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An Evaluation of Road Safety Performance for Selected Road Stretches in Kolhapur City

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Abstract: ***The major cause for global deaths and injuries are mainly due to road crashes. It is worst in developing countries due to rapid and unplanned urbanization. It was estimated in 2010 that about 1, 60,000 persons have died due to road crashes in India. Since, road safety is influenced by many factors it involves complex studies to arrive at the reasons for accidents. As a result the accident study itself remains under estimated in many of the countries specially in developing countries. In recent years several indicators are developed in order to study the factors influencing the accident and based on which the improvement measures can be adopted to reduce accident rate. In the present study two stretches are selected to validate the Road safety Index (RSI) equation and to suggest the improvements to the selected road stretches. Also an analysis is made to check if there is any improvement in the RSI value.***
Keywords: Road safety, WHO, IRC, RSI, Road safety performance

I. INTRODUCTION

Road safety is a multi dimensional issue. In order to improvise the safety of road it incorporates the development and management of road infrastructure, rules and regulations, law enforcement to the road users etc.,. The accident rate has increased rapidly with increase in road network, motorisation and urbanisation in the country. Worldwide, over 1.2 million people are killed in road crashes each year and 20 to 50 million are injured according World health Organisation, 2009. It means that every day around the world, more than 3000 people die from road traffic injury. WHO estimates road accidents will become the world's third leading cause of death by the year 2020. India has a well established road network of about 33 kilometer. At the same time, India has one of the highest accident rates in the world with more than 14 accidents per thousand vehicles every year.

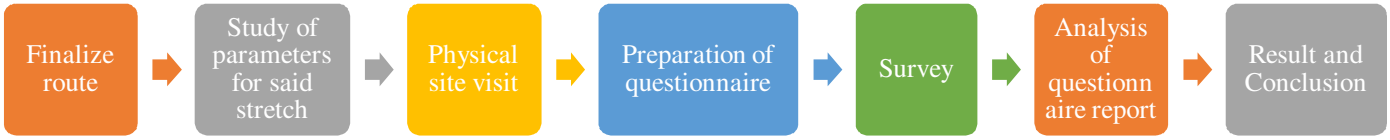
The road safety audit, when used for applications on existing roads is more appropriately termed as RSI. The process is a proven highly cost effective process that assists with production of safe roads.India has the second largest road network in the world with over 3 million km of roads of which 60% are paved. These roads make a vital contribution to India's economy. Road safety is emerging as a major social concern in the country. The statistics with an average mortality rate of 1, 00,000 persons dying in road accidents. India having more than 33 lakh kilometer of well-spread road network. At the same time, India has one of the highest accident rates in the world with more than 14 accidents per thousand vehicles every year, compared to only 6 to 8 accidents per thousand vehicles in developed countries. India accounts for about 10 percent of road accident fatalities worldwide. An estimated 12, 75,000 persons are seriously injured on the road every year. Studies on accidents, the world over, have shown that the human factor is responsible for a majority of accidents. Road Safety is a multi-dimensional issue in order to improve the safety of road; it incorporates the development and management of road infrastructure, rules and regulations, law enforcement to the road users etc.

Kolhapur is the one of the major cities in Maharashtra state. As per report of 2011 censes of Kolhapur city population is 5,49,236 (approximate). The no. of accidents in Kolhapur city increasing day by day is due to increases in population, increase in vehicles registration, increase in road network and rapid urbanization. The no. of accidents due to improper lane changing, prohibitated dangerous passing and merging etc. therefore it is necessary to study the road safety and performance in Kolhapur city.

II. OBJECTIVES

1) Review of current status and literature review and understanding the major causes of accidents of road.
2) To control over the risk involved in operating vehicles.
3) To suggest improvement for safe working of vehicle on road.
4) Detail Study of selected road stretches.

III. METHODOLOGY



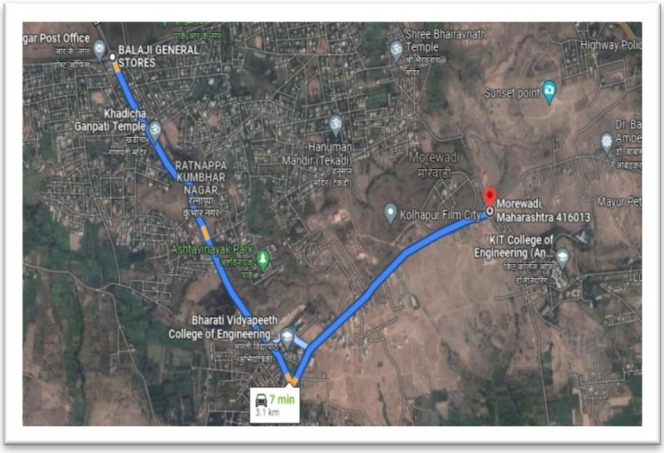


FIG 1. Finalized Road Stretch

The main objectives of the present study are to validate the Road safety Index. Two road stretch were selected for validation of RSI equation. Based on road safety inspections and to measure safety index for different type of roads in Kolhapur city, the following roads were selected. The selected stretch of roads measured 1km.

1) RK Nagar toll plaza to Kandalgaon Kaman.
2) Kandalgaon Kaman to Chitranagari

Many factors influence the rate of the accidents either separately or jointly. In this study, various factors affecting the causes of the accidents were identified and studied in detail.

The five main factors considered were:

a) Roadway Characteristics
b) Traffic Characteristics
c) Roadside Characteristics
d) Pavement Characteristics
e) Miscellaneous Characteristics

The unbiased responses from the field experts were collected based on the scientific questionnaire. Each of the sixteen parameters was rated on nine based on their crucial role played in case of accidents. Rating on a scale from 0 to 100, 100 depicts the safest condition of the road and hence presumed to be the best, whereas, assigning 0 for a particular parameter implies the worst condition of the road. Thus the responses were gathered to develop the trend charts.

Likewise, the responses for the relative weight age needed for the five main factors were collected from the same regular road users, teachers, students local people, RTO officers, on the scale of 0 to 100 .The 230 responses obtained were averaged to get the relative weight age. The relative weight ages of the five main factors which govern the Road Safety Index is as listed below.

- Roadway Characteristics-0.34
- Traffic Characteristics-0.26
- Roadside Characteristics-0.18
- Pavement Characteristics-0.13
- Miscellaneous Characteristics-0.09

Based on the scientific questionnaire, the value scores were given by the experts. These value scores were used for preparing the charts. (Regular road users, teachers , students, local residents, RTO officers) Based on these value scores, trend charts were developed. These charts act as ready reckoned to arrive at the value scores of the parameters under study.

Gradation of roads based on Road Safety Index

The roads were classified based on their safety conditions. In this work, the gradation of the road depends on the Road Safety Index (RSI) obtained from the RSI equation. Accordingly, the road is graded Poor, Good/Average, and Very good

The gradation of road based on the level of service offered

Gradation of roads based on RSI

Table- 1: RSI classification

RSI in %	Level of service
0 to 30%	Poor
31 to 60 %	Good/Average
61 to 100 %	Very good

$$RSI = \frac{\sum_{i=1}^{i=n} wi \times Vei}{\sum_{i=1}^{i=n} wi \times Vsi}$$

Where,

'n' is number of groups that define the overall factors to contribute accident.

'Wi' is the relative weight age allocated with its service characteristics.

'Vei' is the value score for its service characteristics of the existing situation

'Vsi' is the value scores for its service characteristics.

Out of several engineering factors identified, certain important quantifiable parameters were measured and aggregated to a common base scale. In the present study the parameters required in the development of RSI equation such as carriageway width, number of curves, gradient, number of intersections, type of intersections etc., are examined. For the same parameters the valued scores are applied by making use of the charts and the average values are obtained. Based on the average values obtained for different characteristics the RSI value is obtained using the equation as mentioned above. Based on the RSI value the road is categorised from excellent to very poor.

Road Stretch 1. RK Nagar toll plaza to Kandalgaon Kaman

Table 2 describes the roadway characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 2: Road Way Characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Carriage way width	Two lane	2.54%	4.33%
2	Presences of gradient	Slope	7.29%	
3	Intersection visibility	No visibility	3.174%	

Table 3 describes the roadway characteristics of Chitranagari to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 3: Road Way Characteristics of Chitranagari to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Carriage way width	Two lane	0.89%	2.01%
2	Presences of gradient	Slope	3.22%	
3	Intersection visibility	No visibility	1.92%	

Table 4 describes the Traffic Characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 4: Traffic Characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Driving speed	Speed	2.14%	5.22%
2	Road markings	Markings	3.93%	
3	Sign conventions	No. of boards	6.03%	
4	Street lightning	No. of poles	7.47%	
5	Speed breakers	No. of speed breakers	6.56%	

Table 5 describes the Traffic Characteristics of Chitranagari to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 5: Traffic Characteristics of Chitranagari to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Driving speed	Speed	2.85%	5.08%
2	Road markings	Markings	2.91%	
3	Sign conventions	No. of boards	7.01%	
4	Street lightning	No. of poles	4.06%	
5	Speed breakers	No. of speed breakers	8.60%	

Table 6 describes the Pavement Characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 6: Pavement Characteristics of RK Nagar toll plaza to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Pavement Status	Surface	2.34%	2.34%

Table 7 describes the Pavement Characteristics of Chitranagari to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained.

Table- 7: Pavement Characteristics of Chitranagari to Kandalgaon Kaman road stretch

Sr. No.	Characteristics	Observation data	Valued score	Average value
1	Pavement Status	Surface	0.98%	0.98%

IV. RESULTS AND DISCUSSION

1) Above table 2 and 3 shows Road way characteristics of 'R.K. Nagar toll Plaza to Kandalgaon Kaman' road stretch and Chitranagari to Kandalgaon Kaman road stretch, the valued scores obtained as per the recommendations of the experts and the average scores are obtained as 0 to 30% and hence the road is graded as poor.
2) Above table 4 and 5 shows traffic characteristics of 'R.K. Nagar toll Plaza to Kandalgaon Kaman' road stretch and Chitranagari to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained as 0 to 30% and hence the road is graded as poor.
3) Above Table 6 and 7shows pavement characteristics of 'R.K. Nagar toll Plaza to Kandalgaon Kaman' road stretch and Chitranagari to Kandalgaon Kaman road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained as 0 to 30% and hence the road is graded as poor.

V. CONCLUSION

Following are the recommendations for the selected road stretches that are required to meet the IRC code recommendations

1) The RSI value for the selected stretches ranges between 0 and 1. The higher values indicate higher levels of safety for that road. The lower values indicate the worst performance of the road in terms of road safety level. The target value of RSI is 1 and it shows how far the road has to be developed to ensure safety. This direct and simple ranking is quite useful to policy makers and ordinary people since it will show the scale of the problem clearly and easily.

2) Table 8 describes the improvement suggested for R.K. Nagar toll Plaza to Kandalgaon Kaman Road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained

Table- 8: Improvement suggested to R.K. Nagar toll Plaza to Kandalgaon Kaman Road Stretch

Sr.	Characteristics	Improved	Valued
1	Carriage way width	80	2.54%
2	Presences of gradient	80	7.29%
3	Intersection visibility	80	3.174%
4	Driving speed	100	2.14%
5	Road markings	100	3.93%
6	Sign conventions	100	6.03%
7	Street lightning	100	7.47%
8	Speed breakers	100	6.56%
9	Pavement Status	80	2.34%

3) Table 9 describes the improvement suggested for Chitranagari to Kandalgaon Kaman Road stretch and the valued scores obtained as per the recommendations of the experts and the average scores are obtained

Table- 9: Improvement suggested to R.K. Nagar toll Plaza to Kandalgaon Kaman Road Stretch

Sr.	Characteristics	Improved	Valued
1	Carriage way width	80	0.89%
2	Presences of gradient	80	3.22%
3	Intersection visibility	80	1.92%
4	Driving speed	100	2.85%
5	Road markings	100	2.91%
6	Sign conventions	100	7.01%
7	Street lightning	100	4.06%
8	Speed breakers	100	8.60%
9	Pavement Status	80	0.98%

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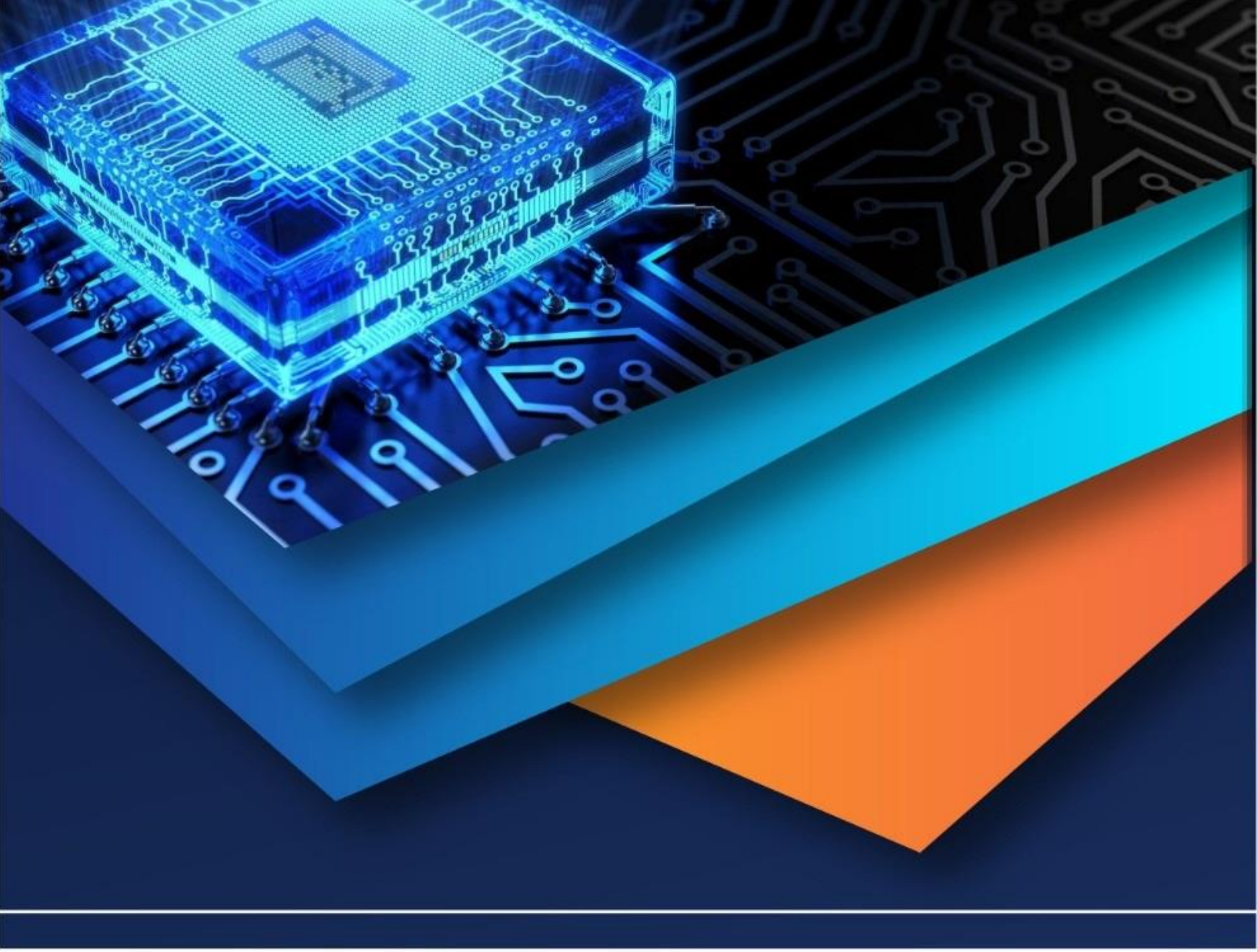

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