motorist was using at the time of the crash: *Facility Type at Crash* and *Travel Lane Type* (if relevant), as well as the facility type the user may have been using just before moving into the conflict zone where the crash occurred—the *Facility Type Precrash.*

The prior choices regarding non-motorist mode do not affect the selections for these variables or any of the other variables in the typing system. The choices for these location context variables also do not affect the *Crash Type* but provide supplemental information. Some of the optional variables are not relevant for *Non-Trafficway* crashes, however, and are not offered for crashes that were coded as occurring at these locations.

Relation to Trafficway (relationToTrafficway in CSV file)

The *Relation to Trafficway* variable defines whether the crash was a trafficway-related crash or not. While most crashes involve one motorist and one non-motorist, if any harmful event in the crash (including a prior collision with a second motor vehicle) was initiated on the trafficway and resulted in a collision with a non-motorist, then that crash should be coded as *On Trafficway*. An illustration is provided to help users make this determination. The definitions are intended to be consistent with the *MMUCC Guideline* (NHTSA 2017).

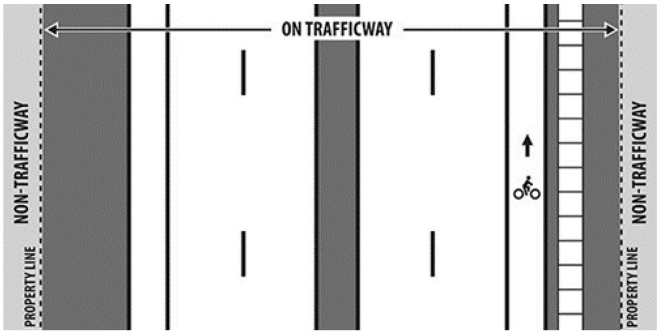
Question: Did the crash occur on or off a trafficway?

[A trafficway includes the roadway, shoulder, roadside, and all facilities within the public right-of-way.]

Category options and illustrations:

On Trafficway—Crash where the unstabilized situation originated within the boundaries of a trafficway or at least one harmful event occurred on the trafficway. The following four examples of *On Trafficway* crashes are not provided within the application. Example 1: A motorist driving on a roadway pulls or runs off the road and crashes into a pedestrian jogging on an unpaved shoulder. Example 2: A motorist driving on a roadway crosses the centerline and crashes into a bicyclist traveling on an adjacent sidepath on the opposite side of the roadway. Example 3: A motorist backs out of a private driveway, into the trafficway, and crashes into a scooter-rider traveling along a sidewalk. Example 4: A motorist backs into another vehicle, sending it over the curb and into a parking lot where it strikes a pedestrian.

See the figure 8 illustration for both *On-Trafficway* and *Non-Trafficway*.



Source: FHWA.

Figure 8. Illustration for both On Trafficway and Non Trafficway.

Non-Trafficway—Crash where the unstabilized situation originated outside the boundaries of a trafficway and no harmful event occurred on a trafficway. For example, a driver starts a vehicle in a private driveway and backs over a pedestrian sitting right behind that vehicle, or, a motorist driving through a parking lot collides with a non-motorist, or, a motorist and someone outside that vehicle, are working on the vehicle in a private yard when the vehicle moves and hits the pedestrian.

Unknown—It is unknown whether the crash was associated with a trafficway.

No illustration is provided since Unknown location type is undefined.

Selecting Unknown for the *Relation to Trafficway* variable skips the user to the *Motorist Maneuver* question and bypasses the *Crash Location Type* and *Non-motorist Facility Type* questions since there is a lack of information about the crash location. *Crash Location Type* options are presented for crashes initiated or occurring in *On Trafficway* or in *Non-Trafficway* locations.

Crash Location Type (crashLocationType in CSV file)

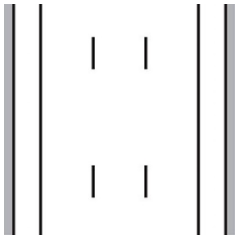
Crash Location Type selections are influenced by the selections made in *Relation to Trafficway***.** This location variable relates to the approximate location of the crash along a trafficway, or, if a non-trafficway crash, a basic descriptor of the type of location. If the motorist entered or left the roadway (whether intentionally or unintentionally) as indicated in the *Motorist Left the Roadway* variable and struck a non-motorist on a non-trafficway facility that was outside the trafficway property lines, PBCAT 3 users should select the location type along the trafficway that is most pertinent to where the non-motorist was struck (which may include *Other or Unknown Trafficway Location)*. The specific facility type (whether within the trafficway or not) can be indicated in a separate variable.

Question:

Where did the crash occur?

Category options and illustrations for Crash Location Type when Relation to Trafficway = On Trafficway:

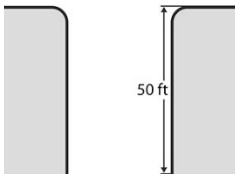
Expressway—Crash occurred on a fully access-controlled trafficway. Note: The crash may occur at or along an interchange area as long as the crash is unrelated to the presence or maneuvers to/from or on an access ramp. Compare to Entrance / Exit Ramp. Additional note: that is not included in the application and users should rule out access-controlled expressway/freeway before selecting Non-junction (along Trafficway). If the crash occurred on an entrance/exit ramp or was related to movements to/from a ramp, select Entrance/Exit Ramp or Related (see figure 9).



Source: FHWA.

Figure 9. Illustration. Expressway

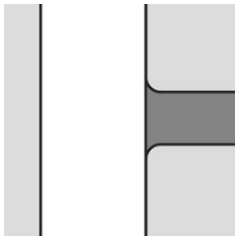
Intersection—Crash occurred at or related to an at-grade junction of two or more roadways of any design or locations within 50 ft of the prolongation of the edge line or curb of the crossing street (see figure 10).



Source: FHWA.

Figure 10. Illustration. Intersection

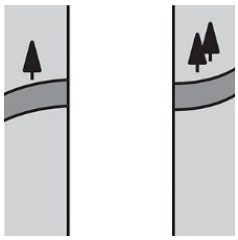
Driveway Access or Related—Crash occurred on or near a driveway access point and was related to movements from the driveway to the trafficway or from the trafficway to the driveway by either party. Driveway-related crashes may occur on a roadway travel lane, midblock crossing, on a shoulder, or on an adjacent pedestrian/bicycle facility along the roadway near a driveway but should be related to the driveway; code as Non-junction otherwise (see figure 11).



Source: FHWA.

Figure 11. Illustration. Driveway access or related.

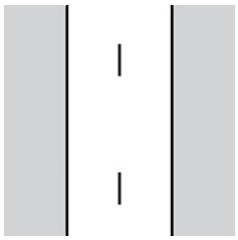
Path Crossing/Junction—Crash occurred at the junction of a shared-use path or trail with a trafficway (see figure 12).



Source: FHWA.

Figure 12. Illustration. Path crossing/junction.

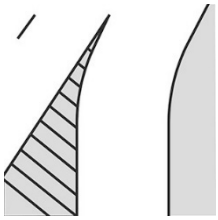
Non-junction (along Trafficway)—Crash occurred at a trafficway location that is not an intersection or a connection between a driveway access, path, or other trafficway, and the crash did not occur on a fully-access-controlled freeway or expressway. [This category includes crashes at midblock, marked crosswalks (see figure 13).]



Source: FHWA.

Figure 13. Illustration. Nonjunction (along Trafficway).

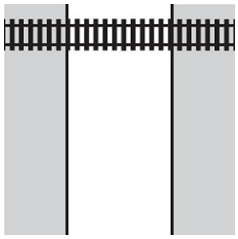
Entrance/Exit Ramp or Related—Crash occurred on a ramp that provides access to or from another roadway or results from an activity, behavior, or control related to the movement of traffic units entering or exiting a ramp (see figure 14).



Source: FHWA.

Figure 14. Illustration. Entrance/exit ramp or related.

Railway Grade Crossing**—**Crash occurred at a railway grade-crossing of a roadway (see figure 15).



Source: FHWA.

Figure 15. Illustration. Railway grade crossing.

Other Trafficway Location—The crash occurred along a trafficway, but the location type is different from those described.

No illustration.

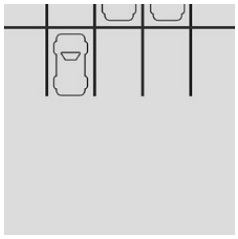
Unknown Trafficway Location—The crash occurred along a trafficway, but the location type cannot be further determined.

No illustration.

PBCAT 3 users can type crashes that occurred in *Non-Trafficway* locations if desired and if *Relation to Trafficway* = **Non-Trafficway** is selected.

Category options and illustrations for Crash Location Type when Relation to Trafficway = Non-Trafficway:

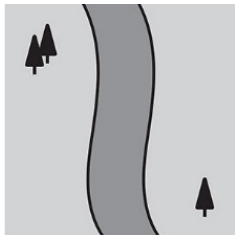
Public Vehicular Area (PVA)—Crash occurred on a commercial or public driveway, parking lot, or other area open to the public and used for vehicular access or parking (see figure 16).



Source: FHWA.

Figure 16. Illustration. Public vehicular area (PVA).

Off-Street Trail/Sidepath—The crash occurred on a trail, shared-use path, or sidepath but was not at a junction with a roadway for motor vehicle traffic (see figure 17).



Source: FHWA.

Figure 17. Illustration. Off-Street Trail/Sidepath.

Other Non-Trafficway—The crash occurred on a private driveway, yard, open area, inside a building, or other area not typically designated for vehicular traffic.

No illustration.

Unknown Non-Trafficway—The crash occurred at a non-trafficway location, but the location type cannot be further determined.

No illustration.

Leg of Intersection (legOfIntersection in CSV file) (Optional)

Whether the crash occurred on the entry leg or the exit leg for the motorist has been associated with injury severity for nonmotorized road users, with the exit legs associated with more severe injuries (Schneider and Stefanich, 2016). This variable also provides further support for whether the crash was a crossing path crash or a parallel path crash at an intersection.

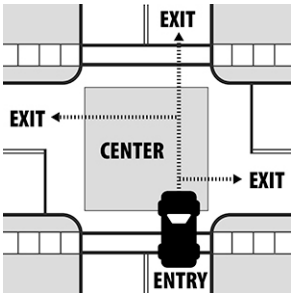
If Intersection is selected for *Crash Location Type*, users are presented the option to code the *Leg of Intersection* where the crash occurred. If any value other than **Intersection** is selected for

Crash Location Type, this variable automatically populates with *Not Applicable*, and users will not see this question.

Question: Where in the intersection did the crash occur?

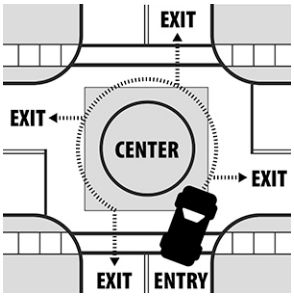
The two accompanying images shown are intended to illustrate the entry leg, versus the exit legs for the motorist, for varied at-grade intersection designs (see figure 18).

Category options and two Illustrations:



Source: FHWA.

A. Subfigure example of leg of intersection exit legs.



Source: FHWA.

B. Subfigure example of leg of intersection exit legs.

Figure 18. Illustration. Category options and two illustrations.

Entry Leg for Motorist (extending 50 ft from corner)

Exit Leg for Motorist (extending 50 ft from corner)

Center Area of Intersection (area bounded by inner curb or edge lines)

Unknown

Road or Lane Departure (roadLaneDeparture in CSV file) (Optional)

Selecting **On Trafficway** for *Relation to Trafficway*, also provides users the option to code an indicator of whether the motorist unintentionally departed the roadway or travel lane in *Road or*

Lane Departure (this variable is presented after the Crash Location variable.) This determination should be applied to the motorist action that initiated the crash sequence.

If **Non-Trafficway** or **Unknown** is selected for *Relation to Trafficway*, this *Road or Lane Departure* indicator automatically populates with **Not Applicable**, since the crash occurred wholly outside the trafficway or the *Relation to Trafficway* is unknown.

Question:

Did the motorist unintentionally leave the roadway or designated travel lane prior to the crash? Category options (no illustrations):

Yes

No

Unknown

Type of Facility the Non-motorist was Using

If there is sufficient available information, following the crash location choices, users may opt to code the specific type of facility used by the non-motorist at the time of the crash (*Non-motorist Facility Type at Crash*). Users may also opt to code the facility type used by the non-motorist just before the crash (*Non-motorist Facility Type Prior to Crash*). The facility type used before the crash may be most relevant to cyclists and other faster modes. Cyclist and other faster modes may have been on a different facility type before entering the conflict area where the crash occurred. Both the facility type being used at and before the crash may be of safety interest and have potential implications for the selection of safety treatments.

Regardless of the crash location characteristics selected earlier, all of the trafficway and non-trafficway-related facility types are offered for **On-Trafficway** crashes because there are many unpredictable scenarios that could involve a motorist departing the roadway and striking a non-motorist on a bicycle or pedestrian facility, shoulder, or other off-roadway area. In addition, non-motorist falls or crashes, which can be coded using PBCAT 3, may not involve a collision with a motor vehicle and may occur on these types of facilities.

Users may choose not to code facility type if the information is already available in the crash database, not available on the crash report, or the facility descriptors are available from other sources, such as roadway inventories. However, the presence of facilities may not always coincide with the facility the non-motorist was on at the time of the crash or used just before the crash. Each jurisdiction may want to weigh the information available in other databases and the ability to code these variables consistently and accurately from crash report information.

Non-motorist Facility Type at Crash *(*facilityTypeCrash in CSV file) (Optional) AND

Non-motorist Facility Type PRIOR to Crash *(*facilityTypePre in CSV file) (Optional)

These two variables use the same set of facility type options and are optional to code by selecting a Skip button.

Question for Non-motorist Facility Type at Crash:

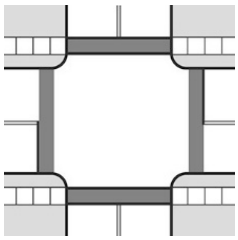
What type of facility was the non-motorist using at the moment of the crash?

Question for Non-motorist Facility Type Prior to Crash:

What facility was the non-motorist using just prior to the crash, which may differ from the facility where the crash occurred?
Note included in the application: [The precrash facility type may be most applicable to cyclists, joggers, and other faster modes; may also be challenging to determine from crash reports.]

Category options and illustrations:

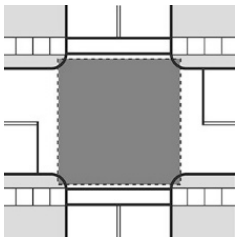
Intersection – Crosswalk—An area of the roadway designated for pedestrian crossing. The crosswalk may be marked on the roadway or may be an implied, legal, crosswalk that is not marked (see figure 19).



Source: FHWA.

Figure 19. Illustration. Intersection—crosswalk.

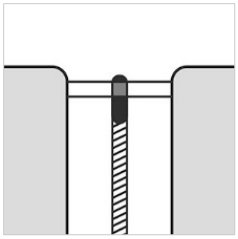
Intersection - Other—An area within the bounds of an intersection but not in a marked or unmarked crosswalk (see figure 20).



Source: FHWA.

Figure 20. Illustration. Intersection—other.

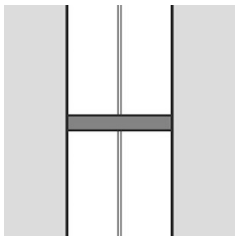
Median/Crossing Island—An area of a trafficway that separates traffic in opposite directions; a crossing island is a type of raised median that provides refuge for crossing non-motorists (see figure 21).



Source: FHWA.

Figure 21. Illustration. Median—crossing island.

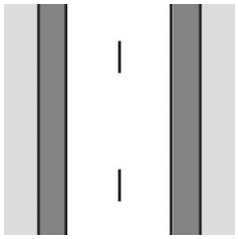
Midblock – Marked Crosswalk—A marked area of the roadway designated for non-motorist crossing that is not located at an intersection (see figure 22).



Source: FHWA.

Figure 22. Illustration. Midblock—marked crosswalk.

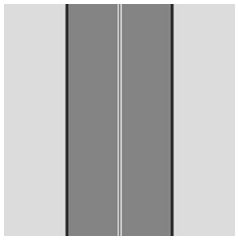
Shoulder/Roadside—A part of a trafficway from the edge of the vehicular travel lanes extending to the property line (including unpaved right-of-way) but excluding designated pedestrian and cyclist facilities (see figure 23).



Source: FHWA.

Figure 23. Illustration. Shoulder/roadside.

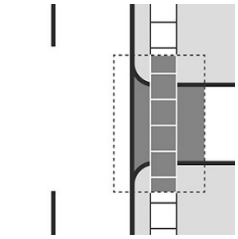
Travel Lane – Other Location—A lane designated for vehicular travel and lacking other facility-type markings/designations (see figure 24).



Source: FHWA.

Figure 24. Illustration. Travel lane—other direction.

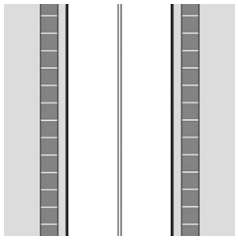
Driveway Access—A sidewalk, bike lane, or shoulder area continued across a driveway access and at the junction with a trafficway (see figure 25).



Source: FHWA

Figure 25. Illustration. Driveway access.

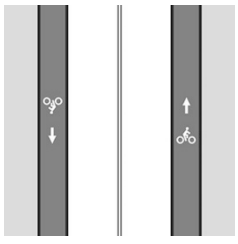
Sidewalk—An area adjacent to travel lanes typically designated for pedestrian use. The area before includes curbs or curb ramps (see figure 26).



Source: FHWA.

Figure 26. Illustration. Sidewalk.

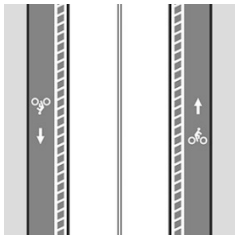
On-Street Striped Bike Lane—An on-road bicycle facility designated by striping, signing, and pavement markings (see figure 27).



Source: FHWA.

Figure 27. Illustration. On-street striped bike lane.

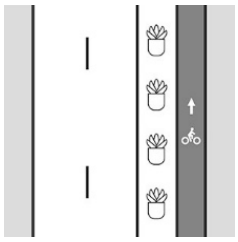
On-Street Buffered Bike Lane—A bicycle lane with a painted buffer separating it from motor vehicle lanes (see figure 28).



Source: FHWA.

Figure 28. Illustration. On-street buffered bike lane.

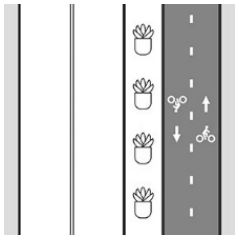
Separated Bike Lane – One-way—A one-way facility designated for use by bicyclists that is adjacent to but physically separated from motor vehicle lanes by a vertical element but is within the trafficway (see figure 29).



Source: FHWA.

Figure 29. Illustration. Separated bike lane—one way.

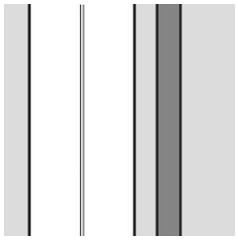
Separated Bike Lane – Two-way—A two-way facility designated for use by bicyclists that is adjacent to but physically separated from motor vehicle lanes by a vertical element and is within the trafficway (see figure 30).



Source: FHWA.

Figure 30. Illustration. Separated bike lane—two-way.

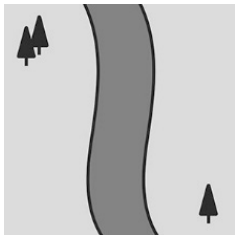
Sidepath—A shared-use path physically separated from motor vehicle traffic by a curb, open space or barrier, but parallel to and within the trafficway used by pedestrians, cyclists, and other non-motorists (see figure 31).



Source: FHWA.

Figure 31. Illustration. Sidepath.

Off-Street Trail—A shared-use pathway that is not adjacent to a roadway and is used by pedestrians, cyclists, and other non-motorists (see figure 32).



Source: FHWA.

Figure 32. Illustration. Off-street trail.

Other Facility—Any facility not described in other options, including parking lane, bus pullout, loading zone, or nontrafficway area (e.g., parking lot, open space).

No illustration.

Unknown—The facility the non-motorist was on is not known.

No illustration.

Travel Lane Type (travelLaneTypeCrash in CSV file) (Optional)

If ***Travel lane – Other Location*** is selected for *Non-motorist Facility Type at Crash*, users are presented the option to code what type of motor vehicle travel lane the non-motorist was using at the time of the crash. If any other values are selected for *Non-motorist Facility Type at Crash, Travel Lane Type* is automatically populated with **Not Applicable**.

Question*:*

What type of vehicular travel lane was the non-motorist using at the time of the crash?

Category options and illustrations (no Illustrations):

Through Lane

Right Turn Lane

Left Turn Lane

Two-Way Left Turn Lane

Free-Flow Right Turn Lane

Dedicated Bus Lane

Other Type Lane

Unknown Lane Type

Maneuvers of the Motorist and Non-motorist Prior to the Crash

The next and most important step in crash typing is to select the motorist and non-motorist maneuvers that preceded the crash. While the location and facility type variables provide important context for where the crash occurred, they do not affect the PBCAT 3 *Crash Type*.

The crash type is derived from the interaction of the motorist and non-motorist maneuvers variables. The application uses the coding of these two variables to automatically create two crash type variables: *Detailed Crash Type* and a *Basic Crash Type* with fewer categories. PBCAT 3 presents the crash type for a given crash to the user following the motorist and non-motorist maneuvers sections.

First, users select the *Motorist Maneuver* that best describes the precrash movement of the motorist. *Motorist Maneuvers* were adapted from the *MMUCC Guideline* (2017) vehicle maneuver/action variable and categories. Next, users are asked to select the category that best describes the Non-motorist *Maneuver/Actions* just before the crash. Non-motorist actions are characterized relative to the *Motorist Maneuver* and likely require consulting the crash diagram and narrative from a crash report to code accurately. PBCAT 3 users should become familiar with the detailed descriptions of these categories before coding and resolve any issues among coders for consistent coding.

Motorist Maneuver (motoristManeuver in CSV file)

Motorist Maneuver is one of the two variables used to generate the two crash type variables. Users can select an **Unknown** option in case the crash report provides insufficient detail to determine the motorist maneuver type. For more information, the relationship of these categories to categories in the *MMUCC Guideline* (2017) for the "Vehicle Maneuver/Action" variable is provided in the Variable Mapping chapter.

Question:

What was the motorist maneuver just prior to the crash?

[If more than one motorist was involved, select the maneuver of the motorist that most caused the crash sequence.]

Category options (no illustrations). Illustrations are provided for most Crash Types after Non-motorist Maneuver is also selected:

S: Going Straight—The motorist movement was essentially straight ahead, including negotiating a curve, overtaking, or passing another road user, changing lanes, or slowing.

R: Turning Right—The motorist was turning right or preparing to turn right.

L: Turning Left—The motorist was turning left or preparing to turn left or making a U-turn.

P: Parked—The motor vehicle was parked at the time of the collision. The vehicle may have been occupied or unoccupied but was not stopped in traffic. [Select Other Maneuver for stopped in traffic.] [Additional note not included in the crash typing application: The motor vehicle may have been parked in a traffic lane, designated parking lane, or in a non-trafficway location (parking lot, etc.) but was not simply stopped in traffic or stopped at other locations.]

E: Entering Traffic Lane—The motorist was entering or merging into a travel lane from a parallel parking, bus, or delivery pull-out zone, ramp, shoulder, or other non-thru facility. [Select a turning option if the motorist was turning from a roadway or a driveway to another roadway.]

B: Backing—The motorist was backing.

O: Other Maneuver—The motorist maneuver was other than those described in previous options. [Select this option for motorists that were leaving a traffic lane or were stopped and remained stopped before the crash.]

U: Unknown Maneuver—The motorist maneuver is unknown or cannot be determined.

N: Non-Collision—One or more motorists may have been involved in events leading up to the crash, but there was no contact between any motor vehicle and the non-motorist.

[Note that is not included in the application: This category should be selected for most non-motorist falls or crashes that do not involve collisions with motor vehicles. If another Motorist Maneuver (who perhaps contributed to the non-motorist fall through some action) is selected in combination with FC: Non-motorist Fall or Crash for the Non-motorist Maneuver, no crash type (i.e., Not Applicable) will be returned. However, the Motorist Maneuver selection will be recorded as the Motorist Maneuver category, and FC: Non-motorist Fall or Crash will be recorded for the Non-motorist Maneuver.]

Non-motorist Maneuver/Action (non-motoristManeuver in CSV file)

Next, PBCAT 3 users are asked to select the category of *Non-motorist Maneuver/Action* that best characterizes the non-motorist movement relative to the motorist's path prior to any turns. This variable also contributes to the *Crash Type.*

Question:

What was the non-motorist's direction of travel, relative to the motorist's direction, just prior to the crash?

[Select the paths BEFORE any pending turns or other maneuvers were completed by either party.]

Category (no illustrations). Illustrations are provided for most Crash Types after Non-motorist Maneuver is selected:

CR: Crossing Path from Motorist's Right—The non-motorist was traveling on a crossing path approaching from the motorist's right, BEFORE any turns.

CL: Crossing Path from Motorist's Left—The non-motorist was traveling on a crossing path approaching from the motorist's left, BEFORE any turns.

CU: Crossing Path, Unknown Direction—The non-motorist was crossing a trafficway or other facility at an angle to the motorist BEFORE any turns, but it could not be determined whether the non-motorist was approaching from the motorist's right or from the left."

PS: Parallel Path Same Direction—The non-motorist was traveling on a more or less parallel path in the same direction as the motorist BEFORE any turns.

PO: Parallel Path Opposite Direction—The non-motorist was traveling on a more or less parallel path in an opposing direction to the motorist BEFORE any turns.

PU: Parallel Path Unknown Direction—The non-motorist was moving in a parallel path to the motorist BEFORE any turns, but it could not be determined whether the non-motorist was moving in the same or opposite direction.

MU: Moving in Unknown Path/Direction—The non-motorist was moving in a direction that could not be determined.

ST: Stationary—The non-motorist was not moving (e.g., was standing, sitting, lying).

OU: Other/Unusual—The non-motorist maneuver does not fit any of the other described options. [Select this option for a person exiting a parked vehicle, holding on to a vehicle, or making other or unusual actions.]

UN: Unknown—The non-motorist movement or actions are unknown or cannot be determined.

FC: Non-motorist Fall or Crash—There was no direct collision with a motor vehicle.

[Note that is not included in the application: This category should be selected for any crash in which the non-motorist crashed or fell but did not collide with a motor vehicle. If another maneuver is selected in combination with N: Non-Collision *Motorist Maneuver*, no crash type (or NA) will be returned as the crash type.]

Both the *Motorist* and *Non-motorist Maneuver* variables are output in the CSV data files, along with the results for *Detailed* and *Basic Crash Type*, which are presented next.

Crash Types

The two crash type variables are both generated automatically by the application in response to user selections of *Motorist Maneuver* and *Non-motorist Maneuver*.

Detailed Crash Type (crashTypeDetailed in CSV file)

Detailed Crash Type results are shown in matrix form in table 1 with longer descriptive names and illustrations following. 'Shorthand' codes are used as the crash type value in the table. For each crash type, the motorist maneuver is indicated first (before the dash), and this code comes from the key description of the motorist maneuver in the left-most column. The non-motorist maneuver is indicated following the dash. The non-motorist portion of the crash type is shown across the top row of the table. For example, **S-CR** is the category code for (Motorist) Going **S**traight–(Non-motorist on) **C**rossing Path from Motorist's **R**ight. The bold and underlined letters indicate those used to form the *Crash Type* code name used in the CSV data files, and these codes are intended to be intuitive once users become familiar with the system. A similar naming scheme, although with crash types defined to also encompass location types, was used by Schneider and Stefanich in their Location–Movement Classification Method (Schneider and Stefanich, 2016).

Basic Crash Type (crashTypeBasic in CSV file)

Basic Crash Type is simply one set of consolidated crash types that may be preferable to use for some safety analysis purposes. In some cases, there may be too few detailed crash types for a systemwide analysis, such as a systemic safety analysis. In other cases, the additional detail may not be needed for the safety analysis purpose. Analysts may create their own recombined categories of crash types, depending on frequency results and analysis needs, as mentioned in the Analysis Notes chapter.

The results for *Crash Type Basic* are shown in table 2. As in table 1, the likely more common groups are shown with a white background or lighter gray. The Crash Type Basic variable is also provided automatically in the CSV data file downloads.

Crash types that result from selections of *Motorist Maneuver* and *Non-motorist Maneuver* are shown to the user in the crash typing application. The *Crash Type Detailed* and *Crash Type Basic* category codes shown in table 1 and table 2 and used in the CSV data file are presented in the Selection Summary window, along with a longer descriptive crash type label (based on the motorist and non-motorist maneuvers), and an illustration of the crash type (for most types). Users can view the resultant crash type and confirm that it correctly reflects the crash before proceeding. This information is also presented in the next section. First, the short-hand crash type codes shown in table 1 are presented, followed by the descriptive crash type name and the illustration. For reference, the combined *Basic Crash Types* are provided in detail in appendix A.

Table 1. Matrix of *Crash Type Detailed* from motorist and non-motorist maneuver selections.

Motorist Maneuver	Non-motorist Maneuver										
	CR: Crossing Path from Motorist's Right	**CL: Crossing Path from Motorist's Left**	**CU: Crossing Path, Unknown Direction**	**PS: Parallel Path Same Direction**	**PO: Parallel Path Opposite Direction**	**PU: Parallel Path Unknown Direction**	**MU: Moving in Unknown Path/ Direction**	**ST: Stationary**	**OU: Other/ Unusual**	**UN: Unknown**	**FC: Non-motorist Fall or Crash**
S: Going **S**traight	S-CR	S-CL	S-CU	S-PS	S-PO	S-PU	S-MU	S-ST	S-OU	S-UN	n/a[1]
R: Turning **R**ight	R-CR	R-CL	R-CU	R-PS	R-PO	R-PU	R-MU	R-ST	R-OU	R-UN	
L: Turning **L**eft	L-CR	L-CL	L-CU	L-PS	L-PO	L-PU	L-MU	L-ST	L-OU	L-UN	
P: Parked	P-CR	P-CL	P-CU	P-PS	P-PO	P-PU	P-MU	n/a	P-OU	P-UN	
E: Entering Traffic Lane	E-CR	E-CL	E-CU	E-PS	E-PO	E-PU	E-MU	E-ST	E-OU	E-UN	
B: Backing	B-CR	B-CL	B-CU	B-PS	B-PO	B-PU	B-MU	B-ST	B-OU	B-UN	
O: Other Maneuver	O-CR	O-CL	O-CU	O-PS	O-PO	O-PU	O-MU	O-ST	O-OU	O-UN	
U: Unknown Maneuver	U-CR	U-CL	U-CU	U-PS	U-PO	U-PU	U-MU	U-ST	U-OU	U-UN	
N: Non-Collision	N/A – No Crash type returned										N-FC

n/a = Not applicable – no crash type for these combinations; CR; CL; PS; PO; PU; MU; ST; OU; UN; FC.

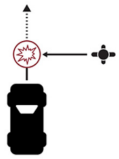
Table 2. Matrix of *Crash Type* Basic grouped from Motorist and Non-motorist maneuver selections.

Motorist Maneuver	Non-motorist Maneuver				
	C: Crossing Path [Includes CR, CL, and CU detailed maneuvers]	**P: Parallel Path [Includes PS, PO, and PU detailed maneuvers]**	**O: Other, Unusual, or Stationary [Includes MU, ST, and OU detailed maneuvers]**	**U: Unknown [Includes only UN detailed maneuver]**	**F: Non-motorist Fall or Crash**
S: Going **S**traight	S-C	S-P	S-O	S-U	n/a
R: Turning **R**ight	R-C	R-P	R-O	R-U	
L: Turning **L**eft	L-C	L-P	L-O	L-U	
P: Parked	P-C	P-P	P-O	P-U	
E: Entering Traffic Lane	E-C	E-P	E-O	E-U	
B: Backing	B-C	B-P	B-O	B-U	
O: Other Maneuver	O-C	O-P	O-O	O-U	
U: Unknown Maneuver	U-C	U-P	U-O	U-U	
N: Non-Collision	Not Applicable – No Crash type returned				N-F

Motorist Going Straight crash types

The definition of motorist going straight encompasses motorists who may have been negotiating a curve, overtaking or passing another road user (not necessarily the non-motorist), slowing, or changing lanes, as well as simply proceeding more or less straight ahead. The group of crash types involving motorists who were going straight just prior to when the crash with a non-motorist occurred is presented as follows:

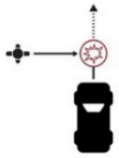
S-CR – Going **S**traight - **C**rossing Path from Motorist's **R**ight (see figure 33).



Source: FHWA.

Figure 33. Illustration. S-CR—going straight—crossing path from motorist's right.

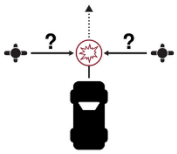
S-CL – Going **S**traight - **C**rossing Path from Motorist's **L**eft (see figure 34).



Source: FHWA.

Figure 34. Illustration. S-CL—going straight—crossing path from motorist's left.

S-CU – Going **S**traight - **C**rossing Path **U**nknown Direction (see figure 35).



Source: FHWA.

Figure 35. Illustration. S-CU—going straight—crossing path from an unknown direction.

S-PS – Going **S**traight - **P**arallel Path **S**ame Direction (see figure 36).

Source: FHWA.

Figure 36. Illustration. S-PS—going straight—parallel path same direction.

S-PO – Going **S**traight - **P**arallel Path **O**pposite Direction (see figure 37).

Source: FHWA.

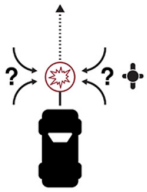
Figure 37. Illustration. S-PO—going straight parallel path opposite direction.

S-PU – Going **S**traight - **P**arallel Path **U**nknown Direction (see figure 38).

Source: FHWA.

Figure 38. Illustration. S-PU—going straight—parallel path unknown direction.

S-MU – Going **S**traight – **M**oving in **U**nknown Path/Direction (see figure 39).



Source: FHWA.

Figure 39. Illustration. S-MU—going straight—moving in unknown path/direction.

S-ST – Going **S**traight - **St**ationary (see figure 40).

Source: FHWA.

Figure 40. Illustration. S-ST—going straight—stationary.

S-OU – Going **S**traight - **O**ther/**U**nusual

No illustration

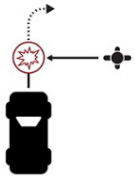
S-U – Going **S**traight - **U**nknown

No illustration

Motorist Turning Right crash types

The group of crash types involving motorists who were turning right or about to turn right—when the crash with a non-motorist occurred—are presented as follows:

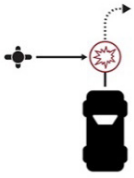
R-CR – Turning **R**ight - **C**rossing Path from Motorist's **R**ight (see figure 41).



Source: FHWA.

Figure 41. Illustration. R-CR—turning right—crossing path from motorist's right.

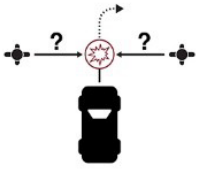
R-CL – Turning **R**ight - **C**rossing Path from Motorist's **L**eft (see figure 42).



Source: FHWA.

Figure 42. Illustration. R-CL—turning right—crossing path from motorist's left.

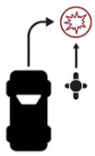
R-CU – Turning **R**ight - **C**rossing Path **U**nknown Direction (see figure 43).



Source: FHWA.

Figure 43. Illustration. R-CU—turning right—crossing path unknown direction.

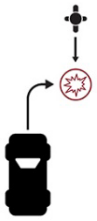
R-PS – Turning **R**ight - **P**arallel Path **S**ame Direction (see figure 44).



Source: FHWA.

Figure 44. Illustration. R-PS—turning right—parallel path same direction.

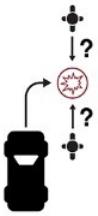
R-PO – Turning **R**ight - **P**arallel Path **O**pposite Direction (see figure 45).



Source: FHWA.

Figure 45. Illustration. R-PO—turning right—parallel path opposite direction.

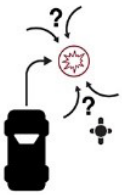
R-PU – Turning **R**ight - **P**arallel Path **U**nknown Direction (see figure 46).



Source: FHWA.

Figure 46. Illustration. R-PU—turning right—parallel path unknown direction.

R-MU – Turning **R**ight – **M**oving in **U**nknown Path/Direction (see figure 47).



Source: FHWA.

Figure 47. Illustration. R-MU—turning right—moving in unknown path/direction.

R-ST – Turning **R**ight – **St**ationary (see figure 48).

Source: FHWA.

Figure 48. Illustration. R-ST—turning right—stationary.

R-OU – Turning **R**ight - **O**ther/**U**nusual

No illustration

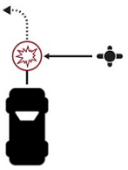
R-UN – Turning **R**ight – **Un**known

No illustration

Motorist Turning Left crash types

Crash types involving motorists who were turning left or about to turn left, or the rarer circumstance of a motorist making a U-turn just before the collision, are shown next. U-turns have similar (although not identical) conflicts and treatments as left-turns and were deemed to be relatively rare, so they were combined with left-turns to reduce the number of distinct crash types.

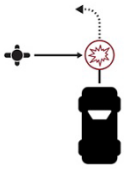
L-CR – Turning **L**eft - **C**rossing Path from Motorist's **R**ight (see figure 49).



Source: FHWA.

Figure 49. Illustration. L-CR—turning left—crossing path from motorist's right.

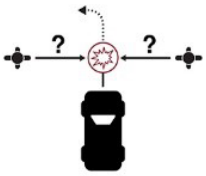
L-CL – Turning **L**eft - **C**rossing Path from Motorist's **L**eft (see figure 50).



Source: FHWA.

Figure 50. Illustration. L-CL—turning left—crossing path from motorist's left.

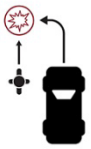
L-CU – Turning **L**eft - **C**rossing Path **U**nknown Direction (see figure 51).



Source: FHWA.

Figure 51. Illustration. L-CU—turning left—crossing path from unknown direction.

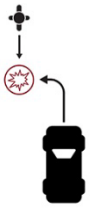
L-PS – Turning **L**eft - **P**arallel Path **S**ame Direction (see figure 52).



Source: FHWA.

Figure 52. Illustration. L-PS—turning left—parallel path same direction.

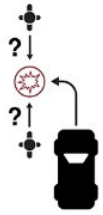
L-PO – Turning **L**eft - **P**arallel Path **O**pposite Direction (see figure 53).



Source: FHWA.

Figure 53. Illustration. L-PO—turning left—parallel path opposite direction.

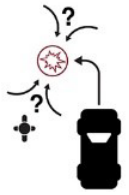
L-PU – Turning **L**eft - **P**arallel Path **U**nknown Direction (see figure 54).



Source: FHWA.

Figure 54. Illustration. L-PU—turning left—parallel path from unknown direction.

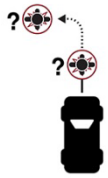
L-MU – Turning **L**eft - **M**oving in **U**nknown Path/Direction (see figure 55).



Source: FHWA.

Figure 55. Illustration. L-MU—turning left—moving in unknown path/direction.

L-ST – Turning **L**eft – **St**ationary (see figure 56).



Source: FHWA.

Figure 56. Illustration. L-ST—turning left—stationary.

L-OU – Turning **L**eft - **O**ther/**U**nusual

No illustration

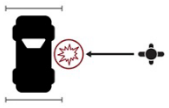
L-UN – Turning **L**eft – **Un**known

No illustration

Parked Motor Vehicle crash types

Crashes involving non-motorists colliding with parked motor vehicles are presented next. Non-motorists may collide with parked motor vehicles at **On Trafficway** locations as well as **Non-Trafficway** locations such as parking lots and driveways.

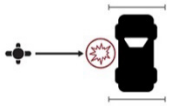
P-CR – **P**arked - **C**rossing Path from Motorist's **R**ight (see figure 57).



Source: FHWA.

Figure 57. Illustration. P-CR—parked—crossing path from motorist's right.

P-CL – **P**arked - **C**rossing Path from Motorist's **L**eft (see figure 58).



Source: FHWA.

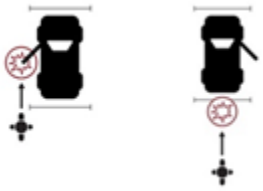
Figure 58. Illustration. P-CL—parked—crossing path from motorist's left.

P-CU – **P**arked - **C**rossing Path **U**nknown Direction (see figure 59).

Source: FHWA.

Figure 59. Illustration. P-CU—parked—crossing path from unknown direction.

P-PS – **P**arked - **P**arallel Path **S**ame Direction (see figure 60).



Source: FHWA.

Figure 60. Illustration. P-PS—parked—parallel path same direction.

P-PO – **P**arked - **P**arallel Path **O**pposite Direction (see figure 61).

Source: FHWA.

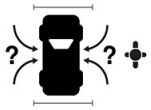
Figure 61. Illustration. P-PO—parked—parallel path opposite direction.

P-PU – **P**arked - **P**arallel Path **U**nknown Direction (see figure 62).

Source: FHWA.

Figure 62. Illustration. P-PU—parked—parallel path unknown direction.

P-MU – **P**arked - **M**oving in **U**nknown Path/Direction (see figure 63).



Source: FHWA.

Figure 63. Illustration. P-MU—parked—moving in unknown path/direction.

No P-ST crash type

P-OU – **P**arked - **O**ther/**U**nusual

No illustration

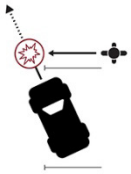
P-UN – **P**arked – **Un**known

No illustration

Motorist Entering Traffic Lane crash types

The next set of crash types includes motorists who were *Entering* a *Traffic Lane* at the time of the crash with a non-motorist. Examples include motorists who were merging into a traffic lane from a non-through type of trafficway facility such as a parking lane, a bus pull-out, stopping/loading zone, ramp, or shoulder. These situations are distinguished from motorists turning onto a trafficway (including from driveways, which are included in turning or other maneuver types) and from crashes that involved motorists who were backing at the time of the crash.

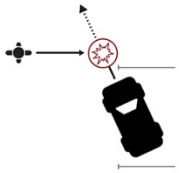
E-CR – **E**ntering Traffic Lane - **C**rossing Path from Motorist's **R**ight (see figure 64).



Source: FHWA.

Figure 64. Illustration. E-CR—entering traffic lane—crossing path from motorist's right.

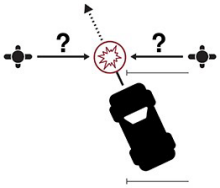
E-CL – **E**ntering Traffic Lane - **C**rossing Path from Motorist's **L**eft (see figure 65).



Source: FHWA.

Figure 65. Illustration. E-CL—entering traffic lane—crossing path from motorist's left.

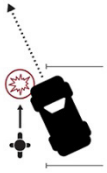
E-CU – **E**ntering Traffic Lane - **C**rossing Path **U**nknown Direction (see figure 66).



Source: FHWA.

Figure 66. Illustration. E-CU—entering traffic lane—crossing path unknown direction.

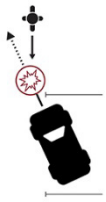
E-PS – **E**ntering Traffic Lane - **P**arallel Path **S**ame Direction (see figure 67).



Source: FHWA.

Figure 67. Illustration. E-PS—entering traffic lane—parallel path same direction.

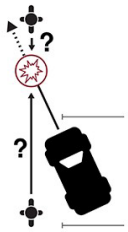
E-PO – **E**ntering Traffic Lane - **P**arallel Path **O**pposite Direction (see figure 68).



Source: FHWA.

Figure 68. Illustration. E-PO—entering traffic lane—parallel path opposite direction.

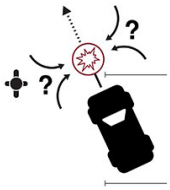
E-PU – **E**ntering Traffic Lane - **P**arallel Path **U**nknown Direction (see figure 69).



Source: FHWA.

Figure 69. Illustration. E-PU—entering traffic lane—parallel path unknown direction.

E-MU – **E**ntering Traffic Lane - **M**oving in **U**nknown Path/Direction (see figure 70).



Source: FHWA.

Figure 70. Illustration. E-MU—entering traffic lane—moving in unknown path/direction.

E-ST – **E**ntering Traffic Lane – **St**ationary (see figure 71).

Source: FHWA.

Figure 71. Illustration. E-ST—entering traffic lane—stationary.

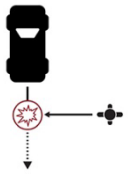
E-OU – **E**ntering Traffic Lane - **O**ther/**U**nusual
No illustration

E-UN – **E**ntering Traffic Lane – **Un**known
No illustration

Motorist Backing crash types

Crashes when the motorist was *Backing* up at the time of the collision are described next. Many backing-related crashes tend to occur in non-trafficway locations such as parking lots, private driveways, and others, but they can also occur on trafficways during parking-related maneuvers, as vehicles enter trafficways and cross driveway access points to roads, and others.

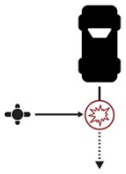
B-CR – Backing–**C**rossing from Motorist's **R**ight (see figure 72).



Source: FHWA.

Figure 72. Illustration. B-CR—backing—crossing from motorist's right.

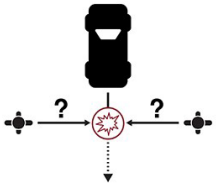
B-CL – Backing–**C**rossing from Motorist's **L**eft (see figure 73).



Source: FHWA.

Figure 73. Illustration. B-CL—backing—crossing from motorist's left.

B-CU – Backing–**C**rossing Path **U**nknown Direction (see figure 74).



Source: FHWA.

Figure 74. Illustration. B-CU—backing—crossing from unknown direction.

B-PS – Backing–**P**arallel Path **S**ame Direction (see figure 75).

Source: FHWA.

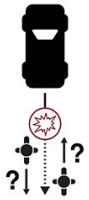
Figure 75. Illustration. B-PS—backing—parallel path same direction.

B-PO – Backing–**P**arallel Path **O**pposite Direction (see figure 76).

Source: FHWA.

Figure 76. Illustration. B-PO—backing—parallel path opposite direction.

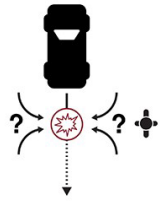
B-PU – Backing–**P**arallel Path **U**nknown Direction (see figure 77).



Source: FHWA.

Figure 77. Illustration. B-PU—backing—parallel path unknown direction.

B-MU – Backing–**M**oving in **U**nknown Path/Direction (see figure 78).



Source: FHWA.

Figure 78. Illustration. B-MU—backing—moving in unknown path/direction.

B-ST – Backing–**St**ationary (see figure 79).

Source: FHWA.

Figure 79. Illustration. B-ST—backing—stationary.

B-OU – Backing–**O**ther/**U**nusual

No illustration

B-UN – Backing–**Un**known

No illustration

Motorist Other Maneuver crash types

The final group of crashes is one in which there is information about the motorist maneuvers, but they were ones that do not fit any of the previously described categories. Crashes involving motorists who were leaving traffic lanes (e.g., exiting to a ramp, parking, but were not turning or backing) or who were stopped and remained stopped before the crash (both tend to be fairly uncommon crash situations) are included in this group. Crashes involving hit-and-run motorists and others may lack detail, particularly if the non-motorist was unable to report on the events and there were no witnesses. Other crashes may have scenarios that are known but do not fit any of the more typical and described maneuvers. Crashes involving **Other/Unknown** types of *Motorist Maneuvers* are shown next:

O-CR – Other Maneuver–**C**rossing Path from Motorist's **R**ight

O-CL – Other Maneuver–**C**rossing Path from Motorist’s **L**eft

O-CU – Other Maneuver–**C**rossing Path **U**nknown Direction

O-PS – Other Maneuver–**P**arallel Path **S**ame Direction

O-PO – Other Maneuver–**P**arallel Path **O**pposite Direction

O-PU – Other Maneuver–**P**arallel Path **U**nknown Direction

O-MU – Other Maneuver–**M**oving in **U**nknown Path/Direction

O-ST – Other Maneuver–**St**ationary

O-OU – Other Maneuver–**O**ther/**U**nusual

O-UN – Other Maneuver–**Un**known

Other crash types are varied and not well-defined, there are no illustrations in the crash typing application.

Motorist Unknown Maneuver crash types

Finally, there are crash types in which the *Motorist Maneuver* cannot be determined from the crash report. These types, which are essentially defined by only the Non-motorist Maneuver, are as follows:

U-CR – **U**nknown Maneuver–**C**rossing Path from Motorist's **R**ight

U-CL – **U**nknown Maneuver–**C**rossing Path from Motorist's **L**eft

U-CU – **U**nknown Maneuver–**C**rossing Path **U**nknown Direction

U-PS – **U**nknown Maneuver–**P**arallel Path **S**ame Direction

U-PO – **U**nknown Maneuver–**P**arallel Path **O**pposite Direction

U-PU – **U**nknown Maneuver–**P**arallel Path **U**nknown Direction

U-MU – **U**nknown Maneuver–**M**oving in **U**nknown Path/Direction

U-ST – **U**nknown Maneuver–**St**ationary

U-OU – **U**nknown Maneuver–**O**ther/**U**nusual

U-UN – **U**nknown Maneuver–**Un**known [both maneuvers are unknown]

Unknown crash types do not have illustrations.

Other Maneuvers and Crash-Related Indicators

For crashes that occurred on trafficways, PBCAT 3 users have the option to code four additional factors that may further describe user movements for certain crashes. These variables do not alter the crash type but add additional information. These variables include:

- Whether the non-motorist was turning or changed trajectory prior to the crash (and which direction);
- Whether the motorist or non-motorist was overtaking (only applied to select parallel path crash types);
- Whether the non-motorist was going in the opposite or same direction as adjacent motorized traffic; and
- An option to indicate a ‘dooring’ type event when a non-motorist struck a Parked vehicle.

These variables are described next.

Non-motorist Turning (non-motoristTurning in CSV file)(Optional)

Turning movements by the non-motorist, if any, are not captured in the *Non-motorist Maneuver* or *Crash Type* variables but are provided as an additional variable option. This question is likely most relevant to capture when the non-motorist was initially on a parallel path with a motorist that was not turning. However, it may also apply to initial crossing path crashes and parallel path crashes when the motorist was also turning. This question may also apply to any type of non-motorist, not only cyclists and other wheeled vehicle users. For example, a pedestrian could be walking or jogging along a sidewalk on an initial path parallel with a motorist who was going straight and suddenly cross into the street (go left or right) into the path of the motorist.

Question:

Did the non-motorist change direction, turn, or merge just prior to the crash?

Category options (no Illustrations):

Straight: The non-motorist continued on a straight path.

Left: The non-motorist turned, merged, or moved left.

Right: The non-motorist turned, merged, or moved right.

Unknown: Unknown whether the non-motorist turned, merged, or changed direction.

Not Applicable

Overtaking Indicator (overtakingIndicator in CSV file) (Optional)

In crashes involving the motorist going straight ahead and the non-motorist on a parallel path in the same direction (S-PS crash type), users are offered the opportunity to also code which party was overtaking the other. This indicator can be used to help align PBCAT 3 data with the overtaking crash types in earlier versions of PBCAT.

Question:

Was the motorist or the non-motorist overtaking the other at the time of the crash?

Category options (no illustrations):

Motorist was Overtaking the Non-motorist

Non-motorist was Overtaking the Motorist

Unknown

Not Applicable

The *Overtaking Indicator* is also automatically populated with Not Applicable, if the *Detailed Crash Type* is not **S-PS. A skip button also allows the User to skip coding this variable.**

(Non-motorist) Contraflow Indicator (contraflowIndicator in CSV file) (Optional)

This variable can also apply to any type of non-motorist, and to most location types or crash circumstances, including intersections. This variable provides an additional indication of the relative travel path of the non-motorist compared to the most adjacent parallel vehicular traffic (if any). This variable can be used to further determine if the non-motorist was traveling in an unexpected direction—say a bicyclist traveling opposite to adjacent vehicular traffic (which may not necessarily be the striking vehicle), or conversely, a pedestrian who was traveling in the same direction as adjacent traffic where there is no pedestrian facility. It may not apply if the

non-motorist is initially on an off-street path or entering a trafficway from a driveway. **Not Applicable** can be selected in these circumstances. The variable could potentially be useful for vehicle technologies research as well.

Question:

Was the non-motorist traveling in the same or opposite direction as adjacent motor vehicle traffic just before the crash?

[If there was no parallel motor vehicle traffic, select Not Applicable.]

Category options (no illustrations):

Same direction

Opposite direction

Unknown

Not Applicable

Dooring Indicator (dooringIndicator in CSV file) (Optional)

Crashes involving parked motor vehicles include non-motorists colliding with an open or opening door when a person is exiting or entering a parked motor vehicle. PBCAT 3 users may code the *Dooring Indicator* to distinguish this contributing circumstance. This question is asked if *Crash Type Detailed* is any of the following types involving parked motor vehicles:

P-PS (Motor Vehicle **P**arked–Non-motorist on **P**arallel Path **S**ame Direction as Motor Vehicle)

P-PO (Motor Vehicle **P**arked–Non-motorist on **P**arallel Path **O**pposite Direction as Motor Vehicle)

P-PU (Motor Vehicle **P**arked–Non-motorist on **P**arallel Path, **U**nknown whether Same or Opposite to Motor Vehicle)

The *Dooring Indicator* variable is automatically populated with *Not Applicable* if none of the above three crash types are involved.

Question:

Did the non-motorist strike the door of a motor vehicle that was open or opening?

Category options (no illustrations):

Yes

No

Unknown

Not applicable

Special Circumstances (All are Optional)

The final options available in PBCAT 3 include 44 separate **Special Circumstance** variables. After coding the crash type and other maneuvers variables, users are offered the option to enter additional optional descriptors that may apply to some crashes. As mentioned in the Getting Started section, users can opt to skip this section, and code the next crash, or may code only relevant circumstance questions and skip other questions.

The *Special Circumstance* questions are presented in appendix 2. No illustrations are provided for these questions. The **Special Circumstance** questions are organized by topic and are presented on four screens numbered 1 through 4 as a visual aid to users. To code these indicator variables, users select "Yes" if the circumstance applies to that crash, and otherwise, skip the variable. Because many of these circumstances may not be explicitly mentioned in crash reports unless they were noted by the reporting officer, the distinction between "No" (not present) and "Unknown" may be difficult to make, and so "No" and "Unknown" options were not provided. Therefore, users are guided to select "Yes" if the factor is clearly noted, and otherwise, to skip over the question.

Skipped variables are automatically populated with Skipped as are other variables that are optional to code. The default *Skipped* feature allows the user to quickly code only those **Special Circumstance** indicators that are of most interest or relevant to the particular crash. As noted in the *Other Variables* section, however, the CSV value of "skipped" may reflect a combination of situations, including the circumstance did not apply to the crash, the circumstance cannot be determined from the crash report (is Unknown), or that the user simply skipped the question (or all of this section).

Coding Test

It is recommended that those beginning a project should conduct their own tests of inter-coder consistency of results using samples of crash reports from their jurisdiction. Users may find certain crash data elements in crash reports that coders may interpret differently. Users may also wish to become familiar with the relationships of PBCAT 3 variables to variables commonly collected in the State's crash data. The Variable Mapping chapter provides more information on this topic, using the *MMUCC Guideline* (2017) to show the relationships to PBCAT 3 variables and category option.

VARIABLE MAPPING

This chapter provides information on how PBCAT 3 variables relate to crash data variables using the *MMUCC Guideline* (2017). PBCAT users can familiarize themselves with these comparisons to better understand PBCAT variable definitions, as well as potential opportunities for integrating non-motorist crash typing within State data systems.

This chapter also provides information about determining and comparing sets of PBCAT 3 crash types and crash locations to variables generated from PBCAT 2 crash typed data. This information is most relevant to users who have data from PBCAT 2 and PBCAT 3 crash typing systems and wish to analyze data from both.

PBCAT 3 Variables' Relationships to Collected Crash (*MMUCC Guideline*-recommended) Data Elements

Variables that are most closely related to crash data variables (as defined by the *MMUCC Guideline* (2017)) are described in the following sections:

- Relation to Trafficway.
- Crash Location Type.
- Facility Type at Crash.
- Motorist Precrash Maneuver.

Users may refer to earlier chapters for more detailed definitions of PBCAT 3 variables.

MODE

Basic mode varies from the *MMUCC Guideline* (2017) to consider operational and safety concerns. The relationship between PBCAT 3 definitions of Mode Basic categories and *MMUCC Guideline* (2017) elements is provided in table 3.

Table 3. PBCAT 3 Mode Basic Variable and Categories with Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3—*Mode Basic* Question: What type of person was involved in the crash?	MMUCC Guideline—*Person type* Definition: "Type of person involved in a crash."
1	Pedalcyclist or Power-Assisted Pedalcyclist—Cyclist using a wheeled vehicle with operable pedals or hand cranks. Motor-power assistance may be present.	Bicyclist Other Cyclist Also may include: *Motor Vehicle Body Type Category:* Moped or Motorized Bicycle
2	Powered Personal Conveyance—A person using a powered or power-assisted personal conveyance device that is not pedal-powered. Examples include electric-powered stand-up and sit-down scooters, electric skates, powered boards, and others.	Other Pedestrian (wheelchair, person in a building, skater, personal conveyance, etc.) [In part, includes only those using powered or power-assisted personal conveyances.]

Table 3. (continued) PBCAT 3 Mode Basic Variable and Categories with Relevant *MMUCC Guideline* (2017) Elements.

Element	**PBCAT 3—*Mode Basic*** Question: What type of person was involved in the crash?	**MMUCC Guideline—*Person type*** Definition: "Type of person involved in a crash."
3	**Pedestrian/Other Pedestrian**—A person on foot, sitting, lying, using a self-propelled conveyance (e.g., stroller, skateboard, skates, kick-scooter, skis), or using a wheelchair that is motorized or nonmotorized.	Pedestrian Other Pedestrian (wheelchair, person in a building, skater, personal conveyance, etc.) – [In part—This category in the *MMUCC Guideline* also includes persons using a Powered Personal Conveyance, which is covered in a separate category in PBCAT 3.]

RELATION TO TRAFFICWAY

In PBCAT 3, the definition of *Relation to Trafficway* variable is intended to be consistent with *MMUCC Guideline* (2017) variable description: *Crash Classification, Characteristics* (Subfield 2) determination of whether a crash was related to a trafficway (table 4). *Relation to Trafficway* in PBCAT 3 is not concerned with *Crash Classification, Ownership* (Subfield 1) of the trafficway (public or private ownership). *Subfield 3 (Secondary Crash)* in the *Crash Classification* group of variables may be useful in coding a Special Circumstance crash factor (Vehicle Vehicle/Object) but is not required to determine crash types in PBCAT 3.

Table 4. PBCAT 3 Relation to Trafficway Crash Context Variable and Categories with Relevant *MMUCC Guideline* (2017) Elements.

Element	**PBCAT 3—*Relation to Trafficway*** **Question:** **Did the crash occur on or off a trafficway?** **[A trafficway includes the roadway, shoulder, roadside, and all facilities within the public right-of-way.]**	**MMUCC Guideline—Crash Classification Subfield 2** **Definition:** **"Subfield 2 (Characteristics) of this element is used to identify the characteristics of the crash with respect to its location on or off a trafficway."** **Refer to "Figure 1: Diagram of the Trafficway" (p. 10) for examples.**
1	On-Trafficway—Crash where the unstabilized situation originated within the boundaries of a trafficway or at least one harmful event occurred on the trafficway.	Trafficway, On-Road, or Trafficway, Not on Road
2	Non-Trafficway—Crash where the unstabilized situation originated outside the boundaries of a trafficway and no harmful event occurred on a trafficway.	Non-Trafficway
3	Unknown—It is unknown whether the crash was associated with a trafficway.	No option listed

Crash Location Type

Crash Location Type (for On-Trafficway locations) in PBCAT 3 is most related to the *Relation to Junction (C15)* variables in *MMUCC Guideline* (2017) and requires examination of both subfields (*Within Interchange Area* and *Specific Location*). The category relationships, including a separate requirement for distinguishing Expressway-related crashes, are listed in table 5.

Table 5. PBCAT 3 Crash Location Type Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 ***Crash Location Type*** **Question: Where did the crash occur?**	MMUCC Guideline ***Relation to Junction*** **"The coding of this data element is based on the location of the first harmful event of the crash. It identifies the crash's location with respect to presence in a junction or proximity to components typically in junction or interchange areas. See figure 3." Diagram of an Interchange (p. 23) and figure 4. Diagram of an Intersection (*MMUCC Guideline,* p. 24 (2017)).** ***Subfield 1 Within Interchange Area* and *Subfield 2 Specific Locations* are used in the following cells.**
1	Expressway–Crash occurred on a fully access-controlled trafficway.	This *MMUCC Guideline* element is not used for distinguishing Expressway.
2	Intersection–Crash occurred at or related to an at-grade junction of two or more roadways of any design or within 50 ft of the prolongation of the edge line or curb of the crossing street.	*Relation to Junction* [Definitions do not align completely] *Within Interchange Area* = No; *and* *Specific Location* = Intersection or Related
3	Driveway Access or Related–Crash occurred on or near a driveway access point and was related to movements from the driveway to the trafficway or from the trafficway to the driveway by either party.	*Within Interchange Area* = No *or* Yes; *and* *Specific Location* = Driveway Access or Related
4	Path Crossing/Junction–Crash occurred at the junction of a shared-use path or trail with a trafficway.	*Within Interchange Area* = No; *and* *Specific Location* = Shared-Use Path or Trail
5	Nonjunction (along Trafficway)–Crash occurred at a trafficway location that is not an intersection or a connection between a driveway access, path, or roadway other than a driveway access, and the crash did not occur on a fully-access-controlled freeway or expressway. [This category includes crashes at midblock, marked crosswalks.]	*Within Interchange Area* = No; *and* *Specific Location* = Non-Junction

Table 5. (continued) PBCAT 3 Crash Location Type Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 ***Crash Location Type*** **Question: Where did the crash occur?**	MMUCC Guideline ***Relation to Junction*** **"The coding of this data element is based on the location of the first harmful event of the crash. It identifies the crash's location with respect to presence in a junction or proximity to components typically in junction or interchange areas. See figure 3." Diagram of an Interchange (p. 23) and figure 4. Diagram of an Intersection (*MMUCC Guideline,* p. 24 (2017)).** ***Subfield 1 Within Interchange Area* and *Subfield 2 Specific Locations* are used in the following cells.**
6	Entrance/Exit Ramp or Related–Crash occurred on a ramp that provides access to or from another roadway or results from an activity, behavior, or control related to the movement of traffic units entering or exiting a ramp.	*Within Interchange Area* = No *OR* = Yes; *AND* *Specific Location* = Entrance/Exit Ramp or Related)
7	Railway Grade Crossing–Crash occurred at a railway grade-crossing of a roadway.	*Within Interchange Area* = No; *AND* *Specific Location* = Railway Grade Crossing
8	**Other Trafficway Location**–The crash occurred along a trafficway, but the location type is different from those described.	*Within Interchange Area* = No *OR* = Yes; *AND* *Specific Location* = Other Location Not Listed within an Interchange Area (median, shoulder and roadside)
9	**Unknown Trafficway Location**–The crash occurred along a trafficway, but the location type cannot be further determined.	*Within Interchange Area* = Unknown *Specific Location* = Unknown

For identifying crashes that occurred on **Expressways**, *MMUCC Guideline (2017)* related variables that might be used include:

Road Functional Class = **Rural Interstate, Rural Principal Arterial–Other Freeway or Expressway, Urban Interstate,** *OR* **Urban Principal Arterial–Other Freeway or Expressway.**

OR

Access Control = **Full Access Control.**

For crashes that occurred entirely outside a trafficway in PBCAT 3, *Relation to Trafficway* = **Non-Trafficway**, *MMUCC Guideline* (2017) variable should be:

Crash Classification, Subfield 1 - Ownership may be either **Public Property** or **Private Property**,

Crash Classification, Subfield 2 - Characteristics should be **Non-Trafficway***, AND*

Non-motorist Location at Time of Crash should be designated **Non-Trafficway Area**.

Facility Type at Crash

The facility type where the non-motorist was located at the time of the collision (*Non-motorist Facility Type at Crash*) provides a more distinct definition of the specific type of travel facility (compared with the general location type) the non-motorist was on at the time and point of the collision. This PBCAT 3 variable is most comparable to the *MMUCC Guideline*-recommended variable *Non-motorist Location at Time of Crash* (variable NM4 in the *MMUCC Guideline* (2017)) (table 6). If a similar variable is accurately collected in the State's crash data, there may be no need to code this optional variable within PBCAT 3.

The *MMUCC Guideline* (2017) does not specify a variable for *Non-motorist Precrash Facility Type* to capture the facility the non-motorist was using just prior to any maneuvers/actions that may have led to the crash.

Table 6. PBCAT 3 Non-motorist Facility Type at Crash Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 ***Non-motorist Facility Type at Crash*** **Question: What facility type was the non-motorist on at the time and point of the crash?**	MMUCC Guideline ***Non-motorist Location at Time of Crash*** **Definition: "The location of the non-motorist with respect to the roadway at the time of the crash." See "figure 20: Separated Bike Lanes compared to other bicycle facility types" (p. 118).**
1	Intersection-Crosswalk–An area of the roadway designated for pedestrian crossing. The crosswalk may be marked on the roadway or may be an implied, legal crosswalk that is not marked.	Intersection-Marked Crosswalk Intersection-Unmarked Crosswalk
2	Intersection-Other–Area within the bounds of an intersection but not in a marked or unmarked crosswalk.	Intersection-Other
3	Median/Crossing Island–Area of a trafficway that separates traffic in opposite directions; a crossing island is a type of raised median that provides refuge for crossing non-motorists.	Median/Crossing Island

Table 6. (continued) PBCAT 3 Non-motorist Facility Type at Crash Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 ***Non-motorist Facility Type at Crash*** **Question: What facility type was the non-motorist on at the time and point of the crash?**	MMUCC Guideline ***Non-motorist Location at Time of Crash*** **Definition: "The location of the non-motorist with respect to the roadway at the time of the crash." See "figure 20: Separated Bike Lanes compared to other bicycle facility types" (p. 118).**
4	Midblock-Marked Crosswalk–Marked area of the roadway designated for pedestrian crossing that is not located at an intersection.	Midblock-Marked Crosswalk
5	Shoulder/Roadside–Part of a trafficway from the edge of the vehicular travel lanes extending to the property line (including unpaved right-of-way), but excluding designated pedestrian and cyclist facilities.	Shoulder/Roadside
6	Travel Lane-Other Location–Lane designated for vehicular travel and lacking other facility type markings/designations.	Travel Lane-Other Location Sign Route (no pavement marking) Shared Lane Markings
7	Driveway Access–Sidewalk, bike lane, or shoulder area continued across a driveway access at the junction with a trafficway.	Driveway Access
8	Sidewalk–Area adjacent to travel lanes typically designated for pedestrian use. Includes curbs or curb ramps.	Sidewalk
9	On-Street Striped Bike Lane–On-road bicycle facility designated by striping, signing, and pavement markings.	On-Street Bike Lanes
10	On-Street Buffered Bike Lane–Bicycle lane with a painted buffer separating it from motor vehicle lanes.	On-Street Buffered Bike Lanes
11	Separated Bike Lane-One-way–One-way facility designated for use by bicyclists that is adjacent to but physically separated from motor vehicle lanes by a vertical element and is within the trafficway.	Separated Bike Lanes [no separate distinction for one-way or two-way]

Table 6. (continued) PBCAT 3 Non-motorist Facility Type at Crash Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 ***Non-motorist Facility Type at Crash*** **Question: What facility type was the non-motorist on at the time and point of the crash?**	MMUCC Guideline ***Non-motorist Location at Time of Crash*** **Definition: "The location of the non-motorist with respect to the roadway at the time of the crash." See "figure 20: Separated Bike Lanes compared to other bicycle facility types" (p. 118).**
12	Separated Bike Lane–Two-way–Two-way facility designated for use by bicyclists that is adjacent to but physically separated from motor vehicle lanes by a vertical element and is within the trafficway.	Separated Bike Lanes [no separate distinction for one-way or two-way]
13	Sidepath–Shared-use path physically separated from motor vehicle traffic by a curb, open space, or barrier, but parallel to and within the trafficway and used by pedestrians, cyclists, and other non-motorists.	Off-Street Trails/Sidepaths
14	Off-Street Trail–Shared-use pathway that is not adjacent to a roadway and is used by pedestrians, cyclists, and other non-motorists.	Shared-Use Path or Trail
15	Other Facility– Any facility not listed in other options, including parking lane, bus pullout, loading zone, or non-trafficway area (e.g., parking lot, open space).	Other
16	Unknown–The facility the non-motorist was on is not known.	Unknown

More specific coding of facility types for *Non-Trafficway* related non-motorist crashes is not provided in PBCAT 3.

Motorist Precrash Maneuver

Motorist Precrash Maneuver is adapted from the *MMUCC Guideline* (NHTSA, 2017) variable type: *Motor Vehicle Maneuver/Action*. Some maneuvers were consolidated for PBCAT 3. These relationships are shown in table 7.

Table 7. PBCAT 3 Motorist Maneuver Categories and Relevant *MMUCC Guideline* (2017) Elements.

Element	PBCAT 3 Question: What was the motorist maneuver just prior to the crash? [If more than one motorist was involved, select the maneuver of the motorist that most caused the crash sequence.]	MMUCC Guideline Motor Vehicle Maneuver/Action categories Definition for: Motor Vehicle Maneuver/Action: The controlled maneuver for this motor vehicle prior to the beginning of the sequence of events.
1	S: Going straight–The motorist movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing.	Changing Lanes Movements Essentially Straight Ahead) Negotiating a Curve Overtaking/Passing Slowing
2	R: Turning right–The motorist was turning right or preparing to turn right.	Turning Right
3	L: Turning left–The motorist was turning left or preparing to turn left or making a U-turn.	Making U-Turn Turning Left
4	P: Parked–The motor vehicle was parked at the time of the collision. The vehicle may have been occupied or unoccupied but was stopped in traffic. [Select Other Maneuver for stopped in traffic.]	Parked
5	E: Entering traffic lane–The motorist was entering or merging into a travel lane from a parallel parking, bus, or delivery pull-out zone, ramp, shoulder, or other non-thru facility. [Select a turning option if the motorist was turning from a roadway or a driveway to another roadway.]	Entering Traffic Lane
6	B: Backing–The motorist was backing.	Backing
7	O: Other maneuver–The motorist maneuver was other than those described in previous options. [Select this option for motorists that were leaving a traffic lane or were stopped and remained stopped prior to the crash.]	Leaving Traffic Lane Stopped in Traffic Other
8	U: Unknown maneuver–The motorist maneuver is unknown or cannot be determined.	Unknown
9	N: Non-collision–One or more motorists may have been involved in events leading up to the crash, but there was no contact between any motor vehicle and the non-motorist.	n/a

Non-motorist Maneuver/Action

PBCAT 3 captures the non-motorist actions relative to the motorist maneuvers, which is a way to measure non-motorist actions with relevance for various types of countermeasures, including vehicle detection technologies. The PBCAT 3 variable *Non-motorist Motorist Maneuver* does not correspond directly to a variable identified in the *MMUCC Guideline* (NHTSA, 2017).

The *MMUCC Guideline* (NHTSA, 2017) does offer recommendations to States on collecting motorist travel direction just before the crash but does not provide a recommendation about non-motorist travel paths or direction. However, some States indicate the travel direction of both motorists and non-motorists before the crash. These indications should be provided in crash diagrams (and narrative descriptions) that are a component of States crash reports, even if non-motorist direction is not captured in a variable in the crash database.

The right column in table 8 displays the relationships for determining the relative direction of non-motorists to motorists that may help to determine non-motorist maneuvers in PBCAT 3. Definitions of motorist *Direction of Travel Before Crash* (V13 in the *MMUCC Guideline* (NHTSA, 2017)) may include: *Not on Roadway, Northbound, Eastbound, Southbound, Westbound*, and *Unknown***.** The shorthand indications used in table 8, which may be based on assigned roadway direction or cardinal direction, are as follows:

- NB = Northbound.
- EB = Eastbound.
- SB = Southbound.
- WB = Westbound.

Note that some States may allow up to two direction indicators (e.g., NW bound), and the corresponding directional relationships may be adapted according to practice.

Table 8. PBCAT 3 Non-motorist Maneuver and Potential Directionality Indicators in Crash Data.

Element	PBCAT 3 *Non-motorist Maneuver/Action* Question: What was the non-motorist's direction of travel, relative to the motorist's direction, just prior to the crash? [Select the paths BEFORE any pending turns or other maneuvers were completed by either party.]	Directionality Combinations for the *Non-motorist Maneuver* (Motorist : Non-motorist direction indications in the crash report)
1	CR: From Motorist's Right—The non-motorist was traveling on a crossing path approaching from the motorist's right BEFORE any turns.	NB:WB EB:NB SB:EB WB:SB
2	CL: From Motorist's Left—The non-motorist was traveling on a crossing path approaching from the motorist's left BEFORE any turns.	NB:EB EB:SB SB:WB WB:NB

Table 8. (continued) PBCAT 3 Non-motorist Maneuver and Potential Directionality Indicators in Crash Data.

Element	PBCAT 3 *Non-motorist Maneuver/Action* Question: What was the non-motorist's direction of travel, relative to the motorist's direction, just prior to the crash? [Select the paths BEFORE any pending turns or other maneuvers were completed by either party.]	Directionality Combinations for the *Non-motorist Maneuver* (Motorist : Non-motorist direction indications in the crash report)
3	CU: Crossing Path to Motorist-Unknown Direction—The non-motorist was crossing a trafficway or other facility at an angle to the motorist BEFORE any turns, but it could not be determined whether the non-motorist was approaching from the motorist's right or from the left.	Crossing path may be indicated in a separate variable or in the report narrative/diagram, but direction may be unclear.
4	PS: Same Basic Direction as Motorist—The non-motorist was traveling on a more or less parallel path in the same direction as the motorist BEFORE any turns.	NB:NB EB:EB SB:SB WB:WB
5	PO: Opposite Direction as Motorist—The non-motorist was traveling on a more or less parallel path in an opposing direction to the motorist BEFORE any turns.	NB:SB EB:WB SB:NB WB:EB
6	PU: Parallel Path to Motorist, Unknown Direction—The non-motorist was traveling in a parallel path to the motorist BEFORE any turns, but it could not be further determined whether the non-motorist was moving in the same or opposite direction.	Parallel path may be indicated in a separate variable or in the report narrative/diagram, but relative direction (same or opposite) may be unclear.
7	MU: Moving in Unknown Direction–The non-motorist was moving in a direction that could not be determined.	Non-motorist movement may be indicated, with unclear directionality.
8	ST: Stationary–The non-motorist was stationary or not detected moving prior to the collision (e.g., was standing, sitting, lying).	Non-motorist may be indicated to be standing, sitting, lying, or otherwise not moving in the report.
9	OU: Other/unusual–The non-motorist' movement does not fit any of the described circumstances. [Select this option for a person exiting a parked vehicle, holding on to a vehicle, or making other or unusual actions.]	Non-motorist may be indicated to be entering/exiting a vehicle, pushing a vehicle, or on a vehicle before the crash.
10	UN: Unknown–The non-motorist's movement or actions are unknown or cannot be determined.	No information about the non-motorist's movement is provided.
11	FC: Non-motorist fall or crash–There was no direct collision with a motor vehicle, although a motor vehicle may have been involved in the lead-up to the non-motorist crash into an object, person, or fall.	Not applicable.

Comparing PBCAT 3 to PBCAT 2 Crash Types

Users of PBCAT 2 (Harkey et al., 2006) may have data from using that system that they wish to analyze with new data from PBCAT 3. Before undertaking this mapping with their own data, users should be aware that, in general, any time changes (major or minor) are made in reporting or coding of crash data, these changes can affect the frequencies of resulting variable categories in the data. Thus, interpretation of results is confounded between what is due to the changes in definition and data processing and what may be due to actual changes in crash trends over time and other reasons (including randomness). This caveat is especially important to bear in mind when comparing PBCAT 3 to PBCAT 2 crash types, since the changes to the logic and variable definitions in PBCAT 3 are substantial. Even when definitions appear similar, the change in logic and order of coding can affect the outcome. Thus, while users can map crash data variables generated in the two systems to similar groups of crash types, users are advised to interpret differences cautiously, considering that some of the changes may be due to these definitions and other changes in the crash typing process. Users should consider the comparisons as trends for generally similar types of crashes. These same cautions could be applied to interpreting PBCAT 2-only trends across time or across jurisdictions. Due to the subjective nature of some of the crash types, differences in trends could be partially due to different coders, laws, and other subjective determinations.

Note that in PBCAT 2, separate crash typing modules and definitions were provided for bicycle-involved and pedestrian-involved collisions. Thus, a first step in mapping crash types between PBCAT 2 and PBCAT 3 will be to identify the mode or road user types involved in the collisions coded in PBCAT 3 that best fit with definitions used when developing the PBCAT 2 data. Appendix 4 presents steps and indepth information on the mapping of PBCAT 3 and PBCAT 2 crash location types and pedestrian and bicyclist crash types. As previously mentioned, because of the extensive re-definition of crash types, the mapping is intended to provide general comparisons of groups of generally similar type.

ANALYSIS NOTES

The chapter provides insights and tips for the analysis of PBCAT 3 data. By simplifying the definitions of crash types in PBCAT 3, these variables are more objective and flexible for varied safety analysis purposes. Location context and other crash-related variables are defined independently from crash types to improve the ability to identify safety relationships. Because crash types are independent of location type and other variables associated with each crash, PBCAT 3 data will enable analysis of the relationships that exist within each data set. By separating the information into distinct variables, agencies can better identify potential relationships to hone-in on opportunities for hotspot, corridor, and systemic level treatments. For example, cyclists riding against the flow of traffic could be associated primarily with certain crash types (e.g., **R-CR** type), but it could also relate to cyclists using certain types of facilities associated with different corridors. It should be possible to determine these relationships since separate variables are available to determine crash types, location and facility types, contraflow riding as well as other crash-related variables).

Analysis Tips

Eighty *Detailed Crash Types* and 33 *Basic Crash Types* can be generated from the combinations of *Motorist* and *Non-motorist Maneuvers*. These numbers include 17 detailed types, for which information is missing for one or both parties, and the 'non-collision' type, leaving 62 well-defined crash types. Some types involving more unusual maneuvers or unclear actions will likely be relatively infrequent in many users' data. If this scenario is the case, analysts may want to combine or regroup some crash types for further analysis.

The purpose of the analysis should inform the variables used and type of analysis. However, before diving into any analysis, it is a good idea to become familiar with the data and explore the frequencies of variables. There may be a need to combine some infrequent types for some analyses. The naming convention of crash types allows PBCAT users and data analysts to recall the meaning, which should facilitate combining 'similar' types (e.g., all types involving motorist **Backing** (**B**-*XX* types) or all types involving non-motorist on a **P**arallel Path **S**ame Direction (*X*-**PS** *types*).

Tip 1: A first step might be to determine the frequencies of each of the crash types (both detailed and basic) by mode and decide if there is a need to combine some categories or focus further analyses on a few more prevalent crash types.

Cross-tabulate *Mode Basic* with

Crash Type (Detailed and *Basic*)

Crash Location Type

(the *Relation to Trafficway* variable can be used to subset crashes by **On-Trafficway** and **Non-Trafficway**)

Tip 2: Depending on the results of step 1 and the purpose of the analysis (e.g., if pedestrian, cyclist, or personal conveyance-focused), analysts may want to subset crashes by ModeBasic or Mode Detailed. Analysts may want to determine whether *Mode Detailed* includes complete data and the relative frequencies of crash types by these different detailed modes.

Then consider examining the two-way (or really three-way) frequencies of:

Crash Type (*Detailed*) with

Crash Location Type

Within each *Mode* being analyzed.

This step allows the analyst to determine which crash and location type combinations may be most important for each mode. This step alone may help to illustrate similarities and differences in collision patterns among different modes and some high-frequency relationships. This analysis may also suggest categories that might be relatively less prevalent among some modes, and potentially consolidated for further analysis.

Tip 3: Following the exploration of crash types by mode and location type, determine other prevalent crash patterns and relationships. These investigations may include exploring the relationships of crash types to facilities the non-motorist was using at the time of the crash (*Non-motorist Facility Type at Crash*) and just before the crash (*Non-motorist Precrash Facility Type*) if this information was coded. Any of the remaining variables and additional non-PBCAT variables from the crash database can be explored by frequency and cross-tabulation frequencies.

Tip 4*:* Several optional indicators that can be coded in PBCAT 3 should also help to flesh out the events of some crashes, particularly those involving bicyclists or faster modes. These variables may be of interest in their own right and can be interacted with *Crash Location Type* and *Crash Type,* as mentioned within their respective sections, to identify prevalent patterns. *Facility Types* may also have a relationship with these patterns and crash types. Variables that may be of interest for any of the *Modes*, regardless of crash or location type, include:

- *Contraflow Indicator*—non-motorist road users such as cyclists or scooter-users may ride in the opposite direction of adjacent traffic, which may have safety effects both along the roadway and at intersections. This variable may also correlate with the facility type these road users are using just before the crash (*Non-motorist Facility Type Prior to Crash*), with some data sets showing this action is more common when bicyclists, for example, are also using sidewalks. For crashes involving **Pedalcyclists** or for **Powered-Personal Conveyance** users, this indicator may suggest a need for facility improvements (including better crossing opportunities), or redesigns to help reduce riding against traffic or on sidewalk facilities.

- *Contraflow Indicator*—For **Pedestrians**, the same variable can be used to determine whether pedestrians were walking against traffic (category of **Opposite direction** in the data) or not. Walking facing traffic is thought to be protective for pedestrians walking where there is no sidewalk or sidepath facility. However, there could also potentially be differences in motorist (or vehicle) detection of pedestrians who are walking in the same

or opposite direction as adjacent traffic, whether along a road section or at intersection. This variable may be useful in multiple types of safety assessments for pedestrians as well as for cyclists and faster non-motorists.

- *Non-motorist Turning* Left or Right—Similarly, the influence of non-motorists trying to turn or turning at the time of the crash could indicate a need for improvements to facilitate non-motorists' travel needs and patterns.

The *Crash Type* and *Crash Location Type* and facilities variables can be used to help identify the circumstances and types of locations most associated with these crash events.

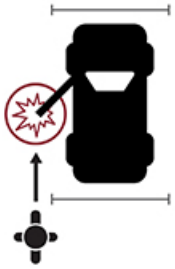
Motorist overtaking bicyclist has been found to be associated with nearly one-third of bicyclist fatalities in the U.S. (Thomas et al. 2019). For crashes involving (Motorist) *Going Straight–(Non-motorist on) Parallel Path Same Direction* (**S-PS** in *Detailed Crash Type*), analysts may want to know which party was overtaking the other for some types of countermeasures purposes (e.g., vehicle detection and response technologies[2]). The Overtaking Indicator variable can be used to examine overtaking. The motorist was overtaking the non-motorist or the non-motorists was overtaking the motorist.

For some types of countermeasures (e.g., provision of separate facilities) it may be less important to identify which party was overtaking the other to understand that there were challenges for non-motorists and motorists to safely share the trafficway space provided when traveling on parallel paths. All **S-P** crashes (*Basic Crash Type*, **Going Straight–Parallel Path**), and potentially other types, including **Parking-**related types, could be identified to consider improvements to the amount and type of separated space to provide for non-motorists.

In relation to on-street parking, users may want to break out another bicyclist crash type commonly referred to as a "dooring" crash in which a bicyclist approaching a parked car hits a car door that has just been opened. This crash type can be serious and may also lead to secondary crashes. The *Dooring Indicator* can assist with breaking out such crashes in which the non-motorist on a parallel path struck a parked motor vehicle. The image of **P-PS** (**Parked: Parallel Path Same Direction**) in the crash typing application represents the Dooring scenario (figure 80), although this general crash type may also include non-motorists running into other areas of parked vehicles. Compare figure 80 to figure 81, which illustrates the non-motorist colliding with the rear of a parked motor vehicle.

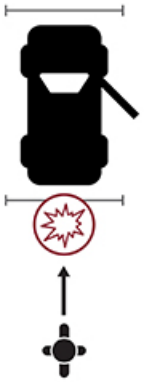
The motorist *Roadway Departure* indicator can help to verify if the motor vehicle left the roadway or proper travel lane before colliding with a non-motorist. Non-motorists may be struck on sidewalk or bike lane facilities, in medians, or other areas along roadsides. This indicator can be used in the case the facility types could not be coded and to determine issues that may relate to motorist loss of control, speeding, or distraction.

[2]For an example of a crash typing study that aimed to understand patterns that may be important with respect to assessing impacts of vehicle technologies for crash avoidance, see MacAlister and Zuby 2015.



Source: FHWA.

Figure 80. Illustration. Illustration of detailed Crash Type P-PS (motor vehicle parked–non-motorist on parallel path same direction as motor vehicle) illustrating the "dooring" scenario.



Source: FHWA.

Figure 81. Illustration. Alternate illustration of detailed Crash Type P-PS (motor vehicle parked–non-motorist on parallel path same direction as motor vehicle) with non-motorist striking the rear of parked motor vehicle.

Tip 5: For analyses of environmental (e.g., light conditions) and personal factors (e.g., age) and interactions with crash types and other variables from PBCAT 3, users will need to link data from the State's crash records system. If spatial attributes are assigned to crashes, other data types (e.g., land use, roadway inventories, demographic data) may also be combined for analysis.

Tip 6: As mentioned previously, depending on the study purpose, consider combining rare and unusual types for some analyses, and focus on more prevalent and injurious types, especially to identify potential systemic issues. Most crashes will be categorized by PBCAT to types

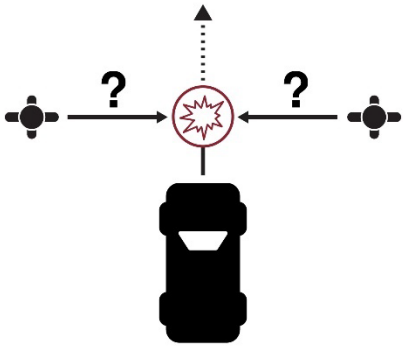
involving motorists going straight or making left or right turns and non-motorists moving at crossing angles or in parallel paths to the motorist. Many of the other situations are likely to occur at relatively low frequencies in most data sets. These situations include types in which the non-motorist was not moving, the non-motorist was moving but in an unknown direction, or the non-motorist movement was not known. In some cases, it may be appropriate to combine these types based on the motorist maneuvers.

The relatively infrequent situations were kept as distinct types in PBCAT 3, as they may be important for some types of indepth studies analyzing complex or unusual factors that could be potential targets for different types of treatment or may be more common at a systemwide level.

Once analysts conduct the initial analyses described in Tip 1, the most prevalent combinations of crash types and location type by mode should become apparent, and users can then make decisions about consolidating rarer crash types (or location types) for further analysis. Analysts may also make use of the *Basic Crash Type* variable, which has already combined some types of non-motorist actions into fewer crash type groupings.

Diagnosis of Hotspot Crash Problems

PBCAT 3 crash types should facilitate indepth safety studies for hotspots or corridors by allowing analysts (using data that are also spatially referenced) to quickly depict the 'types' of collision patterns occurring at locations of concern. For example, an entire corridor may experience a prevalence of **S-C (Motorist Going Straight–Non-motorist on Crossing Path**) types (figure 82) at uncontrolled and controlled intersections, path crossings, and non-junction locations along a trafficway. These crashes may warrant corridorwide treatments to help prevent these types of crashes (e.g., improved lighting, lower speeds), as well as crossing enhancements at specific crossing locations.

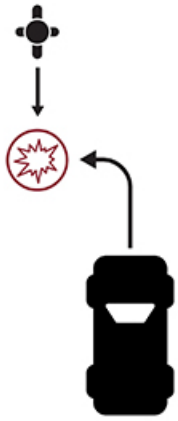


Source: FHWA.

Figure 82. Illustration. S-C (going straight-crossing path) basic Crash Type.

Conversely, a specific intersection with unrestricted turning movements may have a problem with crashes involving motorists turning left across the path of opposite direction non-motorists (L-PO type) as seen in figure 83. The intersection may benefit from various strategies to reduce

conflicts with left-turning motorists. (See the next section. These patterns might also be used to identify systemic issues and treatments.)



Source: FHWA.

Figure 83. Illustration. L-PO (turning left-parallel path opposite direction) Crash Type.

Systemic Analysis

Systemic safety analysis is receiving increasing attention for nonmotorized road user safety. The relative infrequency of motorist to non-motorist crashes, and seemingly random elements, can make it difficult to identify and prevent the next crash hotspot (Thomas et al. 2018). In addition, low frequencies of crashes at any one location can make it challenging to prioritize individual locations for treatment. To address this situation, systemic analysis can be used to identify crash risk factors for prevalent crash-types for the entire road system (or network) (Kumfer et al. 2019). The crash types included in PBCAT 3 should enable users to identify systemic crash type patterns and understand how these patterns are distributed across the network by location types and other contexts. Given the uncertainty in where crashes will occur next, knowing the common crash and location types may help jurisdictions identify potentially appropriate systemic treatments to apply more broadly to similar locations that may be at risk of crashes. Agencies can develop systemic safety treatment plans that do not require waiting for crashes to happen at specific locations before taking action. See Thomas et al. (2018) and Kumfer et al. (2019) for more information.

Countermeasures Resources

The crash type patterns should be linkable to countermeasures included in various Federal and State resources such as the online tools PEDSAFE (Zegeer et al. 2013) and BIKESAFE (Sundstrom et al. 2014), FHWA's Safe Transportation for Every Pedestrian (STEP) (FHWA 2021), and NCHRP reports such as *Guidance to Improve Pedestrian and Bicyclist Safety at Intersections* (Sanders et al. 2020).

APPENDIX A. BASIC CRASH TYPES

The detailed crash types that are consolidated into *Crash Type Basic* are shown in this appendix. The detailed crash types are followed by the Crash Type Basic code used in the data file and a longer description. Associated illustrations are provided for the crash types if one is available.

Going Straight basic crash types

- S-CR, S-CL, and S-CU Detailed types are combined: S-C – Going Straight–Crossing Path (See illustration for S-CU).
- S-PS, S-PO, and S-PU are combined in the Crash Type Basic: S-P - Going Straight–Parallel Path (See illustration for S-PU).
- S-MU, S-ST, and S-OU are combined:
    - S-O – Going Straight–Other, Unusual, or Stationary (No illustration).
    - S-U – Going Straight–Unknown (No illustration).

Turning Right basic crash types

- R-CR, R-CL, and R-CU are combined as: R-C – Turning Right–Crossing Path (See illustration for R-CU).
- R-PS, R-PO, and R-PU are combined: R-P – Turning Right–Parallel Path (See illustration for R-PU).
- R-MU, R-ST, and R-OU are combined:
    - R-O – Turning Right–Other, Unusual, or Stationary (No illustration).
    - R-U – Turning Right–Unknown (No illustration).

Turning Left basic crash types

- L-CR, L-CL, and L-CU Detailed types are combined: L-C – Turning Left–Crossing Path (See illustration for L-CU).
- L-PS, L-PO, and L-PU Detailed types are combined: L-P – Turning Left–Parallel Path (See illustration for L-PU).
- L-MU, L-ST, and L-OU Detailed types are combined:
    - L-O – Turning Left–Other, Unusual, or Stationary (No illustration)
    - L-U – Turning Left–Unknown (No illustration)

Parked basic crash types

- P-CR, P-CL, and P-CU are combined: P-C – Parked–Crossing Path (See illustration for P-CU).
- P-PS, P-PO, and P-PU are combined: P-P – Parked–Parallel Path (See illustration for P-PU).
- P-MU, and P-OU are combined:
    - P-O – Parked–Other, Unusual, or Stationary (No illustration).
    - L-U - Parked–Unknown (No illustration).

Entering Traffic basic crash types

- E-CR, E-CL, and E-CU are combined: E-C – Entering Traffic Lane–Crossing Path (See illustration for C-CU).
- E-PS, E-PO, and E-PU are combined: E-P – Entering Traffic Lane–Parallel Path (See illustration for E-PU).
- E-MU, E-ST, and E-OU are combined:
    - E-O – Entering Traffic Lane–Other, Unusual, or Stationary (No illustration).
    - E-U – Entering Traffic Lane–Unknown (No illustration).

Backing crash types

- B-CR, B-CL, and B-CU are combined: B-C – Backing–Crossing Path (See illustration for B-CU).
- B-PS, B-PO, and B-PU are combined: B-P – Backing–Parallel Path (See illustration for B-PU).
- B-MU, B-ST, and B-OU are combined:
    - B-O – Backing–Other, Unusual, or Stationary (No illustration).
    - B-U – Backing–Unknown (No illustration).

Other Maneuver basic crash types

- O-CR, O-CL, and O-CU Detailed types are combined: O-C – Other Maneuver–Crossing Path (No illustration).

- O-PS, O-PO, and O-PU are combined: O-P – Other Maneuver–Parallel Path (No illustration).

- O-MU, O-ST, and O-OU are combined:

    - O-O – Other Maneuver–Other, Unusual, or Stationary (No illustration).

    - O-U – Other Maneuver–Unknown (No illustration).

Unknown Maneuver basic crash types

- U-CR, U-CL, and U-CU are combined in Crash Type Basic: U-C – Unknown Maneuver–Crossing Path (No illustration).

- U-PS, U-PO, and U-PU are combined in Crash type Basic: U-P – Unknown Maneuver–Parallel Path (No illustration).

- U-MU, U-ST, and U-OU are combined in Crash type Basic:

    - U-O – Unknown Maneuver–Other, Unusual, or Stationary (No illustration).

    - U-U – Unknown Maneuver–Unknown (No illustration).

APPENDIX B. SPECIAL CIRCUMSTANCES VARIABLE OPTIONS IN PBCAT 3

Special Circumstances that may be coded in PBCAT 3 are presented as organized in the crash typing application. These questions may help to identify special events or circumstances related to or that possibly contributed to some crashes. Many of these indicators may also be used to help identify distinct crash types identified in PBCAT 2.

The questions are organized by topic and divided on four screens. The information presented shows the topics used to organize the questions in the application, the question, and the variable name used in the CSV data file (in parentheses).

Many of the Special Circumstances are derived from PBCAT 2 crash types and may be useful for mapping PBCAT 3 crash types to PBCAT 2 crash types. The Circumstance indicators that can be helpful in mapping PBCAT 3 crash types to PBCAT 2 crash types are identified after the variable name as follows:

- Pedestrian crash types = P.
- Bicyclist crash types = B.
- Both Pedestrian and Bicyclist crash types = PB.
- Neither = N.

[Note that the CSV variables names and the PBCAT 2-related indicators are not shown in the crash typing application. Appendix D provides more details on mapping specific crash types or crash groups between PBCAT 2 and PBCAT 3.]

Special Circumstance 1 (Optional) [Screen 1 topics and questions]

Loss of Control/Turning Errors—Motorist or Non-motorist

1. Did the motorist lose control of the vehicle due to mechanical failure, surface conditions, driver error, impairment, or other reasons? (motoristLostControl)–PB.
2. Did the non-motorist lose control (e.g., stumble, fall, or roll into the path of a motor vehicle) due to mechanical problems, surface conditions, impairment, or other reasons? (non-motoristLostControl)–PB.
3. Did the motorist cross into an opposing traffic lane or other facility while making a left or right turn? (motoristTurningError)–B.
4. Did the non-motorist cross into an opposing traffic lane while making a left or right turn? (non-motoristTurningError)–B.

Signal Violation – Motorist or Non-motorist

5. Did the motorist violate a traffic signal before colliding with the non-motorist? (signalViolMotorist)–B.
6. Did the non-motorist violate a traffic signal before colliding with a motor vehicle? (signalViolNon-motorist)–B.

Other Motorist Actions

7. Was the motor vehicle stopped prior to the maneuver that began the sequence of crash events? (e.g., was the motor vehicle initially stopped at a red light, stop sign, in traffic, or waiting to enter or turn into traffic before moving and colliding with the non-motorist?) (motorVhicleStationary)–B (possibly for crash types involving drive outs at stop signs).
8. Did the motorist leave the scene without stopping to render aid or report the crash (Hit and Run)? (hitRun)–N.

Non-motorist Crossing-Related

9. Was the non-motorist on or near the curb or roadway edge and waiting to cross the roadway? (waitingToCross)–P.
10. Did the non-motorist enter the traffic lane in front of a stopped or slowing vehicle and was struck by a vehicle traveling in the same direction as the stopped or slowed vehicle (Multiple Threat)? (multipleThreat)–PB.
11. Was the non-motorist struck while crossing at a signalized location when the light changed and traffic started moving (trapped)?–PB.
12. Did the non-motorist run into the roadway and was struck by a vehicle whose view of the non-motorist was not obstructed (Dash)? (dash)–P.
13. Did the non-motorist walk or run into the roadway and was struck by a motorist whose view of the non-motorist was blocked until an instant before impact (Dart-out)? (dartOut)–P.

Special Circumstance 2 (Optional) [Screen 2 topics and questions]

Transit-Related

14. Was the non-motorist struck crossing in front of a transit bus stopped at a marked bus stop? (transitObstructedView)–P.
15. Was the non-motorist struck while going to from, or waiting at a transit bus stop, regardless of the circumstances? (transitOther)–N
16. Was the non-motorist struck by a transit bus pulling into or away from the curb or loading area? (transitBusPullover)–B.

School-Related

17. Was the non-motorist struck while waiting at a school bus stop or going to or from a stop, with a bus present at the stop? (schoolBusStopBusPresent)–P.
18. Was the non-motorist struck while waiting at a school bus stop, or going to or from a stop, without a bus present at the stop? (schoolBusStopBusNotPresent)–P.
19. Was the non-motorist going to or from school (K-12)? (schoolRelatedTrip)–N.

Delivery Vehicle-Related

20. Was the non-motorist struck by a delivery vehicle pulling into or out of traffic? (deliveryVehiclePullover) – B.
21. Did a stopped or parked delivery vehicle block the view of another motorist that collided with the non-motorist? (deliveryVehicleBlockedView)–N.

Crossing – Other Destinations

22. Was the non-motorist going to or from or standing at a mailbox or newspaper box? (mailbox)–P.
23. Was the non-motorist struck while going to or from an ice cream truck or other type of vendor vehicle parked at the curb or roadside? (vendorTruck)–P.

Special Circumstance 3 (Optional) [Screen 3 topics and questions]

Parking-Related

24. Was the non-motorist in the process of getting into or out of a stopped or parked vehicle when another vehicle struck the person? (enteringExitingVehicle)–P.
25. Did the collision involve a motor vehicle that was entering or leaving an on-street parking space to re-enter traffic on a roadway? (motoristEnteringExitingParking)–B.

Other Non-motorist Actions

26. Was the non-motorist struck while riding a play vehicle that was not a bicycle or powered personal conveyance (e.g., child's tricycle, sled, skates, scooter, wagon, toy car)? (playVehicle)–PB.
27. Was the non-motorist working in the roadway prior to the crash? (workingInRoadway)–P.
28. Was the non-motorist playing in the roadway prior to the crash? (playingInRoadway)–P.
29. Was the non-motorist standing in the roadway prior to the crash? (standingInRoadway)–P.
30. Was the non-motorist lying or sitting in the roadway when struck? (lyingSittingInRoadway)–P.

Head-On

31. Was either the motorist or the non-motorist going the wrong way in a traffic lane, and the two parties collided head on? [This option should not be selected if the non-motorist was using a two-way bicycle/shared use facility and was traveling in an intended direction.] (headOn)–B.

Emergency/Disabled Vehicle-Related

32. Was the non-motorist struck by an active emergency vehicle? (activeEmergencyVehicle)–P.
33. Was the non-motorist struck by a vehicle being pursued by a law enforcement vehicle? (pursuedVehicle)–P.
34. Was the non-motorist struck while near an emergency vehicle at the scene of an incident (including the scene of a prior crash or involving a disabled vehicle)? (nearActiveEmergencyVehicle)–P.
35. Was the non-motorist struck while near or next to a disabled vehicle (including a vehicle that had been in a crash), while walking to or from a disabled vehicle, or while near a tow truck responding to a disabled vehicle? (disabledVehicle)–P.

Special Circumstance 4 (Optional)

Intentional or Dispute-Related

36. Did the motorist intentionally strike the non-motorist? (assaultWithVehicle)–PB.
37. Did the non-motorist intentionally strike the motor vehicle or intentionally cause the crash? (non-motoristIntentionallyCaused)–B.
38. Did the motorist strike the non-motorist during a domestic altercation or other dispute? (disputeRelated)–P.

Other Unusual Circumstances

39. Was the non-motorist sitting on, leaning against, or clinging to a vehicle that began to move, or was moving? (pedestrianOnVehicle)–P.
40. Was the non-motorist struck as a result of a prior vehicle-to-vehicle or vehicle-to-object collision? (vehicleVehicleObject)–P.
41. Was the non-motorist struck by a vehicle that was moving without a driver at the controls or that was set in motion by a child? (driverlessVehicle)–P.
42. Did the crash involve other unusual circumstances, such as a non-motorist being struck by falling cargo or a loose wheel? (otherUnusualCircumstances)–PB.
43. Did the crash occur during a special event (concert, festival, evacuation)? (specialEventContributed)–N.

Surface Conditions

44. Did surfaces such as uneven pavement, debris, drain grate, pavement markings, or manhole cover contribute to the crash? (surfaceConditions)–PB

APPENDIX C. PBCAT 3 COMPLETE CSV FILE VARIABLE LIST.

This appendix displays the variable list for the PBCAT 3 CSV file as shown in table 9.

Table 9. Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
reportNumber	Report number	User-assigned crash identifier.
modeBasic	Mode: Basic	What type of person was involved in the crash?
modeDetailed	Mode: Detailed	What type of pedalcycle/device was used by the person in the crash?
relationToTrafficway	Relation to Trafficway	Did the crash occur on or off a trafficway?
crashLocationType	Crash Location Type	Where did the crash occur?
legOfIntersection	Leg of Intersection	Where in the intersection did the crash occur?
facilityTypeCrash	Non-motorist Facility Type at Crash	What type of facility was the non-motorist using at the moment of the crash?
travelLaneTypeCrash	Travel Lane Type at Crash	What type of vehicular travel lane was the non-motorist using at the time of the crash?
roadLaneDeparture	Road or Lane Departure	Did the motorist unintentionally leave the roadway or designated travel lane prior to the crash?
facilityTypePre	Non-motorist Facility Type prior to Crash	What facility was the non-motorist using just PRIOR to the crash, which may differ from the facility where the crash occurred?
motoristManeuver	Motorist Maneuver	What was the motorist maneuver just prior to the crash?

Table 9. (continued) Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
non-motoristManeuver	Non-motorist Maneuver/ Action	What was the non-motorist's direction of travel, relative to the motorist's direction, just prior to the crash?
crashTypeBasic	Basic Crash Type	The combination of Motorist Maneuver and Non-motorist Maneuver/Action selections is used to generate Basic Crash Type. Basic Crash Type consolidates some categories of Detailed Crash Type.
crashTypeDetailed	Detailed Crash Type	The combination of Motorist Maneuver and Non-motorist Maneuver/Action selections is used to generate Detailed Crash Type.
non-motoristTurning	Non-motorist Turning	Did the non-motorist change direction, turn, or merge just prior to the crash?
overtakingIndicator	Overtaking Indicator	Was the motorist or the non-motorist overtaking the other at the time of the crash?
contraflowIndicator	Non-motorist Contraflow Indicator	Was the non-motorist traveling in the same or opposite direction as adjacent motor vehicle traffic just before the crash?
dooringIndicator	Dooring Indicator	Did the non-motorist strike the door of a motor vehicle that was open or opening?
motoristLostControl	n/a—Special Circumstance indicator	1. Did the motorist lose control of the vehicle due to mechanical failure, surface conditions, driver error, impairment, or other reasons?
non-motoristLostControl	n/a—Special Circumstance indicator	2. Did the non-motorist lose control (e.g., stumble, fall, or roll into the path of a motor vehicle) due to mechanical problems, surface conditions, impairment, or other reasons?
motoristTurningError	n/a—Special Circumstance indicator	3. Did the motorist cross into an opposing traffic lane or other facility while making a left or right turn?
non-motoristTurningError	n/a—Special Circumstance indicator	4. Did the non-motorist cross into an opposing traffic lane while making a left or right turn?

Table 9. (continued) Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
signalViolMotorist	n/a—Special Circumstance indicator	5. Did the motorist violate a traffic signal before colliding with the non-motorist?
signalViolNon-motorist	n/a—Special Circumstance indicator	6. Did the non-motorist violate a traffic signal before colliding with a motor vehicle?
motorVhicleStationary	n/a—Special Circumstance indicator	7. Was the motor vehicle stopped prior to the maneuver that began the sequence of crash events? (e.g., was the motor vehicle initially stopped at a red light, stop sign, in traffic, or waiting to enter or turn into traffic before moving and colliding with the non-motorist?)
hitRun	n/a—Special Circumstance indicator	8. Did the motorist leave the scene without stopping to render aid or report the crash (Hit and Run)?
waitingToCross	n/a—Special Circumstance indicator	9. Was the non-motorist on or near the curb or roadway edge and waiting to cross the roadway?
multipleThreat	n/a—Special Circumstance indicator	10. Did the non-motorist enter the traffic lane in front of a stopped or slowing vehicle and was struck by a vehicle traveling in the same direction as the stopped or slowed vehicle (Multiple Threat)?
trapped	n/a—Special Circumstance indicator	11. Was the non-motorist struck while crossing at a signalized location when the light changed and traffic started moving (Trapped)?
dash	n/a—Special Circumstance indicator	12. Did the non-motorist run into the roadway and was struck by a vehicle whose view of the non-motorist was not obstructed (Dash)?
dartOut	n/a—Special Circumstance indicator	13. Did the non-motorist walk or run into the roadway and was struck by a motorist whose view of the non-motorist was blocked until an instant before impact (Dart-out)?
transitObstructedView	n/a—Special Circumstance indicator	14. Was the non-motorist struck crossing in front of a transit bus stopped at a marked bus stop?

Table 9. (continued) Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
transitOther	n/a—Special Circumstance indicator	15. Was the non-motorist struck while going to, from, or waiting at a transit bus stop, regardless of the circumstances?
transitBusPullover	n/a—Special Circumstance indicator	16. Was the non-motorist struck by a transit bus pulling into or away from the curb or loading area?
schoolBusStopBusPresent	n/a—Special Circumstance indicator	17. Was the non-motorist struck while waiting at a school bus stop or going to or from a stop, with a bus present at the stop?
schoolBusStopBusNotPresent	n/a—Special Circumstance indicator	18. Was the non-motorist struck while waiting at a school bus stop or going to or from a stop without a bus present at the stop?
schoolRelatedTrip	n/a—Special Circumstance indicator	19. Was the non-motorist going to or from school (K-12)?
deliveryVehiclePullover	n/a—Special Circumstance indicator	20. Was the non-motorist struck by a delivery vehicle pulling into or out of traffic?
deliveryVehicleBlockedView	n/a—Special Circumstance indicator	21. Did a stopped or parked delivery vehicle block the view of another motorist that collided with the non-motorist?
mailbox	n/a—Special Circumstance indicator	21. Was the non-motorist going to or from or standing at a mailbox or newspaper box?
vendorTruck	n/a—Special Circumstance indicator	22. Was the non-motorist struck while going to or from an ice cream truck or other type of vendor vehicle parked at the curb or roadside?
enteringExitingVehicle	n/a—Special Circumstance indicator	24. Was the non-motorist in the process of getting into or out of a stopped or parked vehicle when another vehicle struck the person?
motoristEnteringExitingParking	n/a—Special Circumstance indicator	25. Did the collision involve a motor vehicle that was entering or leaving an on-street parking space to re-enter traffic on a roadway?

Table 9. (continued) Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
playVehicle	n/a—Special Circumstance indicator	26. Was the non-motorist struck while riding a play vehicle that was not a bicycle or powered personal conveyance (e.g., child's tricycle, sled, skates, scooter, wagon, toy car)?
workingInRoadway	n/a—Special Circumstance indicator	27. Was the non-motorist working in the roadway prior to the crash?
playingInRoadway	n/a—Special Circumstance indicator	28. Was the non-motorist playing in the roadway prior to the crash?
standingInRoadway	n/a—Special Circumstance indicator	29. Was the non-motorist standing in the roadway prior to the crash?
lyingSittingInRoadway	n/a—Special Circumstance indicator	30. Was the non-motorist lying or sitting in the roadway when struck?
headOn	n/a—Special Circumstance indicator	31. Was either the motorist or the non-motorist going the wrong way in a traffic lane, and the two parties collided head on?
actveEmergencyVehicle	n/a—Special Circumstance indicator	32. Was the non-motorist struck by an active emergency vehicle?
pursuedVehicle	n/a—Special Circumstance indicator	33. Was the non-motorist struck by a vehicle being pursued by a law enforcement vehicle?
nearActiveEmergencyVehicle	n/a—Special Circumstance indicator	34. Was the non-motorist struck while near an emergency vehicle at the scene of an incident (including the scene of a prior crash or involving a disabled vehicle)?
disabledVehicle	n/a—Special Circumstance indicator	35. Was the non-motorist struck while near or next to a disabled vehicle (including a vehicle that had been in a crash), while walking to or from a disabled vehicle, or while near a tow truck responding to a disabled vehicle?

Table 9. (continued) Output CSV variable name, name label in application, and question for PBCAT 3 variables.

CSV Variable Name	Variable Label in Application	Question/Definition
assaultWithVehicle	n/a—Special Circumstance indicator	36. Did the motorist intentionally strike the non-motorist?
non-motoristIntentionallyCaused	n/a—Special Circumstance indicator	37. Did the non-motorist intentionally strike the motor vehicle or intentionally cause the crash?
disputeRelated	n/a—Special Circumstance indicator	38. Did the motorist strike the non-motorist during a domestic altercation or other dispute?
pedestrianOnVehicle	n/a—Special Circumstance indicator	39. Was the non-motorist sitting on, leaning against, or clinging to a vehicle that began to move, or was moving?
vehicleVehicleObject	n/a—Special Circumstance indicator	40. Was the non-motorist struck as a result of a prior vehicle-to-vehicle or vehicle-to-object collision?
driverlessVehicle	n/a—Special Circumstance indicator	41. Was the non-motorist struck by a vehicle that was moving without a driver at the controls or that was set in motion by a child?
otherUnusualCircumstances	n/a—Special Circumstance indicator	42. Did the crash involve other unusual circumstances, such as a non-motorist being struck by falling cargo or a loose wheel?
specialEventContributed	n/a—Special Circumstance indicator	43. Did the crash occur during a special event (concert, festival, evacuation)?
surfaceConditions	n/a—Special Circumstance indicator	44. Did surfaces such as uneven pavement, debris, drain grate, pavement markings, or manhole cover contribute to the crash?

APPENDIX D. PBCAT 2 TO PBCAT 3 VARIABLE MAPPING

Users of PBCAT 2 may have data from that system that they want to analyze along with new data from PBCAT 3. This appendix provides information for identifying similar sets of crash types for these analyses.

Any time changes (major or minor) are made in reporting or coding of crash data, these changes may affect the frequencies of resulting variable categories. This caveat is especially important since the crash typing framework of PBCAT 3 is fundamentally different from PBCAT 2. In PBCAT 2, crash types are defined by a mix of variables, with some types defined solely by maneuvers (similar to PBCAT 3), but other crash types are defined by a mix of factors, including location types, traffic control, facility used, violations by either the motorist or non-motorist, and others. Variables that help define some crash types also include road user errors, vehicle types involved, and other very specialized situations.

In PBCAT 3, all crash types are defined solely by the motorist and non-motorist maneuvers. Locations and other special factors are identified in separate variables. Therefore, the comparison or approximate matching of crash types in PBCAT 3 to PBCAT 2 types often requires examining more than one PBCAT 3 variable. In addition, a hierarchical or step-wise approach to subsetting different types should be followed, as presented in the sections below (*Crash Location Types*, *Pedestrian Crash Types*, and *Pedalcyclist Crash Types*), to generate the most accurate comparisons. This type of approach is needed because a hierarchical coding approach is required in PBCAT 2 (due to potential overlap among some types).

Information is also given for comparing crashes from PBCAT 3 to PBCAT 2 data by *crash location* type (which is relatively straightforward to accomplish) as well as by crash types. Jurisdictions are advised to review these methods and data requirements before typing crashes in PBCAT 3 and to review results consistency before publishing trends based on these comparisons. Detailed crash type comparisons may require users to code Facility Types and other optional variables, as well as Special Circumstances factors for precise matching.

As mentioned in the preceding paragraphs, users should be cautious when comparing the crash types derived from PBCAT 3 with crash types from PBCAT 2 because of the very different frameworks and coding procedures. Users should not strictly interpret trends in crash type data developed using the two coding systems—PBCAT 2 and PBCAT 3 (which may also be affected by time-related trends)—but rather consider the comparisons as ‘general trends.’

Crash Location Types—Mapping PBCAT 3 to PBCAT 2 Pedalcyclist or Pedestrian Crash Data

In PBCAT 2, crash typing was separate for bicyclist and pedestrian-involved crashes, and, although similar, the variables and categories of those variables were defined and named differently between the two modules. Crash location categories that can be considered approximate ‘equivalents’ in PBCAT 2 and PBCAT 3 are shown in matrix form in table 10. (The variable names and descriptive category values are shown for PBCAT 2. Only descriptive values are provided in PBCAT 3.)

Table 10. Crash location variable mapping for PBCAT v. 2 to PBCAT 3.

PBCAT 3 Location Types in Rows (*crashLocationType*)	PBCAT 2 Location (Crash_Location_Desc) in Columns					
	Intersection	**Intersection-Related**	**Nonintersection**	**Nonroadway**	**Unknown (Pedestrian data)**	**Unknown Location (Bicyclist data)**
Intersection	Yes	Yes	N/A	N/A	N/A	N/A
Expressway	N/A	N/A	Yes	N/A	N/A	N/A
Driveway access or Related	N/A	N/A	Yes	N/A	N/A	N/A
Path Crossing/junction with trafficway	N/A	N/A	Yes	N/A	N/A	N/A
Non-junction (along Trafficway)	N/A	N/A	Yes	N/A	N/A	N/A
Entrance/exit ramp or related	N/A	N/A	Yes	N/A	N/A	N/A
Railway grade crossing of trafficway	N/A	N/A	Yes	N/A	N/A	N/A
Unknown trafficway location	N/A	N/A	N/A	N/A	Yes	Yes
Public vehicular area (PVA)	N/A	N/A	N/A	Yes	N/A	N/A
Off-street trail/sidepath	N/A	N/A	N/A	Yes	N/A	N/A
Other non-trafficway	N/A	N/A	N/A	Yes	N/A	N/A
Unknown non-trafficway	N/A	N/A	N/A	Yes	N/A	N/A
May also include relationToTrafficway = unknown	N/A	N/A	N/A	N/A	Yes	Yes

N/A = not applicable; Yes = the value translates from PBCATv3 to the old data.

Note that in comparing PBCAT 2 to PBCAT 3, Intersection and Intersection-Related should be combined to be *approximately* equivalent to Intersection in PBCAT 3. Conversely, Expressway, Driveway Access or Related, Path Crossing/Junction with Trafficway, Non-junction (along Trafficway, Entrance/Exit Ramp or Related, *and* Railway Grade Crossing of Trafficway in PBCAT 3 would be combined to be approximately equivalent to PBCAT 2 Nonintersection category for either bicycle or pedestrian crash data.

Crash Location = Non-roadway in PBCAT 2 has approximately the same definition as Non-Trafficway in the *Relation to Trafficway* variable in PBCAT 3.

PBCAT 3 *Crash Location Type* definitions are provided in the chapter entitled PBCAT 3 Crash Typing System and Variables. Definitions for PBCAT 2 location categories are as follows:

Pedestrian

- Intersection–The crash occurred within the intersection proper or within the crosswalk area. Note: Driveways controlled by signals or signs should be coded as Intersections. Uncontrolled driveways should be coded as Non-Intersection Locations.

- Intersection-Related–The crash occurred outside the intersection crosswalk area but within 15 m (50 ft) of the intersection.

- Non-intersection–The crash occurred off the roadway, including parking lots, driveways, private roads, yards, alleys, and other open areas.

- Non-roadway–The crash occurred off the roadway, including parking lots, driveways, private roads, yards, alleys, and other open areas.
  Note: Crashes occurring on paved shoulders, sidewalks, or driveway crossings are considered to be "roadway" crashes and should not be placed in the Non-Roadway classification.

- Unknown–There is insufficient information to determine where the crash occurred.

Bicyclist

- Intersection–The crash occurred within the intersection proper or within the crosswalk area. Note: Driveways controlled by signals or signs should be coded as Intersections. Uncontrolled driveways should be coded as Non-Intersection Locations.

- Intersection-Related–The crash occurred outside the intersection proper or crosswalk area but was related to the presence of the intersection (e.g., the result of queueing traffic).

- Non-intersection–The crash occurred outside the intersection proper or crosswalk area and was not related to the presence of any intersection.

- Non-roadway–The crash occurred off the street network, which includes parking lots, driveways, alleys, and other open areas. Note: crashes occurring on paved shoulders, sidewalks, or driveway crossings are considered to be "roadway" crashes and should not be placed in the non-roadway classification.

- Unknown Location–There is insufficient information to determine where the crash occurred.

Pedestrian Crash Types—Mapping PBCAT 3 to PBCAT 2 Data

The steps outline a detailed process and the variables and variable values to use to identify similar sets of pedestrian crash types using data from PBCAT 3, compared to data from

PBCAT 2 crash typing. In the steps below, the variable name used in the CSV data file is used to refer to the variables in PBCAT 3.

Step1: Select a comparable set of pedestrian crashes. From PBCAT 3 data, select modeBasic = Pedestrian, Other/Atypical Pedestrian, and/or Powered Personal Conveyance (if these crashes were coded/present in PBCAT 2 data). The detailed Mode variable (modeDetailed) may be used to refine the types of pedestrians that were coded in previous data using PBCAT 2.

Non-collision events, if any, may be identified and excluded in PBCAT 3 using *crashTypeBasic* = N-FC or any non-motorist maneuver = FC: Non-motorist Fall or Crash. Coding pedestrian falls or incidents that did not involve a motor vehicle collision was not an option in PBCAT 2.

Step 2: Exclude any Crashes involving Unknown locations.

TABLE 10 provides the definitions to identify subsets of crashes by location.

- **PBCAT 3 data:** In PBCAT 3, the variable *relationToTrafficway* may be used to identify the subset of crashes that occurred in Unknown locations.

- **PBCAT 2 data:** In PBCAT 2, select Crash Location Description = Unknown.

Step 3: Select Unusual types from PBCAT 2. Match the Crash Type Number or Crash Type Description categories shown in the first two columns of table 11 with the Special Circumstance indicators for pedestrian crashes in the PBCAT 3 data, as shown in column 3. (This special circumstance is consistent with coding in PBCAT 2 that pre-emptively codes these types of crashes before other types. Subset and match the types in the order listed in table 11. If Special Circumstances are not coded in PBCAT 3, then these crashes will be dispersed across various other type categories. These crashes may occur on or off-trafficways. If there is a desire to exclude Off Trafficway crashes from the analysis, the action can be performed in Step 2, also using the values shown in table 10.

Table 11. Pedestrian crashes with special circumstance in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Crash_Type_Basic (Crash Type Number)	PBCAT 2 Crash_Type_Desc (Crash Type Description)	PBCAT 3 Special Circumstance variable name in CSV data (value should = yes)
110	Assault with vehicle	assaultWithVehicle = yes
120	Dispute-related	disputeRelated = yes
130	Pedestrian on vehicle	pedestrianOnVehicle = yes
140	Vehicle-vehicle/object	vehicleVehicleObject = yes
150	Motor vehicle loss of control	motoristLostControl = yes
160	Pedestrian loss of control	non-motoristLostControl = yes
190	Other unusual circumstances	otherUnusualCircumstances = yes
220	Driverless vehicle	driverlessVehicle = yes
230	Disabled vehicle-related	disabledVehicle = yes
240	Emergency vehicle-related	Any of: activeEmergencyVehicle = yes; nearActiveEmergencyVehicle = yes; *OR* pursuedVehicle = yes
250	Play vehicle-related	playVehicle = yes
311	Working in roadway	workingInRoadway = yes
312	Playing in roadway	playingInRoadway = yes
341	Commercial bus-related	transitObstructedView = yes
342	School bus-related	schoolBusStopBusPresent = yes; *AND/OR* schoolBusStopBusNotPresent = yes
320	Entering/exiting parked vehicle	enteringExitingVehicle = yes
330	Mailbox-related	mailbox = yes
360	Ice cream/vendor truck-related	vendorTruck = yes
610	Standing in roadway	standingInRoadway = yes
313	Lying in roadway	lyingSittingInRoadway = yes
510, 520, 590	Any of: waiting to cross—vehicle turning; waiting to cross—vehicle not turning; waiting to cross—vehicle action unknown	waitingToCross = yes

Step 4: Select motorist Backing crashes. See table 12 for the variables to use to match backing crashes in PBCAT 3 data to correspond to PBCAT 2 backing-related crash types. Of the crashes remaining in both datasets after step 3, select the Backing and other relevant crash characteristics shown in table 12.

Table 12. Pedestrian and backing vehicle crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Crash_Type_Basic (Crash Type Number)	PBCAT 2 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable names and category values to select in CSV data
211, 214	Backing vehicle—driveway; Backing vehicle—parking lot	Both: motoristManeuver = B: Backing crashes; *AND* relationToTrafficway = Non-Trafficway
212, 213	Include; backing vehicle—driveway/ sidewalk intersection; backing vehicle—roadway	Both: motoristManeuver = B: Backing crashes; *AND* relationToTrafficway = On Trafficway
219	Backing vehicle—other/unknown	relationToTrafficway = Unknown

Step 5: Select remaining Off Roadway crashes (if included). Select remaining Off-roadway or Non-trafficway crashes exclusive of those identified through Step 4 (those involving Backing vehicles, and the Special Circumstance types identified in Step 3). In PBCAT 3 data, *Relation to Trafficway* = Non-Trafficway corresponds to Crash Location = Off Roadway crashes in PBCAT 2. Table 13 shows the correspondence to two remaining PBCAT 2 types.

Table 13. Other pedestrian off-roadway/off-trafficway crashes in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 2 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
830, 890	Both: off-roadway—parking lot; off-roadway—other/ unknown	relationToTrafficway = Non-Trafficway [any Non-Trafficway crashes remaining after Step 3]

Step 6: Select On Trafficway crashes involving Motorist Going Straight and Pedestrian on Crossing Path. As previously mentioned, these steps are hierarchical. After step 5, identify or map the remaining crashes in both datasets as shown in table 14. Some of these 'types' involve particular circumstances that were split into different types in PBCAT 2. Special Circumstance indicators if coded in PBCAT 3 should enable identification of similar crash types. However, these types could also be combined into one group of Motorist Going Straight and Pedestrian Crossing types by combining all the categories shown for PBCAT 2 and ignoring the PBCAT 3 Expressway and special circumstance indicators (e.g., multipleThreat, trapped) in the 2nd to 5th rows. See the variables and categories in table 14.

Table 14. Motorist Going Straight—Pedestrian Crossing Path crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 2 Crash_Type_Desc (Crash Type Description)	Select in this order	PBCAT 3 variable name and category value in CSV data
910	Crossing expressway	a	relationToTrafficway = On Trafficway; *AND* crashTypeBasic = S-C; *AND* crashLocationType = Expressway
710	Multiple threat	b	relationToTrafficway = On Trafficway; crashTypeBasic = S-C; *AND* *AND* multipleThreat = yes
730	Trapped	c	relationToTrafficway = On Trafficway; *AND* crashTypeBasic = S-C; *AND* trapped = yes
742	Dart-out	d	relationToTrafficway = On Trafficway; *AND* crashTypeBasic = S-C; *AND* dartOut = yes
741	Dash	e	relationToTrafficway = On Trafficway; *AND* crashTypeBasic = S-C; *AND* dash = yes
760, 770	Pedestrian failed to yield; and motorist failed to yield	f	relationToTrafficway = On Trafficway; *AND* any remaining (not subset in previous steps) crashTypeBasic = S-C

Step 7: Identify crashes involving motorists turning in or out of Driveways (Driveway-Access crashes). After step 6, the Facility Type at Crash variable is the best option for identifying crashes involving motorists turning in or out of driveways in PBCAT 3. PBCAT 2 focused on pedestrians who were specifically struck while crossing the driveway access area. See table 15 for the variables and category values to use to identify a comparable group. Note that, for this group, three PBCAT 2 crash types are combined.

Table 15. Motorist turning in/out and pedestrian crossing driveway crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 3 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
460, 465, 469	Motorist entering driveway or alley; motorist exiting driveway or alley driveway crossing—other/unknown	Both: relationToTrafficway = On Trafficway; *AND* facilityTypeCrash = Driveway Access

Step 8: Identify remaining On Trafficway crashes involving Motorist Turns. Following step 7, table 16 provides the variables and category values to use in developing corresponding turning-related crashes that did not involve the pedestrian crossing a driveway access area. Some crash types in both sets may have occurred at driveways, but the pedestrian would have been struck while crossing the street (in a travel lane, crosswalk, etc.).

Table 16. Motorist Turns across different pedestrian paths crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 3 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
781	Motorist left turn—parallel paths	relationToTrafficway = On Trafficway; AND crashTypeBasic = L-P
782	Motorist left turn—perpendicular paths	relationToTrafficway = On Trafficway; crashTypeBasic = L-C
791, 792	Motorist right turn—parallel paths; motorist right turn on red—parallel paths	relationToTrafficway = On Trafficway; crashTypeBasic = R-P
795, 794	Motorist right turn—perpendicular paths; motorist right turn on red—perpendicular paths	relationToTrafficway = On Trafficway; crashTypeBasic = R-C
799	Motorist turn/merge—other/unknown	relationToTrafficway = On Trafficway; crashTypeBasic = L-O, L-U, R-O, R-U

Step 9: Select remaining Parallel Path crashes involving no Motorist Turns. Select parallel path types of crashes involving motorists being struck while on a parallel path with the motorist (walking along a road/trafficway). The most appropriate variables and categories to use are shown in table 17. As previously mentioned, all of these types may be combined from each data set if desired. The group trends may be more accurate than splitting the types.

Table 17. Motorists going straight and parallel path pedestrian crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 3 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
410	Walking along roadway with traffic—from behind	crashTypeBasic = SP; *AND* contraflowIndicator = Same direction; *AND* overtakingIndicator = Motorist was Overtaking the Non-motorist
420	Walking along roadway with traffic—from front	crashTypeBasic = SP; *AND* contraflowIndicator = Same direction; *AND* headOn = yes

Table 17. (continued) Motorists going straight and parallel path pedestrian crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 3 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
430	Walking along roadway against traffic—from behind	crashTypeBasic = SP; *AND* contraflowIndicator = Opposite Direction; *AND* overtakingIndicator = Motorist was Overtaking the Non-motorist
440	Walking along roadway against traffic—from front	crashTypeBasic = SP; AND contraflowIndicator = Opposite Direction; *AND* headOn = yes
459	Walking along roadway—direction/position unknown	crashTypeBasic = SP – any remaining

Step 10: Select all remaining crashes with less distinctive or unknown characteristics. Users may want to group all remaining crashes with less distinctive or unknown characteristics into one "Other/Unknown" grouping. Any remaining types with motorist (particularly) and some non-motorist Other or Unknown maneuvers in PBCAT 3 should go into this group. See table 18 for more information on the less-defined pedestrian crash types.

Table 18. Other less defined pedestrian crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 3 Crash_Type_Basic (Crash Type Number)	PBCAT 3 Crash_Type_Desc (Crash Type Description)	PBCAT 3 variable name and category value in CSV data
620	Walking in roadway	Should be predominantly cases in which non-motoristManuver = MU: Moving in Unknown Direction, predominantly crashTypeBasic = S-MU, possibly E-MU, and O-MU (if any in the data)
680	Nonintersection—other/unknown	Any remaining types at crashLocationType = Nonintersection
690	Intersection—other/unknown	Any remaining types at crashLocationType = Intersections
900	Other—unknown location	Any remaining with Unknown locations: relationToTrafficway = Unknown

Pedalcyclist Crash Types—Mapping PBCAT 3 to PBCAT 2 Data

The following steps outline a detailed process and the variables and variable values to use to identify similar sets of bicyclist crashes using data from PBCAT 3, compared to data from PBCAT 2 crash types. The variable name used in the CSV data file is used to refer to the variables in PBCAT 3. Pedalcyclist crash types in PBCAT 2 were more complex than pedestrian crash types. For example, some bicyclist crash types were a combination of the initial relative paths of the motorist and non-motorist, the crash location type, traffic control, and indicators of multiple 'types' of violations. For these reasons, bicyclist types are grouped more broadly in the mapping. Also, note that, within some steps, there may be a need to process sub-steps in order. These sub-steps are denoted by a, b, c in the third column (if relevant) of the tables. If two rows have the same letter, this double-lettering means these two categories may be determined in the same sub-step.

*Step1: Select a comparable set of pedalcyclist crashes***.** From PBCAT 3 data, select modeBasic = Pedalcyclist or Power-Assisted Pedalcyclist. The detailed Mode variable (modeDetailed) may be used to refine the types of pedalcyclists that were coded in previous data using PBCAT 2. For example, if no power-assisted pedalcyclists were included in earlier data, modeDetailed can be used to select only crashes involving Bicycles, and Other (Nonmotorized) Pedalcycles (if included). PBCAT 2 data are generated using separate modules for pedestrians and for bicyclists. Bicyclist-involved crashes should already be in a distinct dataset.

Step 2: Identify and subset types involving non-road/non-trafficway locations, and a few other situations. Table 19 provides a method for identifying and matching unusual and less-common circumstances in PBCAT 3 crash types to those in PBCAT 2 data. These crash types were identified first in PBCAT 2 before crashes were typed more fully and, though relatively uncommon, could be removed from both datasets before subsetting on other characteristics. This step depends on coding Special Circumstance variables shown in the table. If these variables are not coded, it is still possible to identify the types involving Unknown Location and Non-Trafficway crashes as well as Backing vehicle types in PBCAT 3 data. These crash types should be paired first.

Table 19. Bicyclist crashes involving off-Trafficway, unknown location, bike-only, and backing motorists in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Step	PBCAT 3 Variables and Categories to Match PBCAT 2 Types Listed in First Two Columns
910	Non-roadway	a	relationToTrafficway = Non-Trafficway
980	Unknown location	b	relationToTrafficway = Unknown
400	Bicycle only	c	crashTypeDetailed = N-FC *or* crashTypeBasic = N-F
510	Motorist intentionally caused	e	assaultWithVehicle = yes
520	Bicyclist intentionally caused	f	non-motoristIntentionallyCaused = yes
600	Backing Vehicle	g	motoristManeuver = B: Backing
700	Play vehicle-related	h	playVehicle = yes
800	Unusual circumstances	i	otherUnusualCircumstances = yes

Step 3: Select Turning Errors, Loss of Control, and Pullovers (Into or Out of Traffic) types. Table 20 describes the variables and categories to use for crash types with turning errors, loss of control, and pullovers. For best results, these variables and categories should be selected in order, since more than one special factor may have been selected in PBCAT 3 data.

Table 20. Bicyclist crash types with Turning Errors, Loss of Control, and Pullovers in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Step	PBCAT 3 CSV variables and categories to match PBCAT 2 types in listed in first column
111, 112, 113	Motorist turning error—left turn; motorist turning error—right turn; motorist turning error—other	a	motoristTurningError = yes
114, **115,** **116**	Bicyclist turning error—left turn; bicyclist turning error—right turn; bicyclist turning error—other	a	non-motoristTurningError = yes
121, 122, 123, 124, 129	Bicyclist lost control—mechanical problems; bicyclist lost control—oversteering, improper braking, speed; bicyclist lost control—alcohol/drug impairment; bicyclist lost control—surface conditions; bicyclist lost control—other/unknown	b	non-motoristLostControl = yes
131, 132, 133, 134, 139	Motorist lost control—Mechanical problems; motorist lost control—oversteering, improper braking, speed; motorist lost control—alcohol/drug impairment; motorist lost control—surface conditions; motorist lost control—other/unknown	b	motoristLostControl = yes

Table 20. (continued) Bicyclist crash types with Turning Errors, Loss of Control, and Pullovers in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Step	PBCAT 3 CSV variables and categories to match PBCAT 2 types in listed in first column
216	Bus/delivery vehicle pullover	c	transitBusPullover = yes; *OR* deliveryVehiclePullover = yes [May include a mix of crash types involving crashTypeBasic = E-P and O-P, but the special circumstance variables may be more precise.]
215	Motorist drive-in/out parking	d	motoristEnteringExitingParking = yes [Should include a mix of crash types involving crashTypeBasic = E-P and O-P, which covers motorists Entering Traffic Lane-Parallel Path, and O: Other Maneuver-Parallel Path. This category includes motorist leaving a traffic lane but also includes Stopped motorists. Thus, the Special Circumstance motoristEnteringExitingParking should primarily be used to match PBCAT 2 type]

Step 4: Select Crossing Path at Intersection crash types. As mentioned at the beginning of this section, PBCAT 2 includes a variety of types of traffic control, maneuvers, and behaviors/violations within the mix of intersection crash types. These crash types involve crossing paths before any turns that may have been initiated or intended by the motorist or the cyclist. PBCAT 3 does not embed these varied characteristics in the crash types, so this set of crashes is challenging to match to specific types. Identifying comparable groups still requires the use of several variables and the help of Special Considerations indicator variables included in PBCAT 3. To be more specific for some categories, users may also need to use variables on traffic control and violations from the jurisdictions database from outside of PBCAT 3. Approximate pairings are shown in table 21. Perform this step on crashes that are not matched after step 3.

If desired, these groups can be consolidated in both datasets for Crossing Paths at Intersections groups.

Table 21. Bicyclist-Motorist Crossing Path at Intersection crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Sub-step	PBCAT 3 CSV variables and categories to match PBCAT 2 types listed in first column
151, 152, 154	Motorist drive-out—right turn on red; motorist drive out—signalized intersection; motorist drive-through—signalized intersection	a	*crashLocationType* = Intersection; AND *crashTypeBasic* = S-C, RC, or L-C; AND signalViolMotorist = yes
156, 157	Bicyclist failed to clear—trapped; bicyclist failed to clear—multiple threat [These descriptions may be combined with the next group below involving bicyclist signal violations.]	a	*[crashLocationType* = Intersection; *AND crashTypeBasic* = S-C, R-C, or L-C; *AND* signalViolNon-motorist = yes;] *AND multipleThreat* = yes; *OR trapped* = yes [These violations may be combined with other bicyclist signal violations in the next row by ignoring the trapped and multiple threat indicators.]
153, 155, 159	Bicyclist ride-out—signalized intersection; bicyclist ride through—signalized intersection; bicyclist failed to clear—unknown	b	*[crashLocationType* = Intersection; *AND crashTypeBasic* = S-C, R-C, or L-C; *AND* signalViolNon-motorist = yes [any remaining in this subset after known trapped and multiple threats are removed]
158, 141, 143, 142, 144, 147, 148, 160, 180	*All other intersection crossing crash types:* Signalized intersection—other/unknown; motorist drive-out—sign-controlled intersection; motorist drive-through—sign-controlled intersection; bicyclist ride-out—sign-controlled intersection; bicyclist ride-through—sign-controlled intersection; multiple threat—sign-controlled intersection; sign-controlled intersection—other/unknown; crossing paths—uncontrolled intersection; crossing paths—intersection—other/unknown control	c	*[crashLocationType* = Intersection; AND *crashTypeBasic* = S-C, RC, or L-*C] [any remaining after signal violation types have been removed]* [If further splitting is desired, after identification of the signal violation types in previous steps, the type of traffic control, and violation information for the motorist and bicyclist may be derived from jurisdictional database.]

Step 5: Select Crossing Path at Midblock Crash Types. Crash types involving a crossing path at midblock are also necessary to consolidate somewhat in both datasets, relying primarily on crash location type in PBCAT 3 for comparable groups. These crash types could also be consolidated further into Crossing Path at Midblock type, as shown in table 22.

Table 22. Bicyclist-Motorist Crossing Path at Midblock crash types in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Sub-step	PBCAT 3 CSV variables and categories to match PBCAT 2 types listed in first column
357	Multiple threat—midblock	a	[(crashLocationType = Driveway Access or Related, *OR* Path Crossing / Junction with Trafficway, OR Non-junction (along Trafficway)); *AND* crashTypeBasic = S-C; *AND* multipleThreat = yes]
321, 322	Motorist drive-out—residential driveway; motorist drive-out—commercial driveway/alley;	b	crashLocationType = Driveway Access or Related; *AND* crashtypeBasic = R-C *OR* L-C [may include some 'drive-in' to driveway types]
311, 312	Bicyclist ride-out — residential driveway; bicyclist ride-out — commercial driveway/alley;	b	crashTypeBasic = S-C; *AND* crashLocationType = Driveway Access or Related
318, 319, 328, 329, 380	Bicyclist ride-out—other midblock; bicyclist ride-out — midblock—unknown; motorist drive-out—other midblock; motorist drive-out—midblock–unknown; AND crossing paths-midblock—other/unknown	c	Any crashes remaining involving: crashTypeBasic = S-C, R-C, L-C, or O-C, *AND* crashLocationType = Driveway Access or Related, Path Crossing/Junction, *OR* Non-junction (Along Trafficway)

Step 6: Select Parallel Path crashes involving Motorist Turns. Initial parallel paths involving motorist turns in PBCAT 2 should align reasonably well with these types in PBCAT 3. For parallel path types that included a turn or attempted turn by the cyclist, an additional non-motorist turning indicator variable can be used to identify and match these types, if desired. The variables and values are shown in table 23. It is also possible to consolidate all categories involving initial parallel paths and Motorist Turns.

Table 23. Bicyclist-Motorist Parallel Path crash types with Turns (any location type) in PBCAT 2 and PBCAT 3 data.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	PBCAT 3 CSV variables and categories to match PBCAT 2 types listed in first column
211	Motorist left turn—same direction	crashTypeDetailed = L-PS
212	Motorist left turn—opposite direction	crashTypeDetailed = L-PO
213	Motorist right turn—same direction	crashTypeDetailed = R-PS
217	Motorist right turn on red—same direction	crashTypeDetailed = R-PS
214	Motorist right turn—opposite direction	crashTypeDetailed = R-PO
218	Motorist right turn on red—opposite direction	crashTypeDetailed = R-PO
221, 225	Bicyclist left turn—same direction; *AND* bicyclist ride-out—parallel path	crashTypeDetailed = S-PS; *AND* non-motoristTurning = Left
222	Bicyclist left turn—opposite direction	crashTypeDetailed = S-PO; *AND* non-motoristTurning = Left
223	Bicyclist right turn—same direction	crashTypeDetailed = S-PS; *AND* non-motoristTurning = Right
224	Bicyclist right turn—opposite direction	crashTypeDetailed = S-PO; *AND* non-motoristTurning = Right

Step 7: Select Other Parallel Path crashes involving No Turns. After step 6 types are identified, step 7 includes selecting other parallel path crashes involving no turns. These crash types include overtaking crashes (either the motorist or bicyclist) and head-on types. The variables for comparing these types are shown in table 24.

Table 24. Bicyclist-Motorist Parallel Path with No Turns crash types in PBCAT 2 and PBCAT 3.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	Sub-step	PBCAT 3 CSV variables and categories to match PBCAT 2 types in listed in first column
231, 232, 235, 239	Motorist overtaking—undetected bicyclist; motorist overtaking—misjudged space; motorist overtaking—bicyclist swerved; motorist overtaking—other/unknown	N/A	crashTypeDetailed = S-PS; *AND* overtakingIndicator = Motorist was overtaking the non-motorist
241, 242, 249	Bicyclist overtaking—passing on right; bicyclist overtaking—passing on left; bicyclist overtaking—other/unknown	N/A	crashTypeDetailed = S-PS; AND overtakingIndicator = Non-motorist was overtaking the motorist
244	Bicyclist overtaking—extended door	a	crashTypeDetailed = P-PS, P-PO, or P-PU; *AND* dooringIndicator = yes
243	Bicyclist overtaking—parked vehicle	b	crashTypeDetailed = P-PS, P-O, or P-PU [any remaining, after dooring subset is removed]
250, 255, 259	Head-on—bicyclist; head-on—motorist; head-on—unknown	N/A	crashTypeDetailed = S-PO, AND headOn = yes; [Also, non-motoristTurning should = Straight]

N/A = not applicable.

Step 8. Identify or combine all remaining types. The final types of cyclist-involved crashes may best be combined into one group once other crossing paths and parallel path types have been determined (through Step 7). However, potential groupings are shown in table 25. Because the coding process and definitions of crash types are different in PBCAT 3 compared to PBCAT 2, it is not certain how well these remaining types will align.

Table 25. Varied other less defined bicyclist crash types in PBCAT 2 and PBCAT 3.

PBCAT 2 Bicyclist Crash_Type_Basic (Number)	PBCAT 2 Bicyclist Crash_Type_Desc (Description)	PBCAT 3 CSV variables and categories to match PBCAT 2 types in listed in first column
190	Crossing paths–other circumstances	Any remaining crossing path crashes involving: non-motoristManeuver = CR: Crossing Path from Motorist's Right; CL: Crossing Path from Motorist's Right; or CU: Crossing Path Unknown Direction
280	Parallel paths-other/unknown	Any remaining parallel path crashes involving: non-motoristManeuver = PS: Parallel Path Same Direction, PO: Parallel Path Opposite Direction, or PU: Parallel Path Unknown Direction. These crashes may also sometimes involve crashTypeBasic = E-P, and O-P.
219	Motorist turn/merge-other/unknown	Any remaining crashes involving motorist turns or merges may be included here. motoristManeuver = R: Turning Right, L: Turning Left Note that most of these crashes may involve the bicyclist on an initial crossing path, so crashTypeBasic might be used to identify most of this group: R-C, L-C would be used. Also, some motoristManeuver = S: Going Straight crashes may also involve motorists changing lanes; E: Entering Traffic Lane, and some O: Other Maneuver types may involve motorists merging or changing lanes. However, matching of these types is more problematic.]
970	Unknown approach paths	Any remaining types, especially including types for which the motorist maneuvers are O: Other Maneuver or U: Unknown Maneuver and non-motorist maneuvers were MU: Moving in Unknown Path/Direction, ST: Stationary, OU: Other/Unusual or UN: Unknown

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