

ANALYSIS OF THE IMPLEMENTATION OF ROAD SAFETY ON THE JOMBANG-KERTOSONO ARTERIAL ROAD SECTION

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KEYWORDS

Road Safety, EAN (Equivalent Accident Number), IPA (Importance Performance Analysis)

ABSTRACT

According to data from the Jombang Regency Traffic Traffic Unit of December 2022, there were 114 cases of traffic accidents on the Jombang-Kertosono arterial road. Thus, an analysis of road safety is needed on this road section. The author analyzes the application of road safety using the IPA (Importance Performance Analysis) method, the EAN (Equivalent Accident Number) method, and geometric calculations of roads in accident-prone areas. Based on the analysis of the application of road safety using the IPA method, it is known that the main priority attributes in driving safety are traffic signs and road markings as well as sharp turns which are quite dangerous for motorists. Based on the analysis of accident-prone areas using the EAN method, it is known that STA 01+00 – 02+00 has the highest EAN score of 249 accidents. Based on the road geometric review, it is known that the stopping sight distance of STA 01+00 – 02+00 is 46.78 m which when compared to the standard stopping sight distance is not sufficient and is considered less safe. The value of the side freedom area according to the calculation analysis is 5.4 m which is greater than the available E value, which is 4 m, so it is considered less safe. There are 2 suggested bends using the Spiral-Circle-Spiral type and 2 Spiral-Spiral type bends where each of these bends requires widening the average road pavement width of 1 meter to reduce the risk of traffic accidents on bends due to adequate road width.

INTRODUCTION

Roads are facilities designed to facilitate the movement of people and goods. Roads are land transportation infrastructure in the form of road sections, supporting buildings intended for vehicles, whether above the surface of land or water or below the surface of the land, with the exception of railways, truck roads and cable roads (Sukirman, 1999).

Road safety is very important for land transportation users. According to the Directorate General of Highways, accidents will cause the fifth highest number of deaths in the world by 2030. The risk of traffic accidents for land transportation users can increase as vehicle volume and traffic flow increase (Bolla, Messah, & Koreh, 2013). Traffic accidents can occur randomly at anytime and anywhere. Accidents that occur can be caused by several factors. There are three factors that influence accident cases, namely, human factors, road condition factors, and vehicle factors

(Indriastuti, Fauziah, & Priyanto, 2011). Implementation of road safety is an effort to reduce cases of traffic accidents on the road by paying attention to the factors that cause accidents (Syaban, Azizah, & Wijianto, 2021). Road safety is important in planning comfortable and safe land transportation infrastructure (Masrianto, 2019). Road safety is a global problem (Oktopianto, Nabil, & Arief, 2021). Research on road safety analysis needs to be carried out to determine appropriate handling in accident-prone areas (Oktopianto & Pangesty, 2021). The implementation of road safety also needs to be carried out in order to reduce the number of accident cases in Indonesia (Oktopianto, Shofiah, Rokhman, Wijyanthi, & Krisdayanti, 2021). It is very necessary to study the problem of traffic accidents in terms of causes, consequences and handling [7]. Road safety analysis is carried out to determine problems regarding driver safety and ensure that all road plans can operate properly and safely (Pane, Lubis, & Batubara, 2021).

According to Jombang Regency Traffic Police data as of December 2022, there were 114 cases of accidents that occurred on the Jombang-Kertosono arterial road (Yandi & Lubis, 2020). Based on this data, the most dominant accident cases occurred in the sharp bend area on the Jombang-Kertosono arterial road. Accidents that occur are often caused by driver factors and road facility factors. Road facility factors that cause accidents include incomplete road signs and markings, road shoulders that are still used as public transport stops, and vehicle speeds that exceed safe limits. On the Jombang-Kertosono arterial road there are also several sharp bends which are prone to accidents. Of course, this will be very dangerous for land transportation users using the Jombang-Kertosono arterial road.

Therefore, efforts are needed to reduce the possibility of accidents occurring on the Jombang-Kertosono arterial road, especially in sharp bend areas where at this point the number of accident cases increases every year. The efforts made are to carry out an analysis of the implementation of road safety so that further improvements can be made to the completeness of the road infrastructure.

In this research, the author analyzed the implementation of road safety using the IPA (Importance Performance Analysis) method. Next, the author analyzes accident-prone areas using the EAN (Equivalent Accident Number) method to carry out geometric calculations of roads at accident-prone points. Road safety analysis research on the Jombang-Kertosono arterial road was carried out by processing several primary data and secondary data from the parties concerned.

The EAN (Equivalent Accident Number) method comes from the Transport Road and Research Laboratory (TRRL) method which is used in calculating the weighting of fatality rates and the number of accidents to analyze accident-prone areas (Yahya, Arifianto, & Oktaviastuti, 2022).

An accident-prone area is an area that has a high number of risks and cases of traffic accidents (Soejachmoen, 2004). A blackspot point is the location of an accident counter area, where at this location the number of accident cases with accident criteria that occur is greater than the minimum number determined per year.

Traffic signs and road markings can be the first treatment on road sections prone to accidents due to lack of road equipment. Markings on highways are used to convey instructions and warnings that are not conveyed by other traffic control devices (Yahya et al., 2022).

Road geometry is part of road structure planning which describes the shape and size of the road in terms of cross section and length, as well as other aspects related to the physical shape of the road (Indonesia, 2006). The aim of road geometric planning is to create a safe and efficient road structure (Aswardi, Saleh, & Isya, 2017). Horizontal alignment is the alignment of a road which is a perpendicular projection line of the road axis on the map. Horizontal alignment is a combination of several straight lines and curved lines as projections of the road axis on the horizontal plane. Planning the horizontal alignment of a road is called road alignment (Nariasih, Lemes, & Remaja, 2022).

It is hoped that this research can provide an evaluation and benchmark for the performance of the Jombang-Kertosono arterial road which is closely related to the safety of land transportation users and will serve as an appeal to motorists to be more careful and orderly when driving in order to reduce the number of accidents on the road.

METHOD

In this research, the author carried out an analysis of accident-prone areas based on traffic accident data on the Jombang-Kertosono arterial road using the EAN (Equivalent Accident Number) method. Next, the author analyzes the implementation of land transportation safety using the IPA (Importance Performance Analysis) method based on a review of the completeness of road infrastructure and road geometrics in the form of visibility distance and horizontal alignment. Research using the IPA (Importance Performance Analysis) method can show an index of driver satisfaction with road performance. Road safety analysis research on the Jombang-Kertosono arterial road was carried out by processing several primary data and secondary data from the parties concerned. The method stages in this research are shown in the picture.

RESULTS AND DISCUSSION

Road Performance Measurement Based on the Natural Science Method

Based on measuring road service performance in terms of completeness of road infrastructure and road geometric aspects in the form of visibility distance and horizontal alignment using the IPA method which is explained in the diagram image resulting from the IPA method analysis. The diagram of the analysis results using the IPA method is shown in Figure 2.

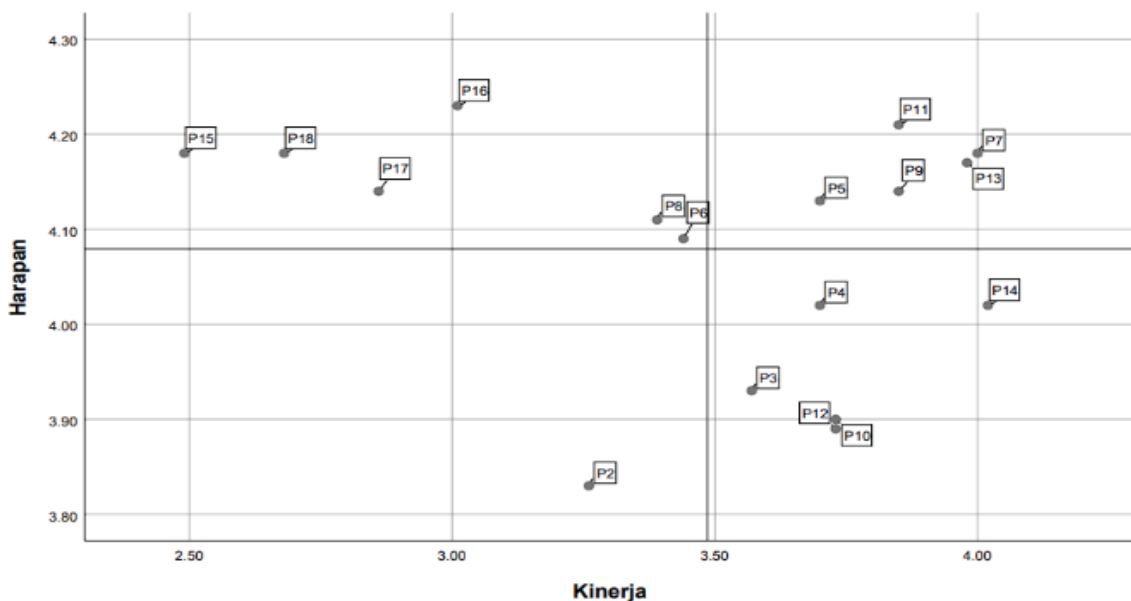


Figure 2. Diagram of IPA Analysis Results
Source: Calculation Results

Based on the diagram resulting from the analysis, there are question attributes from the questionnaire which are in quadrants 1, 2, 3, and 4. The question attributes which have been grouped based on the priority scale are explained as follows:

- 1) The question attributes that are considered to have important value by road users but the performance of the road infrastructure is considered unsatisfactory are located in quadrant 1, namely in the question attribute the condition of signs and markings is good and clearly visible (P6), there are zebra crossing markings at pedestrian crossings (P6). P8), traffic accidents rarely occur at curves (P15), curves are not too sharp (P16), you can drive

comfortably when crossing curves (P17), and the slope of the road at curves is not too sharp (P18).

- 2) The question attributes that are expected to support the satisfaction of drivers and road infrastructure service providers are very good so they must maintain this performance and are located in quadrant 2, namely in the question attributes that the driver's view of the train track is sufficient (P5), dotted markings on the route The road is adequate (P7), the intersection and corner markings are adequate (P9), the public road lighting (P10) at this location is adequate (P11), and there are safety gate barriers and officers guarding the railway crossing (P13).
- 3) Attributes that are not considered too important by road users and therefore do not need to be prioritized excessively are located in quadrant 3, namely in the question attribute of a bus that is stopped to carry passengers and does not interfere with the driver's view (P2).
- 4) Attributes that are considered not very important by road users so that road infrastructure service providers allocate existing resources to other factors that have a higher level of priority are located in quadrant 4, namely in the question attribute of the driver's view at bends is sufficient (P3), view drivers at road intersections are adequate (P4), there are dividing line markings between bicycle lanes and traffic (P10), and warning lights at intersections function well (P12), and road dividers at every corner function well (P14).

Based on measuring road service performance in terms of completeness of road infrastructure and road geometric aspects in the form of visibility and horizontal alignment using the IPA method, it can be seen that:

1. The highest value for the level of suitability of road performance with the respondent's level of expectations is in the question attribute: road barriers at each corner function well, which shows that on this attribute road users are satisfied with road performance.
2. The attributes that are the main priority for improving road safety on the Jombang-Kertosono STA 01+00 – 16+00 arterial road section based on the IPA method, namely:
 - 1) Condition of signs and markings is good and clearly visible (P6)
 - 2) There are zebra crossing markings at the pedestrian crossing (P8)
 - 3) Traffic accidents rarely occur on curves (P15)
 - 4) Corners are not too sharp (P16)
 - 5) Can drive comfortably when crossing corners (P17)
 - 6) The slope of the road at curves is not too sharp (P18)

Analysis of Accident Prone Areas

Based on the results of calculating the Critical EAN value (EANc), an EANc value of 144.06 was obtained. The EANc value will be compared with the EAN value per kilometer to determine the Blackspot point on the Jombang-Kertosono arterial road. A point on a road section is said to be a Blackspot point if the EAN value at that point exceeds the EANc value ($EAN > EANc$). The results of the analysis of accident-prone areas (Blackspot points) on the Jombang-Kertosono STA 01+00 – 16+00 arterial road are shown in table 1.

Table 1
Number of EANs for each kilometer ordered from the largest value

STA	Number of EANs	Category
1+00-2+00	249	<i>Blackspot</i>
9+00-10+00	234	<i>Blackspot</i>
11+00-12+00	207	<i>Blackspot</i>
5+00-6+00	156	<i>Blackspot</i>
4+00-5+00	153	<i>Blackspot</i>
3+00-4+00	147	<i>Blackspot</i>

Source: Calculation Results

From the analysis of accident-prone areas, it was found that the number of EANs that exceeded the EANc value was found at 6 points on the Jombang-Kertosono arterial road section STA 01+00 – 16+00. This shows that this road segment is classified as an accident-prone area (Blackspot point). From the results of the analysis of accident-prone areas, it can be seen that the road section in STA 01+00 – 02+00 has the highest EAN value, namely 249 accident cases. The most dominant cause of traffic accidents comes from the driver, especially due to driver negligence.

Road Geometric Measurement and Overview Components in the Form of Sight Distance and Horizontal Alignment

Based on the geometric analysis of the road at the STA 01+00 – 02+00 curve, it is known that:

1. Based on primary data from BBPJN and survey results regarding vehicle traffic volume on the Jombang-Kertosono arterial road, the results show that traffic volume at peak hours is located in three time frames, namely 07.00-08.00, 12.00-13.00, and 17.00-18.00.
2. Primary data survey in the form of Spot Speed data at STA 01+00 – 02+00 was carried out on 50 vehicles per vehicle type (SM, KR, KB) at peak hours with an observation segment length of 110 meters where the length of this observation segment is the length of the bend. is a blackspot with the highest number of accidents along the Jombang-Kertosono arterial road STA 01+00 – 16+00. From the results of the comparison analysis of Spot Speed data with the planned speed at STA 01+00 – 02+00, it was obtained that the average speed of vehicles crossing curves at STA 01+00 – 02+00 was 41.40 km/hour. The average speed of the vehicle exceeds the design speed limit of 40 km/hour, which can cause a risk of traffic accidents at curve n.
The calculation results regarding stopping visibility at STA 01+00 – 02+00 are 46.78 meters. According to the geometric design guidelines for Bina Marga roads, the standard stopping sight distance on a flat slope with a design speed of 40 km/hour is 50 meters. This shows that the operational stopping sight distance when compared with the standard stopping sight distance is less than adequate and is considered less safe.
3. The calculation results for overtaking visibility at the blackspot point STA 01+00 – 02+00 are 210.4 m with an operational speed of 41.4 km/hour. Based on the Bina Marga guideline specifications, at a design speed of 40 km/hour the visibility distance exceeds the standard by 200 m. It can be concluded that the operational visibility when compared with the visibility ahead of the plan is appropriate and considered safe.
4. From the calculation of the transition curve and the side freedom area at the bend STA 01+00 – 02+00 it is known that the length of L_s (transition curve) is 48.33 m and the value of the side freedom area according to the calculated analysis is 5.4 m. The E value available at the research location, namely 4 m, is less than adequate when compared with the analysis E value. So the visibility at the corner of the Jombang-Kertosono STA 01+00 – 02+00 arterial road is considered less safe.
5. Based on the analysis of the horizontal curve type, it is known that there are 2 curves that are recommended to use the Spiral - Circle - Spiral type and 2 curves with the Spiral - Spiral type where at each curve it is necessary to widen the road pavement by an average of 1 meter to reduce the risk of traffic accidents. on bends due to inadequate road width.

CONCLUSION

Based on the analysis of road safety implementation in terms of completeness of road infrastructure and road geometric aspects, there are attributes of questions from the questionnaire that are the main priority for improvements to improve driving safety on the Jombang-Kertosono arterial road section STA 01+00 – 16+00, namely the condition signs and

markings are good and clearly visible (P6), there are zebra crossing markings at pedestrian crossings (P8), traffic accidents rarely occur at bends (P15), bends are not too sharp (P16), can drive comfortably when crossing corners (Proad), and the slope of the road at the bend is not too sharp (P18). It is known that the blackspot point with the highest number of accidents is located at STA 01+00 – 02+00, where at this point the average vehicle speed, visibility and side clearance areas are considered less safe and can cause the risk of traffic accidents on curves.

On the Jombang-Kertosono arterial road section, it is hoped that improvements can be evaluated, especially at several points that need to be repaired regarding traffic signs in the form of maximum speed limit warnings, rumble strip planning so that drivers can reduce speed before crossing sharp bends which are accident-prone areas, and It is necessary to clear the area around the road to increase the line of sight for drivers crossing sharp bends which are prone to accidents.

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