

## **Vietnam Road Black-spot Evaluation by Accident Schema: Pilot Study for a Sub-urban Area of Hanoi**

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**Abstract:** Although several years ago, the authority has issued guidance on Black-spot Evaluation, but there are still many problems in practical identification. One of them consists of the evaluation of accidents in the black-spot areas to find out the causes and based on these causes, to clarify related problems in the infrastructure that should be improved. In Vietnam, the evaluation of accidents is described by words in the ledger of police and it leads to difficulty in evaluation. By using a system of symbols in an accident schema, the analysis of accident causes seems easier and more effective to be carried out. The paper presents results of a pilot study on black-spot evaluation by such schema in a Sub-urban area of Hanoi and shows experiences from that.

*Keywords:* Road black-spot; Accident schema; Accident symbols

### **1. INTRODUCTION**

Several years ago, the Ministry of Transport has issued guidance on Black-spot Evaluation (MOT, 2005). Based on the criteria of "black spots" in this guidance, to identify whether a road spot as "black" or not, it must be based on the situation of traffic accidents occurring in the area on the number of accident cases, the extent of damages in three cases:

1. 02 serious accidents (accidents with deaths) or
2. 03 or more accidents, including 01 serious incidents or
3. 04 or more accidents, but only injured.

In practical implementation of these criteria, one of them consists of the evaluation of accidents in the black-spot areas to find out the causes and based on these causes, to understand why the spot are "black" and to identify related problems in the infrastructure that should be improved. In Vietnam, the evaluation of accidents is described by words in the ledger of police and it leads to difficulty in evaluation.

In this study, a system of symbols is proposed to describe the evaluation of accidents. Based on that, the causes of accidents could be found so that special features of the area that could lead to high risks in accidents would be clarified. Such system will be presented in the next sections. After that results of pilot study on various black-spots in an area in two neighbor districts of Hanoi will be shown to evaluate the methods. Conclusions are included in the last section

## 2. SYMBOL SYSTEM TO DESCRIBE ROAD TRAFFIC ACCIDENTS

Based on experiences from various documents, the symbols to describe traffic accidents are included in the next table.

Table 1. Symbol System to Describe Road Traffic Accidents

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>● Accidents with deaths</li> <li>⊗ Accidents with injured</li> <li>○ Accidents with damages of property only</li> <li>→ Cars</li> <li>→ Motor bikes</li> <li>→ Cars waiting for signal lights</li> <li>→ Bicycles</li> <li>→ Pedestrian crossing the road</li> <li>8h15 30.4 Time of the accidents</li> </ul> | <p>Types of accidents:</p> <ul style="list-style-type: none"> <li>→○→ Crashing in the same direction</li> <li>→○← Crashing in the opposite direction</li> <li>→○↕ Crashing in side (horizontal)</li> <li>↔ Collision in opposite direction</li> <li>→○ Self-Crashed, Self-falling or hitting obstacles</li> <li>↔ Collision after the overthrow</li> <li>→○→ Crashing into the stopping or parking car</li> </ul> |
|--|---|

## 3. RESEARCH ON "BLACK SPOTS" OF TRAFFIC ACCIDENTS IN LONG BIEN AND GIA LAM DISTRICTS – HANOI CITY

### 3.1. Overview of the Study Areas

Long Bien and Gia Lam are two eastern districts of Hanoi City, located between two river basins (Red River and the Duong River); therefore 07 bridges are placed around. Except two main routes of National Highway No. 1A and National Highway No. 5 located in the areas, there are also a new National Highway No.1A, the dyke road system and the access roads to the industrial parks, approaches to the bridges.

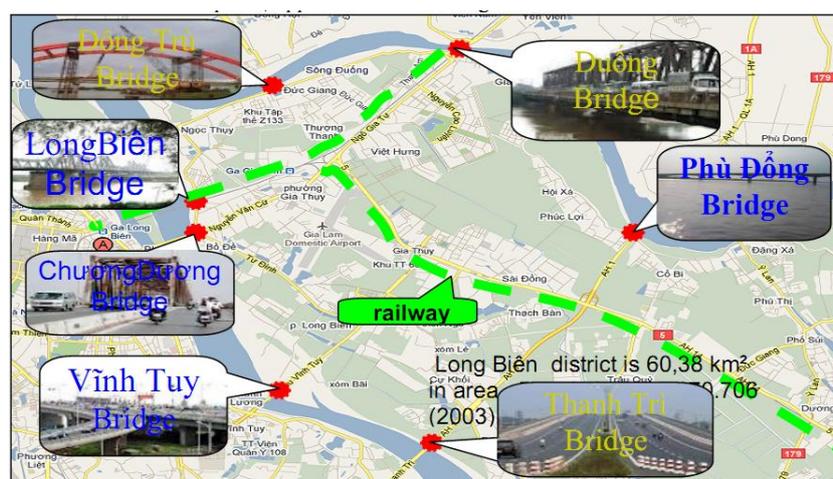


Figure 1. Study area

During 3 years 2008-2010, there have been 7 “black spots” on traffic accidents in the area, including 6 spots on the National Highway No. 5 (NH5) and one at-grade intersection with other road. That means all black-spots are related to NH5. Among them, three black

spots located in Long Bien district: 2 intersections and 1 folk section and the rest, in Gia Lam district

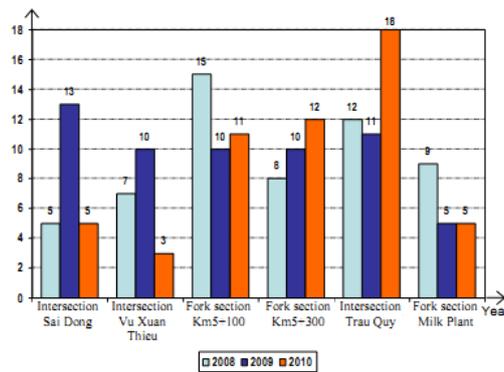


Figure 2: Number of accidents at black-spots

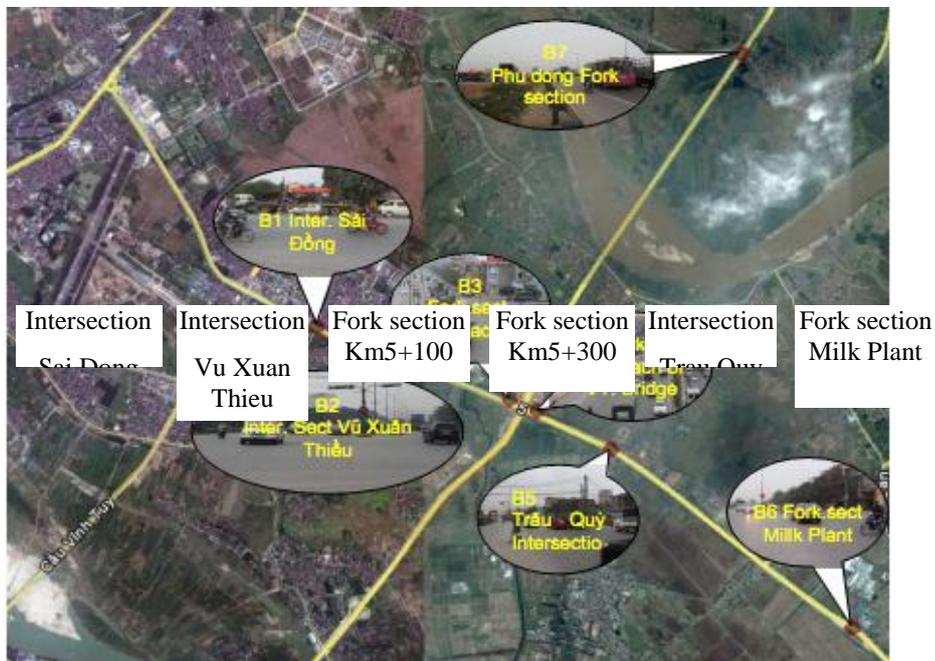


Figure 3. Locations of all 6 black-spots in Long Bien and Gia Lam



Figure 4.: Three black-spots in Long Bien district

### 3.2 Detailed Study on Black-spots

From found black-spots, based on their special feature, it could classify them into 03 types: X-shaped, Fork-section and General one.

#### 3.2.1 Black-spot type X-shaped

Under black-spot type X-shaped, it understand those with a main road and two smaller other linking roads at narrow angles. There are two black-spots with that type as below.

##### a. The 1<sup>st</sup> black spot (B1): Intersection NH 5 - Sai Dong

Among three years, most traffic accidents (13/23) occurred in the year 2009, killing 04 people.

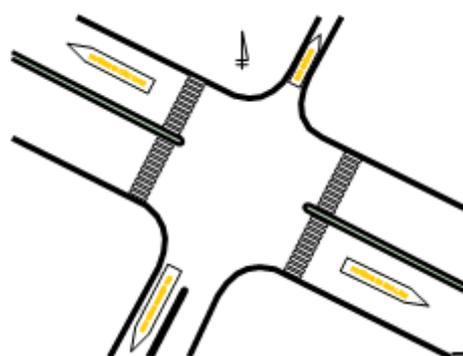


Figure 5. Black-spot B1

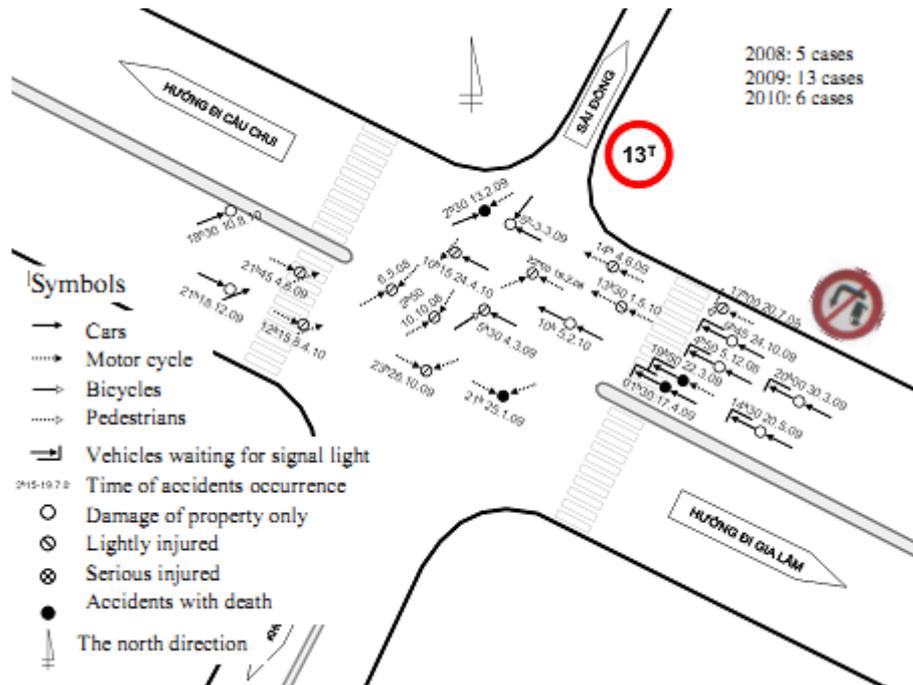


Figure 6: Geometric form and accident evaluation schema of B1

The accidents evaluation in the above figure show following types of accidents:

- Crashing in the same direction: 09 cases only in the direction from Gia Lam to Chui Bridge
- Crashing in the opposite direction: 03 cases between vehicles going out and going into Sai Dong street.
- Side crashing: 10 cases between the car going straight on the NH-5 and the cars turning left
- Crashing into obstacles (median strip): 01

The above analysis results are combined with following field survey results:

- The interchanges are under improvement (expanding the vision for the direction from Sai Dong to NH-5).
- The traffic intensity is rather high during peak hours (converted over 2500 vehicles/hours).
- The common violation of traffic law is crossing the red lights and improper lane stopping.
- Sai Dong Road leading to Sai Dong industrial zone with a width of 5 meters and 13-ton designed load.
- Signal phasing: 3-phase signal light with the cycle of 135 seconds (Figure 7).

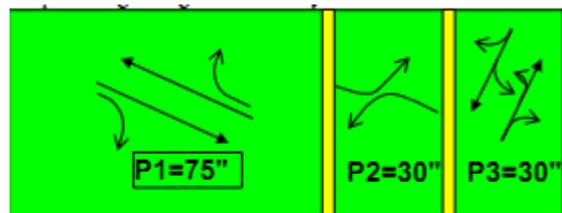


Figure 7. Signal phasing at B1

**b) The 2<sup>nd</sup> black spot (B2): Intersection between NH-5 and Vu Xuan Thieu Street**

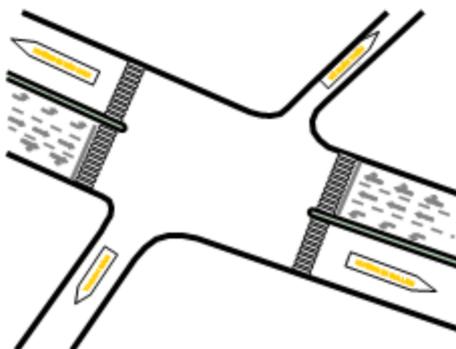


Figure 8. Black-spot B2

Traffic accidents were occurred in 2009 more than other 2 years (10/20 cases). The accidents evaluation in the above figure show following types of accidents:

Types of accidents:

- Crashing in the same direction: 09 cases mainly occurred along the road direction from Gia Lam Street to Chui Bridge
- Side crashing: 8 cases between the cars going straight on the NH-5 and ones turning left (both in and out Vu Xuan Thieu street).
- Crashing into obstacles: 02 cases (1 crash on the median strip, 1 crash on sidewalk)
- Self-falling: 01 case



Figure 9. Geometric form and accident evaluation schema of B2

Field survey results:

- 3-phase signal lights with cycle of 135 seconds.
- The common violation of traffic law is crossing the red lights and improper lane stopping.
- Vu Xuan Thieu Road leading to Sai Dong industrial zone has a width of 5 meters with designed load of 18-ton. The gradient of about 5% is near the traffic point.

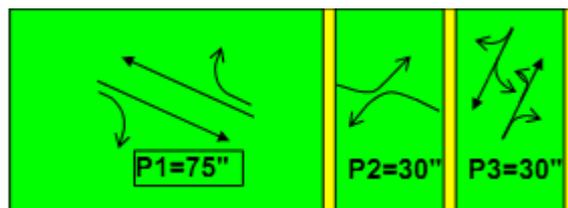


Figure 10. Signal phasing at B2

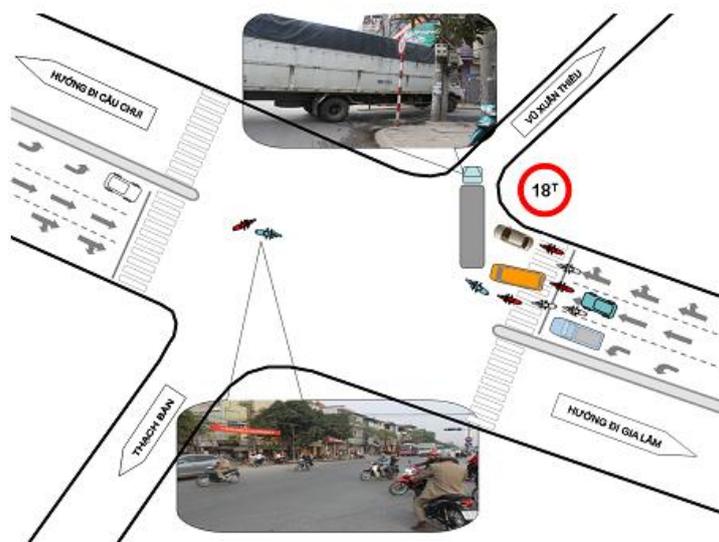


Figure 11. Problems in the B2-spot: turning into narrower road.

### c) Accident causes and general solutions for the two black spots

In analyzing the causes of accidents, there are three followings:

- Drivers pay attention not enough and tentatively violate traffic rule such as run in red-light;
- On infrastructure, there are problems in geometric form of the intersection, especially, the acute angle could make driver difficult in observation, especially in right-turn to the corner.
- Phasing is not optimal and could be revised.

Based on the above analysis results, there are three proposals to improve the spot (X-shaped) on enforcement action, geometric aspect and on phasing as follows.

Proposal 1: Punishing seriously to violators, paying more attention to the violations related to the accident causes such as: failing to follow signal lights; stopping over the lines; parking vehicles in the roadway that obstructing traffic, etc.



Figure 12. Improvement proposal on enforcement

Proposal 2: Improving intersection: Expanding vision, improving gradient and re-draw the lane marker for Sai Dong and Vu Xuan Thieu streets (if there is enough space, it is possible to open a separated lane for vehicles turning right to Vu Xuan Thieu and Sai Dong streets and/or to build the Acceleration/Deceleration Lanes in order to solve the problem of

the difference in the speed of each road); creating speed deceleration painting on Nguyen Van Linh street (NH-5) from 50 meters before entering the intersections. It is desired that the acute angle of intersection such as Vu Xuan Thieu streets is to be a right-angled intersections, but it is difficult for land acquisition. So it proposed to make the acute angle larger as much as possible.

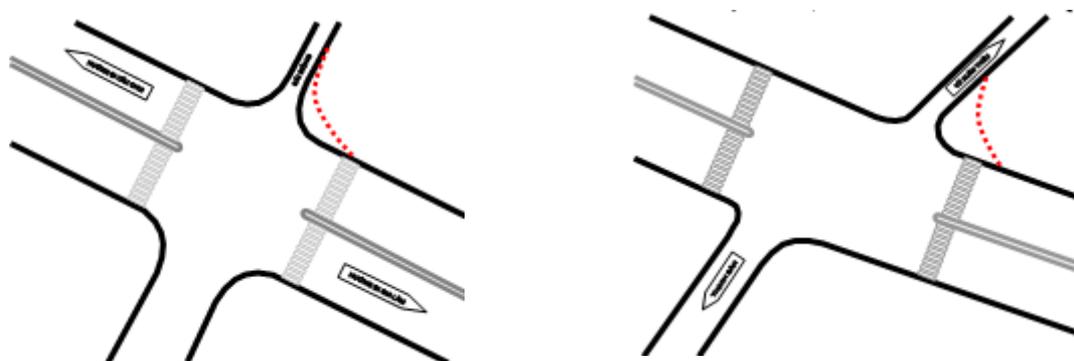


Figure 13. Improvement proposal on geometric aspect

Proposal 3: Rearranging the order of the signal phase for the vehicles turning right into Sai Dong and Vu Xuan Thieu streets, no need to stop for waiting for the traffic.

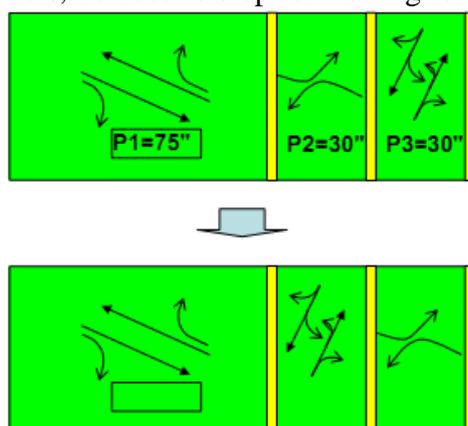


Figure 14. Improvement proposal on phasing

### 3.2.2 Black-spots at fork-sections of NH5

It seems that the fork-section could have high risk for accidents, because here the traffic flow is divided in various direction and collision risks are high. The next two black-spots are similar to each other in many main features:

- All of them are fork-sections of NH5;
- All of them are black-spots in many years and various efforts have been done but it seems no effective;
- That is why the geometric aspect of infrastructure and the traffic arrangement were changed many times.

a) The 3<sup>rd</sup> black spot (B3): The fork-section of the National Highway No. 5 (NH-5) at Km5



Figure 15. The 3<sup>rd</sup> black spot (B3): The fork-section of the NH5 at Km5

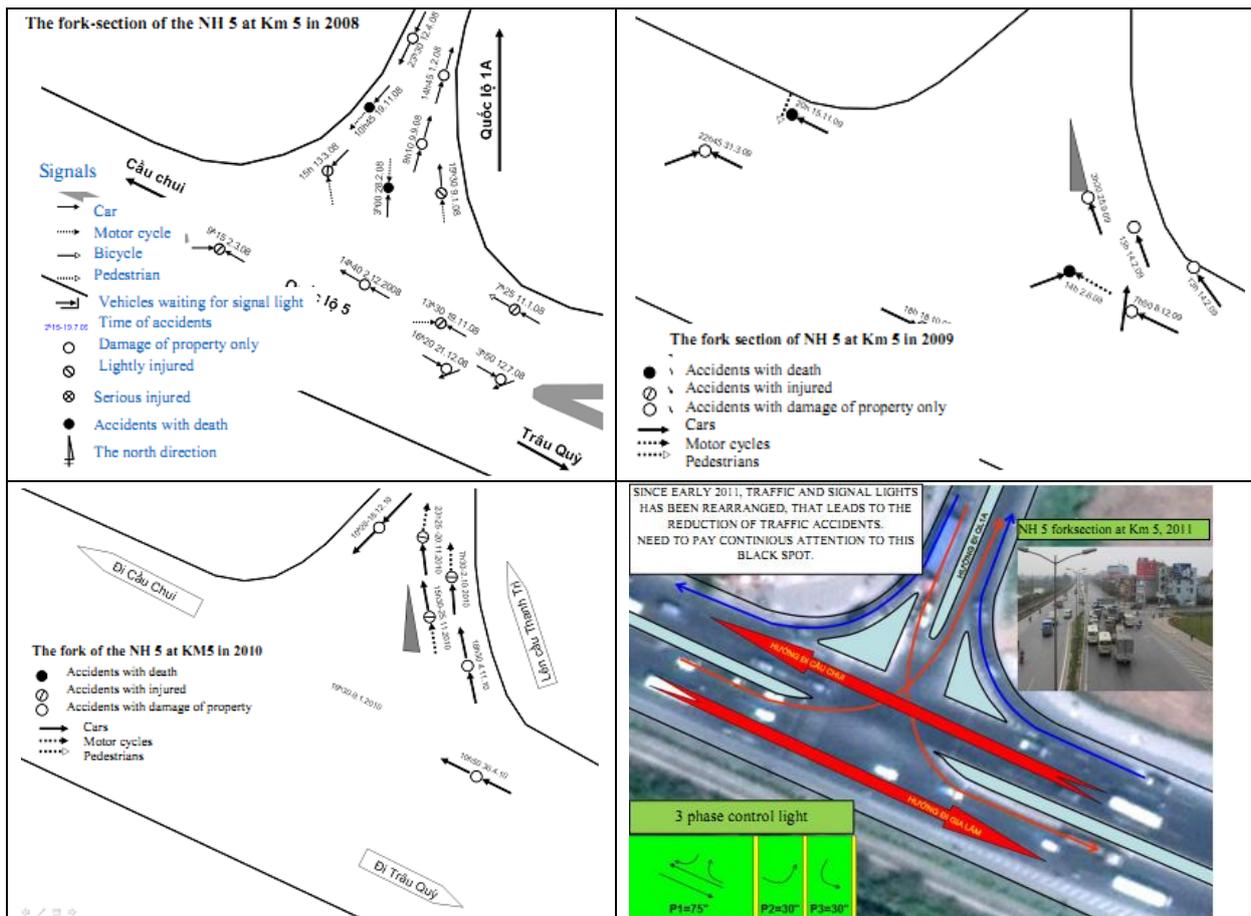


Figure 16. Changes of geometric form and accident evaluation schema by years at B3

**b) The 4<sup>th</sup> black spot (B4): The Fork - section of NH 5 at Km 6**



Figure 17. The 4<sup>th</sup> black spot (B4): The Fork - section of NH 5 at Km 6

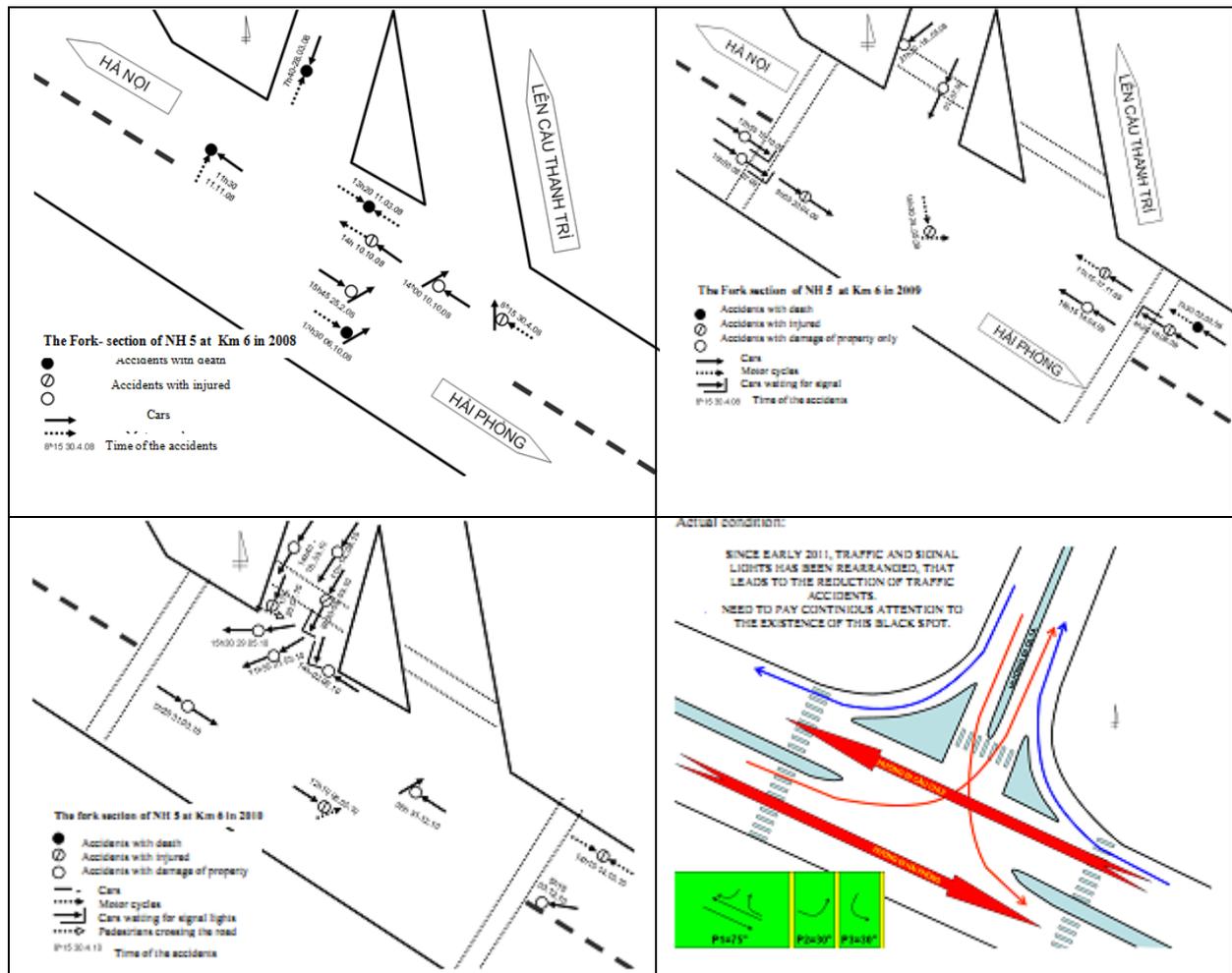


Figure 18. Changes of geometric form and accident evaluation schema by years of B4

### 3.2.3 Other Black-spot

#### a) The 5<sup>th</sup> black spot (B5): Intersection of NH 5 – Trau Quy (B5)

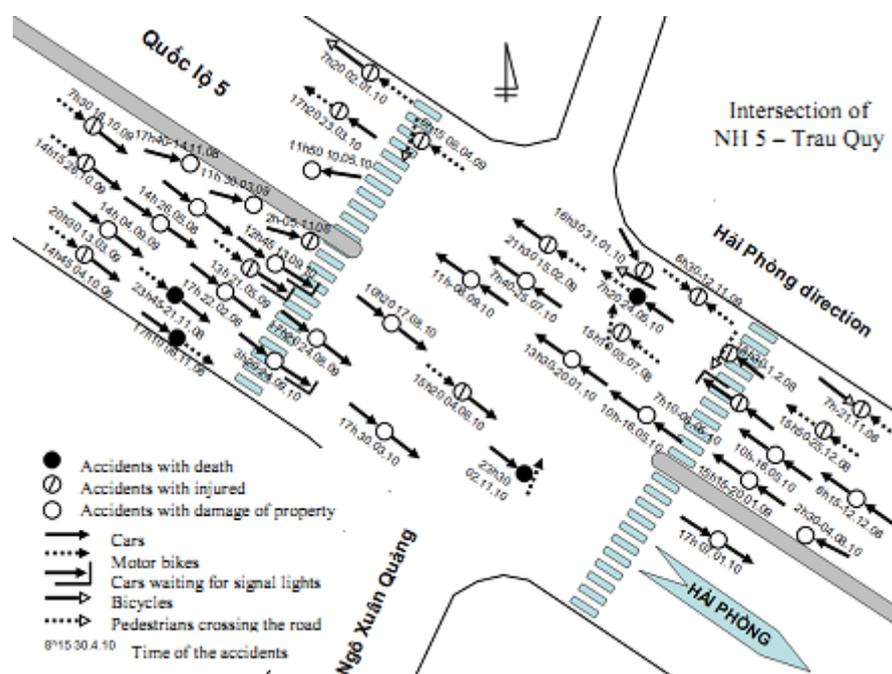


Figure 19. Geometric form and accident evaluation schema at B5

Comment:

1. Number of accidents is similar in the two directions of the road, but concentrating in the direction to the intersection
2. Most traffic accidents occurred in collision type, in the same direction
3. If the vehicles involved in the accidents are all automobiles, accidents are mostly property damage.

Field survey results:

- At the time of the survey (November 2011), the vision at the black spots area are improved the at the intersection by extending the lane of Ngo Xuan Quang street and Co Bi street in order to increase circulation to the two branches of this road.
- The 2-phase light with 68 - second cycle ensures traffic flow but it's unresolved the conflict between the cars turning left and ones going straight on the NH 5.
- The violations still commonly occur such as: Stopping at the wrong line, going against the required direction.

**b) The 6<sup>th</sup> black spot (B6): Fork section: HW No.5 - Road to Milk Plant**

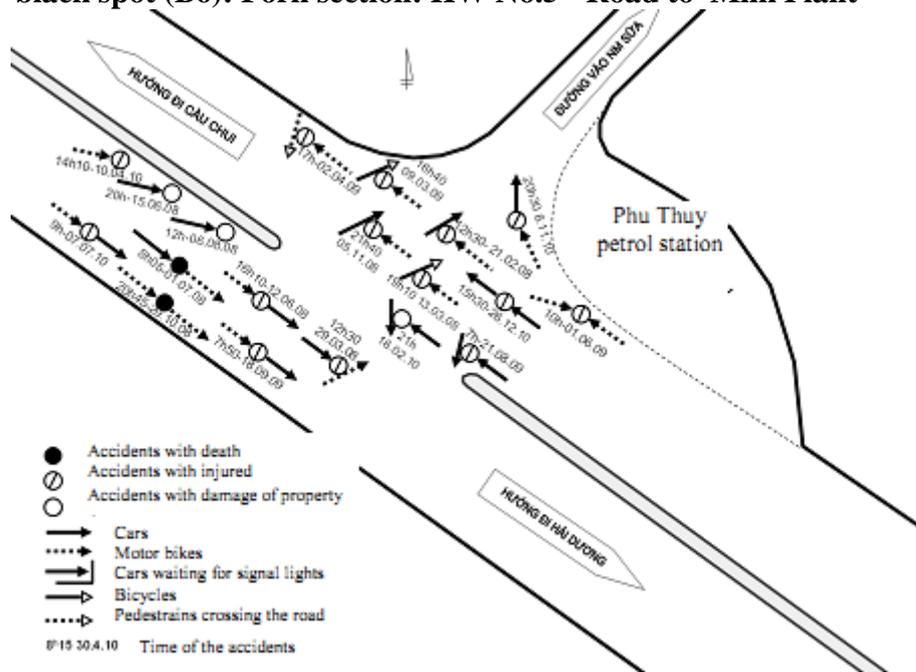


Figure 20. Geometric form and accident evaluation schema at B6

**Comments:**

At the fork-section there are no signal lights, causing the great conflict between the traffic flows.

- Serious consequences of accidents due to the flows of traffic with high speed on the main road (National Road 1B).
- The common accidents types are car crashing each other in the same direction (21/36)
- Popular Violation is not giving way to vehicles on the prioritized road and going against the required direction

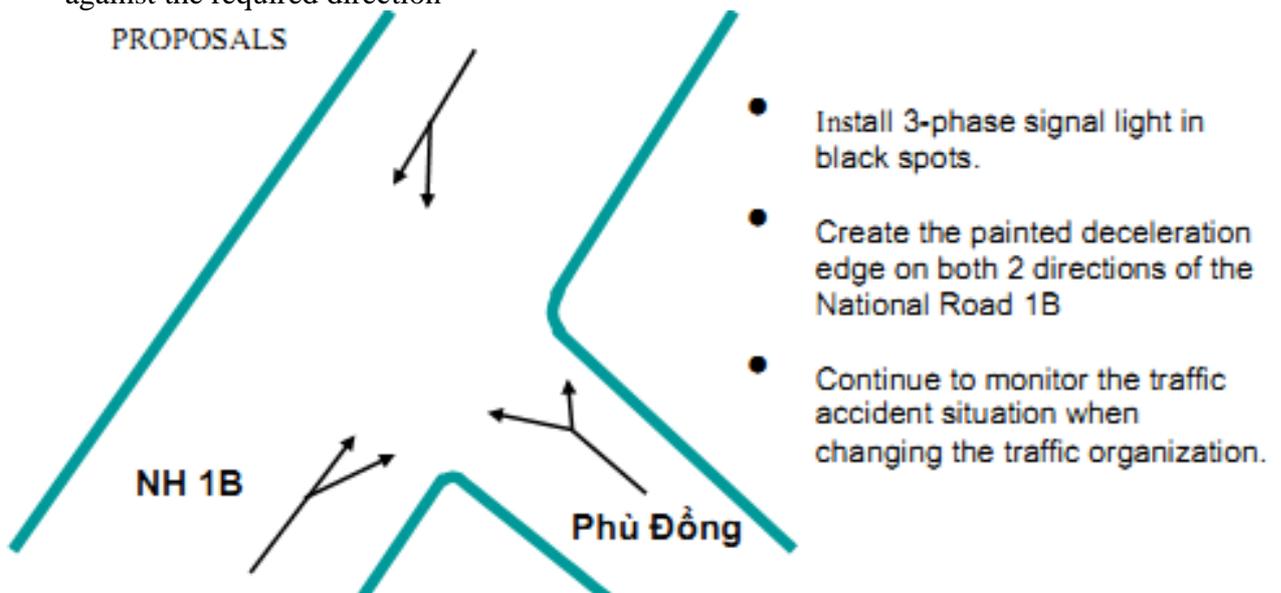


Figure 21. Proposal to improve B6 spot

## 5. CONCLUSIONS AND RECOMMENDATIONS

In the analysis of black-spot, there is a problem that consists of the evaluation of accidents in the black-spot areas to find out the causes and based on these causes, to clarify related problems in the infrastructure that should be improved. In Vietnam, the evaluation of accidents is described by words in the ledger of police and it leads to difficulty in evaluation. By using a system of symbols in an accident schema, the analysis of accident causes seems easier and more effective to be carried out.

Through the study on road traffic accidents in the "black spots" of the two districts of Hanoi, we draw some basic comments:

1. The discovered black spots are junctions (fork-section or intersection) between a major road with other roads.
2. Common types of accidents are crashing each other in the same direction due to unexpected factors. Almost no loss of life occurred with the drivers of cars.
3. The majority of "black spots" are equipped with signal lights but their operation and control mode are improper. During the hours of signal operation, there is no significant reduction in accidents.
4. The violation of traffic participants also widespread (especially the violation relating to the signal lights mode; not stopping, parking in the unregulated places; going against the required direction; pedestrians crossing the road ...).
5. The patrolling, handling of violations of the traffic police have just focused only on peak hours in order to solve the traffic congestion, not concentrated on the time and place having many accidents.
6. The main solutions for black spots:
  - Improving traffic (changing traffic organization)
  - Adjusting the control mode of signal lights
  - Focusing on handling a number of violations related to the causes of traffic accidents in black spots.

### APPENDICE: National Highway No. 5 (NH5)

NH5 is an arterial road linking Hai Phong port to Hanoi, the Northern part of Vietnam.

It starts from Km-166 of National Highway No. 1A (Chui Bridge - Gia Lam - Hanoi), and ends at Chua Ve Port of Hai Phong city. Total length of section is 106 km. National Highway No.5 had been improved and upgraded from June 1996 and completed in June 1998. Highway class: Class 1 in plain area, designed speed of 80 km/h. The National Highway 5 crosses through the territory of Long Bien town, Gia Lam (Hanoi), Van Lam, Yen My, My Hao (Northern Hung Yen), Cam Giang, Hai Duong, Nam Sach, Kim Thanh Hai Duong, An Yang, Hong Bang Hai An (Hai Phong). The towns located along the National Highway 5 are Long Bien district, the Trau Quy Town (Gia Lam), Ban Yen Nhan, My Hao ( My Hao), Lai Cach (Cam Giang), Hai Duong city, Phu Thai (Kim Thanh), and the districts of Hai Phong City.

In parallel with National Highway 5 is a railway route of Hanoi - Hai Phong with 110 km in length. The lanes for non-motorized vehicles and pedestrians are designed at some sections, however these people and vehicle still travel without awareness of traffic rules. At the at-grade intersection between National Highway No. 5 and the other roads, the situation of traffic safety is quite complicated.

#### Technical conditions

\* Highway class: Highway class -1 in plain area, passing through the Red River Delta, where are densely populated with crossroad network, and a completed frontage roads, access road systems.

\* Road foundation: from 26m to 35 m in width, the pavement is from 18m to 23m in width (the 30m of asphalt concrete pavement width with 6 lanes at the section from km0 to km6+600). From Km6 +600 (Phu Thuy - Gia Lam - Hanoi) to Chua Ve Port - Hai Phong, pavements width is mostly from 18m to 23m wide (4 lanes) with hard median strip of 1.2m – 1.5 m in width. National Highway No.5 ensures the traffic movements for two seasons.

\* There are 12 concrete bridges, overpassing the water surface and other roads and railways, with the loading capacity of H30.

\* Pre-stressed concrete underpass bridges crossing road with popular lengths from 18m to 23m, height of 2.5 m, and width of 3m-4 m.

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