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The Intersection Between Highway and Railway at the JPL 295 in District of Lamongan

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Abstract

The intersection between highway and railway (commonly known as JPL), precisely at the JPL 295 in District of Lamongan, is the level crossing which separates two residential areas from the northern and southern sides and is next to the highway. There are other JPL nearby JPL 295 which also separate residential areas located 180 m away to the left and 290 m to the right of JPL 295. These two JPL have single narrow median opening only available to accommodate motorcycle movements. Based on the qualitative observation results at the field, people utilize JPL 295 as the main intersection as indicated from the highest significant traffic flow compared to other JPL. Thus, this research focuses on JPL 295. Double-track railway is available at JPL 295 which indicates relatively high volume of railway traffic. Hence, barrier gates are not included as the main safety system. The focus of this research is on the potentials that may cause accident. Swedish TCT method was implemented in this research in order to provide information in term of road user characteristics involved in conflicts with other road or rail users. It is by calculating the Time to Accident (TA) and Conflict Speed (CS) from every direction and vehicle involved in conflicts and plotting them in the severity level curve. The obtained results are: (1) direction B and C are categorized as severe traffic conflict by 53%, (2) direction B1 and C1 are categorized as severe traffic conflict by 57%, (3) direction D and E are categorized as severe traffic conflict by 77%, (4) direction A vehicle toward train are categorized as severe traffic conflict by 40%, (5) direction B2 vehicle toward train are categorized as severe traffic conflict by 20%. If given a tolerated conflict value by 50%, certain treatments must be performed when reaching the maximum point to lower the level of resulted severe conflict.

Keywords: *JPL 295; Time to Accident; Conflict Speed; Severity Level*

Background of the Study

The intersection between highway and railway (commonly known as JPL), precisely at the JPL 295 in District of Lamongan, is the level crossing which separates two residential areas from the northern and southern sides and is next to the highway.

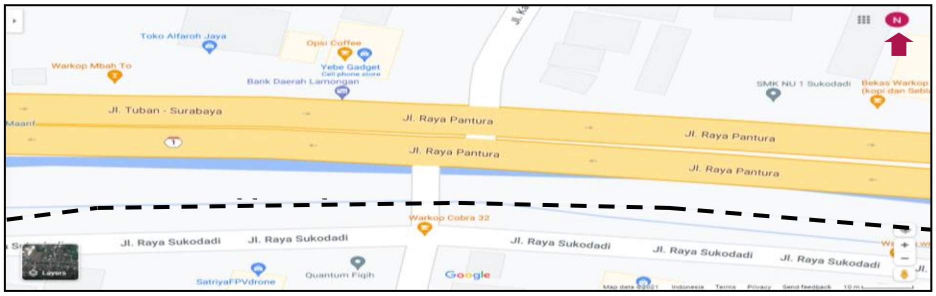


Figure 1. the location of JPL 295 separates the northern and southern parts of residential areas

There are other JPL nearby JPL 295 which also separate residential areas located 180 m away to the left and 290 m to the right of JPL 295. These two JPL have single narrow median opening only available to accommodate motorcycle movements.

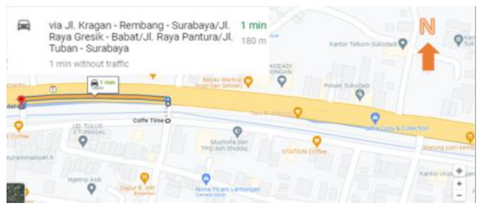


Figure 1. JPL on the left side of JPL 295

Figure 2. Other JPL on the left and right side of JPL 295

According to the qualitative observation results, JPL 295 appeared to be utilized as the main intersection by residents settling in the southern side of the railway to derive access to the northern residents. This is indicated by wider route of level median compared to other JPL on the left and right hand as well as supported by higher value of traffic jam. Throughout the qualitative observation, it is recognized that JPL 295 have the most significant traffic flow compared to other JPL. Therefore, this research focuses on JPL 295. Double-track railway is available at JPL 295 which indicates relatively high volume of railway traffic compared to the condition with single-track. Hence, barrier gates are not included as the main safety system.

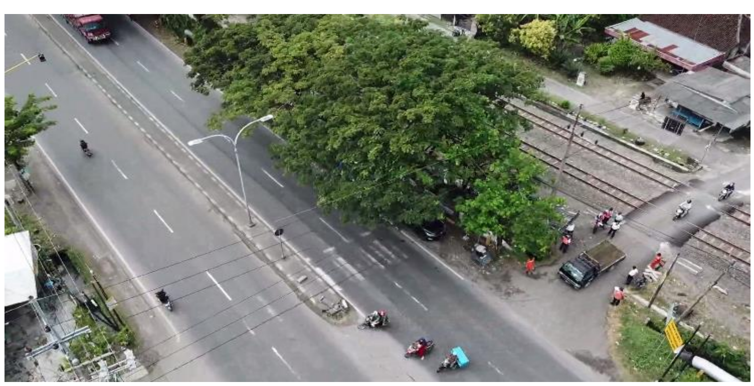


Figure 3. JPL 295 is not equipped with barrier gates

Evidently, this is a disobedient upon the norms made to regulate traffic at level crossings. Law Number 23 of 2007 concerning on Train Affairs article 91, mentions that crossings between railway and roadway are not built on a plot. Exceptions can only be performed by ensuring to maintain the safety and smoothness of railway and highway journeys. Law Number 22 of 2009 concerning on Road Traffic and Transportation article 114, states that level crossings between railway and highway drivers are obligated to (a) stop when the sign beeps, railway barrier gates lowered, and/or other signal given, (b) prioritize train or railway vehicle, and (c) prioritize primary rights to prior vehicle passing the railway. Moreover, it is obligatory for road users to prioritize railway rides at the level crossing as regulated under Law Number 23 of 2007 concerning on Railway article 124. In accordance to Ministerial Regulation Number 36 of 2011 concerning on Crossing and/or Intersection between Railway and Building article 6 chapter 1, states that trains are prioritized in trafficking at level crossing. With double-track railway equipped, the frequency of train travel increases as well as higher volume of traffic from various directions (more significant compared to other JPL around JPL 295). This causes conflict points to emerge between vehicles traversing the intersection with those moving steady as well as between road and rail vehicles. These conflict points have the potential to cause traffic accidents. 5 conflict points are identified which consist of: 1) Conflict point between vehicles from direction B and C, 2) Conflict point between vehicles from direction B1 and C1, 3) Conflict point between vehicles from direction D and E, 4) Conflict point between vehicles from direction A toward train from direction T (direction T is alternated), 5) Conflict point between vehicles from direction B2 toward train from direction T (direction T is alternated)

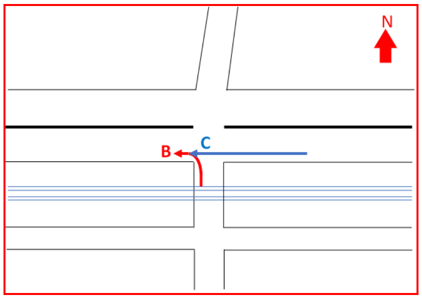


Figure 4. Conflict point between vehicles from direction B and C

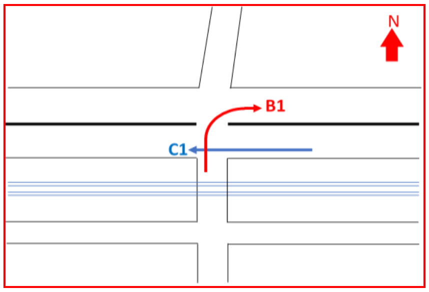


Figure 5. Conflict point between vehicles from direction B1 and C1

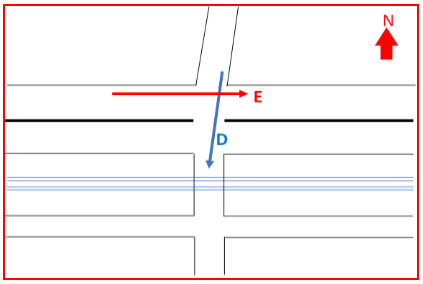


Figure 6. Conflict point between vehicles from direction D and E

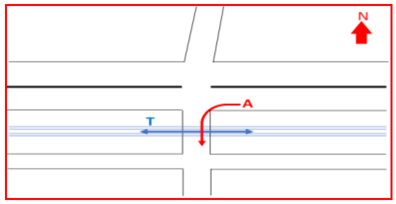


Figure 7. Conflict point between vehicles from direction A and train from direction T (T in 2 directions)

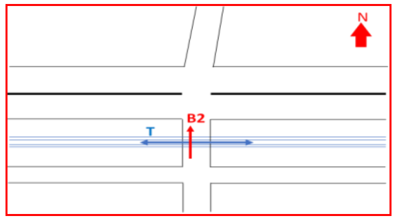


Figure 8. Conflict point between vehicles from direction B2 and train from direction T (T in 2 directions)

The writer assumes that researchers on transportation fields do not merely rely on data concerning about accidents, but have advanced to data concerning on potentials that might cause accident. This is to forestall victims from accidents. Therefore, in accordance to the introduced information above, the writer finds it important to adopt a topic of level crossing safety with entitled "Analysis of Traffic Conflict Points at the Level Crossing of JPL 295, District of Lamongan" as the research foundation in providing factual contribution to minimize conflict points which has the probability of causing accidents, particularly at the level crossing of JPL 295 at District of Lamongan.

The purpose of this research is to evaluate the level of traffic safety at JPL 295 by emphasizing the severity level of the emerging conflict points. Meanwhile, the objectives of this research are to analyze: 1) Severity level in conflict points between vehicle from direction B and C, 2) Severity level in conflict points between vehicles from direction B1 and C1, 3) Severity level in conflict points between vehicles from direction D and E, 4) Severity level in conflict point between vehicles from direction A and train from direction T (direction T is alternated), and 5) Severity level in conflict point between vehicles from direction B2 and train from direction T (direction T is alternated).

Research Method

Statistical descriptive technique was used in order to present information of road user characteristics involved in conflicts with either other road user or rail traffic. As for analyzing severity level from a conflict, the Swedish TCT was applied, as what have been explained earlier in the review of literature. It is by calculating Time to Accident (TA) and Conflicting Speed (CS) from each direction and vehicle involved in the conflict.

The Result of the Study

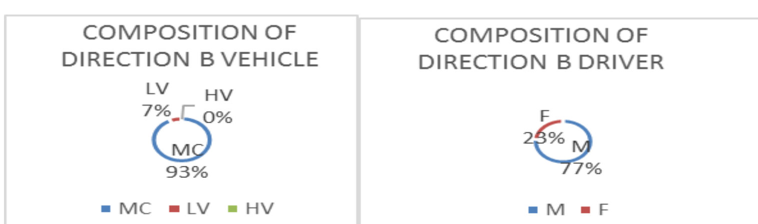


Figure 9. Vehicle from direction B and C

Speed profile of direction B vehicle (km/h) min 10, max 25, average 16,6, Std deviation 4,55. Braking distance profile of direction B vehicle (meter) min 5, max 13, average 9,23, Std deviation 2,75.

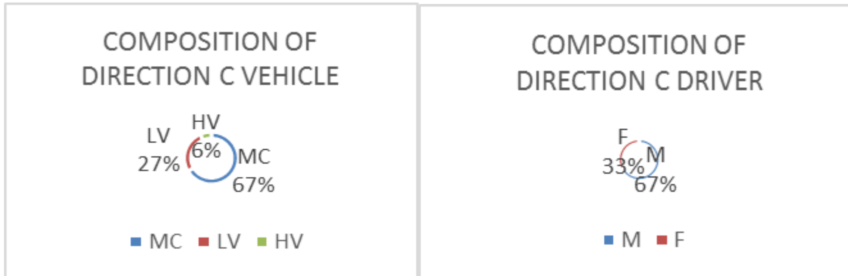


Figure 10. Traffic profile of vehicle from direction B and C

Speed profile of direction C vehicle (km/h) min 35, max 50, average 42,96, Std deviation 4,96 . Braking distance profile of direction C vehicle (meter) min 11, max 34, average 21,23, Std deviation 7,19

Annotation
MC : Motor Cycle
LV : Light Vehicle (Passenger car)
HV : Heavy Vehicle
M : Male
F : Female

The above are 30 randomly chosen samples taken from conflict points occurred in direction B and C. In direction B, it is dominated with motor cycle by 93% and male drivers by 77%, as well as an average of speed by 16.6 km/h with the average of braking start off distance by 9.23 m. As for direction C, it is dominated with also motor cycle by 67% and male drivers by 67%, as well as an average speed by 42.96 km/h with the average of braking start off distance by 21.23 m.

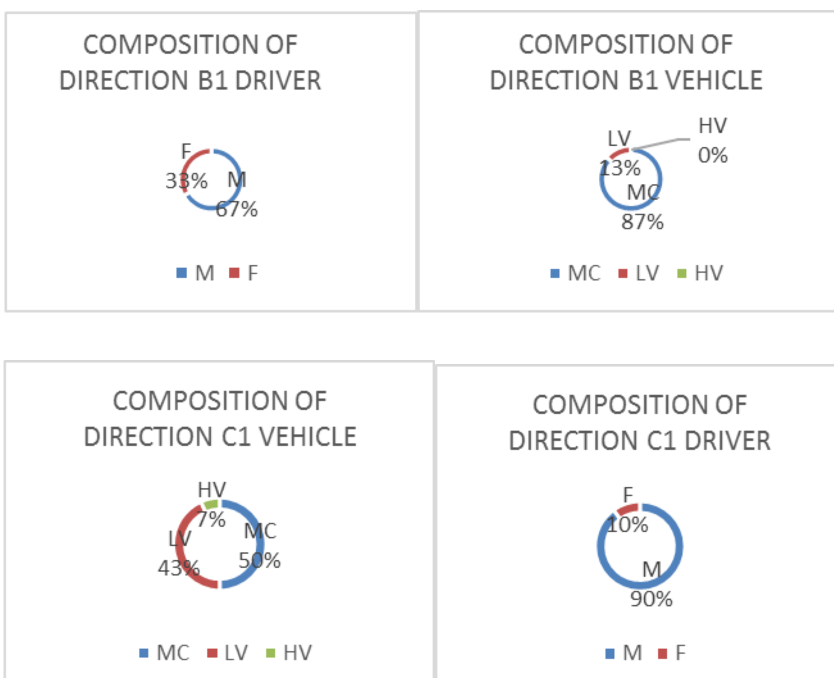


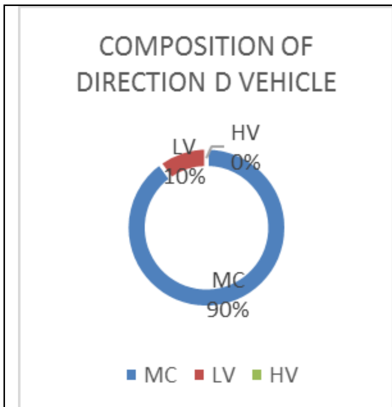
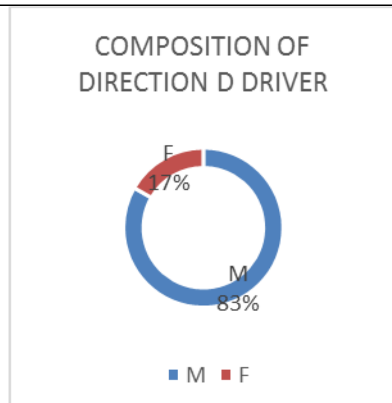
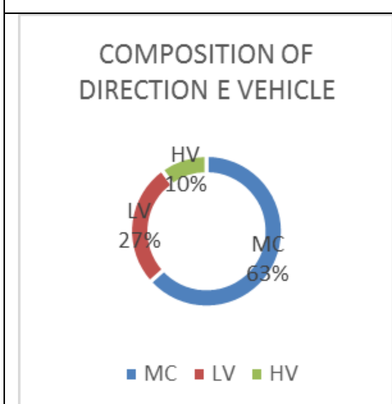
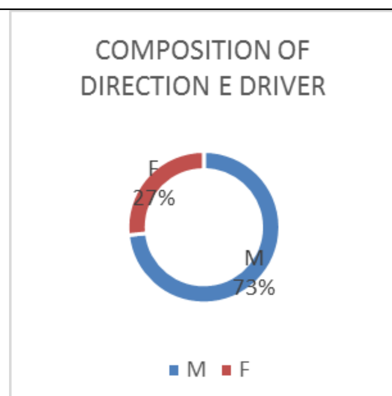
Figure 11. Vehicle from direction B1 and C1

Speed profile of direction B1 vehicle (km/h) min 10, max 25, average 17,4, Std deviation 4,71. Braking distance profile of direction B1 vehicle (meter). Speed profile of direction C1 vehicle (km/h) min 35, max 50, average 42,4, Std deviation 4,65. Braking distance profile of direction C1 vehicle (meter) min 10, max 35, average 21,7, Std deviation 7,17.

MC : Motor Cycle
LV : Light Vehicle (Passenger car)
HV : Heavy Vehicle
M : Male
F : Female

The above are 30 randomly chosen samples taken from conflict points occurred in direction B1 and C1. In direction B1, it is dominated with motor cycle by 87% and male drivers by 67%, as well as an average of speed by 17.4 km/h with the average of braking start off distance by 9.3 m. As for direction C1, it is dominated with also motor cycle by 50% and male drivers by 90%, as well as an average speed by 42.4 km/h with the average of braking start off distance by 21.7 m.

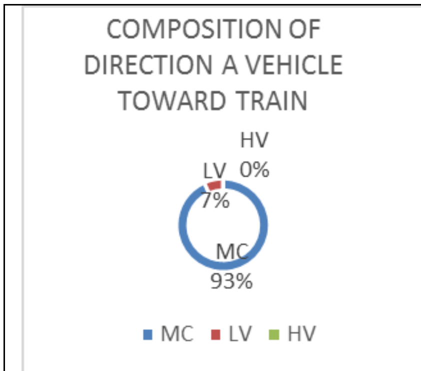
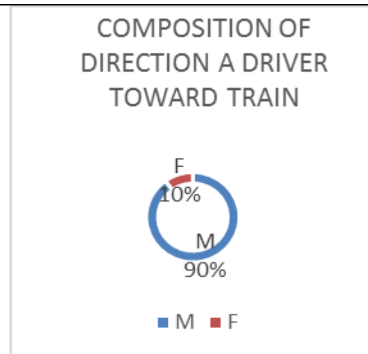
Table 3. Vehicle from direction D and E

		Speed profile of direction D vehicle (km/h) min 25, max 35, average 30,06, Std deviation 3,38 Braking distance profile of direction D vehicle (meter) min 5, max 20, average 12,36, Std deviation 4,26
		Speed profile of direction E vehicle (km/h) min 35, max 60, average 47,56, Std deviation 6,26 Braking distance profile of direction E vehicle (meter) min 10, max 35, average 22,8, Std deviation 8,82

Annotation
MC : Motor Cycle
LV : Light Vehicle (Passenger car)
HV : Heavy Vehicle
M : Male
F : Female

The above are 30 randomly chosen samples taken from conflict points occurred in direction D and E. In direction D, it is dominated with motor cycle by 90% and male drivers by 83%, as well as an average of speed by 30.06 km/h with the average of braking start off distance by 12.36 m. As for direction E, it is dominated with also motor cycle by 50% and male drivers by 90%, as well as an average speed by 47.56 km/h with the average of braking start off distance by 22.8 m.

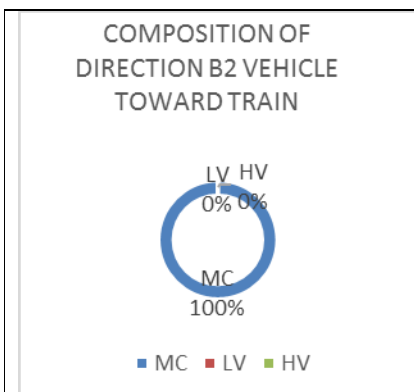
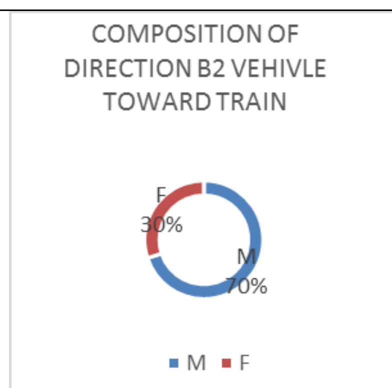
1. **Vehicle from direction A Toward Train from direction E**

		Speed profile of direction A vehicle (km/h) min 25, max 43, average 34,67, Std deviation 5,38 Braking distance profile of direction A vehicle (meter) min 9, max 23, average 15,6, Std deviation 3,83

Annotation
MC : Motor Cycle
LV : Light Vehicle (Passenger car)
HV : Heavy Vehicle
M : Male
F : Female

The above are 30 randomly chosen samples taken from conflict points occurred in direction A and train from direction T. In direction A, it is dominated with motor cycle by 93% and male drivers by 90%, as well as an average of speed by 34.67 km/h with the average of braking start off distance by 15.6 m. As for train from direction T, the calculation is not conducted because the rail did not perform evasive action.

Table 4. Vehicle from direction B2 toward Train from direction T

		Speed profile of direction B2 vehicle (km/h) min 16, max 35, average 24,13, Std deviation 5,72 Braking distance profile of direction B2 vehicle (meter) min 5, max 15, average 10,67, Std deviation 3,05

Annotation
MC : Motor Cycle
LV : Light Vehicle (Passenger car)
HV : Heavy Vehicle
M : Male
F : Female

The above are 30 randomly chosen samples taken from conflict points occurred in direction B2 and train from direction T. In direction B2, it is dominated with motor cycle by 100% and male drivers by 70%, as well as an average of speed by 24.13 km/h with the average of braking start off distance by 10.67 m. As for train from direction T, the calculation is not conducted because the rail did not perform evasive action.

Discussion

Within an analysis, an illustration of calculating technique with Swedish TCT method will be previewed. Complete analysis is provided in a form of table, as described in the attachment.

In the conflict of vehicle from direction B and C, vehicles involved in conflicts are observed and "recorded" from each approaching direction. First vehicle to attempt evasive action is determined as relevant user. In this case, vehicle from direction B is identified as relevant user. Vehicle speed when braking is identified using the speed gun, identify the braking start off point then record the data.

Through one of the sample collecting process, 2 vehicles were involved in a conflict.

Vehicle from direction B is identified attempting evasive action earlier compare to vehicle from direction C. Therefore, vehicle from direction B is applied as relevant user.

Speed (V) = 17 km/h
= 4.72 m/sec
Braking Distance (d) = 6 m
Time to Accident (TA) = d / v
= 6 / 4.72
= 1.27 seconds

Vehicle from direction C

Speed (V) = 44 km/h
= 12.22 m/sec
Braking Distance (d) = 22 m
Time to Accident (TA) = d / v
= 22 / 12.22
= 1.8 seconds

Despite of vehicle from direction B being identified as relevant user, accordingly TA (B) = 1.27 seconds and CS (B) = 17 km/h are applied as variables in plotting on severity level curve. This process is conducted repeatedly until the entire samples from each conflict points are plotted and confirm conflict level categorized as severe (severity level > 26) and as not severe (severity level ≤ 26).

1. **Vehicle Conflict from direction B and C**

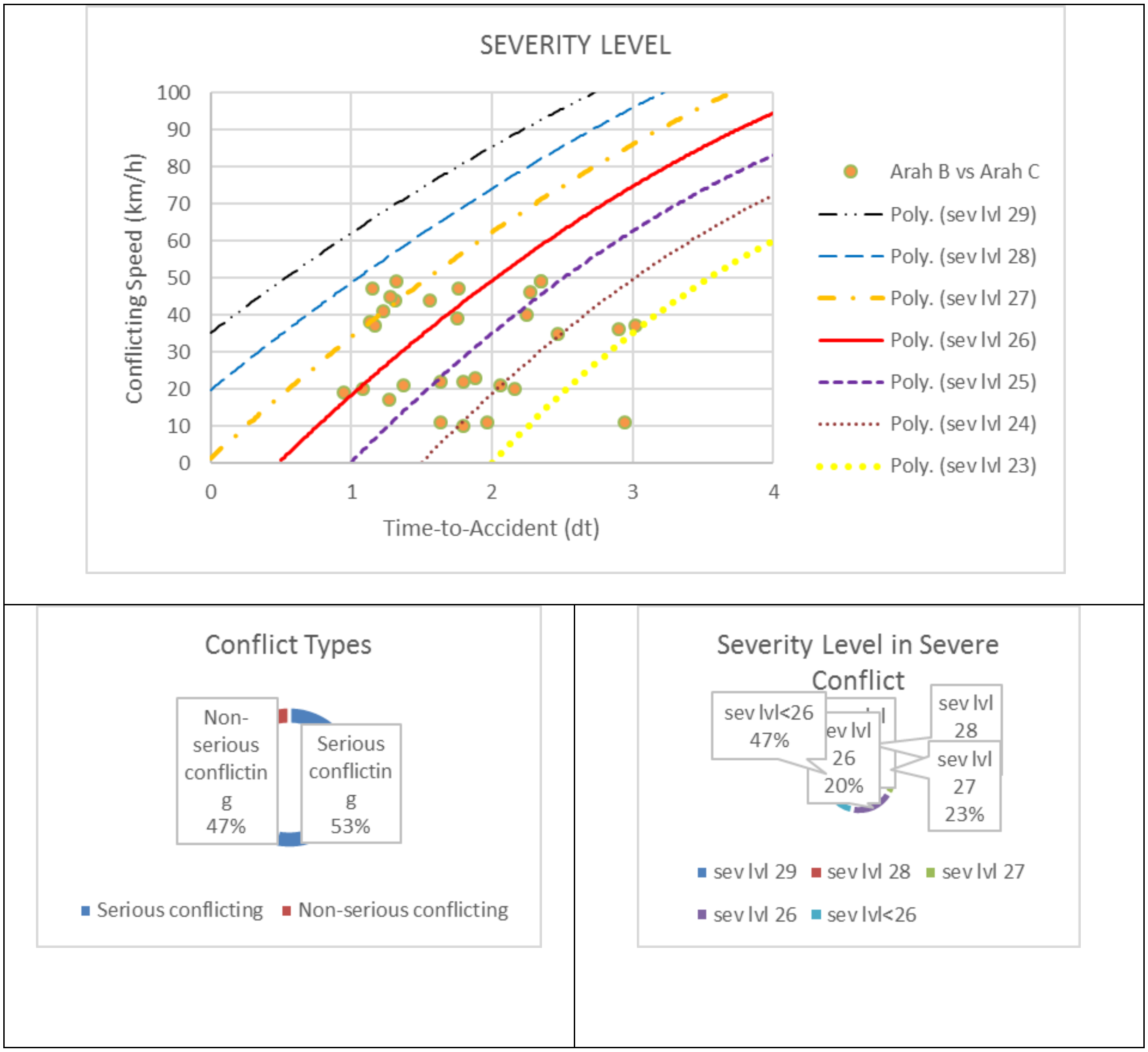


Figure 17. Conflict profile of vehicle from direction B and C

Out of 30 samples analyzed, it is found that 53% of vehicle conflict from direction B and C are categorized as severe conflict, which has severity level by ≥ 26. Whereas for the remaining 47% are categorized as non-severe with severity level by < 26. The identified 53% conflicts are narrowed down to several categories based on the severity level, which are 20% at the severity level of 26, 23% at the severity level of 27, and 10% at the severity level of 28.

2. **Vehicle Conflict from direction B1 and C1**

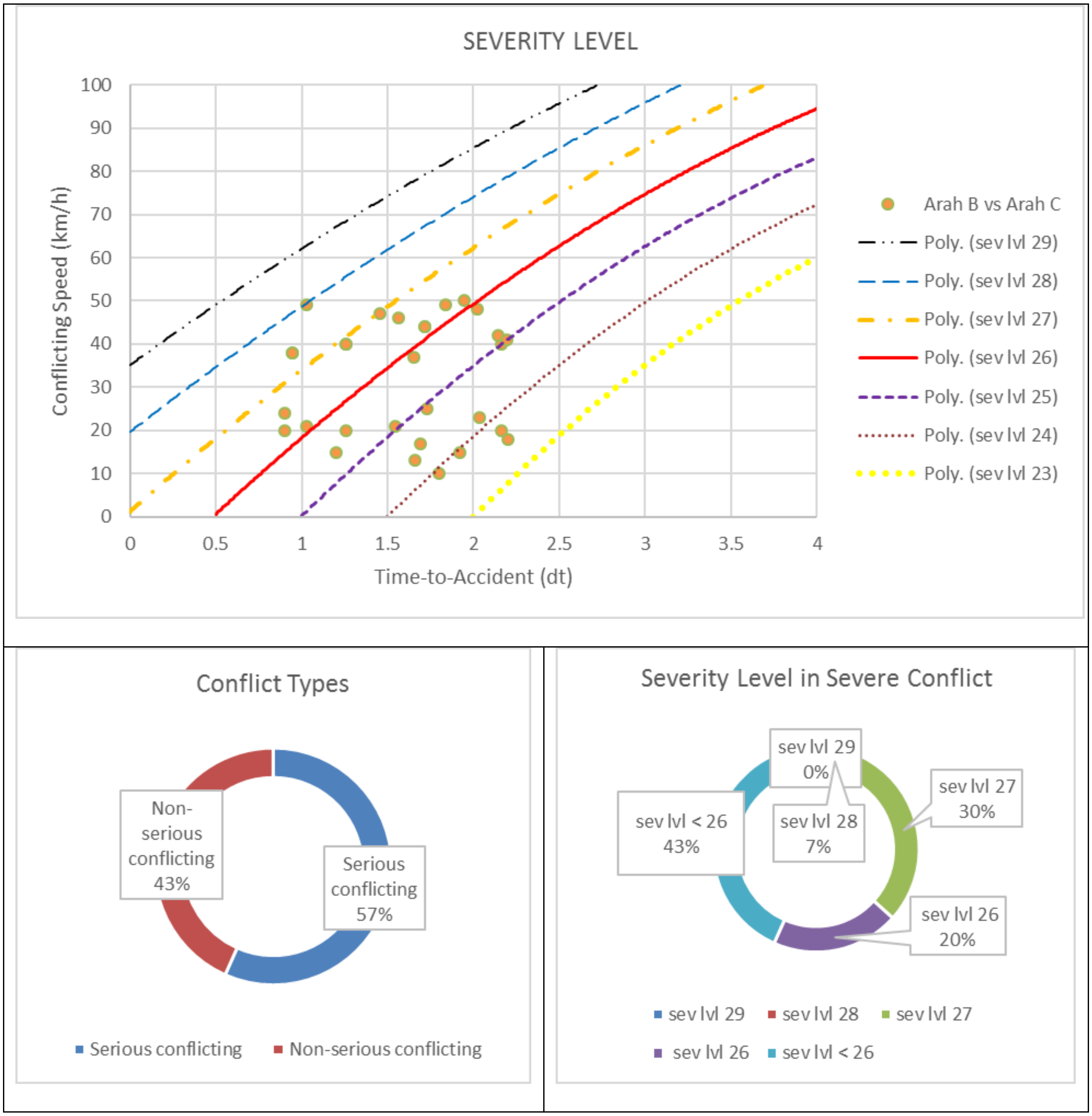


Figure 18. Conflict profile of vehicle from direction B1 and C1

Out of 30 samples analyzed, it is found that 57% of vehicle conflict from direction B1 and C1 are categorized as severe conflict, which has severity level by ≥ 26. Whereas for the remaining 43% are categorized as non-severe with severity level by < 26. The identified 57% conflicts are narrowed down to several categories based on the severity level, which are 20% at the severity level of 26, 30% at the severity level of 27, and 7% at the severity level of 28.

3. **Vehicle Conflict from direction D and E**

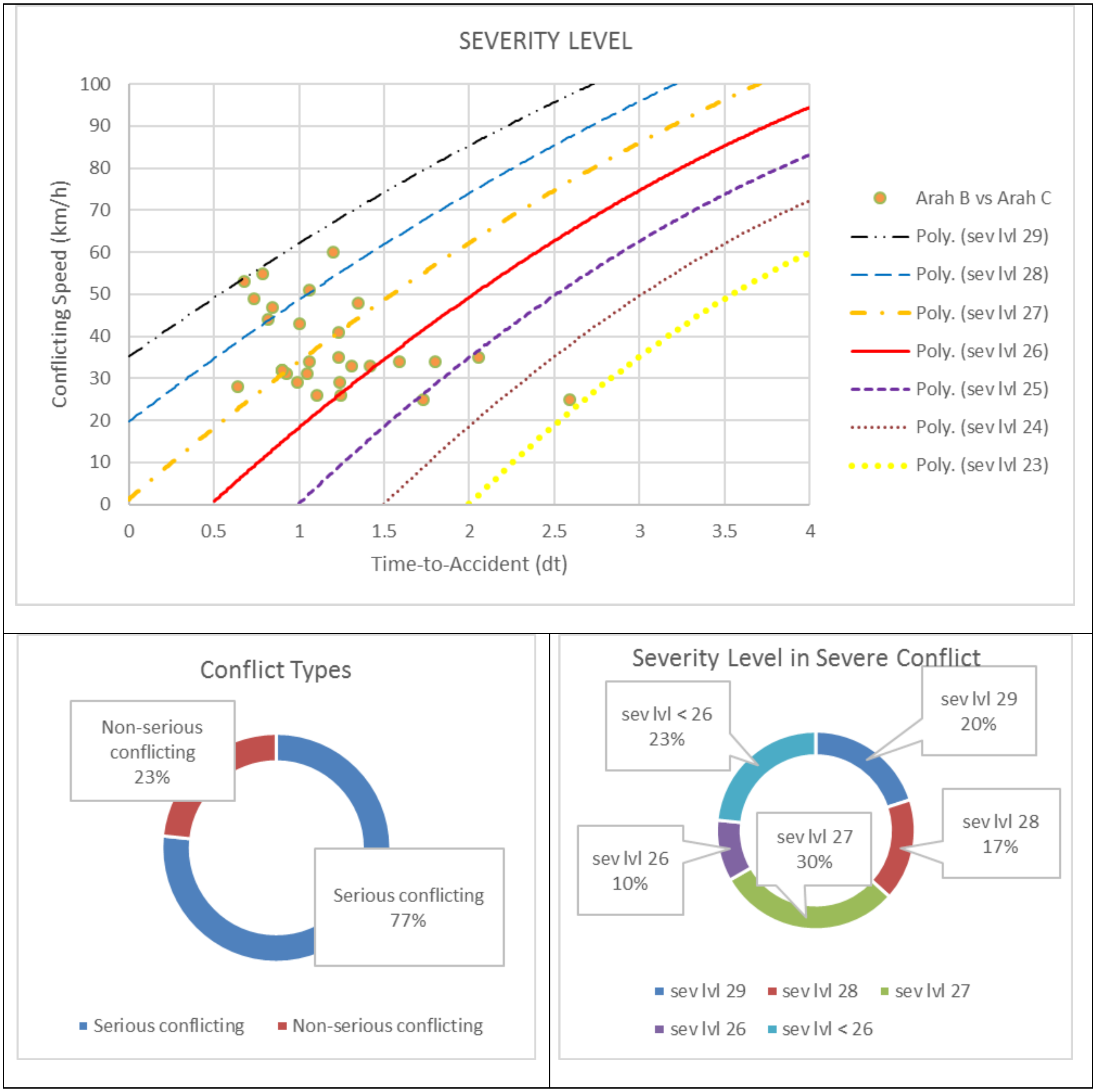


Figure 19. Conflict profile of vehicle from direction D and E

Out of 30 samples analyzed, it is found that 77% of vehicle conflict from direction D and E are categorized as severe conflict, which has severity level by ≥ 26. Whereas for the remaining 23% are categorized as non-severe with severity level by < 26. The identified 77% conflicts are narrowed down to several categories based on the severity level, which are 10% at the severity level of 26, 30% at the severity level of 27, 17% at the severity level of 28, and 20% at the severity level of 29.

4. **Vehicle Conflict from direction A Toward Train from direction T**

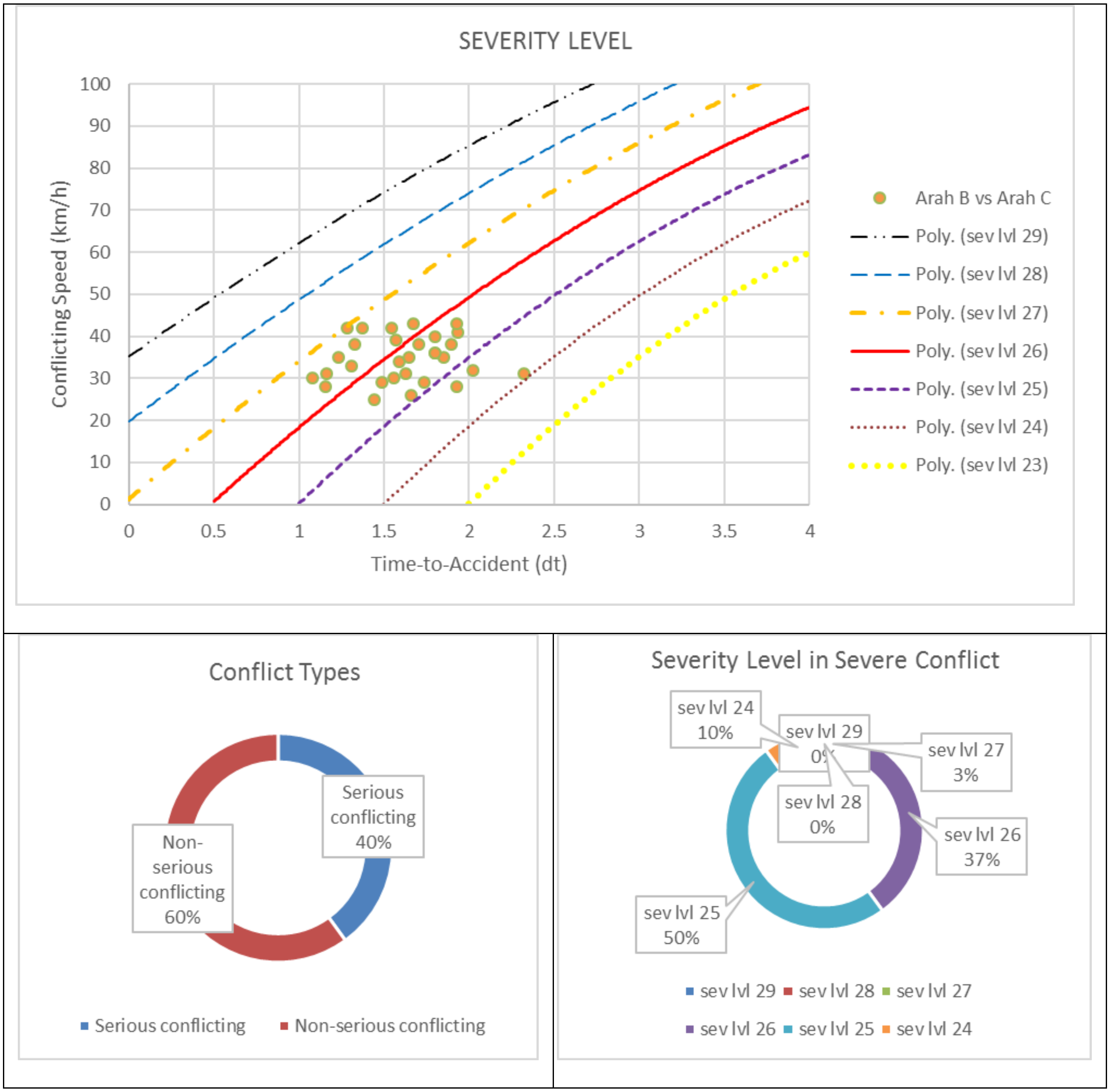


Figure 20. Conflict profile of vehicle from direction A Toward Train from direction E

Out of 30 samples analyzed, it is found that 40% of vehicle conflict from direction A and train from direction T are categorized as severe conflict, which has severity level by ≥ 26. Whereas for the remaining 60% are categorized as non-severe with severity level by < 26. The identified 40% conflicts are narrowed down to several categories based on the severity level, which are 37% at the severity level of 26, and 3% at the severity level of 27. Meanwhile, the calculation on train from direction T was not conducted because the evasive action was not attempted by the train.

5. **Vehicle Conflict from direction B2 toward Train from direction T**

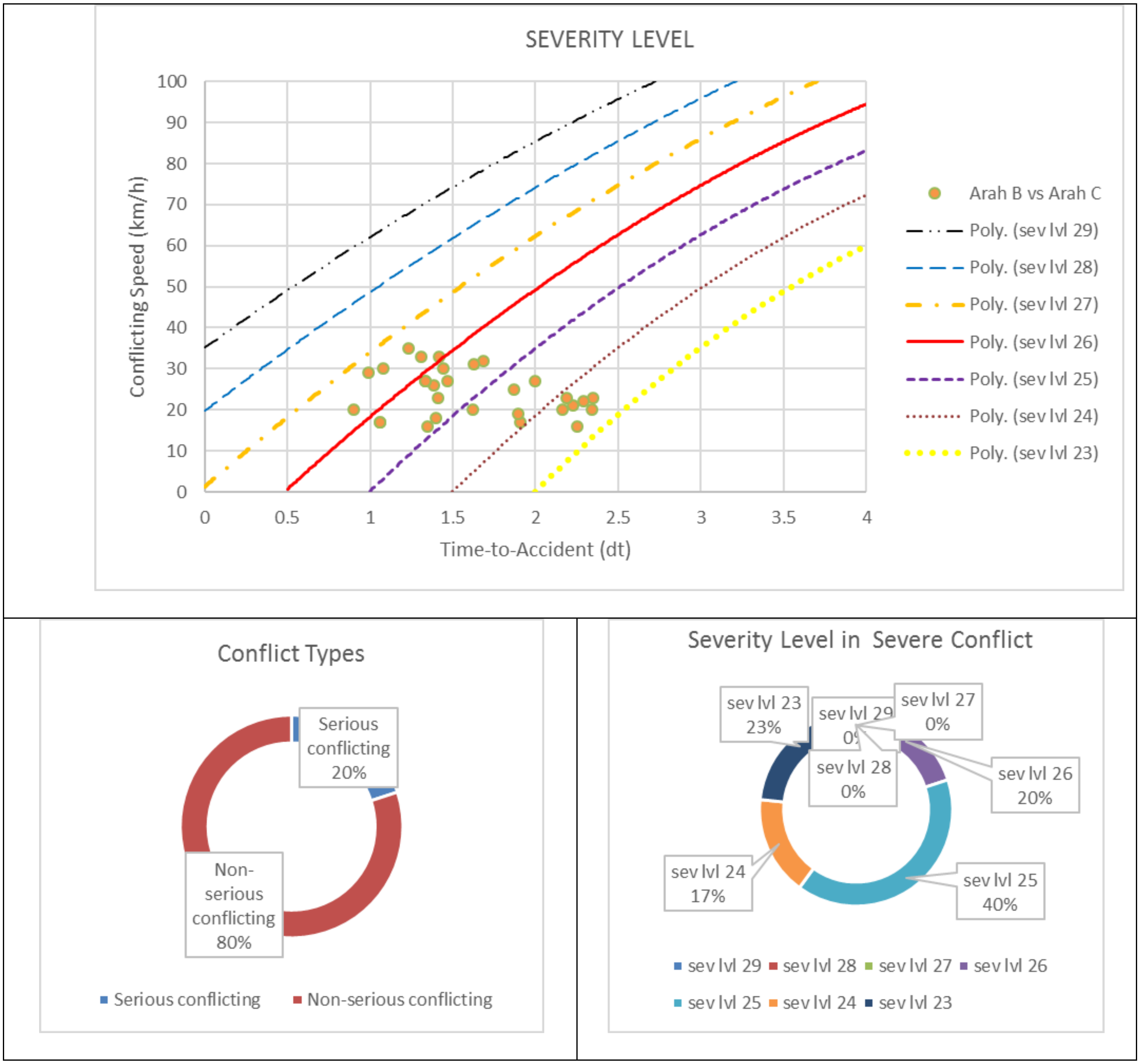


Figure 20. Conflict profile of vehicle from direction B2 toward Train from direction E

Out of 30 samples analyzed, it is found that 20% of vehicle conflict from direction B2 and train from direction T are categorized as severe conflict, which has severity level by ≥ 26. Whereas for the remaining 80% are categorized as non-severe with severity level by < 26. The identified 20% conflicts are narrowed down to several categories based on the severity level, which are 20% at the severity level of 26, and 0% at the severity level of 27 and 28. Meanwhile, the calculation on train from direction T was not conducted because the evasive action was not attempted by the train.

Conclusion

In accordance to the comprehensively analyzed purposes of this research, there are several conclusions drawn as mention below:

1. Vehicle from direction B and C have severe traffic conflict by 53% and the remaining 47% are non-severe traffic conflict.

2. Vehicle from direction B1 and C1 have severe traffic conflict by 57% and the remaining 43% are non-severe traffic conflict.

3. Vehicle from direction D and E have severe traffic conflict by 77% and the remaining 23% are non-severe traffic conflict.

4. Vehicle from direction A toward train from direction C have severe traffic conflict by 50% and the remaining 60% are non-severe traffic conflict.

5. Vehicle from direction B2 toward train from direction C have severe traffic conflict by 50% and the remaining 60% are non-severe traffic conflict.

The writer gave a tolerated conflict value by 50% maximum, certain treatments must be performed when reaching or over the maximum point to minimize severity level in those conflict points.

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