Chapter 4 Countermeasure Planning

This chapter explains the specific work done to analyze the causes of accidents and study countermeasures using the Guideline. But because following this Guideline does not necessarily obtain appropriate causes of accidents and safety countermeasures, managers actually implementing countermeasures must study countermeasures best suited to local conditions with this Guideline as a reference.

The use of the Guideline is premised on the preliminary selection of locations where accidents occur frequently and other countermeasure study locations. Next the manager identifies road characteristics and the types of accidents that occur frequently at the location, and applies his findings to analyze the causes of accidents using Document 1 Table of Causes of Accidents and to select countermeasures suited to each countermeasures study location using Document 2 Table of Countermeasures.

Countermeasure planning and evaluation procedure

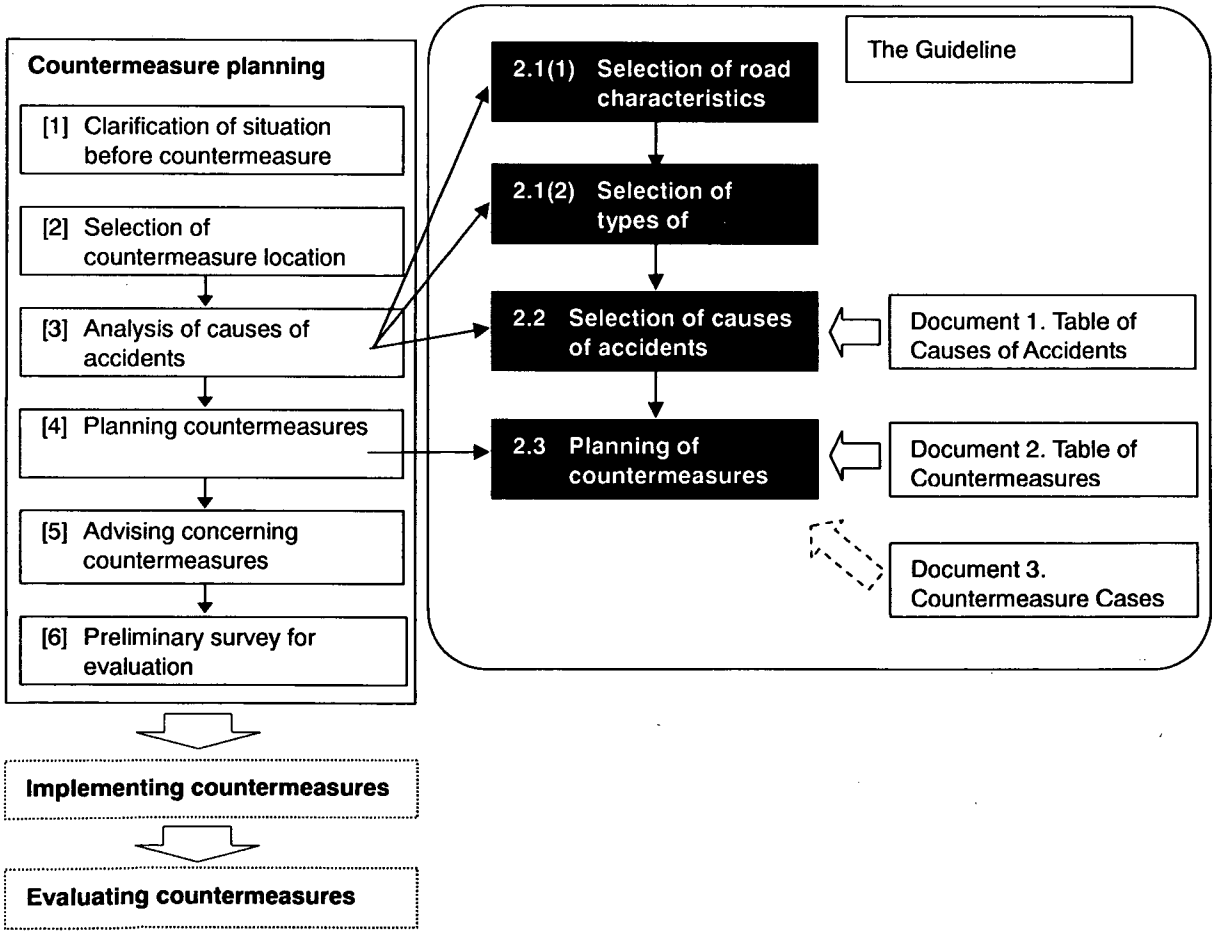


Figure 4.1 Method of Using the Guideline

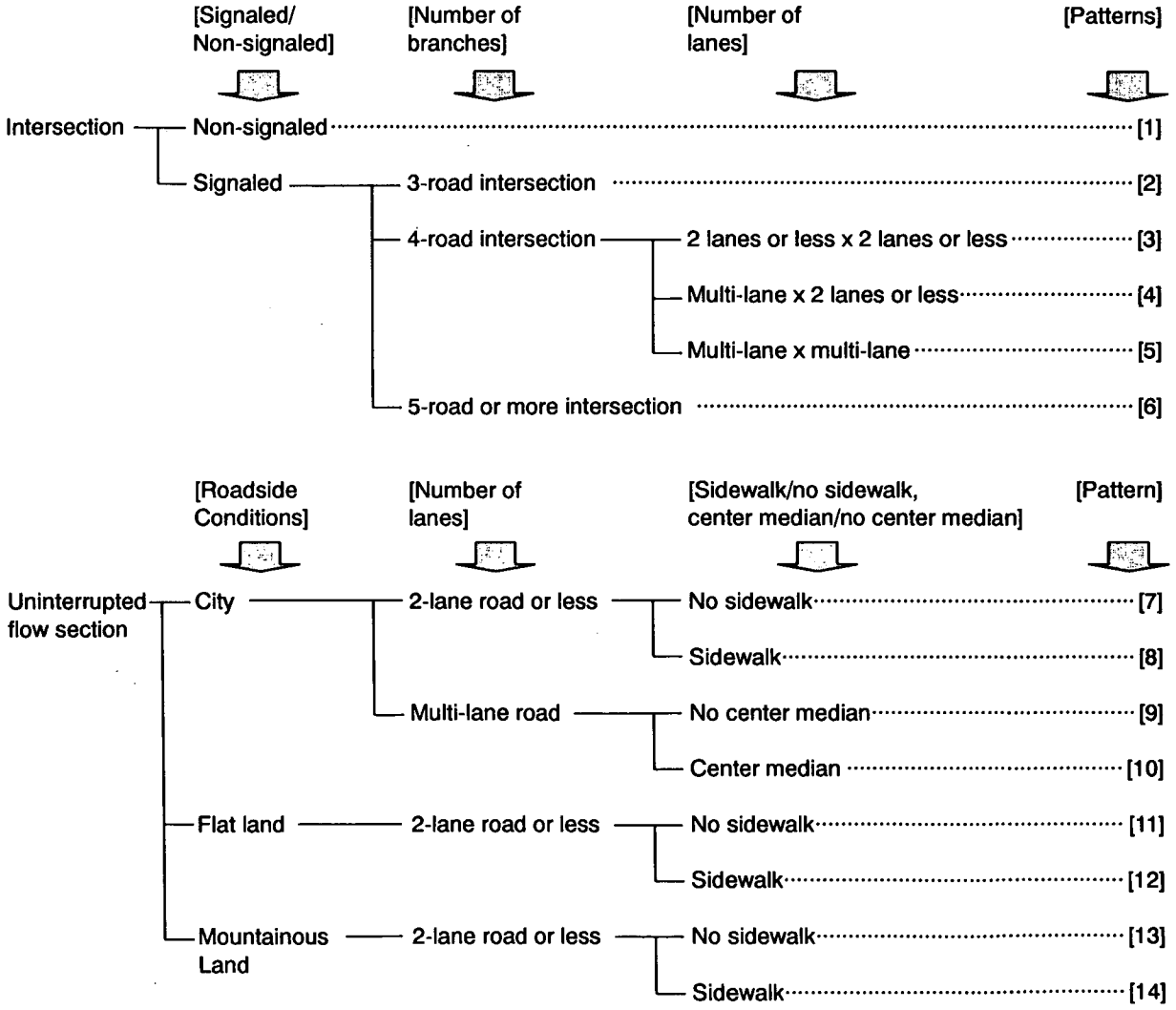
Beginning on the following page, the method of using the Guideline is described in detail beginning from the method of selecting road characteristics.

4.1 Prior preparations

(1) Selection of road characteristics

The first step in using the Guideline is to select road characteristics at the countermeasures study locations. The selection method is to select the pattern from among the 14 road characteristics shown below that corresponds to the countermeasures study location.

Because the road characteristics included are considered to be road characteristics limited to the 557 locations from among hazardous spots, there will be cases where the road characteristics corresponding to the countermeasures study location are not included. In this case reference should be made to other road characteristics. (For example, among uninterrupted flow section on flat land and on mountainous land, multi-lane roads are not included; they are studied with reference to multi-lane roads in cities.)



Note) the number of lanes is selected without including auxiliary lanes (right turn lane, etc.)

Figure 4.1.1 Chart used to Select Road Characteristics

(2) Selection of types of accidents

After the road characteristics of countermeasures study locations have been selected, next the types of accidents to be studied at the location are selected. The selection is done by selecting types from among the following types of accidents (see Fig. 4.1.2).

The purpose of this Guideline is to plan countermeasures focusing on the causes of accidents. For this reason, types of accidents with similar causes were clarified and integrated based on types of accidents defined in the Accident Statistic Reports to establish 12 types of accidents. The types of accidents included were finally set as 9 types by excluding types whose causes are difficult to clarify: "Other pedestrian – vehicle accidents," "When overtaking and passing," and "Other vehicle - vehicle accidents." The correspondence between the accident types defined in the Accident Statistics Reports and the types of accidents included in the Guideline is shown in Table 4.1.1.

The cases that are clarified and integrated are classified in the Accident Statistic Reports as rear-end collisions (while moving) and rear-end collisions (others), but these are unified because it is assumed there are no differences between their causes.

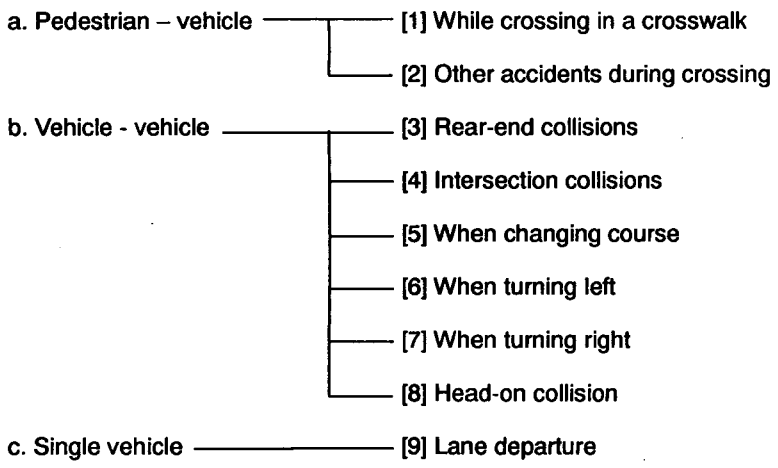


Figure 4.1.2 Chart Used to Select Types of Accidents

Table 4.1.1 Correspondence Between the Types of Accidents in the Statistics Report with those in the Guideline

Categorization of accident types in the Traffic Accident Statistical Reports			Categorization of accident types in the Guideline
Vehicle – vehicle accident	Head-on collision		[8] Head-on collision
	Collision when meeting and passing		
	Intersection collision		[4] Intersection collision
	Collision when overtaking and passing		* When overtaking and passing
	Collision when changing course		[5] When changing course
	Left turn collision		[6] During a left turn
	Right turn collision		[7] During a right turn
	Collision when turning around		
	Collision when crossing		* Other vehicle – vehicle accidents
	Collision when backing up		
	Others		
	Rear-end collision		[3] Rear-end collision
Single vehicle	Collision with parked vehicle		
	Collision with a structures		[9] Lane departure
	Road departure		
	Rolling		
	Others		
Pedestrian - vehicle	Crossing the road	Crosswalk	[1] Crossing in a crosswalk
		Near a crosswalk	
		Near a pedestrian bridge	[2] Crossing at other locations
		Others	
	Walking facing the traffic		* Other pedestrian – vehicle accidents
	Walking with their back to the traffic		
	Playing on the road		
	Working on the road		
	Stopped on the road		
	Others		

Note: * indicates accident types not considered by the Guideline

The types of accidents included in the Guideline include only the top 3 to 5 types for each road characteristic, because there were cases where adequate analysis could not be done to prepare the Guideline because the number of cases is small. There are, therefore, cases where types of accidents that should be studied are not included. In such a case, refer to other road characteristic cases included under this type of accident. For example, because right-turn accidents at non-signaled intersections are not included, reference will be made to a left turn accident at a signaled intersection of a road with 2 lanes or less and a road with 2 lanes or less.

The cases that are included are organized by road characteristics below in Table 4.1.2.

Table 4.1.2 Types of Accidents Included in the Guideline According to Road Characteristics

Road characteristics				Accident types included								
				Crossing in a crosswalk	Crossing at other locations	Rear-end collisions	Intersection collisions	While changing course	Turning left	Turning right	Head-on collision	Lane departure
Intersection	Non-signaled				○	○	○			○		
	Signaled	3-road intersection		○		○	○			○		
		4-road intersection	Intersection of roads with 2 lanes or less			○	○		○	○		
			Intersection of a multi-lane road with road with 2 lanes or less	○		○	○			○		
			Intersection of multi-lane roads			○	○		○	○		
		5-road or more intersection				○	○			○		
Uninterrupted flow section	City	2-lane or less	No sidewalks		○	○				○	○	○
			Sidewalks		○	○			○	○		○
		Multi-lane	No center median			○	○			○		
			Center median			○	○	○		○		
	Flat land	2-lane or less	No sidewalks		○	○					○	○
			Sidewalks		○	○					○	○
	Mountai-nous land	2-lane or less	No sidewalks			○					○	○
			Sidewalks			○					○	○

(3) Other preparations

Before using the Guideline, it is necessary to organize documents concerning past accidents and documents concerning the road traffic environment as preparation for selecting the causes of accidents.

For example, the answers to the questions—when, where, and in what way did the accident occur and who was involved—regarding the types of accidents selected in (2), are organized based on an integrated data base and a chart of the state of the occurrence of accidents.

4.2 Identification of causes of accidents

The causes of accidents are almost entirely human causes such as excessive speed or failure to confirm safety. But background factors contributing to the occurrence of traffic accidents includes cases where road traffic environments induce human causes, and these cases should be approached from the road side in order to prevent accidents. Causes of accidents included in the Guideline are, therefore, causes of accidents linked to road traffic environments.

(1) Structure of the Table of Causes of Accidents

Document 1 Table of Causes of Accidents is used to analyze the causes of accidents. The Table of Causes of Accidents is prepared by Road Characteristics described above in 3.1. This table was prepared by combining three topics: A. Accident occurrence process, B. Check points of road traffic environments that cause accidents, and C. Road traffic environments that cause accidents (see Table 4.2.1). The combinations identified by numbers (1-1, etc.) in the table are combinations of those that have already been studied at hazardous points or combinations that have not been studied but are considered to cause accidents as a result of other studies. The meaning of numbers (1-1 etc.) are combinations of check points of road traffic environment that cause accidents and reference numbers of road traffic environments that cause accidents (see Document 1), and are cause code numbers that correspond to Document 2. Table of Countermeasures

Because this document is a document studied and prepared based on limited cases, there may be combinations of items for which cause code numbers are not recorded, that are causes of accidents. Combinations for which no cause code number has been recorded should be confirmed in the field.

Table 4.2.1 Contents of the Table of Causes of Accidents

Item	Contents
A. Accident occurrence process	It records the processes resulting in the occurrence of accidents by road characteristics and by type of accident, and summarizes recognition and judgement errors of people involved in accidents.
B. Check points of road traffic environments that cause accidents	It summarizes important perspectives that should be considered concerning the presence/absence of traffic road environments that back up the processes resulting in the occurrence of accidents at the time of field surveys.
C. Road traffic environments that cause accidents	It summarizes road traffic environments concerning conditions that cause the check points in B.

(2) Methods of Using the Table of Causes of Accidents

The following is an explanation of the specific procedure used to select the causes of accidents using the Table of Causes of Accidents.

[Selecting the Causes of Accidents Using the Table of Causes of Accidents]

[1] In-office analysis (preliminary preparation) stage

The road characteristics at the countermeasures study location are clarified. Next the types of accidents that occur frequently at the location are identified and those that correspond are selected (For these steps, see 3.1 above).

[2] In-office analysis (selection of causes of accidents) step

The Table of Causes of Accidents matched to the road characteristics at the location is opened, documents concerning past accidents organized by 4.1 Prior Preparations (3) other preparations and documents concerning the road traffic environment are used to hypothesize the road traffic environment conditions related to the occurrence of accidents, then the candidate causes of accidents are selected from among the combinations of A. Accident occurrence process, B. Check points of road traffic environments that cause accidents, and C. Road traffic environments that cause accidents in the table. However, because the documents were studied and prepared based on limited cases, there is a possibility that there will be combinations for which cause code numbers are not recorded that are causes of accidents. If there are combinations without cause code numbers or items that are not listed on the Table of Causes of Accidents that are also considered to be causes, these are all selected.

[3] Field survey step

In the field, it is confirmed whether or not the causes of accidents hypothesized by the in-office analysis actual exist in the field. At the same time, a check is done to find out if there are no causes of accidents that might correspond to A. B. and C. on the Table of Causes of Accidents other than those hypothesized by the in-office analysis to select the causes of accidents that might exist. During this task, if there are presumed causes other than those in the Table of Causes of Accidents these are all selected.

However, because the causes of accidents are related in complex ways with the road traffic environment and human factors etc., judgements must be made fully in accordance with the road structure at the site and the state of accidents while conforming with the Guideline.

Specific examples of analysis done using the Table of Causes of Accidents are presented below.

< [1] Road characteristics selection >

This is a model case of the selection of the installation of warning signs and of advance warning signals as countermeasures at a signaled intersection of a 4-lane road and a 2-lane road where rear-end collisions occur frequently,

In this case, the road characteristics correspond to Pattern [4]: intersection, signaled, 4-road intersection, multi-lane x 2-lanes or less. So pattern [4] in Document 1 Table of Causes of Accidents (Document 1-7) is opened.

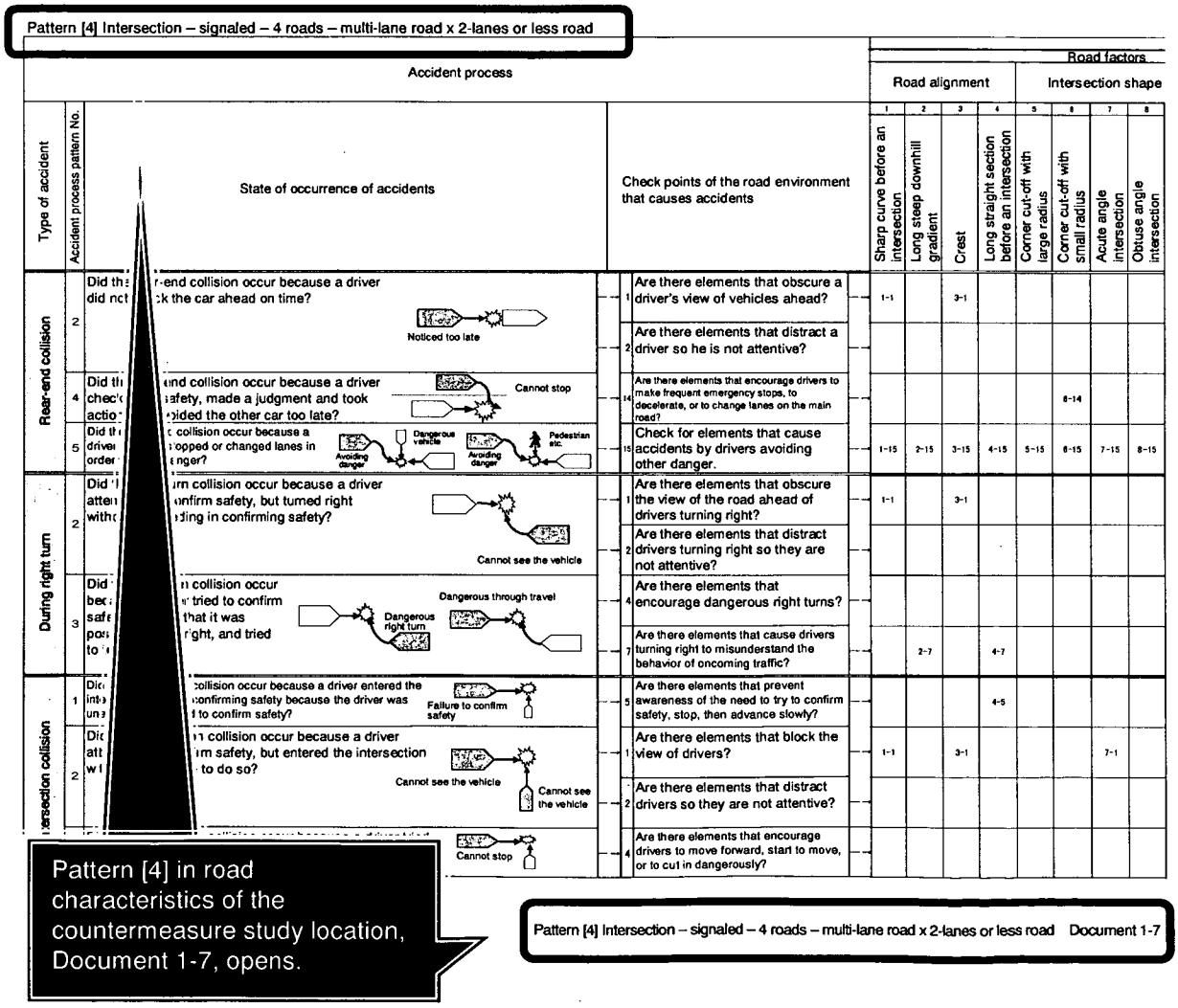


Figure 4.2.1 Example of the Selection of Road Characteristics

< [2] Selection of Type of Accident >

Because at this countermeasures study location, many rear-end collisions have occurred, location of the accident type, rear-end collisions in Document 1 Type of Accidents is viewed.

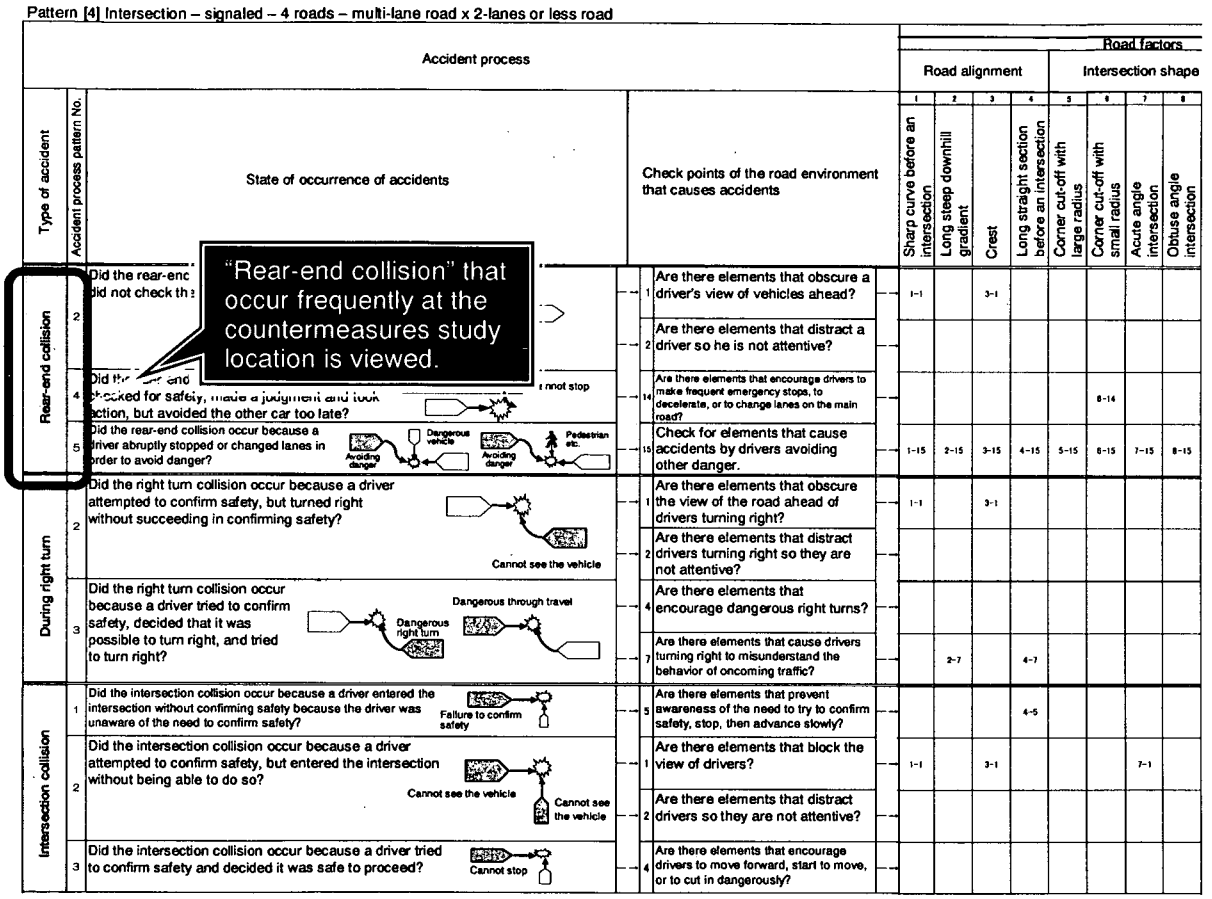


Figure 4.2.2 Example of the Selection of Type of Accident

< [3] Example of the selection of causes of accidents >

Based on the in-office analysis done using documents concerning past accidents that were organized at the preliminary preparation step and the documents concerning the road traffic environment, the combination of processes resulting in the occurrence of an accident "Did the rear-end collision occur because a driver did not check the car ahead on time?" and the road traffic environment check point, "Are there elements that obscure a driver's view of vehicles ahead?" was studied, to hypothesize that because there was definitely a sharp curve ahead of the intersection, the road environment that caused the accident was a "sharp curve".

Next, a field survey was performed with reference to items in the Table of Causes of Accidents confirming that the driver's vision of the road ahead was obscured by a "sharp curve before the intersection," and this is selected as the cause of the accident.

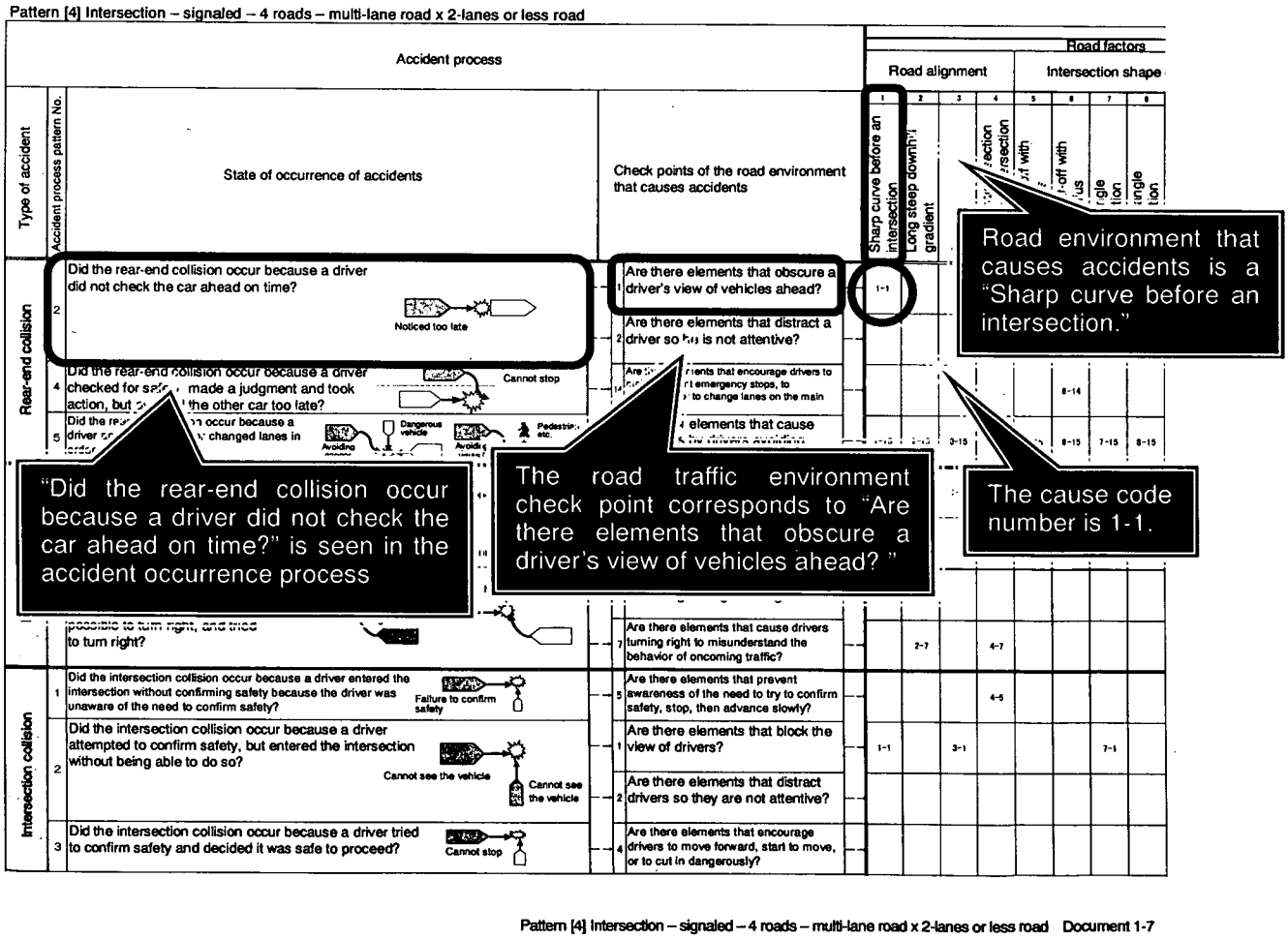


Figure 4.2.3 Example of the Selection of a Cause of an Accident

4.3 Planning countermeasures

Document 2 Table of Countermeasures is used to plan countermeasures. In this Guideline, the correspondence of causes of accidents with countermeasures is linked by cause code number ([ ]-[ ]) in the Table of Causes of Accidents. Therefore, countermeasures are planned by searching for the page in the Table of Countermeasures that include this cause code number based on the case code numbers of causes of accidents specified as stated above.

Four kinds of Tables of Countermeasures have been prepared: Table A and Table B for intersections and Table C and Table D for uninterrupted flow section. (see Fig. 4.3.1)

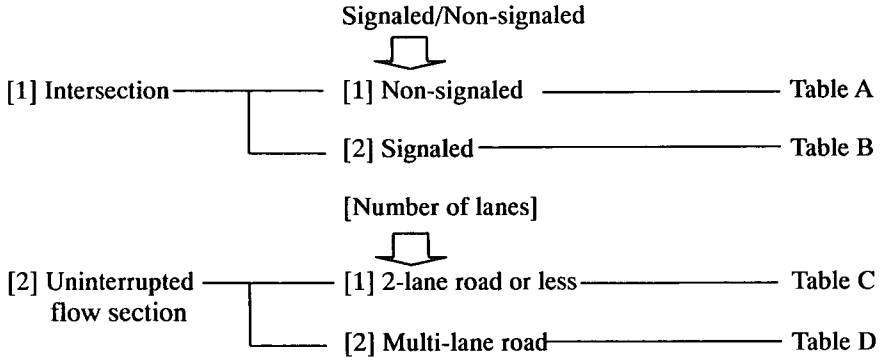


Figure 4.3.1 Table of Countermeasures

Document 2 Table of Countermeasures is used as follows to plan countermeasures.

< Procedure for Planning Countermeasures Using the Table of Countermeasures >

[1] When the Table of Countermeasures that match the road characteristics at the locations where countermeasures are implemented is opened and Document 1 Table of Causes of Accidents is used to select the causes of accidents, the page with the cause code number that is written on the Table of Causes of Accidents is searched.

[2] Because it includes the countermeasures goals and countermeasures work types that are considered to be effective against the causes of accidents, appropriate countermeasures are selected with reference to the state of the road environment, related types of accidents, and the precautions written on the right edge (precautions when selecting and implementing countermeasures). And because this document was studied and prepared based on limited cases, it does not necessarily cover all countermeasures, and if there are countermeasures that it does not include, these are selected.

However, because it is necessary to make judgments according to the state of each countermeasures study location in order to make the final selection of countermeasures, judgments must be made fully in accordance with the road structure and the state of accidents at the countermeasures study location, while conforming with the Guideline.

A specific example of countermeasure selection using the Table of Countermeasures is shown below.

< Example of use >

The countermeasure study location is a signaled right-angled intersection of a 4-lane road and a 2-lane road. In this case, the Table of Countermeasures used is Table B "Signaled Intersection".

Page 2-8 of the Document with the cause code number 1-1 of the specified causes of accidents is opened, "Alerting drivers to the intersection ahead and providing them with information" is selected as the appropriate countermeasures goals according to conditions at the site, and "Warning signs" and "Advance warning signals" are selected as the specific countermeasures work types.

Cause code	Planning the accident countermeasures						Case No.	Case page
		Countermeasure goal	Countermeasures code table number	Countermeasure work type on the countermeasure code table	Precautions when selecting and implementing countermeasures			
1 – 1	1	Alert drivers to the intersection and provide information in advance	2102	Warning sign (201:Intersection ahead)				
			5108	Advance warning light				
	2	Reconstruct the road so the drivers attentiveness does not fall	1301	Alignment improvement	•This is studied only in cases where large scale improvement is possible; land and budget can be obtained etc.			
	3	Control signals so vehicles can stop safely	5117	responsiveness and	•This is studied only in cases where it is difficult after the above mented.			
	1	Control the movement of right-turn vehicl and through vehicles to keep them apart			aggressively multi-lane roads.			
2 – 7	1	Control the speed of through vehicles			road , and 5221 is a ermeasure.)			
			5304	Speed warning display boards				
			2105	Warning sign (208-2:Traffic signal ahead)				
			1404	Improving pavement (level difference pavement)			(9)	Document 3-9
	2	Control the movement of right-turn vehicles and through vehicles to keep them apart	5114	Improving the signal phases (separating left or right turn from through traffic)	•This countermeasure should be aggressively implemented at intersections of multi-lane roads.			
			5102	Installing signals (arrow signals)				
3 – 1	1	Alert drivers to, and provide information about, conditions that will make a location a dead angle for drivers	2105	Warning sign (208-2:Traffic signal ahead)	•This countermeasure is implemented where drivers can stop safely after it alerts them to the intersection.			
	1	Control the movement of right-turn vehicles and through vehicles to keep them apart	5114	Improving the signal phases (separating left or right turn from through traffic)	•This countermeasure should be aggressively implemented at intersections of multi-lane roads.			
			5102	Installing signals (arrow signals)				
	2	Control right turns by vehicles	5003	Prohibiting travel outside a designated direction	•This is studied when countermeasure 1 cannot be taken. (Countermeasure code 5003 is prohibiting right turns.)			
			5009	Prohibiting U-turns				

The accident countermeasures selected are "Warning sign" and "Advance warning light" to alert drivers.

Figure 4.3.2 Example of Planning Countermeasures