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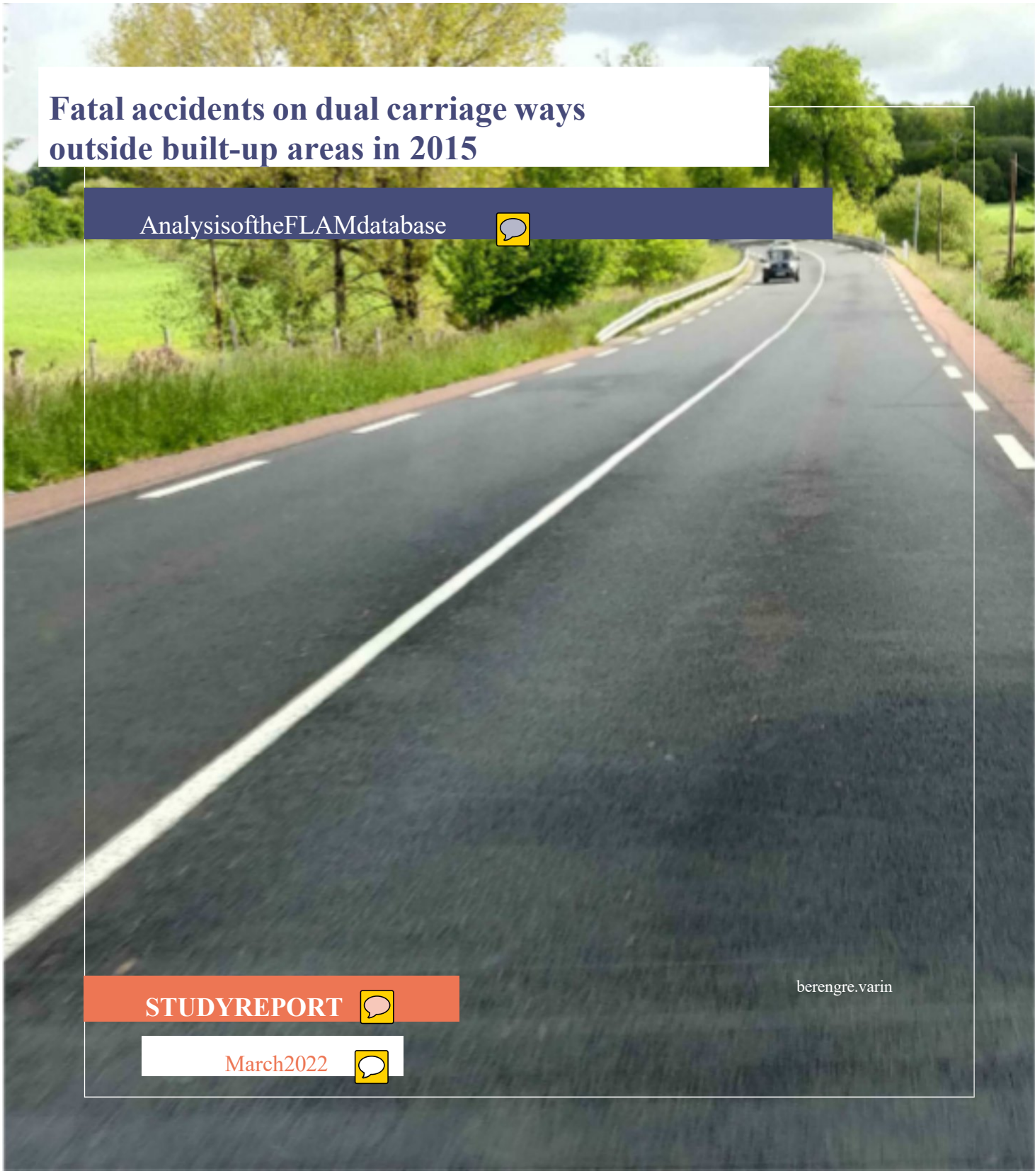

Fatal accidents on dual carriage ways outside built-up areas in 2015

AnalysisoftheFLAMdatabase

berengre.varin

STUDYREPORT

March2022

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Fatal accidents on dual carriageways outside built-up areas in 2015

Analysis of the FLAM database Client: DSR agreement no. 2102828388 Author: Bérengère Varin

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Document version history

Version	Date	Comment
1	December 2021	Initial version
2	February 2022	Following proofreading by the Cerema project team
3	March 2022	Available at

References

Case no.: 21-NC-0503 Partner(s): not applicable
Response to the DSR 2019 call for projects

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Summary of the study

The aim of the study is to provide an overview of fatal accidents on two-way roads outside built-up areas.Theanalyses are based on the "FLAM" database, which was created by Cerema on the basis of fatal accident reports for 2015.

The main determinants of accidents are identified by theme: users, road ownership, roadenvironment.Comparisons are made, in particular between accidents that took place on the main roadnetwork (RN, RD) and those outside this network (other RD, VC).

Most accident factors relate to the road user, in particular their condition (ingestion of substances, occasional or chronic condition), their driving behaviour (compliance with rules, risk-taking or speed practices) or their experience. Certain types of factors relate to the infrastructure or environment, such as visibility masks, road conditions or recovery/avoidance problems. Factors linked to the vehicle have also been highlighted, such as the poor visibility of bicycles or 2WDs, power that encourages high speeds or the poor condition ofthevehicle.

Factors aggravating the consequences of accidents have also been identified, mainly collisions with fixed obstacles on the roadside or failure to wear a seatbelt.

5 to 10 key words to remember from the study

fatal accident	**FLAM project**
two-way road	
long-distance	
accident factor	
infrastructure	

Foreword for publications translated into foreign languages

The purpose of translated documents and publications is to pass on to non-French speaking readers the French know-how set out in the original publication,whether this concerns knowledge, methodologies, tools or best pratices.

Original publications in French are subject to a checking process,which leads to a Cerema commitment regarding their content.

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Context and purpose of the study

Two-way interurban roads make up a vast network of over 400,000 km, managed in part by the State and local authorities, mainly the Departmental County. This network performs multiple functions (transit and/or service and has diverse characteristics in terms of infrastructure provision. It accounts for a significant proportion of journeys made for a variety of reasons, with a mix of different users such as passenger vehicles, heavy goods vehicles, vulnerable road users, farm machinery, etc. In terms of accidents, this network accounts for most of the fatalities on roads outside built-up areas. While the BAAC file provides some information on the overall accident rate, there is a lack of more in-depth knowledge that would enable a diagnosis to be made that is better suited to the heterogeneity of this network.

The main objective of the Sécubidi project is therefore to provide detailed knowledge of accidentology and usage on two-way rural roads in order to :

- Better knowledge for action, in particular estimating and prioritising safety issues by distinguishing between function, characteristics and uses;
- Identify the main accident mechanisms in order to make a diagnosis and estimate the role of infrastructure and users;
- Evaluate the possibility of proposing a specific analysis by territory, typically at the level of a departmental network.

The in-depth study of the FLAM database, which is the subject of this deliverable, contributes to the second objective of the Sécubidi project: to identify the main accident mechanisms in order to make a diagnosis and estimate the role of infrastructure and users.

In addition, the main results from the analysis of the FLAM database will be put into perspective with the issues arising from the analysis of the BAAC in order to obtain the most complete picture possible of the accident situation on two-way roads outside built-up areas.

CONTENTS

SUMMARY

Accidents on two-way roads outside built-up areas were a major factor in fatal accidents in 2015. The FLAM database contains 1,685 such accidents, which can be broken down into different types of network:

- departmental roads outside the main network [RD2] (877 accidents, 52% of the total);
- Departmental roads on the main network [RD1] (570 accidents, or 34% of the total);
- national roads (144 accidents, 9% of the total),
- municipal roads (140 accidents, or 8% of the total).

The majority of accidents occurred during the day (61%), on flat (70%) and straight roads (62% on the main network and 52% on the rest of the network) with a default speed of 90 km/h (80%).

The proportion of work-related accidents is fairly high: 40% of accidents on the main network and 34% on the rest of the network. The difference is explained by a higher proportion of accidents involving a driver on a work-related journey on the main network (25% vs. 17%). Home-work journeys account for 20% on both types of network.

1.1 users

Private car drivers accounted for the majority of road users involved (71%), and most of them were travelling on main roads (84%) and off the main road network (47%). Other types of user were also involved:

- **Pedestrians**: The majority of pedestrians (92% of cases) were walking on road sections. 24% were walking in built-up areas. With 66% of pedestrian accidents, night-time accidents are a major issue, particularly on the main road network: 35% of pedestrian accidents take place at night on the main road network (compared with 29% outside the main road network).
- **Cyclists**: 29% of them were involved in accidents at junctions, mostly off the main road network (18% vs. 11% on the main road network). 20% of cyclists were travelling on a narrow road (width < 6m).
- **2WD**: Intersections are a particular issue for both motorcyclists (25%) and cyclists (23%), with a predominance of intersections off the main road network (17% for motorcyclists and 12% for cyclists). It is the type of network that represents the major challenge on the current section, with a share of 55% for cycles and 43% for motorbikes.
- **LCVs**: They differ from passenger cars in that they are more involved at intersections (24% vs. 16%). Intersections outside the main road network are in the majority (16% vs. 8% on the main road network).
- **HGVs**: HGVs tend to be involved in accidents outside intersections (84%) on the main road (48%).

1.2 Types of accident

Accidents on two-way roads allow interaction between users travelling in opposite directions: 47% of accidents on the main network (main RN+RD) involve users travelling in opposite directions. This proportion is lower on the rest of the network (34%).

The main types of accident are those involving 2 vehicles in a straight section without pedestrians or overtaking, and those involving 1 vehicle without a pedestrian. However, the breakdown varies according to light conditions and the type of road:

- On the main network :
    - During the day, accidents involving 2 vehicles are in the majority (43%) compared with those involving no third party (27%); this distribution is reversed at night;
    - During the day, 15% of accidents occur at intersections,
    - At night, 14% of accidents involve a pedestrian.
- Off the main network :
    - Accidents without third parties account for the majority (39% during the day and 56% at night);
    - Next come 2-vehicle accidents on road sections (32% during the day and 19% at night);
    - accidents at intersections account for 16% of daytime accidents.

Accidents involving overtaking are a major issue: 17% of daytime accidents on the main network and 13% on the rest of the network.

1.2.1 Accidents involving lane departure

55% of drivers involved in accidents on two-way roads outside built-up areas had left the carriageway. These lane departures occurred on bends in 54% of cases, and on straight sections in 45% of cases (1% of cases unknown).

When it is known (i.e. in around 90% of cases), the side of the lane exit is overwhelmingly to the left (71% compared with 29% to the right), whether the road user is initially on a straight section (73% of exits to the left) or on a bend (70% of exits to the left).

For all the users involved, the potential cases of loss of control are 34%, with guidance faults accounting for 20%.

Drivers with offset (excluding malaise)

If we consider only offset drivers who did not become unwell, we obtain the following breakdown:

- 32% of drivers with guidance defects,
- 68% of drivers with loss of control.

Drivers with an offset due to a guidance problem (excluding collisions and intersections)

The problem is present on all networks, but is more of an issue on the RN: 30% of accidents on the RN involve leaving the lane due to a guidance problem (excluding accidents where people feel unwell), compared with 20% on the RD1 and 18% on the RD2.

The majority of drivers who left the lane due to a failure to steer (excluding those who were unwell) were travelling in a straight line, i.e. 55% of the 180 cases.

This proportion is higher on the main network (62%) than off the main network (48%).

When lane exits take place on curves, right-hand curves are approximately 2 times more represented than left-hand curves.

The majority of drivers who left the lane due to a lack of guidance did so by swerving to the left (88% on a straight section, 99% on a right-hand curve and 67% on a left-hand curve). Overall, 255 drivers (88%) made a first swerve to the left, while 35 (14%) made a first swerve to the right.

Although the sample is fairly small (26 cases out of all the accidents), it can be seen that the vast majority of vehicles travelling on the left-hand curve moved towards the inside of the curve. Conversely, there was only 1 case of a vehicle moving to the inside of a right-hand curve.

1.2.2 Striking an obstacle in accidents without third parties

Accidents without third parties (excluding intersections) accounted for 38% of all accidents, or 645 cases. They are characterised by a high proportion of collisions with aggravating fixed obstacles (77%).

Most of these occurred on bends (53% of cases), particularly on the less structuring network : 58% on the RD2, compared with 49% on the RD1 and 39% on the RN.

In some cases (11% of accidents, i.e. 51 cases), vehicles (or users) may hit several obstacles. It is not possible to determine from the database which obstacle caused the most serious accident.

The main type of obstacle struck in accidents involving no third party was trees (49%). Obstacles such as poles/pylons/candelabras and natural low-lying obstacles were hit in 14% of cases. Natural obstacles at high level accounted for 9%. Although they accounted for a relatively small proportion of the accidents, walls/verts (6% in 29 accidents) and nozzle heads (5% in 22 accidents) were also hit.

The distance of the aggravating obstacle from the edge of the carriageway was estimated. If only obstacles with a known distance are taken into account, it can be seen that :

- 60% of obstacles hit on the shoulder were less than 2 m from the edge of the carriageway (this proportion is 54% on the main network (RN+RD1) and 66% off the main network (RD2+VC);
- 83% were less than 4 m away (this proportion is identical for the 2 types of network).

1.3 Accident factors

Human factors account for the vast majority (92%). Inappropriate or excessive speed (38%) and alcohol (31%) are the main factors.

The Infrastructure factors are divided in a similar way between triggering factors (33%) and aggravating factors (36%).

The main factors linked to Infrastructure or traffic conditions are :

- Poorly legible infrastructure that does not allow users to adapt their behaviour : poor legibility of curves (4%), intersections (2%).
- Visibility defects, mainly caused by fixed masks (7%) linked to the environment (4%) and the profile or layout of the road (2%).
- Inadequacy of the infrastructure to cope with dynamic constraints : grip problems on wet roads (7%), poor road condition (e.g. presence of grease or gravel) in 2% of accidents.
- Recovery or avoidance possibilities limited by insufficient shoulder widths (8%) or by the presence of an obstacle on the shoulder (3%).
- Collision with an aggravating fixed obstacle on the shoulder occurred in 35% of accidents. In around 75% of cases, the obstacle was probably less than 4 m from the edge of the carriageway. Trees were the main type of obstacle hit (more than 250 cases).

Vehicle factors were identified in 19% of accidents.

The design and/or characteristics of vehicles were present in 11% of accidents, but these types of factors are directly associated with categories of vehicle and therefore with specific accidents, such as "powerful vehicles" (4% of all accidents, but 17% of motorbikes), the low conspicuity of motorbikes (13%) or bicycles (20%).

1.4 Accidents by type of network

Departmental roads [RD2] appear to account **for the highest proportion of fatal accidents, with 877 accidents, or 52% of all accidents on the two-way network outside built-up areas**. Departmental roads [RD1] accounted for 570 accidents, or 34% of the total, followed by trunk roads (144 accidents, or 9%) and local roads (140 accidents, or 8%).

Overall, there were 702 accidents on the main road network (RN+RD1), or 42% of all accidents on the two-way network outside built-up areas.

1.4.1 Accidents on national roads

Out-of-intersection accidents (86% of all RN accidents) involved a large majority of drivers who left the lane (102 out of 124 accidents). 80% of drivers swerved to the left and 71% collided with an oncoming vehicle.

While the majority of drivers were travelling in a straight line (72%), there was a high proportion of lane departures on bends, particularly on the left, which can result in trajectories being cut on left-hand bends (8 out of 12 cases).

Direct exits from the carriageway (without hitting a vehicle) occurred mainly on roads with grass shoulders (11 cases vs. 8 with paved shoulders). The shoulder, whatever its type, was level with the carriageway in 71% of cases.

In comparison with accidents on main roads, the following points stand out:

- A higher proportion of human factors such as fatigue (1.7 times more, i.e. 26%), inattention without a distractor (1.4 times more, i.e. 13%) and dangerous overtaking (1.4 times more, i.e. 11%).

- Fewer Infrastructure triggers (0.8 or 23%) and aggravators (0.5 or 19%).
- More grip problems on wet roads (1.3 or 9%). A greater role played by the poor condition of the vehicle (1.7 or 13%).

1.4.2 Accidents on departmental roads

Accidents on dual carriageways accounted for 86% of fatal accidents on non-urban two-way roads in 2015.

- 39% of accidents involved at least 1 road belonging to the main network [RD1]. These accidents involved a high proportion of pedestrians (51% of pedestrians involved in accidents on the main road) and HGVs/TGVs (45%). Moped riders (30%) and cyclists (35%) were the least common road users.
- 60% of accidents involve roads that are not part of the main network. [RD2]

Non-intersection lane departure accidents

Out-of-junction accidents involved a large majority of drivers who left the road (1,002 drivers in 1,217 accidents). Drivers travelling off the main road network had a higher proportion of lane departures than those on the main road network (53% vs. 48%).

Around 70% of run-offs were on the left side. The proportion of run-offs involving a collision with a vehicle arriving in the opposite lane is higher on the main network (40% vs 32%). Direct left exits accounted for 35% outside the main network and 30% on the main network.

Drivers travelling off the main road network had 1.2 times more lane departures on bends than on the main road network (60% vs. 50% respectively). The distribution of curves is similar: 50% left curves on the main network and 52% on the rest of the network.

As on the national network, there is a high proportion of lane departures within a curve, particularly on the left : 58% on the main network and 54% on the rest of the network.

Direct exits from the carriageway (without hitting a vehicle) were mainly on roads with grass verges (73% on the main network and 82% on the rest of the network).

The main factors involved in accidents on the main departmental road network [RD1] compared with those on the rest of the departmental network [RD2] are :

- driver fatigue or discomfort (1.4 times more frequent),
- risk-taking (1.3 times more frequent),
- the user's current state: tiredness, carelessness, stress, etc. (1.2 times more frequent).

Certain infrastructure factors are less prevalent:

- Visibility (0.8)
- Striking a fixed obstacle on the shoulder (0.9).

However, there was little difference in the typology of the factors present in accidents on the 2 types of departmental network. There was no specificity in terms of vehicle factors.

The road environment

Analysis of the road environment reveals 5 main configurations in accidents on two-way roads outside built-up areas:

- Rural interurban environments with no particular characteristics: the majority of all accidents, with a higher proportion on the main road network (RN+RD) (66% compared with 46% on the rest of the network).
- Narrow roads less than 6 m wide : this category accounts for 25% of accidents outside the main network (the few cases on the main network involve intersections with roads outside the main network).
- The semi-urban environment, with dispersed housing or business parks : its share is similar for the 2 types of network : 8% of the main network and 6% for the rest of the network.
- Forest roads or roads with wooded surroundings : these account for 8% of accidents on the main network and 11% of accidents on the rest of the network.
- Mountain roads: have a similar share for the 2 types of network: 4% of the main network and 5% for the rest of the network.

Narrow roads and mountain roads have a high concentration of accidents without third parties, particularly off the main network (around 70%).

Accidents in semi-urban areas or where buildings are scattered account for 20% of accidents involving pedestrians on the main network and 13% on the rest of the network.

Narrow roads present the highest risk of collision with a fixed obstacle on an acceleration: 38% of vehicles involved.

Trees are the most common type of obstacle hit. They constitute an aggravating obstacle for 66% of drivers in wooded areas, for 42% of drivers on narrow roads, 36% of those involved in accidents in mountainous areas and 20% of those involved in accidents in areas with diffuse built-up areas.

Tableau de synthèse thématique

	Type de réseau				
	Ensemble des accidents 1685 cas	Réseau principal RN+RD (ppal) 702 cas	VC+RD (hors réseau principal) 976 cas	Réseau RD principal 558 cas	RD hors réseau principal 677 cas
Implantation (en nombre)	15% - 253	15% - 105	15% - 105	15% - 145	15% - 137
Nb de piétons	3% - 55	4% - 45	2% - 38	3% - 34	2% - 21
Nb de cyclistes	3% - 75	2% - 27	3% - 49	3% - 29	3% - 46
Nb de motos	11% - 319	13% - 129	12% - 149	11% - 108	12% - 171
Nb de PL/TC	7% - 207	9% - 116	8% - 91	7% - 74	8% - 89
Facteur	33%	29%	36%	30%	36%
Facteur C	19%	19%	19%	19%	19%
Facteur l'aggravant	36%	31%	39%	30%	37%
Principaux types d'accidents	25% - 418	31% - 215	21% - 202	27% - 145	22% - 196
	14% - 231	12% - 86	15% - 145	14% - 77	11% - 121
	13% - 221	11% - 74	15% - 144	12% - 66	15% - 130
Environnement	n°1	Campagne sans caractéristique particulière			
	54%	58%	46%	58%	48%
	n°2	Route étroite <6m	Habitat diffus, lieu-dit, zone d'activité - Forêt, zone boisée 8%	Route étroite <6m	Habitat diffus, lieu-dit, zone activité 8%	Route étroite <6m
	18%		29%		22%
Conducteurs avec départ hors chaussée et hors intersection	16% - 328	18% - 193	15% - 168	17% - 116	15% - 159
Aux véhicules seuls avec heurt d'obstacle fixe aggravant sur l'ensemble des acc. hors intersection	36% - 630	29% - 173	43% - 325	33% - 155	33% - 281
Obstacles fixes aggravants selon le tracé en plan	Rectiligne : 41% - 222 Courbe : 59% - 269 Inconnu : 1% - 4	Rectiligne : 51% - 88 Courbe : 48% - 81 Inconnu : 1% - 1	Rectiligne : 43% - 135 Courbe : 56% - 179 Inconnu : 1% - 3	Rectiligne : 50% - 78 Courbe : 49% - 74 Inconnu : 1% - 1	Rectiligne : 41% - 112 Courbe : 58% - 169 Inconnu : 1% - 3

Table 1: Summary table of accidents on two-way roads outside built-up areas in 2015 by theme

INTRODUCTION

Presentation of the FLAM project

In 2017, Cerema undertook a study to analyse the course of fatal accidents and determine the factors behind them. These took place during the same year (2015) and across the whole of France (mainland France and overseas territories excluding the Pacific zone).

This analysis is based on an anonymised database derived from the reading and coding of legal accident procedures drawn up by the police (FLAM database).

Data collection methods

Upon formal request, AGIRA-TransPV provided Cerema, from June 2017, with the court proceedings relating to fatal traffic accidents in 2015 in its possession.

As this organisation does not collect PVs from the Pacific zone, the French Overseas Territories have not been treated in their entirety.

Of the 3,276 files transmitted, 3,103 could be linked to 2,878 fatal accidents in the BAAC file. The link was made initially via Concerto (stabilised basis for the 2015 report), and then via the Accidents portal, which is updated regularly.

Representativeness of accidents

The 2015 annual accident report (ONISR) recorded 3,373 fatal accidents:

- 3160 in mainland France ;
- 146 in the French overseas departments ;
- 67 in the French overseas departments and territories.

The FLAM database contains 2,878 fatal accidents, representing around 85% of fatal accidents in 2015.

Content of the database

From a quantitative point of view, the BAAC file is a very comprehensive collection of data on road accidents. However, there is room for improvement in terms of quality. Some of the data needed for a detailed understanding of accidents do not appear: accident mechanisms and their causes, detailed vehicle manoeuvres, etc.

In order to obtain qualitative data, the FLAM project has created a database that accurately describes almost all fatal accidents in 2015.

Additional information specific to the study

The following additional features have been added to the database

- identification of roads forming part of the main network (RN and RD) ;
- estimation of geometric data (road width, distance of obstacles from the edge of the carriageway) ;

- details of the driver's accident situation (overtaking manoeuvre, drifting out of the traffic lane, loss of dynamic control, etc.).

Factors in fatal accidents

The factors contributing to fatal accidents were identified on the basis of traffic accident reports drawn up by the police.

The causal factors at the origin of the accident have been identified. They will also be referred to as triggering factors in the document. They are associated with the various parties involved. The factors may be related to the road infrastructure (I), the human being (H), the vehicle (V) and/or the traffic conditions - weather and traffic - (C). Certain I and C factors are sometimes grouped together as the Environ- ment factor.

Some factors do not contribute to the cause of the accident, but may aggravate its consequences. These are known as "aggravating factors". They mainly involve failure to use safety equipment (e.g. not wearing a helmet) and hitting a fixed obstacle. The list of factors is available in Appendix 2.

To take account of the uncertainty inherent in the process of analysing accident reports, the analysts have indicated whether causality is almost certain or probable. In the case of fatal accidents, the accident mechanism is not always identified with certainty because of the possible absence of testimony or contradictory testimony.

Precautions in interpreting factor-related analyses

The factor analyses are based on the aggregation of quasi-certain and probable factors.

Of the 1,685 fatal accidents on two-way roads outside built-up areas in the FLAM database, almost 4,850 factors have been identified as causal factors. More than 3,500 of these were considered to be almost certain (72%). Nearly 980 factors aggravating the consequences of the accident were identified; 88% were considered to be almost certain.

Analyses based on the reading of accident reports, which may contain missing information (particularly in the case of 2WD accidents with no witnesses), involve certain uncertainties. The various results should therefore be interpreted with caution.

The study report "Factors in fatal accidents in 2015. Exploitation de la base FLAM. Ledoux, Vincent, Cerema, 2021" presents the results of the analysis of triggering factors for all fatal accidents in France in 2015.

Document reading convention

The subject of the study is fatal accidents on two-way roads outside built-up areas. For the sake

of simplicity, the document sometimes refers only to :

- two-way roads (in which case this means "outside built-up areas"),
- accidents (in this case, "fatal").

The percentages relating to accident factors take into account all accidents, including those without an identified cause.

The figures may vary depending on the subject analysed. The differences may be due, for example, to unknown data, possible double-counting (particularly in accidents at intersections with 1 road on the main network and 1 road off the main network) or accidents involving several cyclists or 2WDs.

Identification of network types

a) Definition of network types

The overall main network is made up of national roads and main departmental roads. Accidents on communal roads and non-main departmental roads make up the rest of the network.

The departmental network is divided into 2 categories: the main network [RD1] and the rest of the network [RD2].

The main RDs are the departmental roads corresponding to the criteria used in the 2018 road safety report. This network has been identified as follows:

- The DSR has collected from the prefectures the classification defined by the departmental council and the associated length of road. Each departmental council uses its own classification for managing its road network, often in 3 or 4 categories associated with its own definitions.
- The main network is the result of the concatenation of the linear sections from the first 2 categories, provided that their share of the linear section is less than 42% of the total network. If this proportion exceeds 42%, only the category 1 network will be included in the main network. (According to "La sécurité routière en France, bilan de l'accidentalité de l'année 2018, p 39, ONISR, 2019").

b) Identifying the type of network involved in accidents

Accidents can take place on national, departmental or local roads. Some accidents, particularly those at junctions, may involve more than one category of road.

The database identifies the road on which the vehicle involved was travelling. An accident may involve 2 different road identifiers (intersection with users travelling on different roads).

The classification of accidents by type takes into account the presence of at least 1 road belonging to the highest type (e.g. an accident with 1 RN and 1 VC will be identified as an accident on the main network; an accident with VC and RD2 will be identified as an accident outside the main network).

c) Work on the location of accidents on RD

It was not always possible to pinpoint the exact location of accidents (lack of PR or GPS coordinates, particularly for accidents outside intersections).

In the absence of a precise location, it was checked whether or not the area where the accident occurred was part of the main departmental network.

- If the entire area (distance between PRs) falls within the list of sections identified as part of the main network, the accident falls into the category of a main road accident.
- If the entire area (distance between PRs) is not included in the list of sections identified as part of the main network, the accident is classified as an accident outside the main network.
- 7 accidents on departmental roads could not be assigned to any group, in particular because knowledge of the main network was not known in the department where the accident occurred. These accidents are taken into account in the overall analyses, but not in the analyses by type of network.

1. OVERALL ACCIDENT FIGURES FOR TWO-WAY ROADS IN 2015

The FLAM database contains 1,685 accidents on two-way roads outside built-up areas. On this type of network, this represents 97% of the accidents recorded in the BAAC.

These accidents involved 2,760 vehicles and 3,836 road users, including 86 pedestrians.

There were 2059 victims, including 1509 killed and 550 injured, 337 of whom were hospitalised.

1.1 Identification of the networks concerned

1.1.1 Types of roads

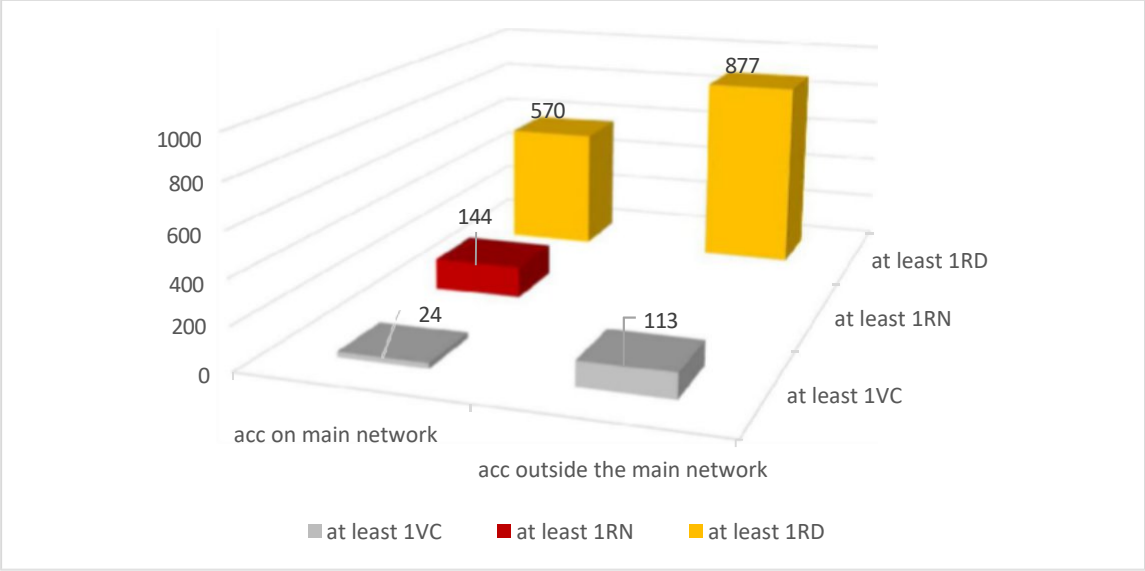


Figure 1: Breakdown of accidents by type of network
NB: some accidents may be counted several times (accidents at intersections).

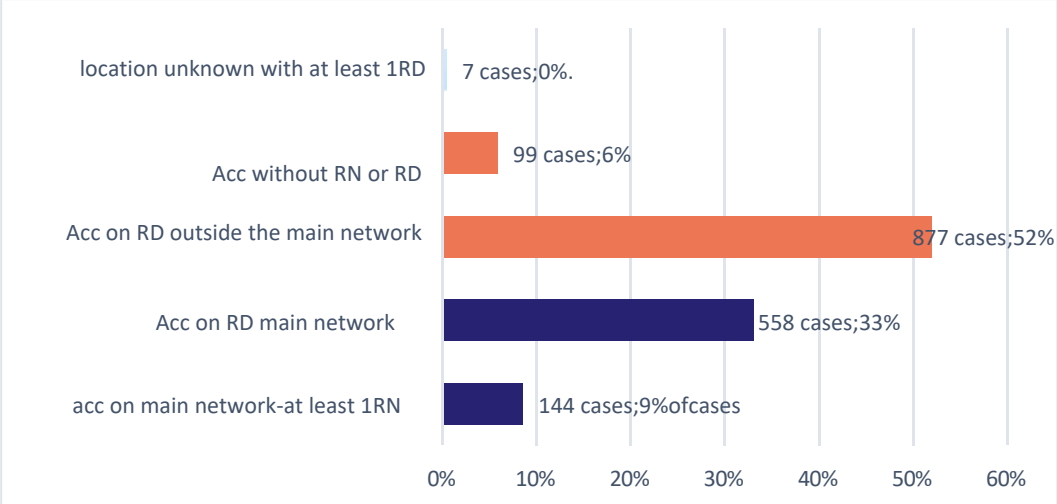


Figure 2: Share of accidents by network

Figure 1 and Figure 2 show that :

- the vast majority of accidents involved at least one road user travelling on a département road (1,447 cases),
- 42% of accidents occurred on the main road network (33% on RDs and 9% on RNs).

1.1.2 Accidents at intersections, on main roads and on private roads

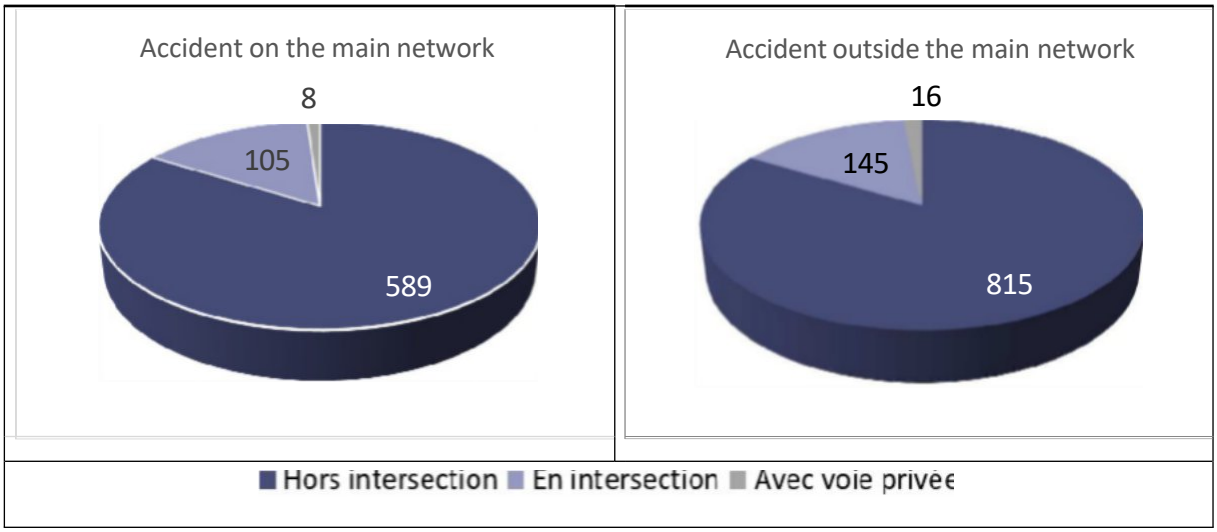


Figure 3: accidents at intersections, out of intersections and with a vehicle on a private road, on or off the main network

Figure 3 shows a similar breakdown of accidents:

- **on the main road network: 84% of accidents in sections and 15% of accidents at intersections** ; the remaining 1% involved vehicle movements to or from a private road (2 cases of vehicles entering and 6 cases of vehicles leaving),
- **off the main road network: 84% of accidents in sections and 15% of accidents at intersections** ; the remaining 2% were linked to vehicle movements to or from a private road (6 entry cases and 10 exit cases).

In the remainder of this document, accidents involving private roads are associated with non-intersection accidents.

2. THE MAIN FACTORS IN ACCIDENTS ON TWO-WAY ROADS

Human	Infrastructure	Traffic conditions	Vehicle
Trigger: 92 Aggravating: 17	Trigger: 33 Aggravating: 36	Trigger: 19 Worsening: 1%.	Trigger: 19 Aggravating: 3%.

Table 2: Share of factor types -1685 accidents on two-way roads

The tables below list the number of accidents with the type of quasi-certain or probable associated triggering factor and their proportion. It was impossible to identify the triggering factor in 31 accidents, i.e. 2% of the total.

Several levels of detail are proposed. The least detailed level of factors may have fewer cases than the sum of the detailed factors, because 1 accident may involve several factors of the same type. Details of the groupings of factors are available in appendix 9.2.

An identification of the level of the issue associated with the detailed factor is proposed:

- red box: for factors present in more than 30% of accidents;
- orange box: from 10 to 30% ;
- yellow box: 5 to 9%.

Main factors Human				
User condition 65% - 1095 cases	Ingestion of substances 39% 660 cases	alcohol	31% - 524 cases	
		drugs	16% - 272 cases	
		medicines	4% - 62 cases	
	One-off condition 33% 562 cases	fatigue	14% - 228 cases	
		non-technological inattention	9% - 153 cases	
		discomfort, health problem	11% - 179 cases	
		stress, nervousness	3% - 50 cases	
		habit, monotony	3% - 44 cases	
	Chronic condition 6% of the time 106 cases	pre-existing disability	3% - 45 cases	
		advanced age	5% - 76 cases	
		suicide, homicide	3% - 48 cases	
		excessive or inappropriate speed	38% - 642 cases	
Driving behaviour 53% - 896 cases	15% rules of conduct 251 cases	priority rules	11% - 186 cases	
		no traffic	1% - 25 cases	
		safety distance	2% - 33 cases	
		change of direction not signalled	1% - 16 cases	
		risk-taking	12% - 204 cases	
Experience 15% - 247 cases		inexperience, youth	11% - 188 cases	
		poor knowledge of the vehicle	6% - 104 cases	
Anticipation / Manoeuvring 8% - 128 cases		inappropriate or untimely manoeuvres	5% - 88 cases	
		mis judging distances or speeds	3% - 43 cases	
Perceptibility to pedestrians and cyclists 4% - 59 cases		poor visibility for pedestrians	3% - 47 cases	
		failure to wear high-visibility clothing	1% - 16 cases	
Technological tools 4% - 67 cases		technological distraction	4% - 64 cases	
		use of technological tools	0% - 4 cases	

User status

Impairment of the physical or psychological capacities of at least one of the people involved plays a role in 65% (1,095 cases) of fatal accidents. This impairment is attributable to :

- consumption of alcohol, drugs or medication (39%; 660 cases), with a high preponderance of alcohol (31%; 524 cases);
- a one-off/passenger physical or psychological condition (33%; 562 cases) associated with :
    - non-technological inattention (9%; 153 cases) linked to the user's activity (handling objects, talking to a passenger, etc.) or to an external factor that diverts the user's attention from the driving situation;
    - fatigue (14%; 228 cases), explained more by a lack of sleep and busy days (11%; 190 cases) than by the length of the journey (2%; 41 cases);
    - an illness or health problem (11%; 179 cases);
    - situations of stress or irritation (3%; 50 cases);
    - monotony of driving or the habit of the place (3%; 44 cases);
- and/or a chronic reduction in the user's abilities due to advanced age (5%; 76 cases) or a disability linked to a motor, visual, hearing or cognitive impairment (3%; 45 cases); each of these impairments was identified in around 1% of accidents.

Driving behaviour

Risky driving behaviour or disregard for the rules of the road were present in 53% (896 cases) of accidents:

- Speed, whether excessive or inappropriate (including slow speed) for the driving situation, was a contributing factor in (38%; 642) of the situations.
- Among the deviations from the rules of the road identified, failure to give way, whether intentional or not, was the most significant issue (11%; 186 cases). Unauthorised contra-flow traffic, driving in the wrong direction or in a lane in which the driver is not authorised to travel was identified in 1% of accidents. Failure to keep a safe distance between two vehicles and problems with changing lanes or direction without signalling (indicators, arm raised for cyclists, etc.) were noted in 2% and 1% of cases respectively.
- The analysis also reveals the importance, in fatal accidents, of risky practices on the part of road users (12%; 204 cases), whether associated with deliberate risk-taking: racing, wheeling for 2WDs, pedestrians running across the road without looking, etc. (5% of accidents; 87 cases), dangerous overtaking (7%; 119 cases) or 2WDs queue-jumping (1%).

Experience

The young age of pedestrians or drivers and their lack of experience were blamed in 11% (188 cases) of accidents. Ignorance of the vehicle, whether borrowed or new, was involved in 6% (104 cases) of accidents.

Anticipation / maneuver

Lack of anticipation or inappropriate manoeuvres were contributory factors in 8% (128 cases) of situations. They were attributable to :

- incorrect assessment of distances or speeds (3%; 43 cases);
- inappropriate evasive or emergency manoeuvres (5%; 88 cases).

Pedestrian and cyclist visibility

Lack of conspicuity of pedestrians and cyclists was a factor in 4% (59 cases) of accidents. Failure to wear high-visibility equipment in circumstances where it was required was reported in 1% of cases.

Use of technological tools

Finally, the study shows that inappropriate use of certain technological tools is a triggering factor in 4% (67 cases) of accidents. This concerns both inattention problems arising from the use of a telephone or other technological tool (4%; 64) and, in a few fairly rare cases (<1%), the incorrect use of driver assistance systems such as GPS or cruise control.

	Main factorsInfrastructure/Trafficconditions				
Visibility 9% - 147 cases	Mask 8% - 132 cases	7% fixed 115 cases	profile, road layout	2%- 40 cases	
			cases environment (vegetation, wall)	4% - 65 cases	
			other	1% - 16 cases	
			mobile	1% - 21 cases	
			Street lighting	1% - 13	
			Other	0% - 4 cases	
			curve	4% - 60 cases	
			intersection	2% - 38 cases	
Legibility 7% - 118 cases			specific zone	0% - 2 cases	
			other	1% - 22 cases	
			road geometry	1% - 13 cases	
Suitability for dynamic constraints 12% - 199 cases	surface condition 11% - 188 cases		wet grip	7% - 121 cases	
			grease, grit etc.	2% - 39 cases	
			poor road condition	2% - 28 cases	
			other	0% - 4 cases	
Recovery / Avoidance 12% - 204			road shoulder (width and/or type of surface)	8% - 138 cases	
			obstacle on shoulder	3% - 56 cases	
			other	1% - 15 cases	

Obstacle on carriageway 2% - 35 cases	moving obstacles	2% - 26 cases	
	non-fixed obstacles	1% - 9 cases	
Coherence of track elements and their environment 2% - 29 cases	running section	0% - 3 cases	
	intersection	0% - 3 cases	
	pedestrian traffic	0% - 3 cases	
	roadside verges	0% - 1 case	
	exploitation	1% - 11 cases	
	other	1% - 10 cases	
Flow management 0% - 3 cases	intersection (no facilities)	0% - 3 cases	
Environmental conditions 6% - 109 cases	weather	3% - 50 cases	
	glare	4% - 62 cases	

Visibility

This is the main issue in terms of environmental factors. It mainly concerns obstructions to visibility (8%; 132 cases), whether fixed (7%; 115 cases) or mobile (1%; 21 cases), and public lighting problems (1%; 1 case). Fixed obstructions to visibility can be explained in particular by :

- the presence of elements close to the tracks (4%; 65 cases) such as walls, vegetation... ;
- the geometry of the road (2%; 40 cases) in terms of its plan or longitudinal profile.

Legibility

Legibility characterises the infrastructure's ability to give an accurate, easily and quickly understandable image of the nature of the road, its environment and the behaviour expected of users.

The proportion of accidents in which a lack of legibility of the infrastructure and its surroundings was noted is estimated at (7%; 118 cases) of accidents. It includes, in particular, defects in legibility:

- curves (4%; 60 cases) linked to their geometry (a series of curves of different radii, a tight curve after a long straight stretch) or their signage;
- intersections (2%; 38 cases) because of their layout (intersection located after a curve, a high point, etc.), their complexity, their unusual nature and/or the absence or inappropriateness of signs.

Matching infrastructure to dynamic constraints

This criterion describes the ability of the infrastructure characteristics (gradient, profile, grip, etc.) to prevent dynamic imbalances from breaking (skidding, overturning, etc.).

Present in 12% (199 cases) of the accidents studied, the inadequacy of the infrastructure to cope with the dynamic constraints of the road was manifested mainly by loss-of-control problems linked to the state of the road surface (11%; 188 cases), particularly a wet road surface (7%; 121 cases), the presence of foreign bodies such as gravel or grease (2%; 39 cases) or the poor state of the road (2%; 28 cases).

Possibility of recovery or avoidance

In (12%; 204) of accidents, one or more elements of the infrastructure prevented avoidance or recovery manoeuvres from being carried out, or from being carried out correctly, which would have prevented the accident from occurring. In (8%; 138) of accidents, this obstacle was due to the insufficient width of the shoulders (or their non-existence) and/or the nature of their surface (grass, mud, etc.). In 3% of accidents, it was due to the presence of an obstacle (sign, tree, etc.) in the recovery zone.

Presence of moving or non-fixed obstacles on the carriageway

Whether animals, parked vehicles or various other objects, their unannounced and/or unexpected presence on the road was a factor in 2% (35 cases) of accidents.

Consistency of all elements of the infrastructure with its environment

The coders identified factors pointing to inconsistencies between the road infrastructure, its components, its use and the environment in (2%; 29 cases) of the accidents. Analysis of the factors, considered individually or in groups, did not reveal any particular singularity, as the numbers involved were small.

Managing flows with safety in mind

The aim is to assess whether the infrastructure is suitably designed for the size and nature of the user flows using it.

Factors relating to this theme were noted in only 3 accidents.

Environmental conditions

This category includes factors related to weather conditions (6%; 109 cases) and the dazzle of at least one of the road users involved (4%; 62 cases). The dazzle was caused by the sun (3%; 51 cases) or the headlights of other vehicles (1%; 11 cases).

Combined factor "grip problems on wet roads" and "excessive or inappropriate speed - id148-id149".

The factor "grip problems on wet roads" was identified for 7% of all drivers involved in accidents. This figure was 9% for those involved in accidents on the RN.

The combination of "grip problems on wet roads" and "excessive or inappropriate speed" - id148-id149
The figure for "road accidents" is 3% for all accidents, and 9% for accidents on major roads.

Main factors Vehicle		
Design / features 11% - 180 cases	low visibility of bicycles and 2WDs	4% - 66 cases
	powerful vehicle	4% - 71 cases
	blind spot or specific field of vision	1% - 14 cases
	PL configuration	1% - 24 cases
	high-spec 4x4 vehicle	0% - 5 cases
Status 9% - 145 cases	general condition	3% - 57 cases
	tyre condition	5% - 80 cases
	load status	1% - 18 cases
	driver assistance system	0% - 1 case
Other 3% - 44 cases	other factors, including mechanical failure	3% - 44 cases

Vehicle design

The design and/or specific size of vehicles were implicated in 11% (164 cases) of fatal accidents. These were problems related to :

- low visibility of two-wheelers (bicycles and 2WDs) due to their small size (4%; 66 cases);
- the use of a powerful vehicle conducive to inappropriate driving behaviour - high acceleration, unbridled mopeds, etc. - (4%; 71 cases);
- blind spots or reduced fields of vision of vehicles (1%; 14 cases);
- the configuration of HGVs (1%; 24 cases), particularly because of their size.

Status

Present in (9%; 145 cases) of accidents, this theme concerns malfunctions relating mainly to:

- tyres and their wear, bursting or under/over-inflation (5%; 80 cases);
- the general condition of the vehicle or the absence of signs (3%; 57 cases);
- the condition of the load (1%; 18 cases).

Other factors Vehicle

In 3% (44 cases) of accidents, the coders used this mode, which covers various causes linked to the vehicle, including mechanical failures.

	Main aggravating factors			
Human 17% - 280 cases			not wearing a seatbelt	13% - 223 cases
			not wearing a helmet	2% - 42 cases
			advanced age	1% - 15 cases
Infrastructure 36% - 601 cases	severity of impact linked to equipment 1% - 17 cases			1% - 15 cases
	obstacles in the vicinity of pavement 35% - 590 cases	colliding with a fixed obstacle on a shoulder-ment		35% - 582 cases
Environment 1% - 12 cases			drowning	1% - 12 cases
Vehicle 1% - 14 cases			vehicle fire	1% - 14 cases

Aggravating factors Human

They are mainly linked to the failure of cyclists and 2WD users to wear helmets (2%) and the failure to wear seatbelts (13%).

Aggravating factors Infrastructure

They are a major factor in fatal accidents on two-way roads outside built-up areas (36%).

Striking a fixed obstacle on the shoulder was the most significant factor (35%).

It is difficult to determine the real impact of aggravating factors on the increase in the severity of the consequences of the accident. Some factors, such as hitting a fixed obstacle, may be associated with not wearing a seatbelt (6% of drivers or passengers combine these 2 factors, i.e. 120 cases).

3. THE MAIN TYPES OF ACCIDENT

Accidents are classified according to a decision tree that associates an accident with a single type of accident. It is presented in appendix 9.3.

Daytime accidents account for the majority of accidents, and their proportion is identical across the networks : 61%. Accidents at sunrise or sunset account for around 8% of accidents.

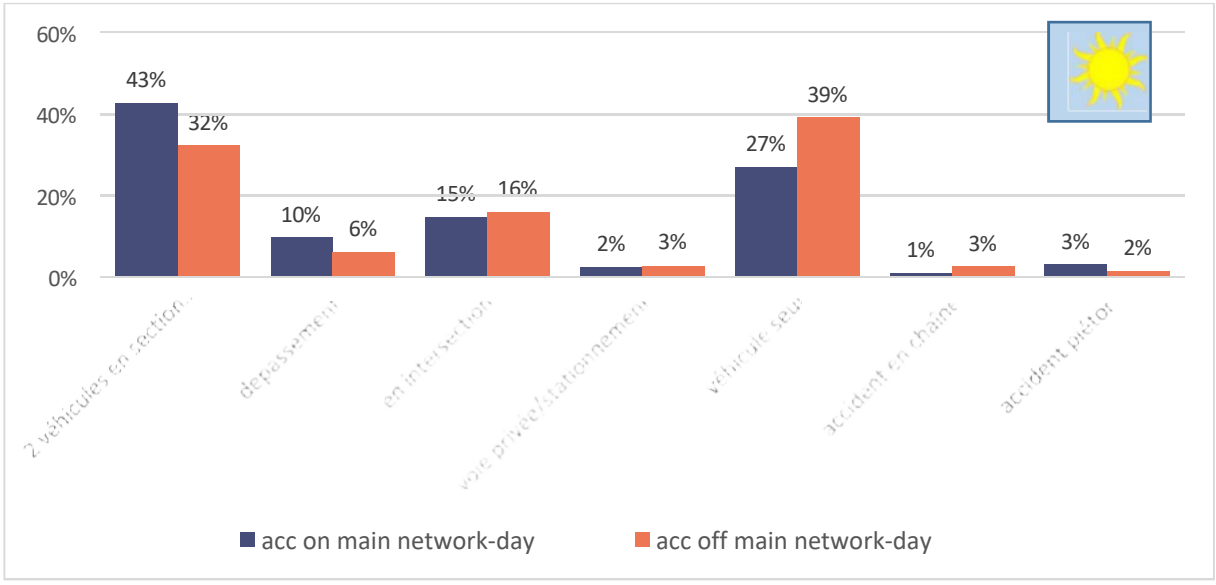


Figure 4: Daytime accidents by network

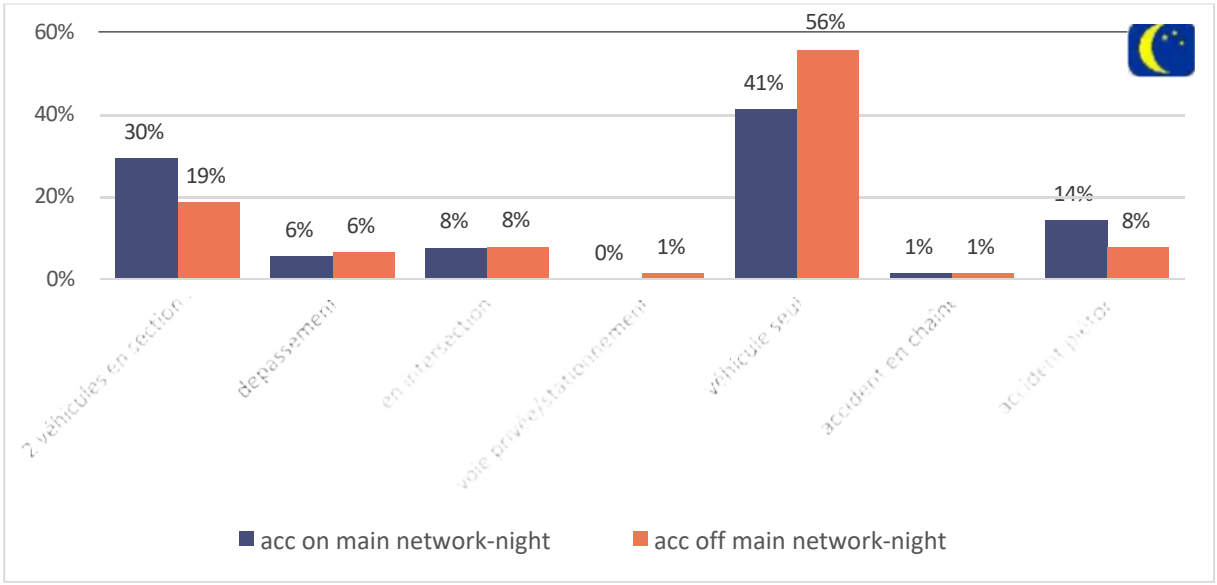


Figure 5: Night-time accidents by network

Figure 4 and Figure 5 show some disparities in accident types according to network and light conditions, which may probably be linked to different traffic characteristics.

Main network (RN+RD1) :

Accidents involving 2 vehicles on a road section and accidents with no third party represent the main types of accident on the main network. Their distribution is reversed according to light conditions:

- during the day: accidents involving 2 vehicles are in the majority (43%) compared with those involving no third party (27%);
- At night : accidents involving no third party are in the majority (41%) compared with those involving 2 vehicles (30%). This was followed by daytime accidents at junctions (15%) and with an overtaking vehicle (10%). There were 14% of accidents involving pedestrians at night.

Off the main network :

Accidents involving no third party are the most common on the non-main network (39% during the day and 56% at night). Next come 2-vehicle accidents on the main road (32% by day and 19% by night).

Intersection accidents account for 16% of daytime accidents.

Additional analysis of overruns :

It has been identified that the driver was carrying out an overtaking manoeuvre at the time of the accident or just before.

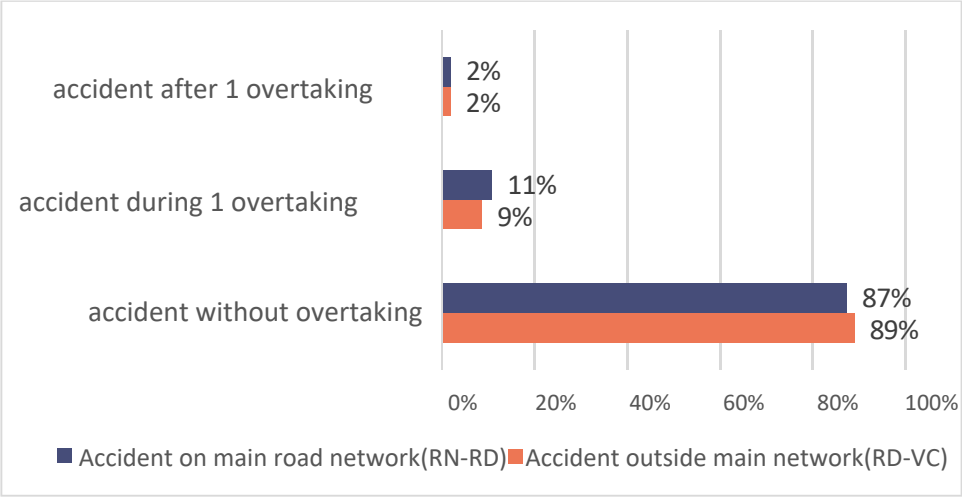


Figure 6: Additional identification of cases of exceedance by network

Further analysis of the cases of overtaking associated with accidents shows that the classification of the main types of accident (Figures 4 and 5) slightly underestimates these accidents. This undervaluation is due to the initial classification of accident types (accidents involving overtaking exclude accidents involving pedestrians, those at intersections and those involving parked vehicles or vehicles entering/leaving the local road).

Figure 6 completes the information on overruns as follows:

- Accidents **on the main road** accounted for 13% of all accidents involving overtaking. The **Daytime accidents account for 17%** of accidents involving overtaking, and night-time accidents for 10%.
- Accidents **outside the main road network** accounted for 11% of all accidents involving overtaking. The **Daytime accidents account for 13%** of accidents involving overtaking, and night-time accidents for 10%.

Accidents linked to overtaking are a major issue on two-way roads outside built-up areas, whatever the type of network.

3.1 Longitudinal profile and plan of the route encountered by the sites involved

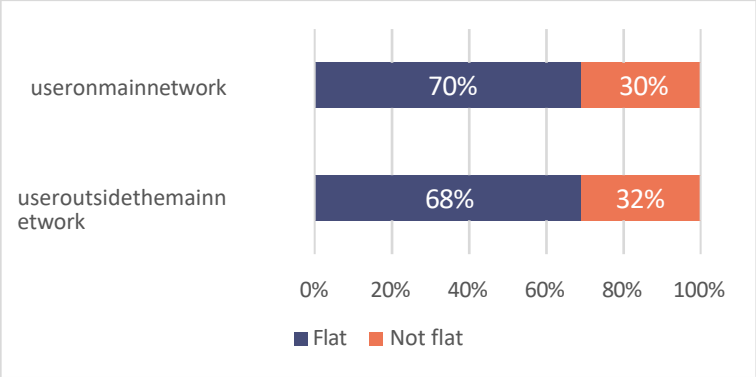


Figure 7: Pavement profile by network

Figure 7 shows no difference in profile depending on the type of road: around 70% of the road users involved were travelling on a flat road.

When the road was on a slope, the distribution of profiles was broadly similar for the 2 networks :

- downhill: 13% on the main network and 15% off the main network,
- Bottom of slope: 2% on main network and 3% off main network,
- climbing: 9% on the main network and 11% off the main network,
- hilltops: 6% on the main network and 4% off the main network.

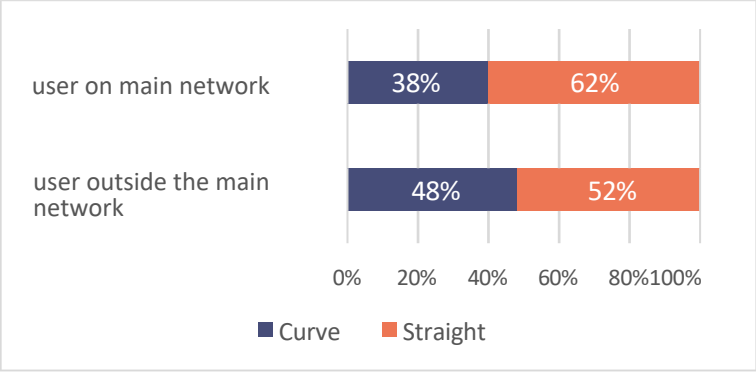


Figure 8: layout of the carriageway according to the network

Figure 8 shows that the majority of users on the main road network travelled on a straight carriageway (62%). Those travelling off the main road network took curves in 48% of cases.

In terms of the length of curves affected, the overall impact of curves is very significant.

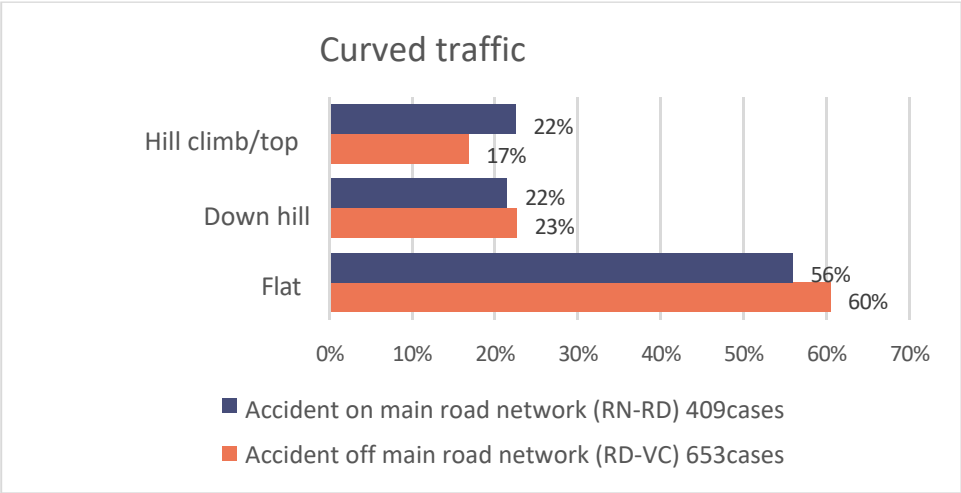


Figure 9: Pavement profile for drivers negotiating curves, by network

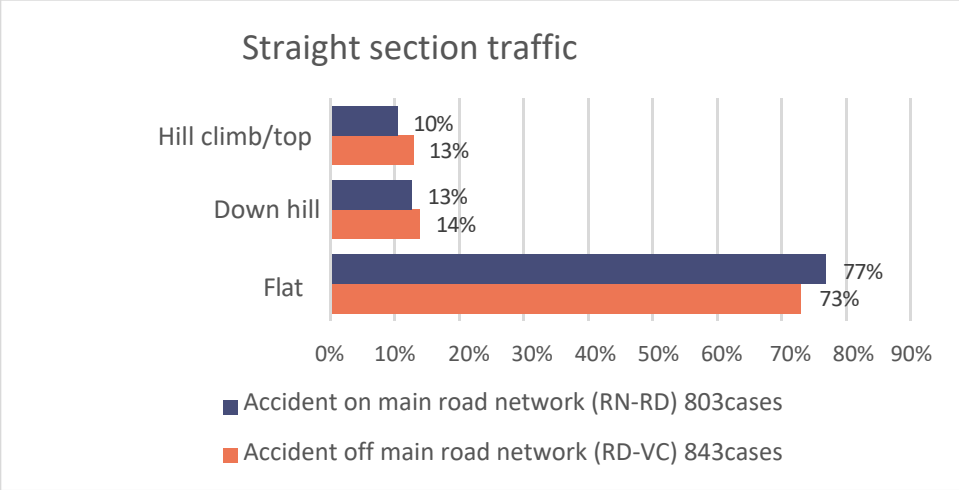


Figure 10: Pavement profile for drivers travelling in straight sections, depending on the network

Figure 9 and Figure 10 show that :

- drivers on curves encounter a higher proportion of downhill or uphill roads (between 17% and 23%) than those on straight sections (between 10% and 14%);
- the proportion of drivers travelling downhill is similar depending on the type of network;
- drivers on curves on the main network have a higher proportion of uphill drivers than those off the main network (22% vs. 17% respectively).

3.2 Maximum authorised speeds

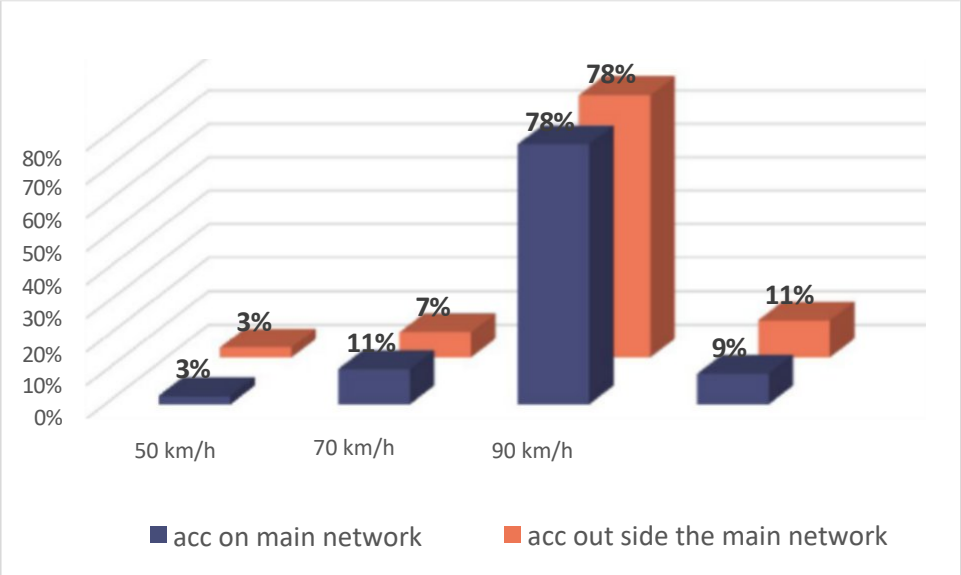


Figure 11: VMA share by network

The MAVs were known for around 90% of accidents.

The majority of roads are 90 km/h for both types of network: 78%.

3.3 Accidents involving an oncoming vehicle in the opposite lane

Accidents on two-way roads are unique in that they allow interaction between oncoming road users.

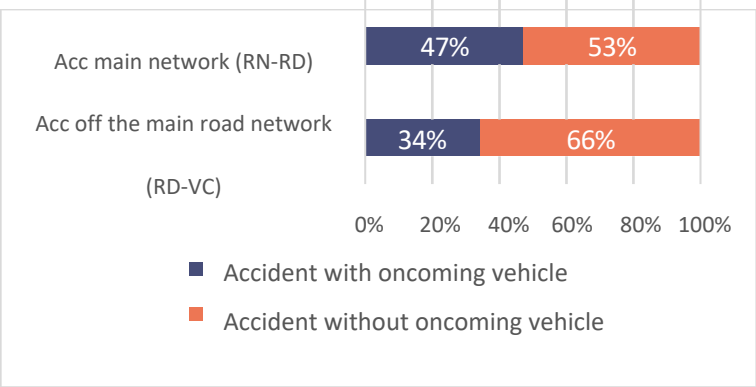


Figure 12 shows the proportion of accidents involving vehicles travelling on opposite carriageways, excluding intersections and accidents involving pedestrians.

The results show that :

- accidents on the main road network include a high proportion of accidents involving users travelling on opposite lanes: 47%. Traffic density increases the risk of interactions.

- the proportion of accidents involving users on opposite carriageways outside the main network is lower: 34%.

When traffic conditions were known (85% of accidents on the main network and 83% off the main network), the majority of accidents took place in free-flowing traffic (91% of accidents on the main network and 96% off the main network).

An analysis of accidents involving an oncoming vehicle, cross-referenced with traffic conditions, shows that :

- in accidents with oncoming traffic, the proportion of **heavy traffic** is slightly higher (10% on the main network and 6% off the main network) than in accidents without oncoming traffic (4% on the main network and 2% off the main network).
- Accidents in traffic jams are a very small minority (4 cases on the main network and 3 cases off the main network).

3.4 Work-related accidents

Work-related accidents may involve at least 1 user (driver or pedestrian) moving :

- as part of a work-related journey (driver whose job includes driving),
- and/or 1 home-work journey.

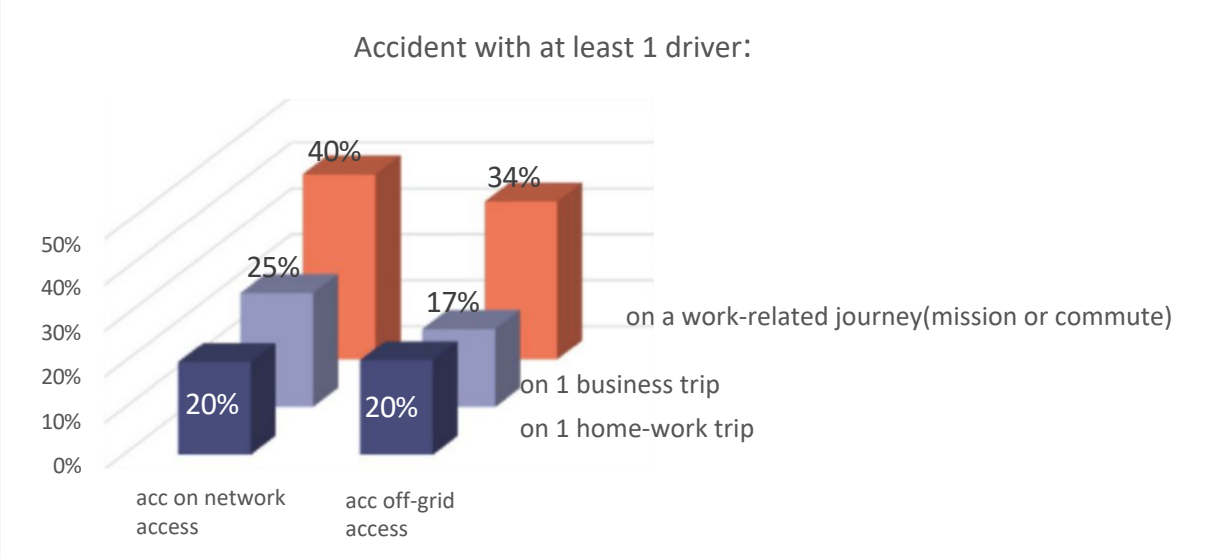


Figure 13: Share of occupational accidents by network

Figure 13 shows that work-related accidents account for a significant proportion of accidents on two-way roads (40% of accidents on the main network and 34% off the main network).

The proportion of accidents involving at least 1 road user on a home-work journey is identical on the 2 networks: 20%.

Work-related commuting accidents are 1.5 times more common on the main network than on the rest of the network (25% vs. 17% respectively).

3.5 Accidents involving alcohol

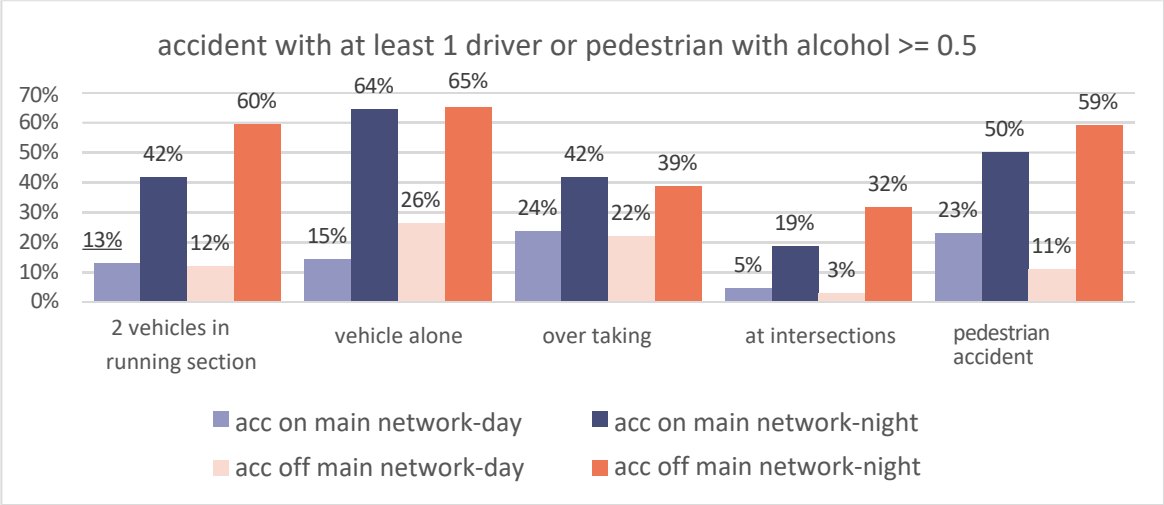


Figure 14: Percentage of accidents involving alcohol, by network, type of accident and light conditions

Figure 14 shows the proportion of accidents involving at least one driver or pedestrian with a blood alcohol concentration of 0.5 g/l or more.

The results show that :

- accidents at night always involve a higher proportion of drink-drivers than during the day, with the increase factor ranging from 1.8 for overtaking situations to 5 or even 10 in the worst case,
- accidents involving overtaking during the day have a fairly high proportion of drink-drivers (24% on the main network and 22% off the main network respectively),
- alcohol has a strong impact on the type of accident recorded, depending on the type of network: for example, at night, while there are more accidents involving 2 vehicles on a straight section of the main network (30%) than on the non-main network (19%), there are far more accidents involving 2 vehicles on a straight section and with alcohol on the non-main network (60%) than on the main network (42%). This trend is also observed for accidents involving pedestrians and those at junctions.

A comparison of the alcohol levels of drivers and pedestrians shows that :

- the blood alcohol level was known for 65 pedestrians out of 86 (76%). It was greater than or equal to 0.5 g/l for 31 pedestrians (36% of the total);
- the blood alcohol level is known for 90% of drivers. It was greater than or equal to 0.5 g/l for 476 of them (17% of the total).

4. LANE DEPARTURES AND COLLISIONS WITH OBSTACLES

4.1 Exits from track

Additional coding of the database makes it possible to distinguish the vehicle that has left the lane and the side of the offset. An estimate of the type of lane departure was made using data from the

description of the accident (eyewitness accounts, traces on the carriageway or verges). 3 main types of lane departure were identified. These are :

- offset due to vehicle guidance problems, which are generally progressive,
- loss of control of the vehicle, which implies a problem of dynamics that may be associated with a mismatch between speed and the constraints of road grip or alignment,
- loss of control when avoiding or colliding with an animal.

The analyses below only concern drivers involved in accidents on road sections.

4.1.1 Types of output channel

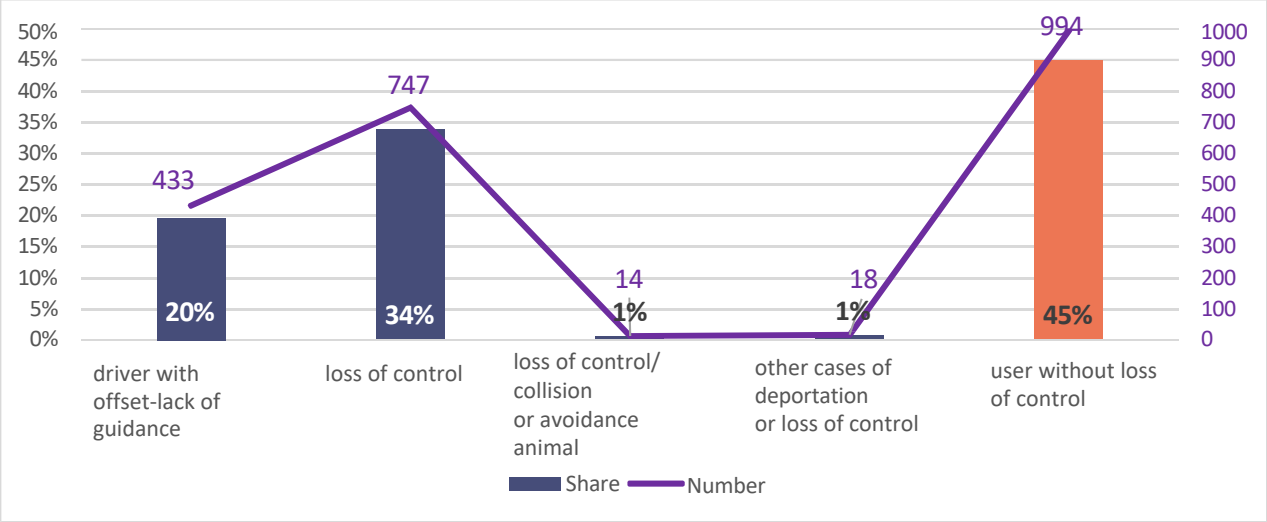


Figure 15: Representation of lane exits for conductors in running sections

Figure 15 shows that 55% of drivers involved in accidents on two-way roads outside built-up areas had left the carriageway. The accident study of lane departures carried out as part of the ROADSENSE project in 2012 showed that 50% of accidents outside built-up areas (all types of road, including motorways) involved loss of control or lack of guidance.

54% of these lane exits were on curves, 45% on straight sections (1% unknown).

When it is known (i.e. in around 90% of cases), the side of the lane exit is overwhelmingly to the left (71% compared with 29% to the right), whether the user is initially on a straight section (73% of exits to the left) or on a bend (70% of exits to the left).

For all the road users involved, the potential cases of loss of control are 34%, and possible guidance faults are 20%.

If we consider only offset conductors, we obtain the following breakdown:

- 37% of drivers with guidance defects,
- 64% of drivers lost control of the vehicle.

This distribution is similar to that in the ROADSENSE study (35% vs. 65%), despite the differences in sample size (environment, severity of accidents, types of road).

The drivers who potentially had an accident (165 drivers with factor id129 "accident, health problem") generally had an offset linked to a lack of guidance: 64%. 33% of them had lost control of the vehicle.

4.1.2 Track exits with offsets linked to a guidance fault

This section analyses the cases of lane departures linked to a lack of guidance for drivers who have not been unwell. The aim is to determine what is at stake in these lane departures, in an attempt to understand the value of proposing the installation of audible lane departure warning systems on the carriageway.

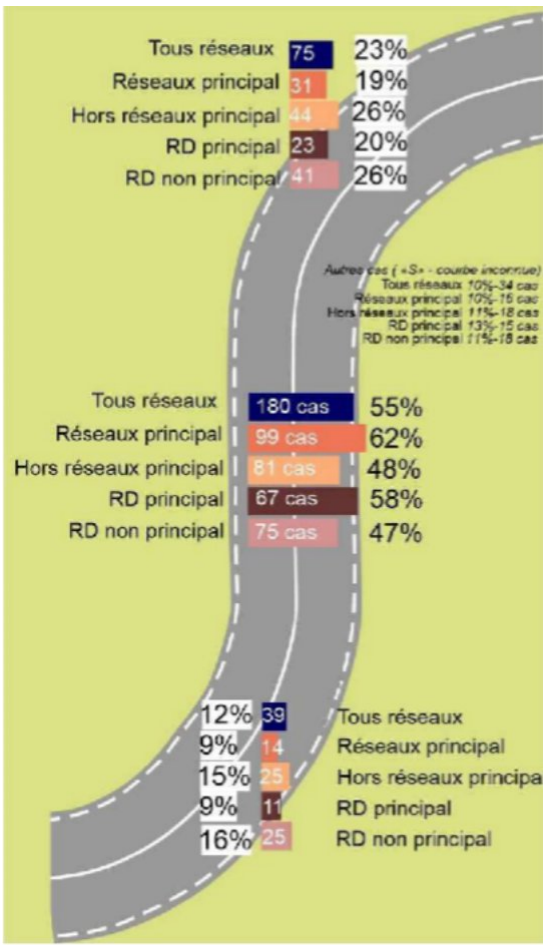


Figure 16 shows that the majority of drivers who left a lane due to a lack of guidance were travelling in a straight line.

This proportion is higher on the main network (62%) than off the main network (48%).

According to the ROADSENSE study, 49% of accidents involving failure to steer occurred in a straight line.

When lane exits take place on curves, right-hand curves are about 2 times more represented than left-hand curves.

Figure 16: Representation of the proportion of drivers with lane departure due to a lack of guidance according to the plan - accidents outside intersections

The problem is present on all the networks, but is more of an issue on the RN: 30% of accidents on the RN (data not shown) involve lane departure due to a guidance problem (excluding the right-of-way), compared with 20% on the RD1 and 18% on the RD2.

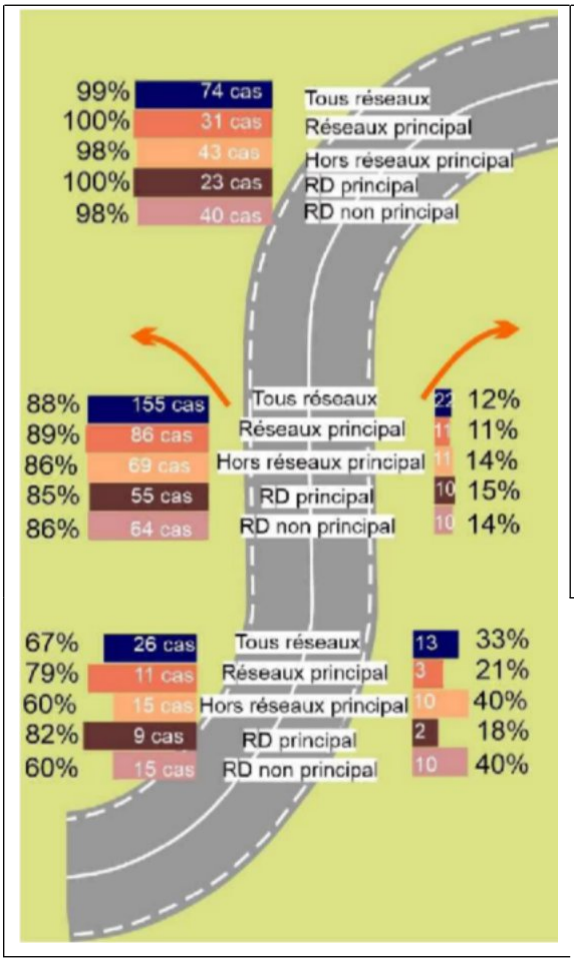


Figure 17 shows that the majority of drivers who left a lane due to a lack of guidance initially swerved to the left.

Although the sample was fairly small (26 cases out of all the accidents), it can be seen that the vast majority of vehicles travelling on a left curve swerved towards the inside of the curve. On the other hand, there was only 1 case of a vehicle moving to the inside of a right curve.

There are 255 drivers (88%) with an offset to the left, and 36 to the right.

There is a difference with the ROADSENSE study, which identifies 32% of left exits and 68% of right exits.

Figure 17: Representation of the distribution of the side of the 1er offset according to the plan alignment - drivers with lane departure linked to a guidance fault - accidents outside intersections

4.2 Bumping into obstacles

4.2.1 Types of obstacle

The database identifies several types of obstacle:

- the obstacles triggering the accident, which may
  - cause the accident by their sudden and/or unexpected presence on the roadway (moving obstacle (e.g. animal) or non-fixed obstacle (e.g. parked vehicle)),
  - prevent the vehicle from being recovered when located in the recovery zone;
- Obstacles not coded as aggravating (e.g. the vehicle ends its trajectory against an obstacle, without any identified physical impact on its occupants);
- aggravating fixed obstacles, where the impact has potentially aggravated the consequences of the accident for the driver or passenger of the vehicle, without it having been possible to verify the consequences. They are mainly found on the shoulders of the road.

The following analyses (up to paragraph 5) concern non-intersection accidents.

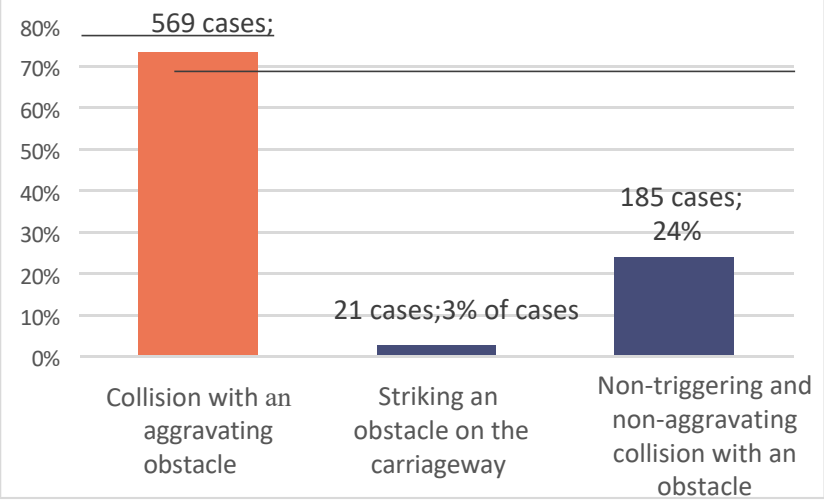


Figure 18: Types of collision with obstacles in accidents

Figure 18 shows that :

- the proportion of accidents triggered by hitting an obstacle was low: 3% in 21 cases,
- the proportion of non-aggravating collisions with obstacles following the impact was 24% for 185 cases,
- collision with an aggravating fixed obstacle represents the most important issue: 73% for 569 cases.

4.2.2 Accidents without third parties

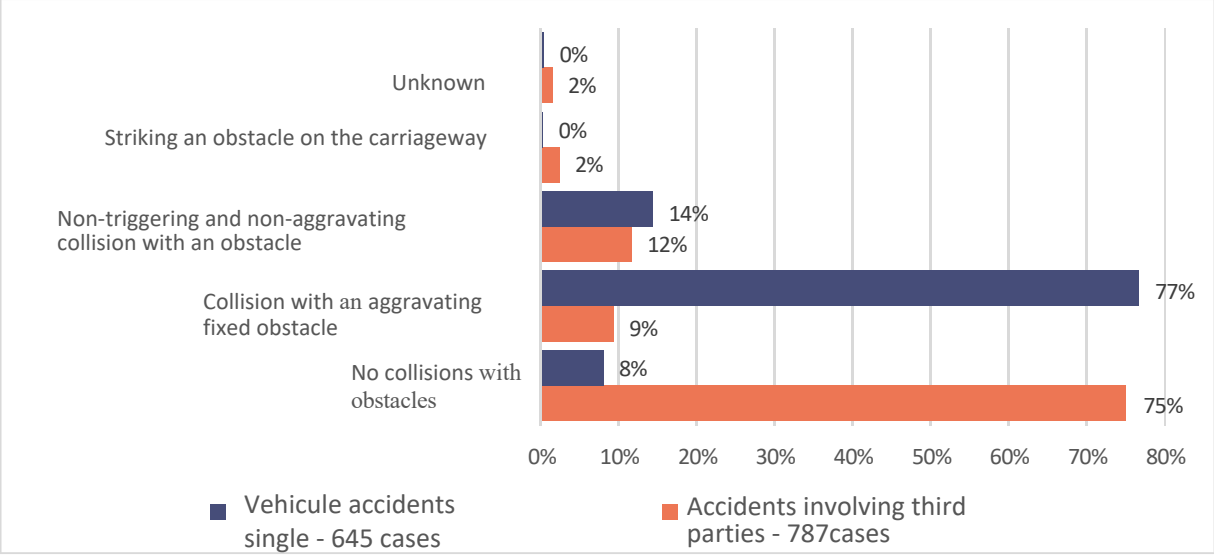


Figure 19: Breakdown of collisions with obstacles - accidents without third parties / accidents with third parties

Figure 19 shows that accidents without third parties (and outside intersections) have a high proportion of collisions with aggravating fixed obstacles (77%). The cases where no third party was involved included accidents where a road user was ejected and cases of discomfort.

Accidents involving third parties involve a small proportion of obstacles: 2% triggering obstacles, 9% collisions with aggravating fixed obstacles.

In addition, it was found that most accidents involving obstacles (outside intersections, without third parties) took place on bends (53% of cases), particularly on the less structured network: 58% on the RD2, compared with 49% on the RD1, and 39% on the RN.

The following analyses will concern accidents without third parties, which is the type of accident generally taken into account in studies of obstacles.

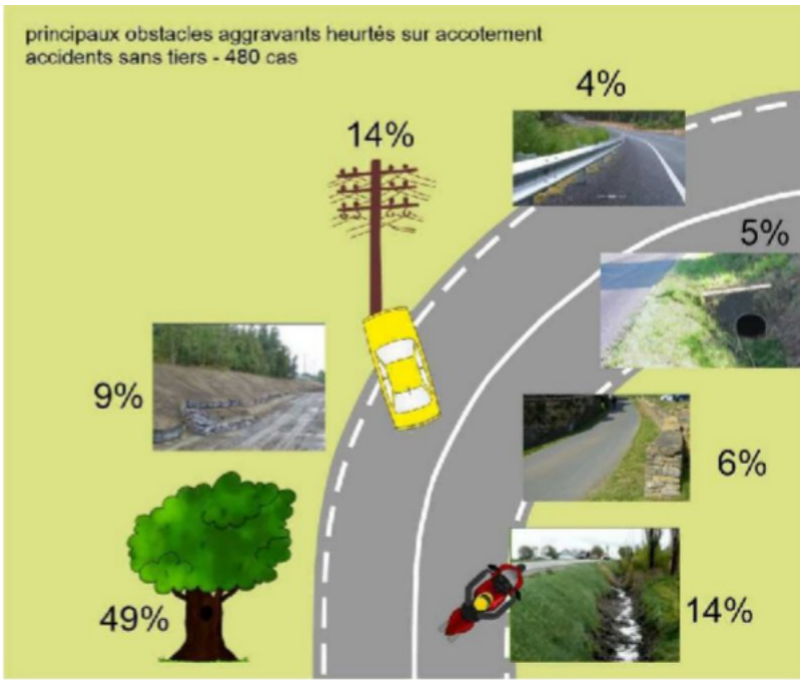


Figure 20: Share of the main types of aggravating fixed obstacles hit by unaccompanied vehicles

In some cases (11% of accidents, 51 cases), vehicles (or users) may hit several obstacles. It is not possible to determine from the database which obstacle caused the most serious accident. Figure 20 identifies the collision with at least one obstacle of the type shown.

The main type of obstacle hit in accidents with no third party was a tree (49%).

Obstacles such as poles/pylons/candelabras and natural low-lying obstacles were hit in 14% of cases.

The proportion of natural obstacles at the top is 9%.

Although they accounted for a relatively small proportion of accidents, there were also collisions with walls/verts (6% in 29 accidents) and nozzle heads (5% in 22 accidents).

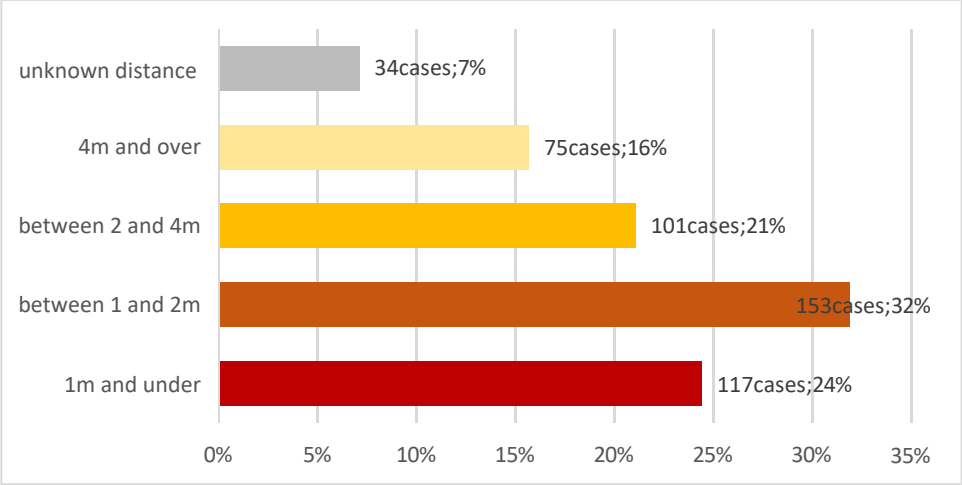


Figure 21: Distance of the aggravating fixed obstacle from the edge of the carriageway

If we consider only obstacles with a known distance, we can see that :

- 60% of the obstacles hit on the hard shoulder were less than 2 m from the edge of the carriageway;
- 83% were less than 4 m away.

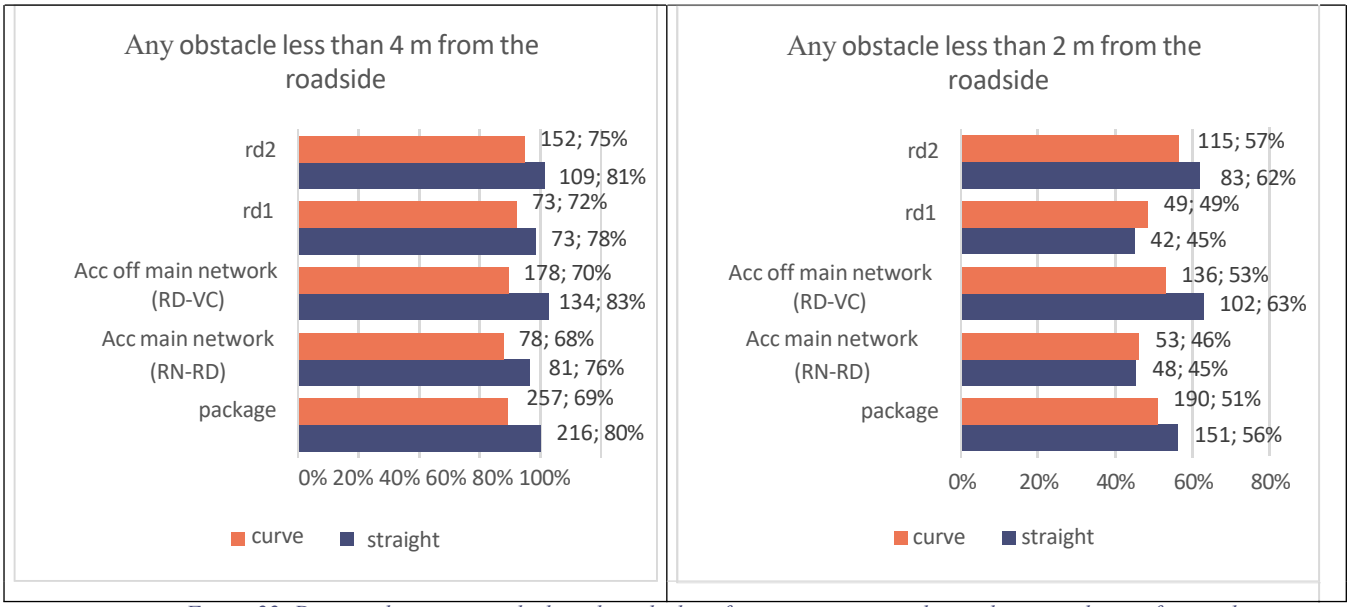


Figure 22: Distance between struck obstacle and edge of carriageway according to layout and type of network

Figure 22 shows that the fixed roadside obstacles hit in accidents without third parties :

- are closer to the edge of the carriageway in straight sections than in curves when they are less than 4 m away on all types of network (between 1.1 and 1.2 times closer),
- are closer to the edge of the carriageway in straight sections than in curves when they are less than 2 m away in all accidents, in accidents outside the main network and in accidents on non-main roads,
- are similarly distributed in accidents on the main road network when they are less than 2 m from the edge of the carriageway, this proportion being lower than for other networks (around 50%).

The proportion of unknown distances is slightly higher in accidents on curves (around 10% on curves compared with 5 to 8% on straight sections).

5. ANALYSIS BY NETWORK TYPE

Departmental roads [RD2] appear to account **for the highest proportion of fatal accidents, with 877 accidents, or 52% of all accidents on the two-way network outside built-up areas**. Departmental roads [RD1] accounted for 570 accidents, or 34% of the total, ahead of trunk roads (144 accidents, or 9%) and local roads (140 accidents, or 8%).

Overall, there were 702 accidents on the main road network (RN+RD1), representing 42% of the total number of accidents on the two-way network outside built-up areas.

5.1 Accidents on national roads

The FLAM database contains 144 accidents (9% of the total) involving 291 drivers and pedestrians, at least one of whom was travelling on a dual carriageway outside built-up areas.

These accidents resulted in 159 fatalities, including 12 pedestrians, 4 cyclists, 23 motorcyclists, 5 moped riders and 40 passengers (including 2 on 2WD vehicles).

5.1.1 Intersection accidents on RN

The database includes 20 intersection accidents involving 42 road users.

These accidents involved a high proportion of vulnerable road users: 2 2WDs, 2 cyclists and 2 pedestrians. There were 5 HGVs.

13 accidents took place during the day (65%), 5 at night and 2 at dawn. Accidents involving pedestrians and cyclists took place during the day.

9 accidents involved an intersection between a main road and a dual carriageway, 2 between a main road and a dual carriageway, the other cases involved users travelling solely on the main road (users turning towards an intersecting road). There were no accidents between 2 RNs.

The majority of intersections were T-shaped (8 cases). X intersections were present in 5 cases.

8 users encountered a yield sign (not on the road), 4 a stop sign and 1 a level crossing light.

8 accidents involved a left-turning road user. The only right-turn accident involved 1pedestrian crossing the road from right to left.

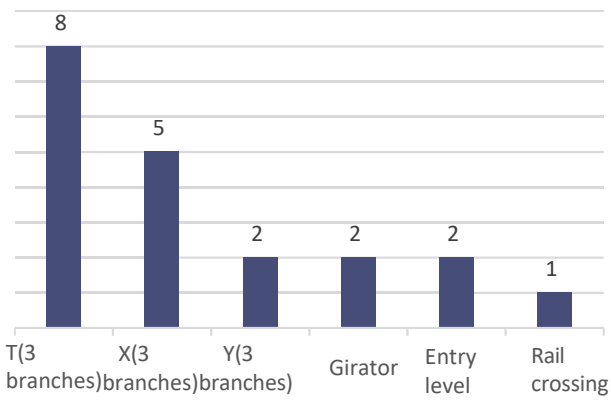


Figure23:representation of intersection types

5.1.2 Non-intersection lane-departure accidents on RN

102 drivers left the road. Most of them moved to the left (80%):

- 71% of rear-end collisions with an oncoming vehicle in the opposite lane,
- 6% direct output on the left,
- 3% exited to the left after biting the right shoulder.

Direct exits to the right accounted for 11% of cases.

Other cases and unknown exit side account for 9%.

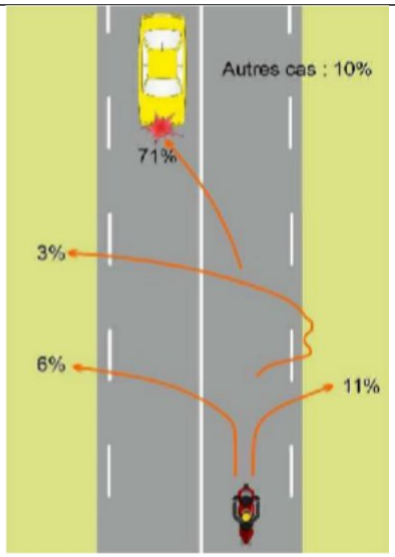


Figure 24: Representation of the main trajectories of drivers with lane departures

A breakdown of all lane departures according to road alignment (93 known cases) shows that :

- 67% of drivers were driving in a straight line,
- 20% were on the right curve,
- 13%were on a left curve.

Although the majority of run-offs to the left involve a collision with a vehicle, they are distributed differently depending on the route (data not shown):

- 18 cases out of 19 on the right curve,
- 48 cases out of 62 (77%) in straight sections,
- 6 cases out of 12 on a left curve.

On the left curve, there was a high proportion of exits onthe inside of the curve: 8 out of 12 cases.

Lane departures on right bends tend to be caused by vehicules that are unable to take the bend and collide with a vehicule in front.

On left bends,it's more a case of trajectories being cutoff.

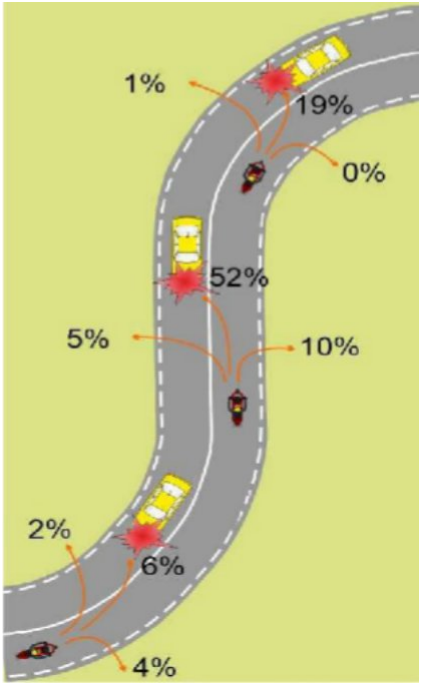


Figure 25: Representation of the main trajectories of drivers with lane departures by route - all lane departures

Roadside verges

The 23 drivers who exited to the right or left of the carriageway (excluding collisions with oncoming vehicles) always had a hard shoulder.

- The shoulder was grass in 48% (11 cases) of cases, and surfaced in 35% (8 cases). There was 1 case of gravel shoulder, 1 kerb and 2 unknown cases.

- The roadway and shoulder were level in 70% of cases (16 cases) and had a step in 13% of cases (3 cases). The information was unknown in 4 cases.

5.1.3 Aggravating fixed obstacles on the shoulder of RN

The proportion of drivers who hit an aggravating fixed obstacle on the hard shoulder was 17%, or 21 cases. The main types of obstacle hit on the hard shoulder were :

- Trees are the main issue, with 8 cases;
- natural obstacles at ground level (ravines, ditches, cuttings) represent 3 cases;
- natural obstacles on the slopes (embankments and rock faces) represent 3 cases;
- walls or low walls represent 3 cases;
- Pole-type obstacles (poles, pylons, lampposts) represent 2 cases;
- The other obstacles consist of a concrete block and a kerb.

One-off obstacles (trees, poles) are more often to blame than natural obstacles at higher or lower levels.

The distance of the obstacle from the edge of the carriageway was established either using the dimensioned plans from the accident reports or using the internet (geoportail, google maps). Distances could not be estimated in 5 cases (24%).

A large majority of the obstacles hit were less than 4 metres from the edge of the carriageway: 67% (14 cases).

The proportion of obstacles less than 2 metres away was 57% (12 cases).

5.1.4 Accident factors on RN

Human	Infrastructure	Traffic conditions	Vehicle
Trigger: 93 Aggravating: 13	Trigger: 23 Aggravating: 19	Trigger: 17	Trigger: 20%. Aggravating: 3%.

Table 3: Share of factor types - accidents on the RN

An analysis of the types of factors (triggers) involved in accidents shows that human factors account for a high proportion: 93%. The other types of factor are present in smaller proportions: 23% infrastructure factors, 17% environment factors and 20% vehicle factors.

Aggravating infrastructure factors were present in 19% of cases, and human factors in 13% of cases.

Combinatorial analysis of the factors (not shown) shows that :

- Most accidents involve human factors alone (56% of cases). There were no cases of factor I alone.

- 3% of accidents involve at least 1 factor of each type.
- Combinations of multiple factor types almost always have at least 1 factor H: HV 11%, HI 8%, HEI 8%, HVI 3% and HE 3%. IV and EV combinations are not recorded.

Comparison of factors: Accidents on the main RN network / accidents on the main RD network

Human	Infrastructure Traffic conditions	Vehicle
Punctual user status (1,2) 72 Fatigue (1.7) 26% Fatigue (1.7) 26 • lack of sleep (1.9) 22% Inattention other than distractors (1.4) 13% Dangerous overtaking (1.4) 11 Poor knowledge of the vehicle (2.8) 11 Inexperience or youth (1,2) 12	Grip problems on wet roads (1.3) 9%	Poor condition of vehicle (1.7) 13
Driving behaviour (0.9) 49 Non-compliance with rules of conduct (0.9) 13 Excessive or inappropriate speed (0.9) 34% Blood alcohol level of driver or pedestrian (0.7) 22%	Infrastructure factors (0.8) 23 Recoveries/avoidance (0.6) 7% Legibility (0.6) 3% Glare (0.4) 1% Aggravating Collision with fixed obstacle on ac- cordage (0.5) 17%	

Key to the interpretation: The "Fatigue" factor occurs 1.7 times more frequently in accidents on the main RN network than in those on the main RD network. This factor accounted for 26% of accidents on main roads.

Accidents on the national road network have a lower proportion of infrastructure factors (0.8) and aggravating factors (0.5) than those on the main departmental network. Factors linked to a lack of grip on wet roads were more prevalent (1.3).

The poor condition of the vehicle is identified more frequently in accidents on RNs (1.7).

The following human factors are more present:

- driver fatigue, particularly when linked to a lack of sleep (1.9 times more frequent),
- poor knowledge of the vehicle (2.8 times more frequent).

5.2 Accidents on departmental roads

The FLAM database contains 1,454 accidents, or 86% of the total, (for 2,450 drivers and pedestrians) involving at least 1 road user travelling on a dual carriageway outside built-up areas.

These accidents resulted in 1,580 fatalities, including 63 pedestrians, 65 cyclists, 154 motorcyclists and 61 moped riders (i.e.22% vulnerable users) and 271 passengers (17%).

39% of accidents (570 cases) took place on the main departmental network and 60% (877 cases) outside this network.

7 accidents could not be linked to any type of network.

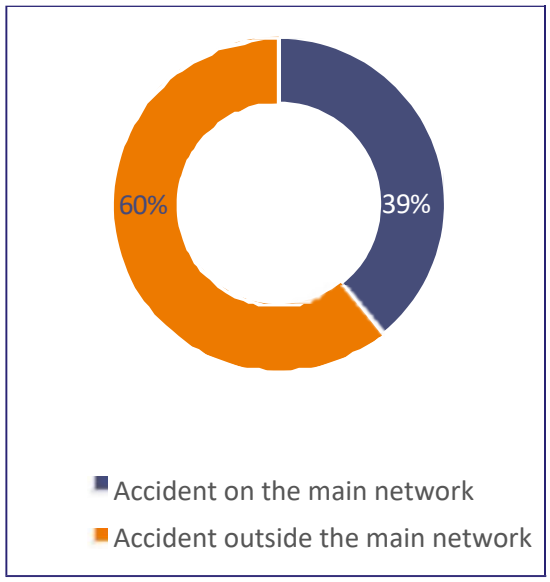


Figure 26: Accidents on main roads - breakdown by type of network

The proportion of accidents occurring on the main network (*versus* the non-main network) varies little according to the type of user.

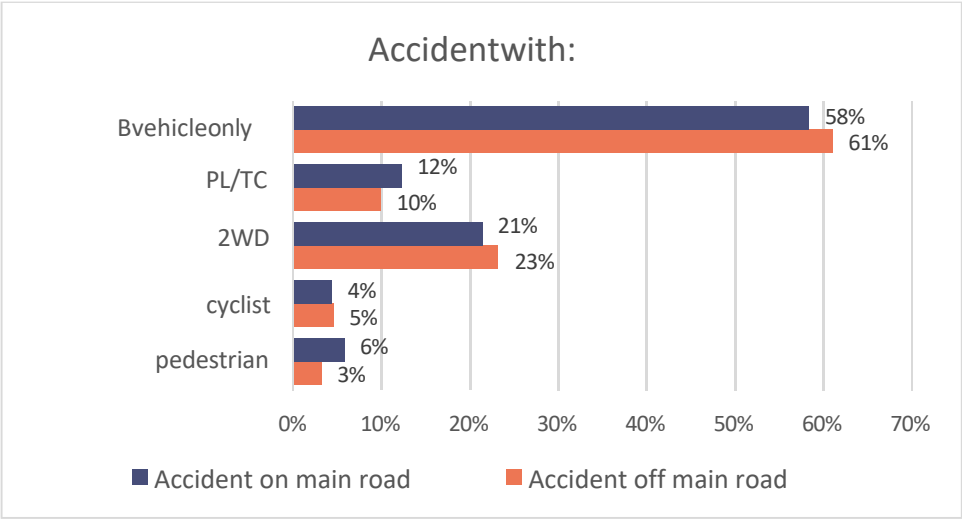


Figure 27: Share of accidents by type of user and network

5.2.1 Intersection accidents on RD

The database contains 237 intersection accidents.

Accidents at intersections involving at least 1 road belonging to the main network are included under accidents on the main network.

Accidents at intersections account for 17% of all accidents on the main road network and 16% of those outside the main road network.

On the main RD network (RD1), these accidents involved 203 road users, 22% of whom were vulnerable road users (4 pedestrians, 8 bicycles and 33 2WDs).

Outside the main RD network (RD2), these accidents involved 270 road users, 27% of whom were vulnerable road users (2 pedestrians, 12 bicycles and 60 2WDs).

Daytime accidents account for the majority of accidents on the 2 types of network: 75% on the main network and 73% on the rest of the network. Accidents at dawn or dusk accounted for 9% and 7% respectively. Accidents involving cyclists took place during the day. 1 pedestrian accident in 6 took place at night.

Accidents between 2 main roads accounted for the majority: 54% of accidents outside the main network and 42% on the main network. Accidents between RDs and VCs have a similar share for the 2 types of network: 20% of accidents off the main network and 23% on the main network. 13% of accidents on the main road network involved a dual carriageway

The majority of intersections were X-shaped (48% of cases). T-intersections were present in 37%ofcases.

Non-priorityusers:

Theproportionofrighttrafficissimilaronthe2 types of network: 10%.

Theproportionofyieldsignsishigherinaccidents on the main road (48% vs. 27%).

TheStopshareis62%offthemainnetworkand 35% on the main network.

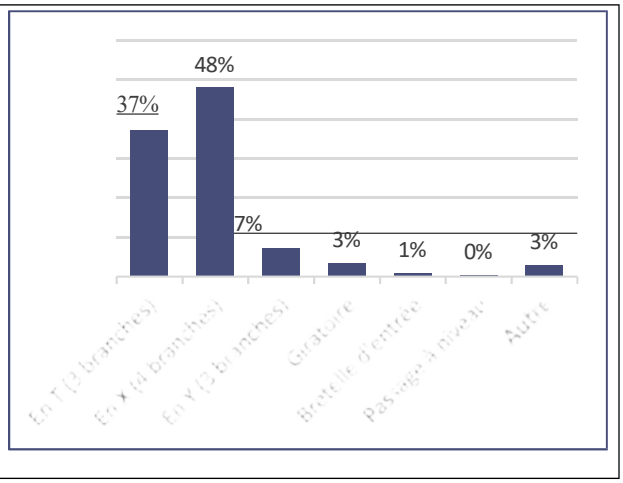


Figure 28: Representation of the main types of intersection

34% of accidents on the main road involve a left-turning road user. This proportion rises to 40% off the main road network.

5.2.2 Non-intersection lane-departure accidents on RD

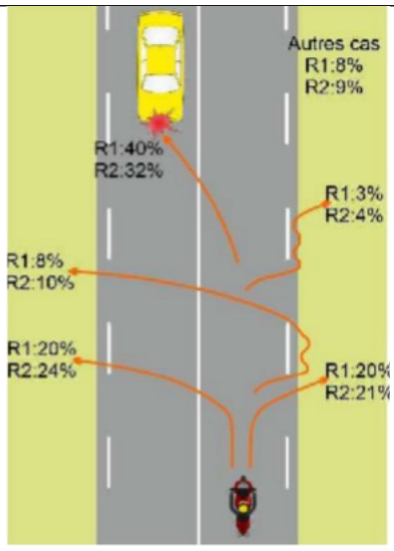
1,002 drivers left the road. The proportion of lane-departing drivers was higher in accidents off the main road than in those on the main road (53% in 622 cases vs. 48% in 377).

Most of them swerved to the left (68% of drivers on the main network and 66% off the main network). However, there isa difference between the 2 types of network, which is probably linked to the volume of traffic:

- 1.2 times more rear-end collisions with vehicles arriving in the opposite lane on the main network [R1] (40%vs32%),
- 1.2 times more direct left exits outside the main network [R2] (35% vs 30%).

The other types of output are similar on the 2 networks:

- Exit to the left after crossing the right shoulder:8% on the main road network and 10% off the main road network,



- 23% direct right exits on to the main road network and 25% off the main road network.

Figure 29: representation of the main trajectories of drivers with lane departures on the main network(R1)and off the main network (R2)

Ifwebreakdownalllanedeparturesbyroadalignment,wefind that there are disparities depending on the type ofnetwork:

The proportion of drivers travelling on a straight section was 1.2 higher in accidents on the main network than in those off the main network (50% in 173 cases vs. 40% in 227).

While the number of curves is 1.2 times higher in accidents outside the main network, the distribution of lane departures according to the side of the curve is similar:

- on the main network: 25% left curves and 25%rightcurves,
- off the main network: 31%left curves and 29% rightcurves.

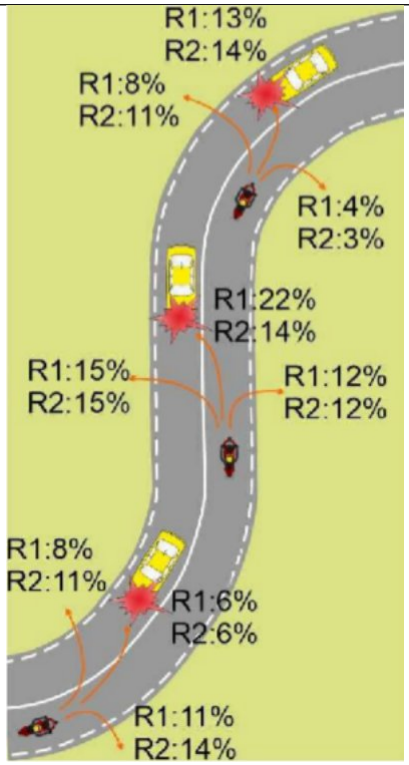


Figure 30: Representation of the main trajectories of drivers with lane departures by route - all lane departures

A comparison of track exits by route showst hat:

The proportion of drivers colliding with an oncoming vehicle is particularly high on right bends, even off the main road network:

- 53% on main roads,i.e.1.2 times more than on straight sections;
- 50% off the main network, i.e. 1.5 times more than on a straight section.

Left curves have a high proportion of lane departures on the inside of the curve:

- 57% on main roads, i.e. 3.6 times more than on rightbends;
- 54% off the main network, i.e. 5.4 times more than onthe right curve.

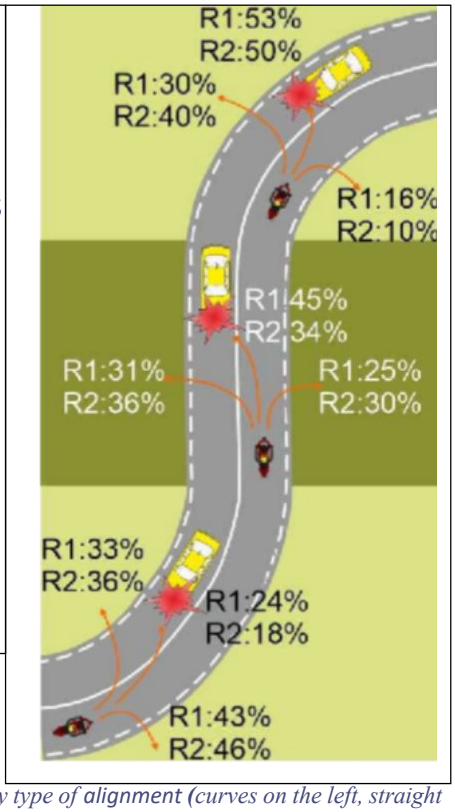


Figure 31: Representation of the main trajectories of drivers with lane departures by type of alignment (curves on the left, straight section, curve on the right).

Roadside verges

Grass verges are in the majority: 73% on the main network and 82% off the main network. Paved shoulders are present in 11% of carriageway exits on the main network and 6% off the main network.

Knowledge of the difference in level between the carriageway and the shoulder is partial for the 2 types of network (around 70%). This shows that :

- on the main network, 55% of drivers with a lane departure were in the presence of a level carriageway, this proportion is 57% for the rest of the network;
- on the main road network, 13% of drivers leaving the carriageway had to negotiate a step between the carriageway and the shoulder, compared with 14% for the rest of the network.

Emergency maneuvers by lane-departure drivers

Overall, drivers' knowledge of emergency manoeuvres involving lane departure is low. The information is known for :

- 50 to 60% of drivers involved in accidents without a third party ;
- Around 30% of drivers swerve to the left and collide with an oncoming vehicle.

In the event of a collision with another vehicle, around half of the drivers leaving the lane did not take evasive action (100%: including unknown cases). Approximately 45% of drivers at the other side of the road carried out an emergency manoeuvre, 28% did not and the information was unknown for 27%. If they did perform a manoeuvre, it was of the following type:

- Warning the driver when leaving the lane (headlights, horn) in 17% of cases, i.e. 11 drivers,
- Braking in 58% of cases, i.e. 37 drivers,
- Changing trajectory to move away from the other vehicle in 69% of cases, i.e. 44 drivers, including 22 drivers (34%) who moved to the right-hand shoulder.

5.2.3 Aggravating fixed obstacles on the shoulder of RD

The proportion of drivers who hit an aggravating fixed obstacle on a carriageway shoulder is almost the same for each type of network:

- 17% on the main network ;
- 20% off the main network.

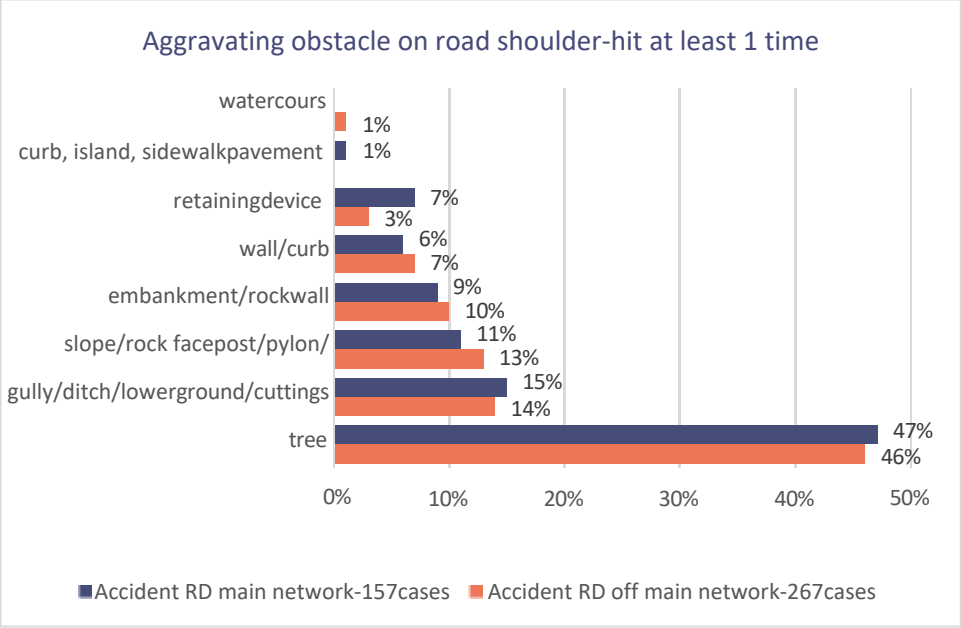


Figure 32: Main types of aggravating obstacles hit on verges

The types of obstacles hit on the roadside are broadly similar according to the type of network:

- Trees are the main issue: 47% of drivers on the main network and 46% off the main network;
- natural downhill obstacles (ravines, ditches, cuttings) and pole-type obstacles (poles, pylons, lampposts) each account for between 11% and 15% of the obstacles hit.

As in the case of the RNs, the majority of obstacles are point obstacles.

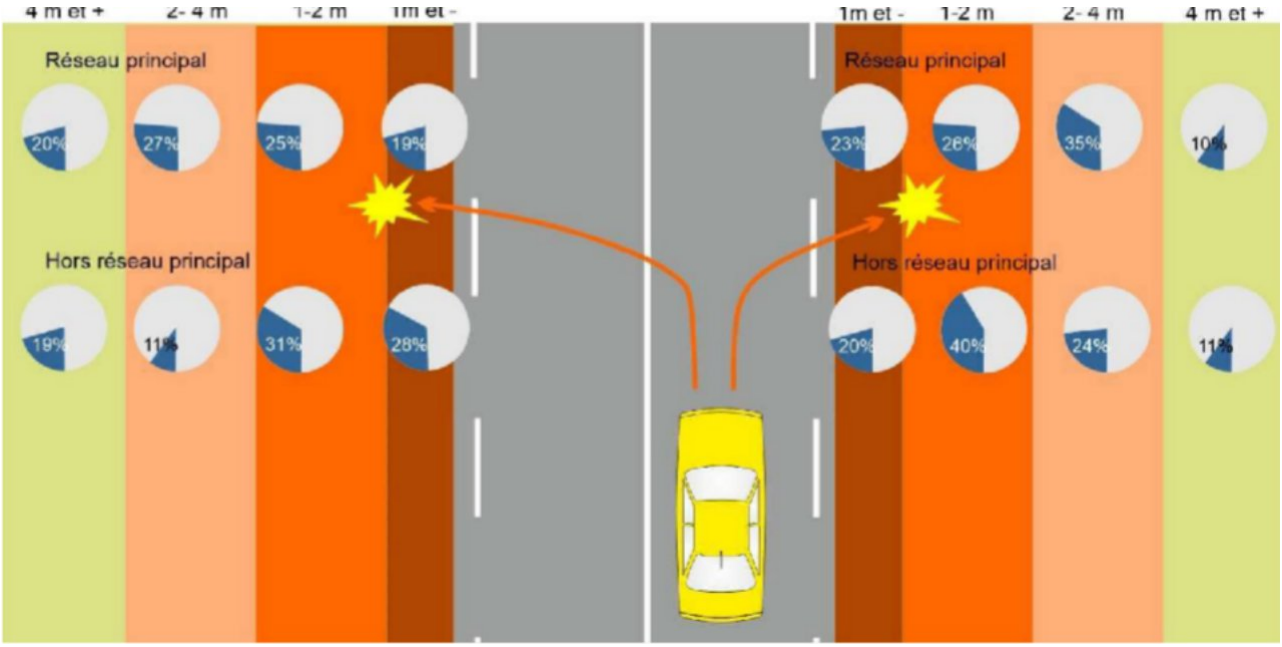


Figure 33: Estimation of the distance of the obstacle from the edge of the carriageway

The distance of the obstacle from the edge of the carriageway was established, either with the help of dimensioned plans taken from accident reports, or with the help of the internet (geoportail, google maps). Distances could not be estimated for around 6% of obstacles on the right-hand side of the carriageway and for around 10% of those on the left-hand side.

A large majority of the obstacles hit were less than 4 metres from the edge of the carriageway:

- on the main network: 71% on the left-hand side and 84% on the right-hand side ;
- outside the main network: 70% on the left-hand side and 84%

on the right-hand side. The proportion of obstacles less than 2 metres away is high:

- on the main network: 44% on the left-hand side and 49% on the right-hand side ;
- off the main network: 59% on the left-hand side and 60% on the right-hand side.

NB: the differences observed between the left and right sides for distances of less than 4 metres remain if the distribution calculations are carried out on known distances (12% difference on the main network and 8% difference outside the main network).

Off the main road network, the obstacles hit are clearly closer to the carriageway than on the main road network.
On the main road network, the proportion of accidents involving obstacles close to the carriageway (- 2 m) and (- 4 m) remains very high despite the tools available to deal with them.

5.2.4 Accident factors on RD

Human	Infrastructure	Traffic conditions	Vehicle
Trigger : • R1 : 91% • R2 : 92% Aggravating : • R1 : 14% • R2 : 17%	Trigger : • R1 : 31% • R2 : 36% Aggravating : • R1 : 34% • R2 : 37%	Trigger : • R1 : 20% • R2 : 19% Aggravating : • R1 : 1% • R2 : 1%	Trigger : • R1 : 18% • R2 : 18% Aggravating : • R1 : 2% • R2 : 1%

Table 4: Share of factor types - accidents on main roads (R1) and non-main roads (R2)

Analysis of the types of factors involved in accidents shows that they are distributed in a similar way across the 2 types of network. Only infrastructure factors account for 1.2 times the proportion outside the main network (31% on the main network vs. 36% outside the main network).

Infrastructure-related aggravating factors are present in around 35% of cases, and human-related aggravating factors in 15% of cases.

Combinatorial analysis of the factors (not shown) shows that :

- The majority of accidents involve only human factors (46% of cases on the main network and 43% off the main network).
- 2% of accidents on the main road and 3% off the main road have at least 1 factor of each type.
- Combinations of multiple types of factor almost always present at least 1 factor H. The association: HI is present in 15% of accidents on the main network and 18% off the main network; HV is present in 10% of accidents on the main network and 8% off the main network.

Comparison of factors: Accidents on main roads/accidents off main roads

Human	Infrastructure Traffic conditions	Vehicle
Fatigue (1.4) 15% vs 11 Discomfort (1.4) 13% vs 9% Risk-taking (1.3) 14% vs 11% State of punctual user (1,2) 36% vs. 31%.		
Weak experience (driver/vehicle knowledge) (0.8) 12% vs. 15% Inappropriate or untimely manoeuvre (0.8) 4% vs. 6% (0.8) Excessive or inappropriate speed (0.9) 36% vs. 39% Blood alcohol level of driver or pedestrian (0.9) 29% vs. 32 Aggravating factor (not wearing a helmet or seatbelt) (0.9)	Infrastructure factors (0.8) 31% vs 36% for Visibility (0.8) 8% vs 10% Striking a fixed obstacle on a shoulder (0.9) 33% vs 37	

Key to the interpretation: The "Fatigue" factor occurs 1.4 times more frequently in accidents on the main road network than in those off the main road network.

The main factors involved in accidents on the main departmental road network compared with those on the rest of the departmental network are :

- driver fatigue or discomfort (1.4 times more frequent),
- risk-taking (1.3 times more frequent),
- the user's current state: fatigue, inattention, stress, etc. (1.2 times more frequent).

Certain infrastructure factors are less prevalent:

- Visibility (0.8)
- Striking a fixed obstacle on the shoulder (0.9).

However, there was little difference in the typology of factors present in accidents on the 2 types of network. There was no specificity in terms of vehicle factors.

6. FOCUS ON USERS

6.1 pedestrians

The database includes 80 accidents on two-way roads outside built-up areas involving 86 pedestrians.

44 accidents took place on the main road network (RN+RD) (i.e. 55%) and 34 outside this network (RD+VC).

Piétons		Type de réseau				
		Ensemble des accidents	Réseau principal RN+RD1	VC+RD2	RD1	RD2
		86 cas	46 cas	38 cas	34 cas	31 cas
8% Hors inter 92%		8% 7 cas	6% 5 cas	2% 2 cas	5% 4 cas	2% 2 cas
		92% 79 cas	48% 41 cas	42% 36 cas	35% 30 cas	34% 29 cas

Figure 34: Breakdown of pedestrians involved at intersections/non-intersections by type of road network

Most of them were travelling on road sections (92% of cases), which is much more than other categories of user (see following paragraphs).

With 66% of pedestrian accidents, night-time accidents are a major issue, particularly on the main network: 35% of pedestrian accidents take place at night on the main network (compared with 29% outside the main network).

The proportion of pedestrians involved in intersections is higher on the main networks than on the secondary networks, for example 12% on [RD1] compared with 6% on [RD2].

The main types of accident involving a pedestrian are as follows:

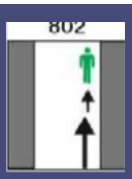
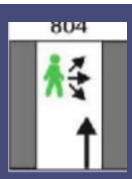
			 Other cases
Accident on main road network (RN+RD) 44 accidents	39% 17 accidents	14% 6 accidents	11% 5 accidents
Accident outside the main network 34 accidents	18% 6 accidents	15% 5 accidents	18% 6 accidents

Table 5: Main types of accident involving a pedestrian, by type of network

Table 5 shows that :

- The most common configuration in pedestrian accidents on the main road network is represented by pictogram 802 "pedestrians with their back to the vehicle's path": 39% for 17 accidents;

- accidents outside the main road network were more diffuse. The 2 main categories were 802 (18% for 6 accidents) and 804 "pedestrian crossing the carriageway from left to right" (15% for 5 accidents);
- There is a significant proportion of atypical accidents (11% on the main network and 18% off the main network).

	Human	Infrastructure	Traffic conditions	Vehicle
Factor in pedestrian accidents	90%	25%	21%	4%
Pedestrian factor	96%	26%	7%	NC

Table 6: Share of factor types - pedestrian accidents

In 80% of accidents, at least one accident factor was attributed to the pedestrian, i.e. 69 pedestrians.

The proportion of human factors associated with the pedestrian was high: 96%. The main factors

identified in accidents involving pedestrians (at least 10 cases) are as follows:

- The condition of the road user accounted for the majority of the major groups of factors: 79% of pedestrian accidents, with a high proportion associated with the pedestrian (50 cases out of 63 accidents).
- Substance use is present in 50% of accidents. It is strongly associated with pedestrians
    - alcohol: 43%, i.e. 40 cases, 31 of which involved pedestrians
    - drugs: 21%, i.e. 17 cases, 15 of which involved pedestrians.

Punctuality: 30% is associated with the driver, i.e. 15 cases out of 24. Inattention was present in 19% of accidents, i.e. 15 cases.

- Risk-taking was potentially present in 25% of accidents. This only concerned pedestrians (20 cases). Excessive or inappropriate speed on the part of the driver was identified in 13% of accidents (10 cases).
- Infrastructure/Environment factors are mainly related to :
    - visibility problems (19% - 15 cases), including 13% of masks which are essentially fixed (10 cases);
    - environmental conditions (weather/glare) in 13% of accidents (10 cases).

6.2 The cyclists

The database includes 70 accidents on two-way roads outside built-up areas involving 76 cyclists, 7 accidents involving a single cyclist.

27 accidents took place on the main network and 43 off it, i.e. 61%.

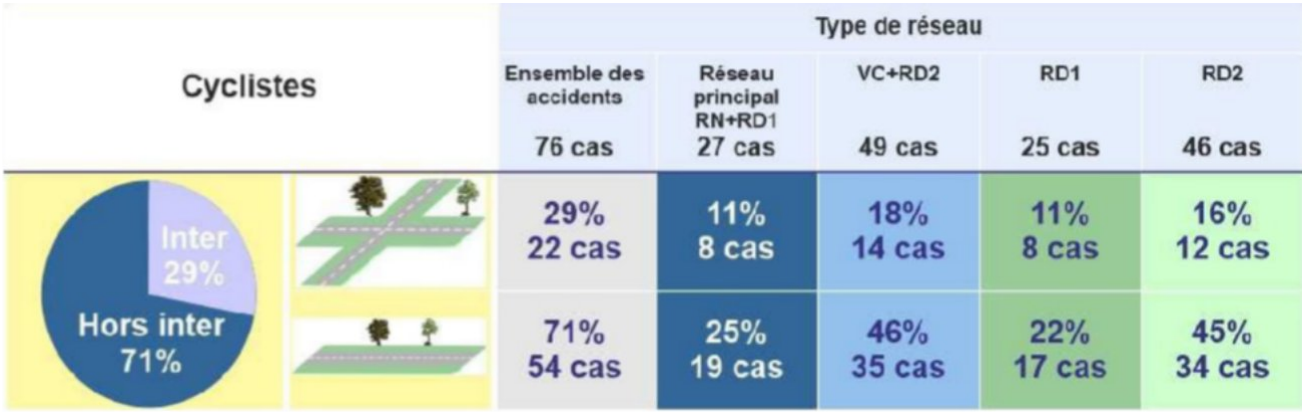


Figure 35: Breakdown of cyclists involved at intersections/outside intersections by type of network

29% of them were involved in accidents at junctions, rather than on the main road network (18% vs. 11% on the main road network).

The main types of accident involving a cyclist are as follows:

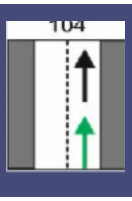
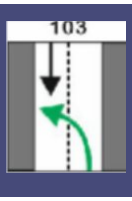
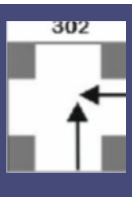
			
Accident on main road network (RN+RD) 27 accidents	41% 11 accidents	19% 5 accidents	7% 2 accidents
Accident outside the main network 43 accidents	16% 7 accidents	7% 3 accidents	12% 5 accidents

Table 7: Main types of accident involving a cyclist by type of network

Table 7 shows that :

- The most common configuration in accidents involving cyclists on the main road network is represented by pictogram 104 "a vehicle collides with the rear of the vehicle in front, which is maintaining its speed": 41% for 11 accidents; accidents of type 103 "a vehicle swerves into the opposite lane when a vehicle is coming in the opposite direction" are present in 19% of cases (5 accidents);
- accidents outside the main road network are more diffuse. The 2 main pictograms were 104 (16% for 7 accidents) and 302 "accident at intersection: 2 vehicles going straight ahead and coming from perpendicular directions" (12% for 5 accidents).

	Human	Infrastructure	Traffic conditions	Vehicle
Factor in accidents cyclists	94%	21%	23%	24%
Factor associated with the cyclist with third parties 54 cases	89%	22%	9%	22%
Factor associated with cyclist without third parties 7 cases	71%	14%	43%	0%

Table 8: Share of factor types - cyclists

In 80% of accidents, at least one accident factor was attributed to the cyclist, i.e. 61 cyclists.

The factors associated with cyclists involved in accidents with a third party and those associated with cyclists without a third party vary slightly

- While human factors account for 94% of accidents involving cyclists on dual carriageways, they account for 89% of accidents involving cyclists with third parties and 71% of accidents involving cyclists alone.
- Traffic conditions were associated with 3 cyclists alone (43%) and 5 cyclists involved in accidents with third parties (9%).
- The bicycle is not a factor in accidents involving cyclists alone. It accounts for 22% of the factors associated with cyclists involved in accidents with third parties (12 cases).
- Infrastructure factors account for a higher proportion of accidents involving cyclists and third parties

(22% vs. 14%). The main factors identified in accidents involving cyclists (at least 10 cases) are as follows:

- In accidents involving cyclists, factors related to driving behaviour were the main cause: 59% of accidents, or 41 cases. 43% of cyclists involved in accidents with a third party had this type of factor, i.e. 23 cases. This proportion is the same for solo cyclists, with 3 cases.
    - Failure to observe the rules of the road was present in 36% of accidents (15 out of 25 cases involving cyclists). Failure to give way accounted for 26% (13 out of 18 cases involving cyclists).

- Excessive or inappropriate speed was identified in 20% of accidents (9 out of 14 cases involving cyclists, including 3 cases involving cyclists alone).
- Risk-taking is present to a lesser extent: 10% of accidents, but 5 out of 7 involve cyclists.

- The condition of the road user was an issue in 50% of the accidents, with a high proportion associated with cyclists (21 out of 35 accidents, including 1 case of a lone cyclist).
- Substance use was present in 19% of accidents. It was strongly associated with the cyclist involved in the accident with a third party in 8 out of a total of 13 cases.
  - alcohol: 14%, i.e. 10 cases, 8 of which involved the cyclist with a third party and none involved the cyclist alone,
  - drugs: 7%, i.e. 5 cases, none of which involved the cyclist.
- The one-off condition: 34% (24 cases) was split between the driver and cyclist, i.e. 12 cases for cyclists with third parties and 1 for cyclists alone. Inattention was present in 23% of accidents, i.e. 16 cases, 7 of which involved cyclists.
- Problems of anticipation and manoeuvring account for a significant proportion of accidents involving cyclists: 20%, or 14 cases. This mainly involved the cyclist misjudging the distance or speed of the vehicle in front of him (10 cases).
- Problems of poor perception of cyclists are widespread. They concern all types of factor:
  - Vehicle: poor visibility of the bicycle due to its size - 17% of accidents, 12 cases ;
  - Infrastructure: masks to visibility - 16%, including 14% fixed masks (7 constituted by a tree or vegetation out of 10 cases);
  - Environment: glare is present in 10% of accidents, and is associated with the driver in 6 out of 7 cases;
  - Human: failure to wear high-visibility clothing was identified in 16% of accidents (11 cases).
- Although it is not possible to quantify its effect on aggravating the consequences of the impact, the aggravating factor of not wearing a helmet was observed in 26% of the accidents (i.e. 18 cases). 4 of the 7 cyclists involved in the accident alone were not wearing helmets.

6.3 Light vehicles

1,795 car drivers were involved in 1,386 accidents. The database includes 191 drivers of light commercial vehicles involved in 182 accidents.

Voitures particulières		Type de réseau				
		Ensemble des accidents	Réseau principal RN+RD1	VC+RD2	RD1	RD2
		1795 cas	790 cas	998 cas	632 cas	921 cas
Inter 16%		16% 280 cas	7% 131 cas	8% 146 cas	7% 120 cas	8% 141 cas
Hors inter 84%		84% 1515 cas	37% 659 cas	47% 852 cas	29% 512 cas	43% 780 cas

Figure 36: Distribution of cars involved at intersections/outside intersections by type of network

Private car drivers accounted for the majority of road users involved (71%), and most of them were travelling on main roads (84%) and off the main network (47%).

The proportion of car drivers involved in intersections is higher on the main networks than on the secondary networks, for example 23% on [RD1] compared with 15% on [RD2].

Véhicules utilitaires légers		Type de réseau				
		Ensemble des accidents	Réseau principal RN+RD1	VC+RD2	RD1	RD2
		179 cas	85 cas	94 cas	66 cas	87 cas
Inter 24%		24% 43 cas	8% 14 cas	16% 29 cas	8% 14 cas	16% 28 cas
Hors inter 76%		76% 136 cas	40% 71 cas	36% 65 cas	29% 52 cas	33% 59 cas

Figure 37: Breakdown of LCVs involved at intersections/non-intersections by type of network

They differ from cars in that they are more involved at intersections (24% vs. 16%). Intersections outside the main road network are in the majority (16% vs. 8% on the main road network).

Unlike for passenger cars, the proportion of LCV drivers involved in intersections is higher on secondary networks than on main networks, for example 21% on [RD1] compared with 32% on [RD2].

LCV drivers have a lower proportion of factors than car drivers (63% vs. 73% respectively).

Accidents involving passenger cars (1,327 cases) / light commercial vehicles (121 cases)

Human	Infrastructure Traffic conditions	Vehicle
Condition of the user as a whole (1.3) 65% Punctual user status (1,2) 35% State of the user substances (1.5) 38% • blood alcohol (1.5) 31% • narcotics (1.3) 15% of the total Excessive or inappropriate speed (1.4) 32% Little experience (driver/vehicle knowledge) (1.9)12% • young or inexperienced driver (1.7) 10%	Suitability for dynamic stresses - pavement condition (1.7) 10% • adhesion problems on wet roads (1.7) 10% Aggravating: collision with a fixed obstacle on the shoulder (1.4) 29%	
Driving behaviour (0.9) 45% Failure to comply with the rules of the road (0.4)11% Risk-taking (0.6) 7% Failure to observe right of way rules (0.4) 9% Unsafe overtaking (0.5) 5% Aggravating factor (not wearing a helmet or seatbelt) (0,8) 11%	Infrastructure factors (0.9) 32% Visibility (0.5) 10% of the total • masks (0.5) 9%	Vehicle factor (0.7) 12%

Accidents on RN (119 cases) / accidents on main RD (446 cases)

Human	Infrastructure Traffic conditions	Vehicle
Punctual user status (1.1) 69% Fatigue (1.7) 28% Inattention excluding distractor or telephone (1.7) 14% Low experience (driver/vehicle knowledge)(1.6) 18% • young or inexperienced driver (1.3) 12% • unusual vehicle (2.6) 10%	Suitability for dynamic constraints (1,2) 12%	Condition of the vehicle (1,6) 8%
Failure to give way (0.7) 7% Blood alcohol level of driver or pedestrian (0.7) 19% Aggravating factor (not wearing a helmet or seatbelt) (0.4) 4%	Infrastructure factors (0.7) 21% Visibility (0.6) 6% • fixed masks (0.4) 3% Recovery/avoidance lack of space (0.4) 3% Aggravating Collision with fixed obstacle on the shoulder (0.5) 13%	

The main factors associated with cars involved in accidents on the national road network compared with those on the main departmental network are :

- fatigue (1.9 times more frequent),
- inattention outside the use of distractors (1.7 times more frequent),
- driver inexperience due to age (1.3) or unfamiliarity with the vehicle (2.8),
- the user's current state: fatigue, inattention, stress, etc. (1.2 times more frequent).

Certain infrastructure factors are less prevalent:

- Legibility (0.3)
- Visibility (0.6), including the presence of fixed masks (0.4)

- No or insufficient recovery area (0.3)
- Striking a fixed obstacle on the shoulder (0.5).

Accidents on main road network (446 cases) / off main road network (688 cases)

Human	Infrastructure Traffic conditions	Vehicle
Fatigue, lack of sleep, busy day/week (1.3) 16% Discomfort (1.4) 13%		
Unfamiliarity with the vehicle (0.7) 4%	Infrastructure factors (0.9) 31% Readability (0.5) 2% Recovery/avoidance lack of space (0.8) 8% Aggravating Striking a fixed obstacle on an acceleration (0.9) 28%	

The main factors involved in accidents on the main departmental road network compared with those on the rest of the departmental network are broadly similar. There are a few differences, but they are fairly small.

Factors more present :

- fatigue (1.3 times more frequent),
- malaise (1.4 times more frequent).

Certain infrastructure factors are less prevalent:

- Legibility (0.5)
- No or insufficient recovery area (0.8)
- Striking a fixed obstacle on the shoulder (0.9).

6.4 moped riders

75 moped riders were involved in 75 accidents. Most of them were travelling off the main road network (67%).

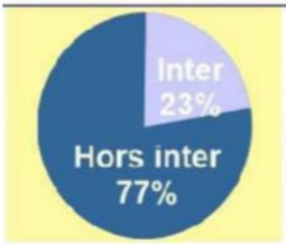
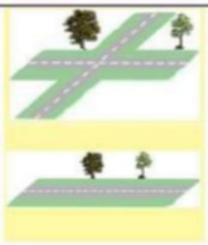
Cyclos		Type de réseau				
		Ensemble des accidents	Réseau principal RN+RD1	VC+RD2	RD1	RD2
		75 cas	24 cas	50 cas	19 cas	43 cas
		23% 17 cas	9% 7 cas	12% 9 cas	8% 6 cas	11% 8 cas
		77% 58 cas	23% 17 cas	55% 41 cas	17% 13 cas	47% 35 cas

Figure 38: Breakdown of moped drivers involved at intersections/outside intersections by type of road network

Intersections are a particular issue for cyclists (23%), with a predominance of those off the main network (12%). This is the type of network that represents the major challenge on the current section, with a share of 55%.

The main types of accident involving moped riders are as follows:

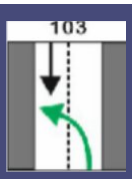
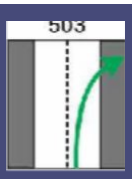
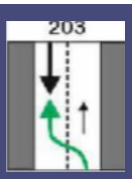
			
Accident on main road network (RN+RD) 12 accidents	33% 4 accidents	8% 1 accident	0%
Accident outside the main network 32 accidents	28% 9 accidents	28% 9 accidents	13% 4 accidents

Table 9: Main types of accident involving a moped driver, by type of network

Table 9 shows that :

- accidents outside the main network fall into 2 main configurations:
  - pictogram 103 "a vehicle swerves into the opposite lane when a vehicle is coming in the opposite direction": 28% for 9 accidents,
  - pictogram 503 "single vehicle involved with lane departure on the right": 28% of cases also ;
- accidents on the main network have only one pictogram associated with several accidents. 4 accidents took place in configuration 103.

Comparison between cyclists (63 cases) and private cars (1,327 cases)

Human	Infrastructure Traffic conditions	Vehicle
Risk-taking (2.0) 14 • non-compliance with rules of conduct (1.5) 17% • Voluntary risk-taking (3.7) 11% Little Little experience (driver/vehicle knowledge)(2.0) 24% • inexperience/young driver (2.3) 22% • unfamiliarity with the vehicle (1.2) 6% Narcotics (1.4) 21% Aggravating factor (helmet/not wearing seatbelt)(1.6) 17%	Environmental factors (1,4) 24% Legibility - overall (3.5) 14% • Curve legibility (6% vs 1%) Dynamic (1.3) 13% Grip problemson wet road surfaces (1.4) 10%	Factors Vehicle (2.9) 35 Weak perceptibility (5.7) 17 Vehicle condition (3.0) 21 • absence of illuminated signs (13% vs 0%)
User condition (0.8) 52 • Blood alcohol level (0.8) 24 • Fatigue (0.2) 3% • Discomfort (0.7) 8% • Inattention (0.7) 6% Telephone (0% vs 4%) Excessive or inappropriate speed (0.7) 24	Recovery/avoidance (0.2) 3% Visibility (0.6) 6% • Visibility masks (0.5) 5% (0.5) Aggravating Striking a fixed obstacle on the shoulder (0.7) 22%	

While human factors are the most prevalent (81%), there is a high proportion of vehicle factors associated with cycles (35%, i.e. 2.9 times more than for private cars).

6.5 The motorcyclists

319 motorcyclists were involved in 304 accidents. Most of these were off the main road network (60%).

Motos		Type de réseau				
		Ensemble des accidents	Réseau principal RN+RD1	VC+RD2	RD1	RD2
		319 cas	129 cas	189 cas	108 cas	171 cas
Inter 25%		25% 81 cas	9% 28 cas	17% 53 cas	8% 27 cas	16% 52 cas
Hors inter 75%		75% 238 cas	32% 101 cas	43% 136 cas	25% 81 cas	37% 119 cas

Figure 39: Distribution of motorcyclists involved at intersections/outside intersections by type of road network

Intersections represent a particular challenge for motorbikes (25%), with a predominance of those off the main road network (17%). It is the type of road network that represents the major challenge on current sections, with a share of 43%.

The proportion of motorbike drivers involved in intersections is higher on secondary networks than on main networks, for example 25% on [RD1] compared with 30% on [RD2].

The main types of accident involving a motorcyclist are as follows:

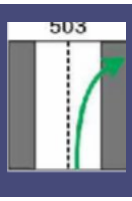
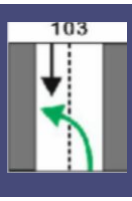
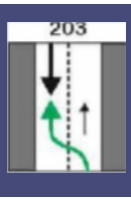
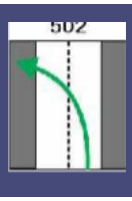
				
	503	103	203	502
Accident on main road network (RN+RD) 86 accidents	22% 19 accidents	15% 13 accidents	12% 10 accidents	10% 9 accidents
Accident outside the main network 121 accidents	24% 29 accidents	22% 27 accidents	4% 5 accidents	12% 15 accidents

Table 10: Main types of accident involving a motorcyclist by type of network

Table 10 shows that :

- 48% of accidents outside the main network are concentrated in 2 types of accident
  - 24% (29 accidents) for pictogram 503 "single vehicle involved with lane departure on the right".
  - 22% (27 accidents) for pictogram 103 "a vehicle swerves into the opposite lane when a vehicle is coming in the opposite direction".
- On the main road network, while the 503 pictogram is the most common configuration (22% for 19 accidents), the other types of accident are more widespread: 15% of type 103, 12% of type 203 "one

vehicle overtakes a vehicle and collides with another vehicle coming in the opposite direction" and 10% type 502
"Single vehicle involved with lane departure on the left".

While human factors are the most prevalent (82%), there is a high proportion of vehicle factors (32%, i.e. 2.7 times more than for passenger cars).

Comparison between motorbikes (268 cases) and private cars (1,327 cases)

Human	Infrastructure Traffic conditions	Vehicle
Driving behaviour (1.4) 63% Risk-taking (3.1) 22% • excessive or inappropriate speed (1.7) 55% • dangerous overtaking, tailgating (3.2) 16 • Voluntary risk-taking (2.0) 6% Poor experience (driver/vehicle knowledge) (1.5) 18% • driver inexperience/youth (1.2) 12% • unfamiliarity with the vehicle (2.0) 10%	Infrastructure factors (1.4) 44% Factors Environment (1,2) 20% of total Infrastructure design (5.3) 16% Legibility - overall (5.5) 22% • Curve legibility (13% vs 1%) • *negotiating a tight curve after a long straight (8% vs. 1%)* • *sequence of 2 curves of different radii (4% vs 0%)* Dynamics - surface condition (1.2) 12% Visibility (1.8) 18 • masks (1.7) 15% of sales	Factors Vehicle (2.7) 32% Powerful vehicle (8.5) 17% Low perceptibility (4.3) 13%
User condition (0.5) 32% • Blood alcohol level (0.5) 16 • Fatigue (0.1) 2% • Discomfort (0.3) 3% • Inattention (0.2) 2% • Older driver (0% vs 5%) • Telephone (0% vs 4%) Aggravating factor (not wearing a seatbelt/helmet) (0,3)	Dynamics - Grip problems on wet pavement (0.6) 4% Recoveries/avoidance (0.3) 4%	

Comparison of heavy motorbikes (231 cases) / light motorbikes (37 cases)

Human	Infrastructure Traffic conditions	Vehicle
Risk-taking (1.4) 23% • dangerous overtaking, queue-jumping (1,2) 16% Excessive or inappropriate speed (1,2) 57%	Infrastructure factors (1.5) 46% Environmental factors (1.5) 21% Infrastructure design (3.4) 17% Legibility (1.6) 23% • legibility curve (3.0) 15% Dynamics - surface condition (1.7) 13% Grip problems on road surfaces wet (5% vs 0%) Aggravating Collision with fixed obstacle on the shoulder (1.1) 30%	Vehicle factor (2.1) 34% Vehicle power (19% vs. 0%) Weak perceptibility (1.7) 14%
Condition of the user (0.5) 29% Unfamiliarity with the vehicle (0.6) 9% Unwellness (0.2) 2% vs 8% Blood alcohol level (0.5) 14% Narcotics (0.5) 11%		Condition of the vehicle (0.4) 5%

Comparison between motorbikes (268 cases) and cyclists (63 cases)

Human	Infrastructure Traffic conditions	Vehicle
Driving behaviour (1.4) 63% Risk-taking (1.6) 22% • Excessive or inappropriate speed (2,3) 55% • dangerous overtaking, queue-jumping (2.3) 16% Unfamiliarity with the vehicle (1.7) 10%	Infrastructure factors (1.4) 44% Legibility - overall (1.6) 22% • Curve legibility (2.1) 13% Visibility (3.0) 18% • masks (3.0) 15% Aggravating Collision with fixed obstacle on ac- cotement (1.4) 30%	Powerful vehicle (2.1) 17%
User condition (0.6) 32% • Blood alcohol level (0.7) 16% • narcotics (0.6) 13% • Discomfort (0.4) 3% • Inattention (0.3) 2% Older driver (0% vs 5%) Driver inexperience/youth (0.5) 12% Failure to comply with rules of conduct (0.4) 7% Voluntary risk-taking (0.5) 6% Aggravating factor (not wearing a seatbelt/helmet) (0,2)	Factors Environment (0.8) 20% of total Dynamics - Grip problems on wet roads (0.4) 4%	Factors Vehicle (0.9) 32% Weak perceptibility (0.8) 13% Condition of the vehicle (0.3) 6% • absence of illuminated signalling (0.1) 1% • condition of tyres (0.6) 4%

Comparison of motorbikes on the main road network (RN+RD) (108 cases) / motorbikes off the main road network (RD+VC) (160 cases)

Human	Infrastructure Traffic conditions	Vehicle
Narcotics (2.1) 19 Risk-taking (1.5) 27		Condition of tyres (2.2) 6%

• queue climbing (6% vs 1%) • voluntary risk-taking (1.7) 8%	Aggravating Collision with fixed obstacle on ac-cotement (1.1) 31	
Blood alcohol (0.7) 13% Excessive or inappropriate speed (0.9) 50% Little experience (driver/ vehicle knowledge) (0.8) 16% • inexperience/young driver (0.6) 9% • unfamiliarity with the vehicle (0.7) 7%	Infrastructure factors (0.9) 41% Traffic conditions factors (0.9) 19% Visibility (0.8) 16% • masks (0.8) 13% Dynamics - surface condition (0.8) 10%	Powerful vehicle (0.7) 14% Low perceptibility (0.9) 12%

6.6 Heavy goods vehicles

192 HGVs were involved in 184 accidents. Most of these were on the main road (58%).

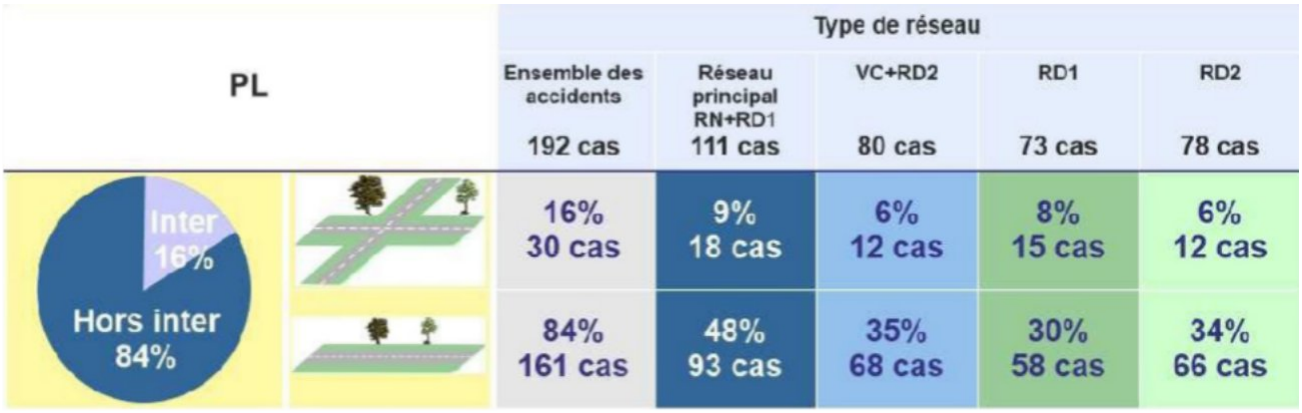
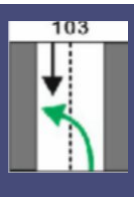
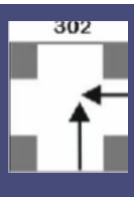


Figure 40: Breakdown of motorcyclists involved at intersections/outside intersections by type of road network

The proportion of HGV drivers involved in intersections is higher on the main networks than on the secondary networks, for example 20% on [RD1] compared with 15% on [RD2].

HGVs tend to be involved in accidents outside intersections (84%) on the main road (48%).

The main types of accident involving HGVs are as follows:

		
Accident on main road network (RN+RD) 108 accidents	65% 70 accidents	4% 4 accidents
Accident outside the main network	54%	9%

89 accidents	48 accidents	8 accidents

Table 11: Main types of accident involving HGVs by type of network

Table 11 shows that :

- the vast majority of accidents involving HGVs are represented by the pictogram 103 "a vehicle swerves into the opposite lane when a vehicle is coming in the opposite direction" (65% of accidents on the main network, i.e. 70 cases, and 54% of accidents on the rest of the network, i.e. 48 cases).

HGV drivers are less likely to be involved in accidents:

- 42% of drivers have at least 1 triggering factor.
- The human factor is relatively low compared with other drivers : 56% compared with 85% for passenger cars.

Comparison of HGV/HGV (80 cases) / private car (1,327 cases)

Human	Infrastructure Traffic conditions	Vehicle
	Infrastructure factors (1,2) 38% Recovery/avoidance (1.3) 16%	Factors Vehicle (3.3) 39% Pedestrian or vehicle in the blind spot (9.5) 5% Mass and configuration (28% vs 0%)
Human factors (0.7) Condition of the user (0.4) 24% • Blood alcohol (0.1) 4% • Fatigue (0.2) 4% • Discomfort (0.2) 3% • Drugs (0.4) 6% Low experience (driver/vehicle knowledge) (0.4) 5% Failure to comply with the rules of the road (0.5) 6% Aggravating factor (not wearing a seat belt)(0.4) 5%	Aggravating Collision with fixed obstacle on ac- cotement (0.2) 5%	

Comparison HGV with trailer or semi-trailer (53 cases) / single HGV or road tractor (23 cases)

Human	Infrastructure Traffic conditions	Vehicle
Excessive or inappropriate speed (1.6) 38% Punctual user status (2.1) 19% • Fatigue (6% vs 0)	Environmental factors (5.7) 23% Dynamic (17% vs 0) Grip problemson wet roads (11% vs 0%)	
Use of substances (0.2) 4% Drugs (0.3) 4% Failure to comply with rules of conduct (0.4) 4% Driver inexperience/youth (0.1) 2% vs 13%	Visibility (0.8) 17% • fixed masks (0.8) 17% • of which trees or vegetation (0.6) 13%	Vehicle factors (0.7) 34% HGV mass and configuration (0.7) 25%

Comparison of HGVs on the main road network (RN+RD) (40 cases) / HGVs off the main road network (RD+VC) (39 cases)

Human	Infrastructure Traffic conditions	Vehicle
Human Factor (1,2) 60% (in %) Discomfort (5% vs 0) Driving behaviour (1,3) 40% • Excessive or inappropriate speed (2.2) 38%	Intersection legibility (0% vs 8%) Grip problems on wet roads (2.0) 10% Recovery/avoidance - place (1.9) 15%	Mass and configuration of the PL (1,2) 30% Vehicle condition (2.0) 10%
Substance use (0.2) Failure to comply with priority rules (0% vs 8%) Driver inexperience/youth (0.1)	Environmental factors (0.6) 13 Infrastructure factors (0.7) 33 Visibility - fixed masks (0.5) 13 Suitability for dyna- mic constraints (0.8) 10% (0.8)	Pedestrian or vehicle in blind spot (3% vs 8%)

7. FOCUS ON THE ROAD ENVIRONMENT

The database includes a mode for characterising the environment of the damaged road.

If the initial input of information is not homogeneous (input in free text), a grouping has been carried out in post-processing. The groupings are listed below. The mountain environment was identified before the width of the road: a narrow mountain road is classified in the category "mountain"

	Number of accidents	Share
Countryside and long-distance	915	54%
Countryside and interurban on narrow roads (< 6m)	258	15%
Semi-urban, locality, dispersed housing, peri-urban, commercial or industrial zone	122	7%
Forest, wooded area	161	10%
Mountain	76	5%
Vineyards	7	0%
Sea, seaside resort	3	0%
Structure, canal, specific point (interchange, level crossing), work zone	12	1%
Unknown	130	8%
Grand total	1685	100%

Table 12: Breakdown of accidents by type of environment

7.1 Breakdown of accidents by environment and category of network

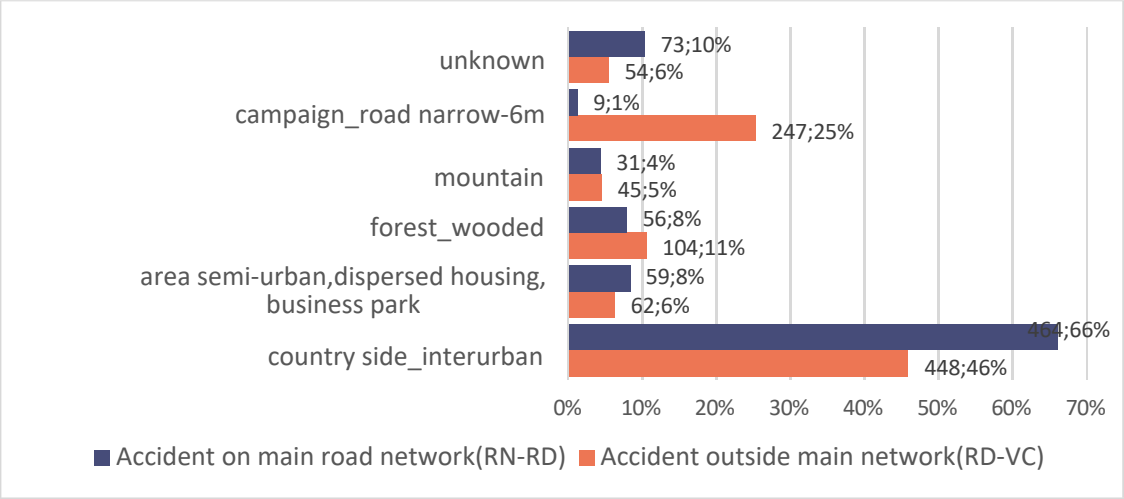


Figure 41: Breakdown of accidents by main types of environment and network category

Figure 41 shows that :

- Most accidents took place in an interurban environment with no particular characteristics (66% of accidents on the main network and 46% off the main network);
- Narrow roads (with a total width of less than 6m[1]) represent a major issue in non-main network accidents (25%);
- the proportion of roads in woodland or wooded areas is not negligible (8% of accidents on the main network and 11% off the main network)
- the share of other types of environment is broadly similar for the 2 types of network.

[1] The width of the road was determined either using the plans in the PVs or from measurements taken on the Geoportail website.

7.2 Users involved according to the environment

nombre d'usagers	campagne, interurbain	route étroite (<6m)	lieu-dit, habitat diffus, péri-urbain, zone commerciale, industrielle	forêt, zone boisée	montagne	inconnu
piéton-86 cas	67%	7%	24%	1%	0%	0%
Bicyclette-76 cas	55%	20%	0%	4%	8%	12%
cyclo-75 cas	47%	27%	13%	11%	1%	1%
moto-394 cas	63%	15%	8%	6%	6%	1%
vh de catégorie B-2020 cas	55%	17%	7%	6%	4%	10%
PL-IC-207 cas	77%	6%	6%	6%	3%	2%
Tracteur Agricole-30 cas	63%	27%	0%	0%	3%	3%
Autre vh-33 cas	45%	21%	15%	3%	3%	3%
Tous usagers-2846 cas	58%	12%	8%	9%	4%	8%

Figure 42: Breakdown of users involved by environment

Figure 42 shows that although the majority of road users are involved in accidents in an urban environment without any particular characteristics, there are some specific features.

- 24% of pedestrians were travelling in built-up areas,
- Narrow roads involved a higher proportion of cyclists (20%), moped riders (27%) and drivers of agricultural tractors (27%) than for motorbikes, HGVs and category B vehicles (cars + light commercial vehicles).
- On mountain roads, the proportion of cyclists (8%) and motorcyclists (6%) was slightly higher than for other road users. Despite the small sample, 42% of motorcyclists (8 cases) were riding in groups, compared with 24% in environments with no special characteristics.

7.3 The main types of accident according to the environment

Accidents are classified according to the following categories:

- series 100: 2-vehicle accident on a road section with no pedestrians
- 200 series: accident involving overtaking outside a junction
- 300 series: intersection accident
- series 400: accident with private road, car park entrance/exit
- 500 series: single-vehicle accident with no pedestrians
- 700 series: chain collision
- 800 series: pedestrian accident

The coding decision tree is available in appendix 9.3.

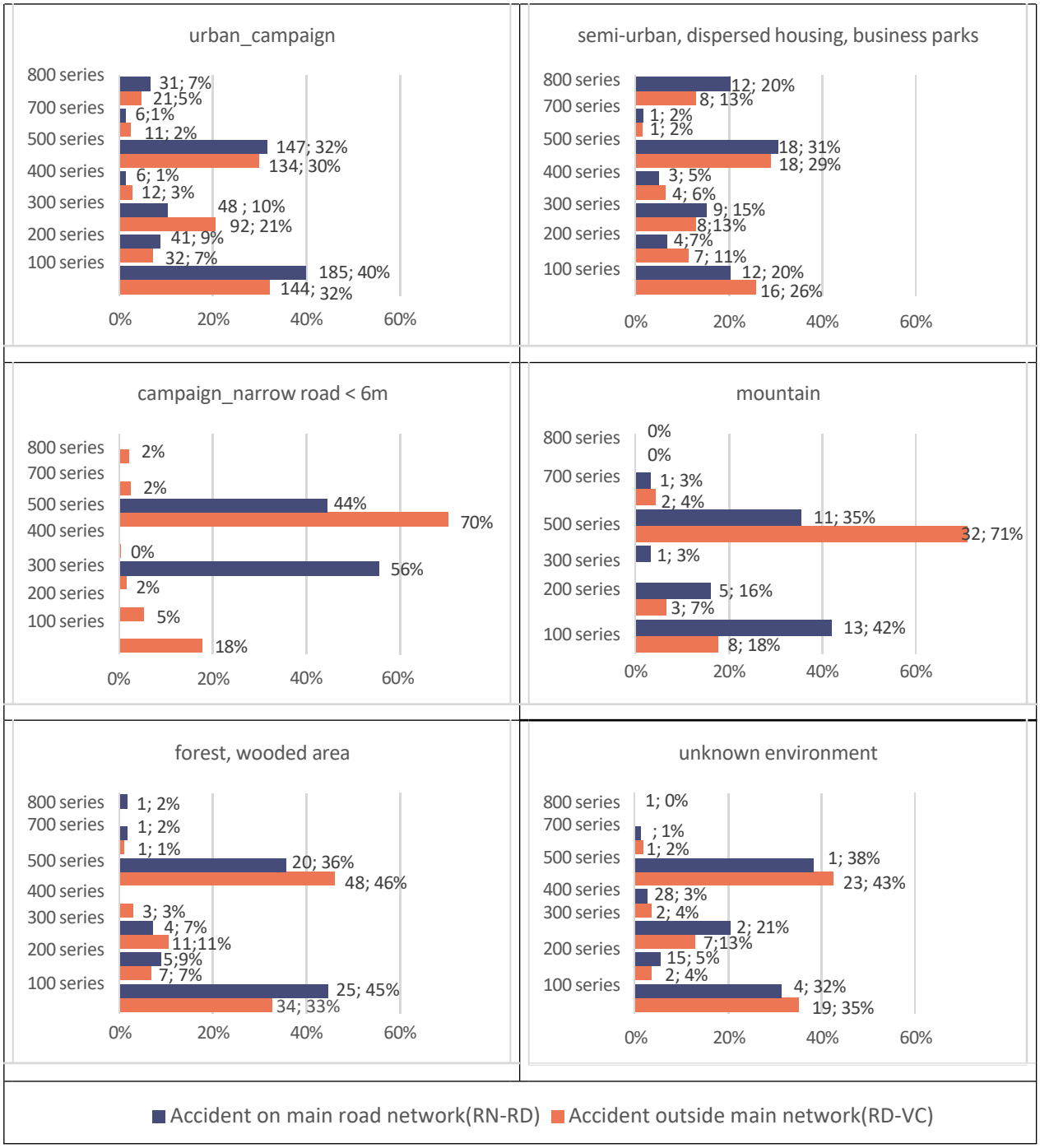


Figure 43: Major types of accident by environment

Analysis of Figure 43 shows some specific features relating to the main types of accident according to the environment:

- Accidents on mountain roads and narrow roads show a high concentration of single-vehicle accidents, particularly off the main network, accounting for 70% of cases.
- Accidents on mountain roads on the main network show a high proportion of 2-vehicle accidents on the road section: 42%.
- Accidents in semi-urban areas, with scattered housing or business parks, involve the highest proportion of pedestrians: 20% on the main network and 13% off the main network.

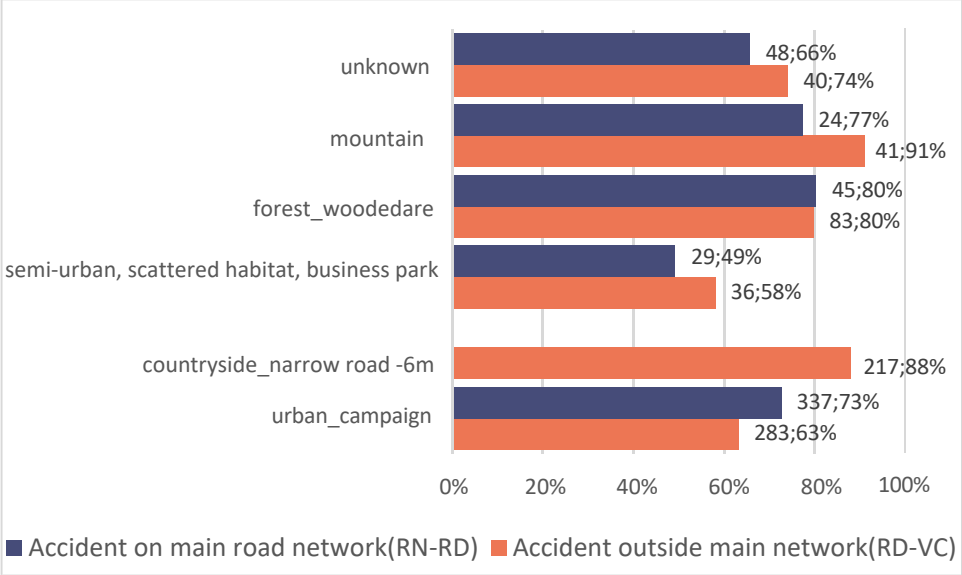


Figure 44: Percentage of accidents involving loss of control or guidance problems by environment

Figure 44 shows that the majority of accidents involved loss of control or guidance problems. Slight variations are observed depending on the environment and/or the type of network.

- Accidents in semi-urban areas, with scattered housing or business parks, are the least likely to involve loss of control or guidance problems.
- Accidents on mountain roads and narrow roads off the main network almost exclusively involved a vehicle losing control or having a steering problem (91% and 88% respectively).
- Accidents in woodland or forest areas account for 80% of cases involving a vehicle that has lost control or has a guidance problem.

7.4 Collision with an aggravating fixed obstacle on shoulder

	Number of vehicles/users hitting 1 obstacle on the shoulder	Share
Countryside and long-distance	241 cases	15%
Countryside and interurban on narrow roads (<6m)	123 cases	37%
Semi-urban, locality, dispersed housing, peri-urban, commercial or industrial zone	35 cases	16%
Forest, wooded	56 cases	22%
area Mountain	22 cases	19%
Unknown	31 cases	14%
Grand total	512 cases	100%

Table 13: Representation of vehicles/users having hit 1 aggravating obstacle on the verge

Table 13 shows that there is a high incidence of collisions with fixed obstacles on the shoulders of narrow roads (involving 37% of the vehicles involved).

Wooded and mountainous environments also have a fairly high proportion of roadside collisions (22% and 19% respectively).

Étiquettes de lignes	au moins 1 arbre	au moins 1 poteau/pylone /candélabre	au moins 1 ravin/fossé/contre bas/déblais	au moins 1 talus	au moins 1 DR	au moins 1 mur/muret	au moins 1 paroi rocheuse
campagne, interurbain	105	36	39	17	13	13	7
route étroite (<6m)	52	19	26	10		7	2
avec bâti, zone commerciale...	7	6	2			11	1
forêt, zone boisée	37	2	3	4	2		1
montagne	8		3	3	3	1	4
inconnu	16	2	4		3	3	
Total "tous environnements"	**261**	**79**	**88**	**40**	**30**	**41**	**15**

Figure 45: Type of aggravating obstacle hit on the verge, by environment

Figure 45 shows that trees are the type of obstacle most frequently hit. Trees were an aggravating obstacle for 66% of drivers in wooded areas, 42% of drivers on narrow roads, 36% of those involved in accidents in mountainous areas and 20% of those involved in accidents in areas with diffuse built-up areas.

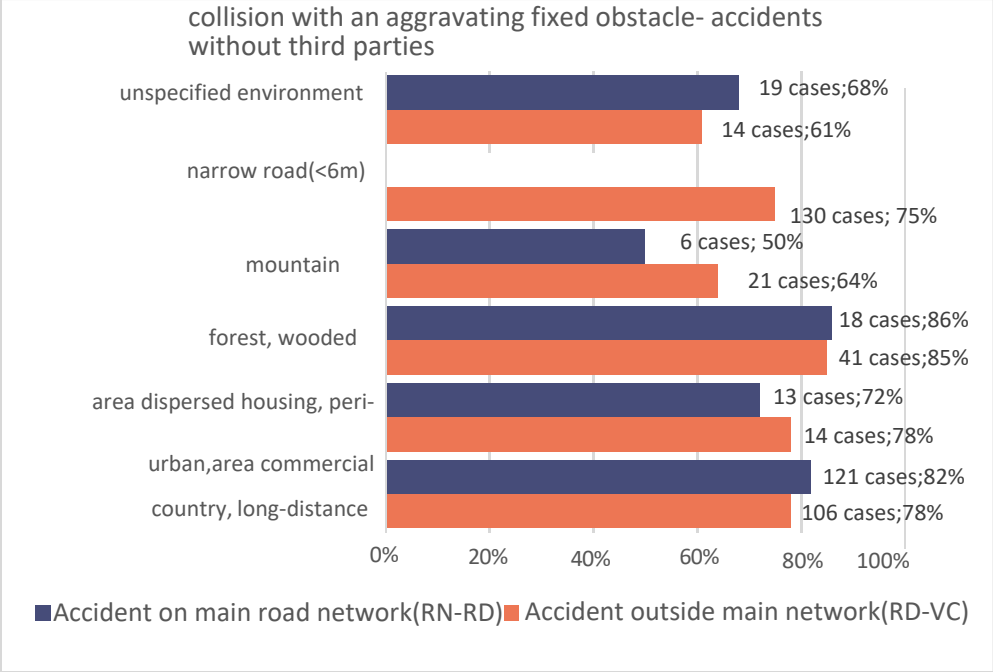


Figure 46: Percentage of accidents without a third party hitting an aggravating fixed obstacle, by environment and type of network

Figure 46 shows that in accidents without third parties, the proportion of collisions with aggravating fixed obstacles is broadly similar between the main network and the rest of the network.

The proportion of collisions with fixed obstacles in accidents without third parties was 71% for all accidents. A detailed analysis of the accident environment shows that :

- accidents in wooded or forest areas involve a high proportion of collisions with fixed obstacles (86% on the main network and 85% on the rest of the network),
- the mountain environment does not have the highest proportion of collisions with fixed obstacles (64% outside the main network), but the sample is small,
- the proportion of "long-distance with no particular characteristics" and undetermined environments on the main network is slightly higher than on the rest of the network (82% vs. 78% and 62% vs. 31% respectively).

7.5 Main accident characteristics by environment and network category

7.5.1 Interurban environment with no special features

The drivers were mainly on straight sections (around 60%).

a) Road exits

The cases of roadway exits are broken down as follows:

- to the right in 23% of cases,
- to the left in 71% of cases, hitting a vehicle for 48% of all users on the main road network and 41% of those off the main road network.

Plan view

- The main issue on straight sections is left drift with vehicle collision (56% on the main network and 42% off the main network).
- Left and right curves account for a balanced share overall. However, there is a significant number of offsets on the inside of left curves (53% on the main network and 59% off the main network, with 24% of vehicles hitting the opposite lane for both types of network).
- On right-hand bends, the proportion of vehicles hitting the opposite lane is around 60% for both types of network.

b) Accident factors

Accidents on the main network (465 cases) / accidents off the main network (447 cases)

Human	Infrastructure Traffic conditions	Vehicle
Discomfort (1.6) 13% Fatigue - sleep and/or long journey (1.8) 18% Inattention (1,2) 11% Inexperience/young people (1.3) 17%	Pavement dynamics/condition (1.4) 10% Aggravating Collision with fixed obstacle on ac- cotement (1.1) 31%	
Driver's blood alcohol level (0.9) 28% Non-compliance with rules of conduct (0.6) 13% Excessive or inappropriate speed (0.9) 37%	Visibility mask (0.5) 6% Legibility (0.5) 5%	

Key to the interpretation: The "Discomfort" factor occurs 1.6 times more frequently in accidents on the main road network than in those off the main road network.

Accidents in interurban environments with no particular characteristics (915 cases) / other environments (770 cases)

Human	Infrastructure Traffic conditions	Vehicle
Hazardous overtaking (1.9) 9% Risk-taking (1.8) 15% of sales Failure to comply with the rules of the road (1.5) 17% Failure to comply with right of way rules (1.4) 13% Inattentiveness (1,2) 10% of total		Features/design (1,9) 12% Low perceptibility (bike/2RM) (6% vs 2%)
Driver blood alcohol (0.8) 30% Driver older (3% vs 6%) Aggravating factor: not wearing headgear/helmet (0.7) 14%	Dynamics/pavement condition (0.6) 8% • adhesion on wet pavement (0.6) 5% Aggravating Collision with fixed obstacle on hard shoulder (0.8) 30%	

In accidents in an interurban environment with no particular characteristics, the 2 types of network have similar characteristics.

The key issues are

- hitting a vehicle in the opposite lane
- offsets on the inside of left-hand curves.

7.5.2 Narrow road environment

Very few main roads are of the "narrow" type (9 cases).

Accidents outside the main road network were more specific: 57% took place on curved sections.

a) Road exits

The cases of roadway exits are broken down as follows:

- to the right in around 40% of cases,
- to the left in around 55% of cases, with collision with a vehicle for 25% of users on the main road network and 13% of those off the main road network.

Plan view

- In straight sections, the offsets are generally distributed between the 2 sides of the road.
- Left and right curves account for a balanced share overall. However, there is a significant number of offsets on the inside of left-hand curves (53% on the main network and 59% off the main network, with 24% of vehicles hitting the opposite lane for both types of network).
- On right bends, the proportion of vehicles hitting the opposite lane is around 60% for both types of network.

b) Accident factors

Accidents on narrow roads (258 cases) / interurban environment with no particular characteristics (915 cases)

Human	Infrastructure Traffic conditions	Vehicle
Driver's blood alcohol level (1.4 - 39%) Inexperience/youth (1.4 - 17%) Excessive or inappropriate speed (1.1 - 44%) Factor aggravating factor (not wearing helmet) (1.8 - 20%)	Environment factor (1.3 - 22%) Infrastructure factor (1.3 - 41%) Recovery/avoidance (1.6 - 18%) • absence or inadequacy of a retreat area Cuperation (1.7 - 12%) • Obstacle in the recovery zone (2.1 - 7%) Road dynamics/condition (2.1 - 17%) • grip on wet roads (1.9 - 10%) Aggravating Collision with fixed obstacle on hard shoulder (1,8 - 54%)	
Non-compliance with rules of conduct (0.3 - 5%) Risk-taking (0.5 - 8%) Fatigue (0.6 - 9%) Temporary condition of the user (0.8 - 28%)		Vehicle factor (0.7 - 14%)

7.5.3 Mountain environment

This environment concerns 76 accidents, 31 of which took place on the main network and 45 outside the main network.

The drivers were mainly driving **round bends (around 80%)**.

a) Road exits

Cases of roadway exits differ slightly depending on the type of network. They are distributed as follows:

- On the main road: on the right in 17% of cases, on the left in 79% of cases. Collision with an oncoming vehicle concerned 50% of users.
- Off the main road: on the right in 44% of cases, on the left in 51% of cases. Collision with an oncoming vehicle affected 12% of users.

Plan view

- Despite relatively low numbers (18 accidents on curves on the main network and 32 on the rest of the network), right curves are in the majority (67% on the main network and 59% on the rest of the network).
- Note the presence of offsets on the inside of the curve
    - left traffic on the main network (3 cases where a vehicle in the opposite lane collided)
    - mostly on the right outside the main network (5 cases vs. 2 on the left).

- Around 60% of road users on rightbends on the main road collided with an oncoming vehicle (7 cases). There were 2 cases outside the main road network.

b) Accident factors

Mountain accidents (76 cases) / Narrow roads (258 cases)

Human	Infrastructure Traffic conditions	Vehicle
Fatigue (1.3 - 12%) Inexperience/youth (1.4 - 17%) Factor aggravating factor (not wearing helmet) (1.8 - 20%)	Recovery/avoidance (0.9 - 16%)	Vehicle condition (1.7 - 14%) • tyre condition (1.8 - 9%) • load condition (17.0 - 7%)
Discomfort (0.8 - 9%) User condition (0.9 - 55%) • substance use (0.7 - 34%) • narcotics (0.9 - 14%) • blood alcohol (0.7 - 28%) Inexperience/youth (0.7 - 13%) Excessive or inappropriate speed (0.8 - 36%)	Infrastructure factor (0.9 - 36%) Aggravating Collision with fixed obstacle on shoulder (0.7 - 37%)	

Mountain" accidents (76 cases) / interurban environment with no particular characteristics (915 cases)

Human	Infrastructure Traffic conditions	Vehicle
Factor aggravating factor (not wearing helmet) (1.8 - 20%)	Factor in traffic conditions (1.3 - 22%) Infrastructure factor (1.1 - 36%) Recovery/avoidance (1.4 - 16%) • no or insufficient recovery zone (1.6 - 12%) Road dynamics/condition (2.1 - 17%) • grip on wet roads (1.7 - 9%) Aggravating Striking a fixed obstacle on a shoulder (1.2 - 37%)	Vehicle condition (1.9 - 14%) • tyre condition (2.2 - 9%) • load condition (8.6 - 7%)
Human factor (0.9 - 87%) User condition (0.8 - 55%) • spot condition (0.8 - 28%) • blood alcohol (0.9 - 28%) Inexperience/youth (0.8 - 13%) Excessive or inappropriate speed (0.9 - 36%) Driving behaviour (0.8 - 46%) Risk-taking (0.6 - 9%)		

7.5.4 Scattered housing, suburban areas, business parks

This environment concerns 122 accidents, 59 of which took place on the main network and 62 off the main network.

The drivers were mainly **on straight sections (around 65%)**.

a) Road exits

The majority of road exits are on the left side.

- On the main road in 62% of cases. Collision with an oncoming vehicle involved 35% of all users.
- Off the main road in 73% of cases. Collision with an oncoming vehicle concerned 41% of all users.

Plan view

- Despite relatively low numbers (18 accidents on curves on the main network and 32 on the rest of the network), right curves are in the majority (67% on the main network and 59% on the rest of the network).
- Note the presence of offsets on the inside of the curve
    - left traffic on the main network (3 cases where a vehicle in the opposite lane collided)
    - mostly on the right outside the main network (5 cases vs. 2 on the left).

Around 60% of road users on right bends on the main road collided with an oncoming vehicle (7 cases). There were 2 cases outside the main road network.

b) Accident factors

Accidents in "dispersed housing, suburban areas, business parks" (122 cases) / interurban environments with no particular characteristics (915 cases)

Human	Infrastructure Traffic conditions	Vehicle
User status, consumption of subsidies (1.2 - 44%) • Driver's blood alcohol level (1.1 - 30%) • Pedestrian blood alcohol level (2.3 - 6%) • narcotics (1.4 - 24%) Excessive or inappropriate speed (1.1 - 42%)	Infrastructure factor (1.1 - 33%) Visibility (1.8 - 16%) • mask (1.4 - 12%) • fixed mask (1.5 - 11%)	
Temporary condition of the user (0.9 - 32%)	Recovery/avoidance (0.3 - 3%) • no or insufficient recovery zone (0.1 - 1%)	

Accidents on the main network (59 cases) / accidents off the main network (62 cases)

Human	Infrastructure Traffic conditions	Vehicle
Pedestrian blood alcohol level (2.1 - 7%) Risk-taking (1.8 - 20%)	Infrastructure factor (1.2 - 36%) Environment factor (1.3 - 19%) Visibility (1.1 - 17%) • fixed mask (1.7 - 14%) Grip on wet roads (1.3 - 8%)	
Driver's blood alcohol level (0.9 - 29%) Inexperience/youth (0.7 - 12%) • inexperience/youth (0.8 - 10%) • unfamiliarity with the vehicle (0.2 - 2%) Factor aggravating factor (not wearing helmet) (0.7 - 10%)	Aggravating Collision withfixed obstacle on hard shoulder (0.8 - 29%)	

7.5.5 Environment " wooded area, forest

This environment concerns 161 accidents, 56 of which took place on the main network and 104 off the main network (i.e. 65%).

Drivers involved in accidents on the **main road network** were mainly driving **on straight sections (63%)**. Drivers involved in accidents off the main road network were divided between curves and straight sections (52% vs. 47%).

a) Road exits

The majority of road exits are on the left side.

- On the main road in 60% of cases. Collision with an oncoming vehicle affects 50% of all users.
- Off the main road in 68% of cases. Striking an oncoming vehicle concerned 31% of all users.

Plan view

- The number of accidents on the main network is low (17), but left and right curves are equally distributed. Outside the main network, right bends are the most common (65%).
- Note the presence of offsets on the inside of the curve:
    - on the left curve, with 3 cases out of 8 known on the main network and 11 cases out of 18 outside the main network.
    - 4 cases on rightbends, 3 of which were off the main network.
- **Accident factors**

Wooded area, forest" accidents (161 cases) / interurban environment with no particular characteristics (915 cases)

Human	Infrastructure Traffic conditions	Vehicle
Driver's blood alcohol level (1.1 - 34%) Excessive or inappropriate speed (1.1 - 42%) Unsuitable or inappropriate manoeuvres (1.5 - 7%)	Infrastructure factor (1.1 - 35%) Environment factor (1.2 - 20%) Road dynamics/condition (1.7 - 14%) • grip on wet roads (1.8 - 10%) Recovery/avoidance (1.3 - 14%) • no or insufficient recovery zone (1.5 - 11%) Aggravating Collision with fixed obstacle on ac- cotement (1.2 - 39%)	Vehicle condition (1.8 - 14%) tyre condition (1.7 - 7%)
Narcotics (0.8 - 14%) Discomfort (0.7 - 7%) Inattention (0.7 - 7%) Fatigue (0.9 - 12%) Driving behaviour (0.8 - 13%) • voluntary risk-taking (0.2 - 1%) • dangerous overruns (0.5 - 4%) • non-compliance with priority rules rity (0.7 - 9%) Inexperience/youth (0.7 - 11%) • inexperience/youth (0, - 9%) • ignorance of vehicule (0,7 - 4%)	Legibility (0.6 - 5%) Recovery/avoidance (0.3 - 3%) • absence or insufficiency of recovery zone (0.1 - 1%)	Design/features of the vehicle (0.7 - 9%) • low perceptibility cycling/2RM (0.5 - 3%) • vehicle powerful (0.5 - 2%)

Accidents on the main network (57 cases) / accidents off the main network (103 cases)

Human	Infrastructure Traffic conditions	Vehicle
Risk-taking (3.6 - 11%) Fatigue (1.5 - 16%)	Environment factor (1.7 - 28%) Infrastructure factor (1.1 - 37%) Grip on wet roads (1.8 - 14%)	
Unsuitable or inappropriate maneuvers (0.2 - 2%) Narcotics (0.7 - 11%)	Visibility - fixed mask (0.5 - 5%) Recovery / avoidance (0.8 - 12%) Aggravating Collision with fixed obstacle on shoulder (0.7 - 30%)	

8. APPENDICES

8.1 Bibliography

Ledoux, Vincent. *Factors in fatal accidents in 2015. Exploitation de la base FLAM.* Cerema, 2021. Varin, Bérengère. *FLAM 2RM. Fiches thématiques.* Cerema, 2020.

Battaglia, Valérie. *FLAM pedestrians. Fiches thématiques.* Cerema, 2021.

8.2 List of accident factors

Triggering factors Human

Group Level 1	Group level 2	Grouping level 3	id
User status	Ingestion of substances	alcohol	123, 124
		narcotics	143
		medicines	135
	One-off condition	fatigue125	125, 126
		non-technological inattention	119
		discomfort, health problem	129
		stress, irritability	108
		habit, monotony	153, 154
	Chronic condition	pre-existing disability	111,112,113,127
		advanced age	151,152
		suicide, homicide	144
		excessive or inappropriate speed	148 ,149, 150
Driving behaviour	Rules of conduct	priority rules	141
		traffic prohibited	110,147
		safety distance	140
		change of direction not reported	107
Experience		risk-taking	114,115,142
		inexperience, youth	121,122
Anticipation / Maneuver		poor knowledge of the vehicle	155
		inappropriate or untimely maneuver	130,131
Pedestrian and cyclist visibility		misjudging distances or speeds	133,134
		low pedestrian visibility	118
		failure to wear high-visibility clothing	138
Technological tools		technological distraction	128,146
		use of technological tools	109,116,145

Triggering factors Infrastructure/Environment

Level 1 grouping	Grouping of factors by sub-level			id base
Visibility	Mask	fixed	profile, road layout	23
			environment (vegetation, wall)	24,27
			other	21,22,25,26,28
		mobile		17,18,19,20
	street lighting			29,30,31
	Other			32
Legibility	curve			35,36,37
	intersection			38,39,40,41,42,43,44,45
	specific zone			46,47,48
	other			33,50,51
	road geometry			54,55,58,59
Suitability for constraints dynamics	surface condition	wet grip		170
		presence of grease, gravel, etc.		57
		poor road conditions		53,56
	other			52
Recovery / Avoidance	road shoulder (width and/or type of surface)			60,62
	obstacle on shoulder			63
Obstacle on pavement	other			61,66
	moving obstacles			74,75
	non-fixed obstacles			76,77
Coherence	running section			85,87,88
	intersection			78,79,82,91
	pedestrian traffic			86,89,90,92
	roadside verges			80,84
	exploitation			83

Flow management	other	81
	intersection (no facilities)	94,95,96,97,98,99,100,101
Environmental conditions	weather	104
	glare	105,106

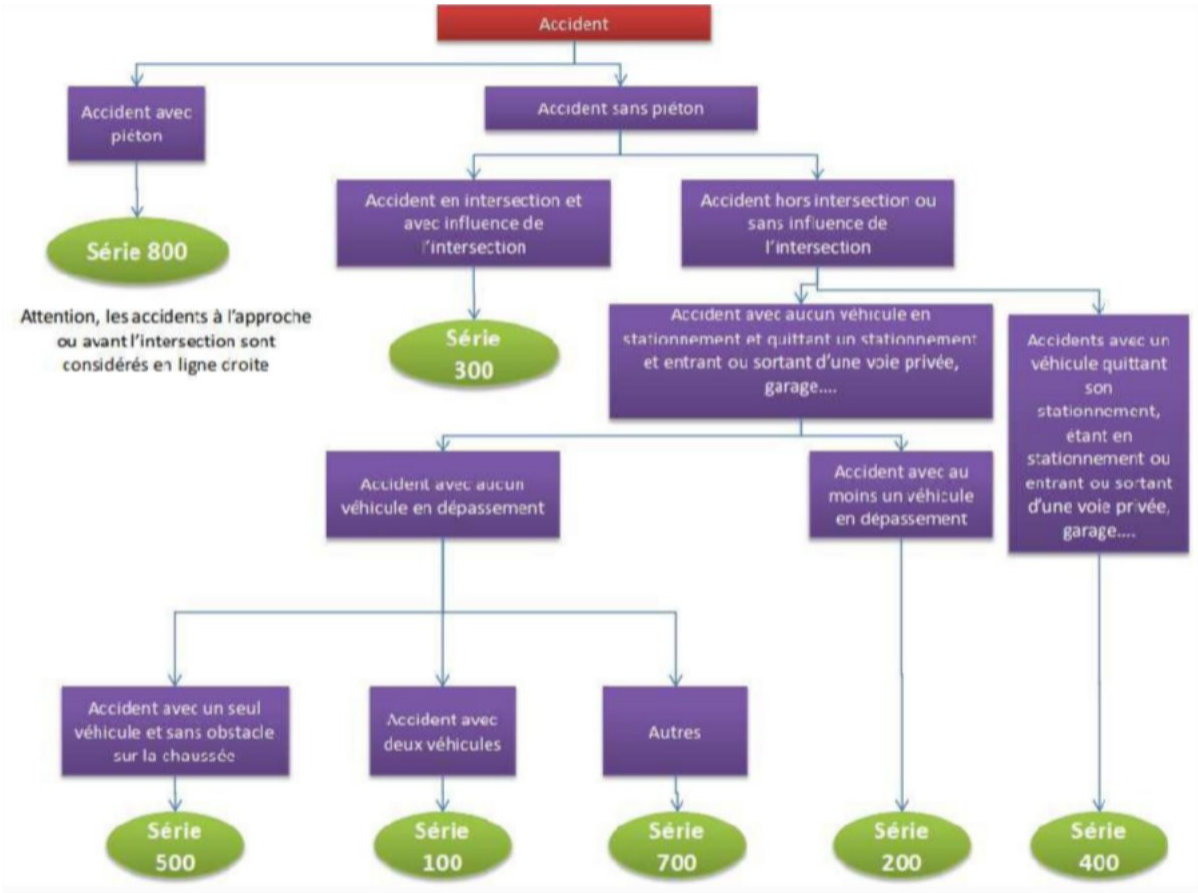
Triggering factors

Level 1 grouping	Grouping level 2	id base
Design / features	low visibility of bicycles and 2WDs	117
	powerful vehicle	162
	blind spot or specific field of vision	156
	PL configuration	132
	high-spec 4x4 vehicle	164
Status	general condition	160,161
	tyre condition	158
	load status	159
	driver assistance system	163
Other	other factors, including mechanical failure	157

Aggravating factors

Description	HVIC	id base
not wearing a helmet (bicycle, 2WD, rollerblades, etc.)	H	136
not wearing a seatbelt	H	137
2WD users not wearing personal protective clothing	H	139
old age (age-related fragility)	H	166
vehicle fire (death resulting from vehicle fire, not impact)	V	167
other aggravating factor vehicle	V	169
impact severity - other	I	64
severity of impact - falling objects on the road (trees or stones that are not intentionally falling on a moving vehicle)	I	65
severity of impacts - restraint system problem - motorbike screen missing on bends (aggravating factor)	I	67
severity of impact - restraint system problem - extremity (aggravating factor)	I	68
severity of impact - restraint system problem - obstacle hit after passing restraint system rollover after hitting restraint system, vehicle returned to roadway after hitting a DR	I	69

8.3 Decision tree for determining the accident group



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