

# The 85th Percentile Speed: the Compliance of Road Users with the 60km/h Speed Limit at U-turn

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**Abstract:** Federal Road (FT050) has a National Speed Limit of 90km/h and a speed limit of 60 km/h imposed at every U-turn. Speed limits and signs are posed to inform road users of the appropriate driving speed for safe travel speed for safety measures. However, FT050 is famous as the deadliest stretch of roads in Malaysia with one of the most blackspot locations compared to the other federal road in Malaysia. This study aimed to identify the compliance of road users with the 60 km/h speed limit imposed at 5 U-turn located from KM 0 to KM 20 and to determine the reasons for non-compliance. From the analysis of total 552 vehicles speed taken from 6 U-turns during peak hour, the 85th percentile speed shows the drivers are driving above 60 km/h which indicated non-compliance with the 60 km/h speed limit mainly due to human driving behaviour especially aggressive driving and speeding.

**Keywords:** non-compliance; speed limit; U-turn

## 1. Introduction

Speed limits is a regulatory traffic control enforced to control speed and set to reflect the sensible behaviour of majority in improving road traffic safety and reducing the number of road traffic casualties resulting from road collisions. In Malaysia, the National Speed Limits for non-expressways is 90km/h but for safety measure lower speed limits are required such as at U-turn, intersection or school zones (Jabatan Kerja Raya Malaysia, 2016). According to the 85th percentile speed of free-flowing traffic, a consistent of 60 km/h speed is imposed at every U-turn and speed signs are installed. However, there are many studies concluded drivers were speeding when approaching intersections or U-turn which is the main contributor to road crashes. Non-compliance of the speed limit will cause unsafe passing, rear-end collisions and weaving on multilane roads (Jabatan Kerja Raya Malaysia, 2016). This happens when drivers behave adversely and the speed vary drastically especially in approaching U-turn because the reduction and increment in speed which lead to accident. Speed choice is

one of the reason strongly related to accident risk. (World Health Organization, 2018) WHO reported speed is one of the five key to behavioural risk factors, to manage this, speed limit are set with law enforced to reduce travel speed. Travel speed of vehicles influences the risk of crash as well as the severity of injuries and the likelihood of death resulting from crash. Road accidents happens when there are traffic conflicts between vehicles movement that lead to longer travel time and traffic congestions. The three main contributing factors to road accidents are human, environment and vehicles, where human behaviour is the leading reason to this tragic phenomenon. In a research report by MIROS (Sarani et al., 2012), among the five categories of roads in Malaysia (highways, federal, state, municipal and other), the highest fatal accidents occurred on federal roads and the main causes of road accidents are risky driving, speeding and fatigue. The trend in the forecast for road accidents, there will be an increase of 56% fatalities in 2020 from the existing high number of fatalities (Malaysian Institute of et al., 2014). An article by The Star on the 5th May 2009, Federal Road FT050 is marked as the deadliest

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stretch of roads in Malaysia and this is supported by accident data given by (Royal Malaysia Police, 2018b), Johor is the second state in Malaysia with the highest number of road accidents in 2017 at the record of 76121 cases where in Batu Pahat, 8445 accidents which is the highest after Johor Bahru. Therefore, this study aimed to identify the compliance of road users with the 60 km/h speed limit imposed at U-turn inside the freeway of 90 km/h on FT050 and to determine the reasons why road users do not comply with the 60 km/h signage installed for the U-turn.

Table 1. Distances between U-turns. Source: ATJ 8/86 (Jabatan Kerja Raya Malaysia, 2015)

Design Standard	Distance between U-turns	Design Standard	Distance between U-turns
R6	No U-turns allowed	U6	No U-turns allowed
R5	3km	U5	2km
R4	2km	U4	1km
		U3	1km

U-turn is a 180 degree rotation performed to reverse the direction of travel and it is known as U-turn because the U shaped manoeuvre (Al-Masaeid, 1999). Midblock U-turning facilities are median openings on multi-lane highways to assist with these deft manoeuvres. U-turning facilities built either as complimentary to existing road geometric design or they are built as replacement to existing facilities on the premises to reduce conflicts and ease congestions at adjoining intersections (Rahman & Ben-Edigbe, 2015). There are also areas where this manoeuvres are not allowed as shown in Table 1 above. In the design of U-turn, the selection of locations is important. Therefore, it is important to first understand the guide in the design for U-turn (Jabatan Kerja Raya Malaysia, 2015). The two main categories of area are rural and urban areas. Urban areas are areas having at least of populations of at least 1000 building and houses and business activity is prevalent that within the gazetted municipality limits. Other areas than urban areas are regarded as rural areas. In the seven group of design standard, R6, R5 and R4 are classified as rural areas while U6, U5, U4, U3 are for urban areas in descending order of hierarchy. Roads with the higher geometric design standard, they are function to provide long distance travel, required higher design speeds for comfort and safety. It is always designed with divided carriage way and with full access control. Also roads with heavier traffic will be provided with a higher standard. Whilst road which serve local traffic, where the effect of speed is less significant can have a lower design speed. FT050 is classified as a 4 lanes dual carriageway paved federal roadway built under JKR R5 road standard.

## 2. Methodology

This study focuses on KM 0 to KM 20 of FT050 connecting Batu Pahat-Kluang-Mersing. A study by (Omar et al., 2017) , FT050 is one of the most blackspot locations compared to the other federal road in Malaysia with KM 1 – KM 10 and KM 21 – KM 23 as the most dangerous stretches along FT050. Even after U-turn is dedicated to improve the geometric feature of the road, this enhancements do not help in reducing the continuous growing in the accident rate. To understand this phenomenon, 5 U-turn facilities situated at the blackspot locations are selected along FT050 for this study as shown in Table 2 below.

Spot speed study was conducted to identify the travel speed of the vehicles approaching the defined U-turn locations. A minimum of 100 vehicles was collected for each U-turn locations and for this study a total of 552 vehicles was observed. The speed data was analysed to obtain the 85th percentile travel speed and compared with the 60 km/h speed limit. This data collection will also illustrates the compliance of road users with the speed limit signs and the percentage of users obeying those signs. Radar gun was used for the spot speed study to obtain the speed and video recording was used to study the driver behaviour. The supporting details from the recording will served its purpose as observatory evidence and for in-depth research. The recordings can be repeated to study the driving pattern and the driver behaviour when approaching the U-turn facilities. The secondary data is the accidents data from the Royal Malaysia Police (PDRM Batu Pahat) used to show the current accident trends in the study locations. Besides, site visit was carried out at each U-turn so that site details such as the position of erected signs and the geometrical design of the facilities with the current conditions on site are recorded for this study.

Table 2. Selected U-turn locations

Name	Location
U-turn 1 / U1	Near Institut Perguruan Tun Hussein Onn
U-turn 2 / U2	Near Sharp Manufacturing
U-turn 3 / U3	Near SMK Sri Gading
U-turn 4 / U4	Near BHP Petrol Parit Raja
U-turn 5 / U5	Near Kolej Kemahiran Tinggi Mara Sri Gading

## 3. Results and discussions

Table 3 below shows the layout of signs at the study locations obtained from the site visit. From the site observation, the width of the U-turn at U3 is narrower compared to the other U-turns which is not suitable for heavy-weighted vehicles. In this section of the road, there is a 5 km horizontal road from Parit Sembrong to the signalised intersection at Pura Kencana without any

curvatures or traffic lights that will obstruct or slow down the driving speed as depicted in Figure 1 below. This section is a school zone with speed limit signs and other warning signs built to warn of the safe speed, yet there is driver travelling at 122 km/h and the highest average speed also found here. As for U1 and U2 the U-turn is slightly curved, at these locations, the speed is slightly lower than U3 but the speed still relative high to the 60 km/h speed limit. For U4 and U5, there are traffic lights situated near the U-turn, the speed at these locations also found to be at a high speed due to red-running. Drivers tend to hit the acceleration when the traffic lights turn amber. Besides, U4 and U5 are placed about 1.5km apart from each other which

is not suitable according to Table 1 when FT050 is designed according to R5 design standard.

At U1, there is a need for the placing of flashing beacons at warning signs. Study found when flashing beacons are installed in combination with curve warning signs and chevrons, there is a 37-percent to 76-percent reduction in various crashes (Montella, 2009). At U2 due to the large number of pedestrian movement especially during peak hours, placing of overhead bridge or road safety campaign for the workers there. Study found pedestrian with good attitude and polite when crossing street will be safe (Bilema et al., 2017).

Table 3. Signage of selected U-turn locations

Location	Layout
U1	
U2	
U3	



Figure 1. 5km horizontal section at U3



Figure 2. Travel speeds from Parit Raja to Batu Pahat

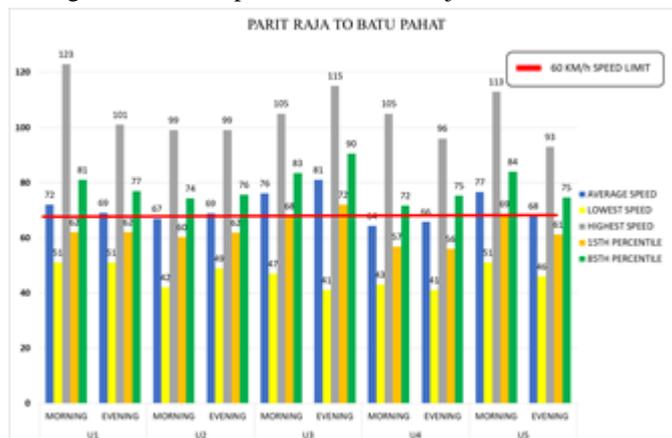


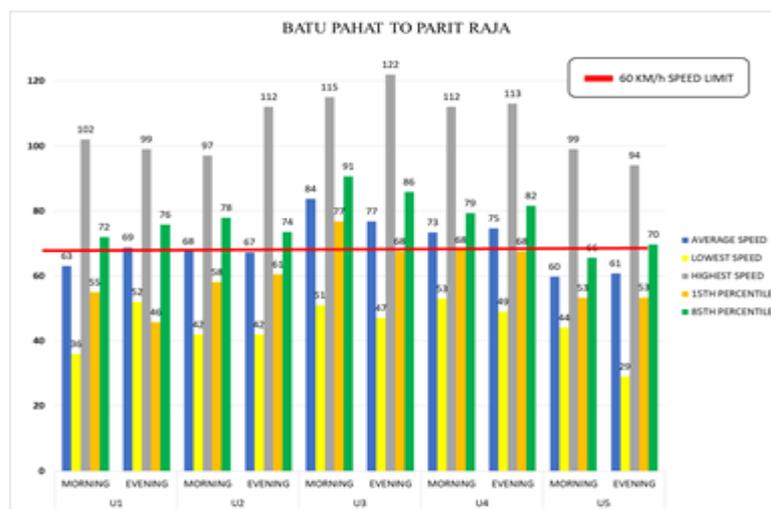
Table 4. 85th percentile speed with the class type from Parit Raja to Batu Pahat

PARIT RAJA TO BATU PAHAT								
85th PERCENTILE								
	CLASS 1		CLASS 2		CLASS 3		CLASS 4	
	MORNING	EVENING	MORNING	EVENING	MORNING	EVENING	MORNING	EVENING
U1	84	87	87	77	83	80	61	67
U2	79	85	74	77	78	76	66	64
U3	89	97	85	93	85	93	75	80
U4	61	65	68	66	68	68	60	65
U5	86	81	88	80	91	78	70	46
AVERAGE	79	82	79	79	81	79	68	64
AVERAGE	80		79		80		66	

Figure 2 above shows the travel speed analysis for U-turn U1 to U5 from the direction of Parit Raja to Batu Pahat. The lowest speed is the U3 and U4 rounds of 41 km/h which is less than the specified U-turn speed limit. However, the highest average speed is at U3 in the evening at 81km/h, along this section of straight road there is SMK Sri Gading nearby which has a school zone of 30 km/h speed limit. U3 also had the highest speed at 115 km/h. The speed vary

drastically pose a threat to the safety on this U-turn. Overall, the 85th percentile speed data at each U-turn shows all of the vehicles are travelling at a speed above the 60 km/h limit. Further analysis is done shown in Table IV above. All classes of vehicles are speeding above 60 km/h and majority of them are speeding at U3. The analysis also show Class 1 (motorcycles) and Class 3 (van/mpv/light truck) are the ones with the highest speed of 80km/h.

Figure 3. Travel speeds from Batu Pahat to Parit Raja

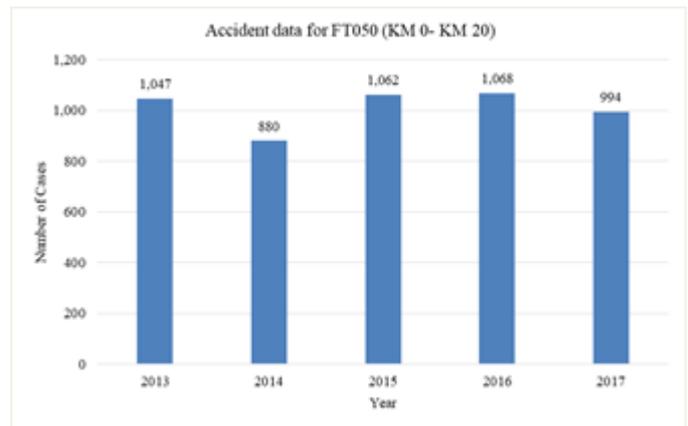


5. 85th percentile speed with the class type from Batu Pahat to Parit Raja

BATU PAHAT KE PARIT RAJA								
85th PERCENTILE								
	CLASS 1		CLASS 2		CLASS 3		CLASS 4	
	MORNING	EVENING	MORNING	EVENING	MORNING	EVENING	MORNING	EVENING
U1	87	77	76	78	74	72	51	61
U2	86	81	76	76	76	70	75	67
U3	99	98	92	88	92	87	80	56
U4	82	82	85	83	80	87	71	75
U5	64	74	69	71	71	72	59	61
AVERAGE	82	84	80	79	79	79	71	65
AVERAGE	83		80		79		68	

Figure 3 is the speed analysis for U-turn U1 to U5 in the opposite direction from Batu Pahat to Parit Raja. The speed pattern also shows a trend of speeding where all the 85th percentile speeds are above the 60 km/h speed limit. The highest average speed again recorded at U3 in the evening of 122 km/h which is twice the speed limit. From Table 5, Class 1 (motorcycles) and Class 2 (car) are the two classes travelling at the highest speed when approaching U-turn. Video recordings show evidence of aggressive driving, which is closely related to the travel speed of the drivers and speeding. Human behaviour such as aggressive driving leading to speeding and the reason why driver could not comply to the 60 km/h speed limit. Ignorance of speed limit is often used as an excuse for speeding (Edquist et al., 2009). Drivers can be very impatient on the road, action such as tailgating vehicles ahead, insufficient gap between vehicles are proved to be unsafe (Jiuh-Biing & Wu, 2015), weaving and sudden changing of lane (M.S. Nemmang et al., 2017) and speeding (Liu, 2011; Mohd Shafie Nemmang & Rahman, 2016; Rahman & Ben-Edigbe, 2015; Scott-Parker et al., 2013) will expose drivers to the risk of danger, if a car in the adjacent street fail to give way and pull out in front will easily lead to accident. From the video footages, vehicles driving so near to the vehicles in front at a distant less than 5m or above the 3 second gap, sudden change of lanes, speeding and weaving that is dangerous. This is also the reasons behind the high number of accident on FT050 (KM 0 – KM 20) (Royal Malaysia Police, 2018a) in Figure 4 below.

Figure 4. Accident data for FT050 (KM 0- KM 20). Source: (Royal Malaysia Police, 2018a)



#### 4. Conclusion

From the spot speed study and analysis, this study concluded that the road users do not comply with the 60 km/h speed limit at U-turns along FT050 (KM 0 – KM 20). The 85th percentile shows all the speed at travelling at more than 60 km/h, majority the road users regardless of the class do not travel at a safe speed. Most of them are speeding when approaching U3 because of the 5km horizontal road without any obstructions, can be very dangerous because there is a school zone in this section. From the site visit and video recording, the main reason road users are unable to obey the speed signs because they are driving recklessly such as aggressive driving, speeding, red running, tailgating,

insufficient gap, weaving and sudden change of lanes. While on site, there are many damages on the road furniture and facilities that yet to be restored and repaired cause by the previous accident and weathering. The geometric design of the U-turn facilities that do not comply with the standard, the overlapping of various speed among 90 km/h, 60 km/h and 30 km/h due to the complex mixture of U-turn and school zones too influence the driving behaviour of road users.

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