# Assessment of Safety Risk for Signalized and Un-signalized Intersection in a Road Network

**Daya Shankar Pandey, P.K. Agarwal**

***Abstract*: The spectacular increase of number of motor vehicles on the road is mainly attributed ingeneration of traffic problems like accidents, congestions, delays etc., especially in the urban premises of developing countries. This paper examines the traffic problems and sustainable improvement of road intersection at Bhopal, India. The special and temporal constitutions of the vehicle as well as pedestrian traffic at the intersections were examined and the characteristics of the junction indoctrinating the delay problems are identified. Data regarding the traffic volume, land use and pedestrian movement activities are collected through surveys, expert opinion and literature . Analysis of the collected data revealed that the improper planning of the junctions, lack of traffic signals and unauthorised parking are the major factors contributing to the traffic congestions. Various Using data collected from surveys, traffic frequency and severity standards for signalized and Un signalized have been established. The methodologies are developed incorporating the relative importance of different severity of different safety indices at intersection. The relative importance (weights) of very low, low, medium and high severity condition is developed using data collection and expert opinions experience people which have knowledge in development/safety development at intersection were obtained by conducting a survey. .***

***Keywords*: Road safety, Un- Signalized Intersection, Signalized Intersection, Traffic Survey**

## I. INTRODUCTION

Road accidents are clearly the most frequent and major cause of damage to human lives. The severity of road accidents, measured in terms of number of persons killed per 100 accidents has increased from 28.5 in 2014, to 29.1 in 2015 (MORTH, 2015).India has only 1 % of total vehicles across globally but it has 10 percent of total deaths (Times of India 2012). The reason behind this scenario is extremely dense road traffic, lack of planning and implementation in accordance to safety factors (proper geometric design, environmental conditions and traffic rules). More than half of road accidents occur at intersections. This has given a thrust to redesigning of the existing intersections. In a recent study in America (by FHWA) it was found that out of total fatal and injury crashes 56.7% of it took place at intersections, and on an average 53.5% crashes of all crashes took place at intersections only. In India this data ranges between 30%-35%. And in Australia 43% of urban crashes and 11% of rural crashes are at intersections. Vehicles moving in different directions, as well as pedestrians (wanting to cross the road) might try to occupy same space at the same time. Hence, to avoid accidents and improve overall efficiency, it is necessary to reduce this conflict for space. A signalized intersection has 32 conflict points whereas roundabout with one circulating lane and one entry lane has 8 traffic conflict points. An un-signalized intersection is the most hazardous locations in any road network. The conflict can be reduced by intelligent design of intersections based on evaluation of safety factors. Implementation and continued success of road-intersections depend on improved understanding of major safety factors. These factors include- traffic control devices, road and intersection geometry, driver behaviour, light and heavy vehicle characteristics, behaviour and requirements of other road users, traffic flow characteristics and operation of traffic control to resolve vehicle to vehicle conflicts (as well as vehicle to pedestrian conflicts). Optimization of above mentioned factors improve traffic and pedestrian safety, operational performance, environment and aesthetics.

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## II. METHODOLOGY BASED FRAMEWORK

In this section, framework for signalized intersections based on the above methodology is presented in brief (similar process, applied to un-signalized intersections, is already discussed in more detail). As per the methodology, the framework is developed in four stages.

**Stage I: Development of a Hierarchical Structure to Identify Safety Factors Affecting Safety at Signalized Intersection**

For signalized intersections, ten safety factors have been identified and classified. The ten factors have been classified into following four categories- improper intersection geometry, unsafe traffic operation, poorly designed traffic signals, and other safety factors.

**Stage II: Determination of Relative Importance of Identified Safety Factors**

For signalized intersections, it has been found that more important safety factors are- absence of cross-walk, and inadequate entry angle. These safety factors have relatively higher impact on the overall safety index.

**Stage III: Developing Assessment Tool (SIEM) for Evaluation of Overall Safety of Signalized Intersection.**

Formula for computing safety index values for each of the ten safety factors associated with signalized intersections is developed. These safety indices are used to compute the overall safety factor of the signalized intersection. The formula for the overall safety factor of signalized intersection is as follows:

$$SSI = \sum_{i=1}^{i=n} SSFI_i \quad \text{....Equation 1}$$

Where:

SSI = Overall safety index for the given signalized intersection.

$SSFI_i$ = Signalized intersection safety factor index for $i^{th}$ safety factor

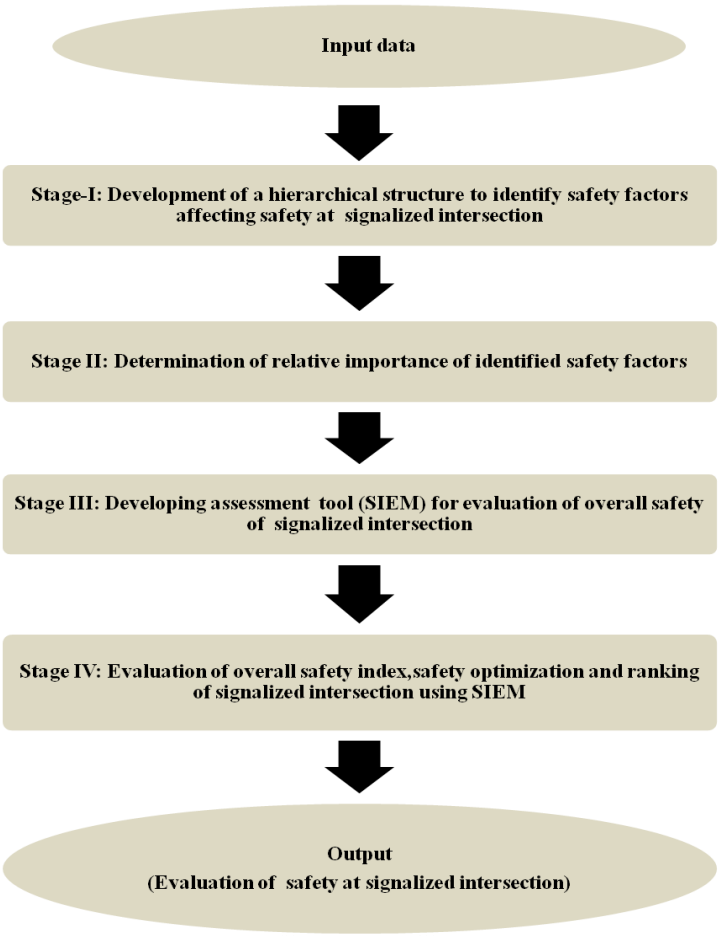


**Figure 1: Methodology based framework for evaluation of safety at signalized intersection**

## III. RESULT ANALYSIS OF THREE DIFFERENT SIGNALIZED INTERSECTIONS

**Table 1 Input data for identified Signalized intersections $SI_1$, $SI_2$, $SI_3$**

| S. No. | Safety Component ID | Safety Component | Notation | Desired value | Available Value | | |
|---|---|---|---|---|---|---|---|
| | | | | | (I) | (II) | (III) |
| | | | | | Board Office Square (SI1) | Jyoti Talkies Square (SI2) | TT Nagar Tiraha (SI3) |
| 1 | SSFI-1 | Gaps-in-median | GM | 12 | 10 | 9 | 10 |
| 2 | SSFI-2 | Inadequate Entry Angle | IEA | 60 | 60 | 50 | 45 |
| 3 | SSFI-3 | Inadequate Entry Radius | IER | 40 | 31 | 29 | 26 |
| 4 | SSFI-4 | Level of Service | LOS | 80 | 60 | 50 | 30 |
| 5 | SSFI-5 | Poor Lighting | PL | 20 | 15 | 10 | 8 |
| 8 | SSFI-6 | Traffic Signs | TS | 14 | 12 | 10 | 8 |
| 9 | SSFI-7 | Absence of Cross Walk | ACW | 8 | 8 | 3 | 3 |
| 10 | SSFI-8 | Narrow/No shoulder | NS | 1 | 0 | 0 | 0.5 |
| 6 | SSFI-9 | Slow Moving Vehicle Composition | SMVC | | | | |
| 7 | SSFI-10 | Non Motorized Transport Composition | NMTC | | | | |

All intersection (Board Office, Jyoti Talkies and TTnagr) have desired index value and they apply proposed method to optimized parameter to enhance security. As show on table 1

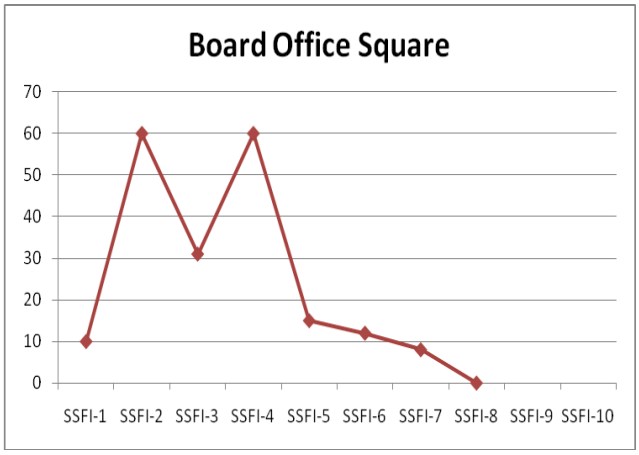


**Figure 2 Graph of safety indices parameters with Actual value (Present value) of Signalized Intersection of Board Office Square**

Figure 2 presents the Available value of safety parameter identified signalized intersections on the basis of result obtained using developed methodology for the board office square.

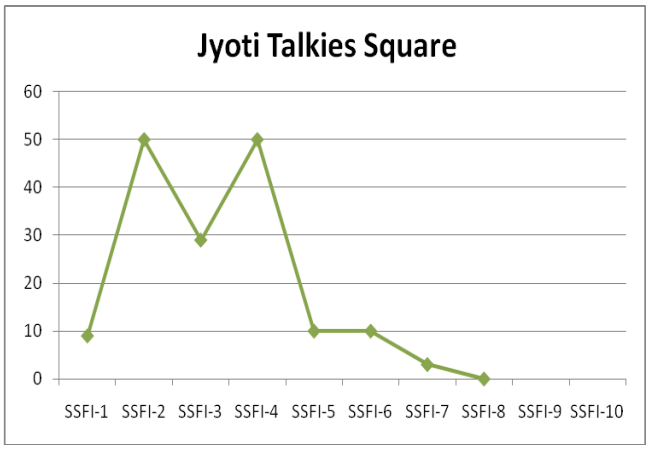


**Figure 3 Graph of safety indices parameters with Actual value (Present value) of Signalized Intersection of Jyoti Talkies Square**

Figure 3 presents the Available value of safety parameter identified signalized intersections on the basis of result obtained using developed methodology for the Jyoti Talkies Square.

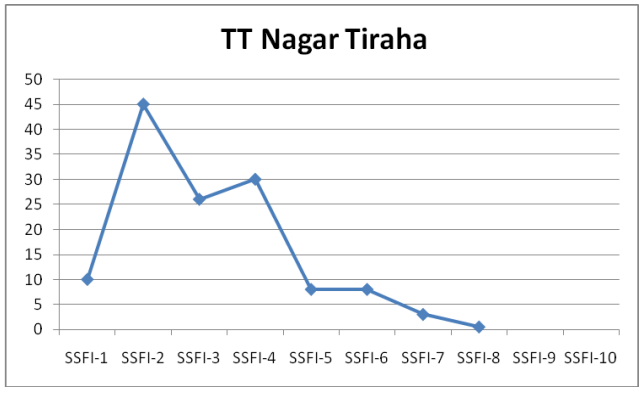


**Figure 4 Graph of safety indices parameters with Actual value (Present value) of Signalized Intersection of TT Nagar Tiraha**

Figure 4 presents the Available value of safety parameter identified signalized intersections on the basis of result obtained using developed methodology for the TT Nagar Tiraha.

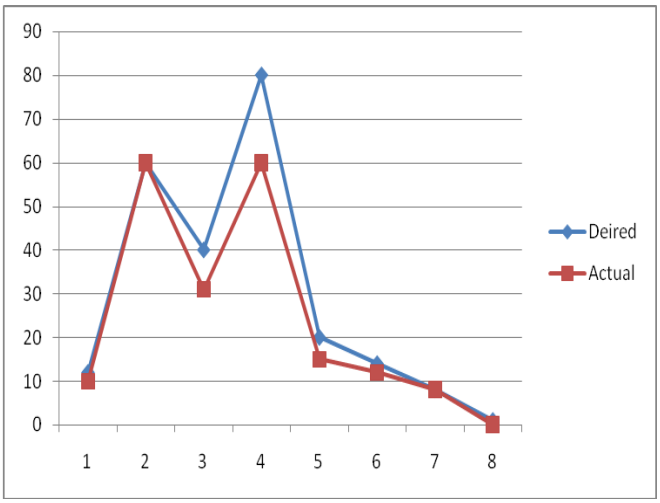


**Figure. 5 Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of Board Office Square**

This section presents the comparison of the results of level of safety at identified signalized intersections based on the overall safety Indices determined in pervious section. Table 1 shows the Desired and available parameter indices using developed methodology and figure.5 presents the Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of Board Office Square to identified signalized intersections on the basis of result obtained using developed methodology.

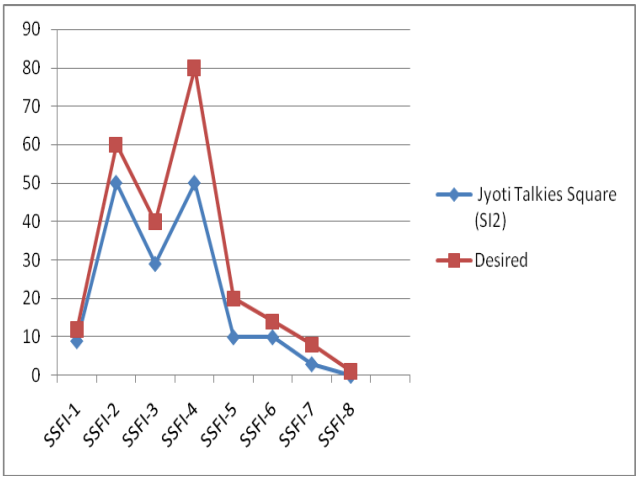


**Figure 6 Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of Jyoti Talkies Square**

Desired and available parameter indices using developed methodology and figure 6 presents the Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of Jyoti Talkies Square to identified signalized intersections on the basis of result obtained using developed methodology.

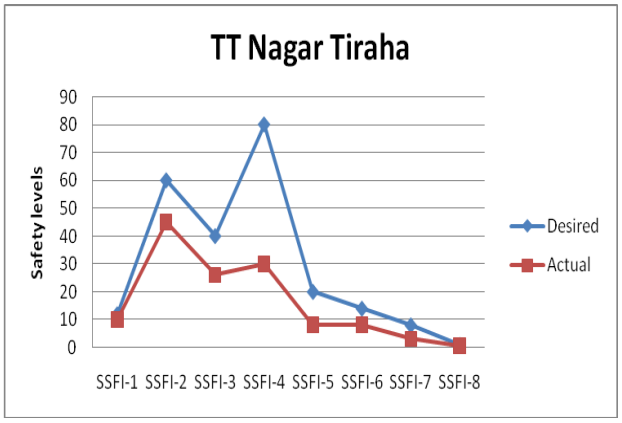


**Figure 7 Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of TT Nagar Tiraha**

Desired and available parameter indices using developed methodology and figure 7 presents the Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of TT Nagar Tiraha to identified signalized intersections on the basis of result obtained using developed methodology.

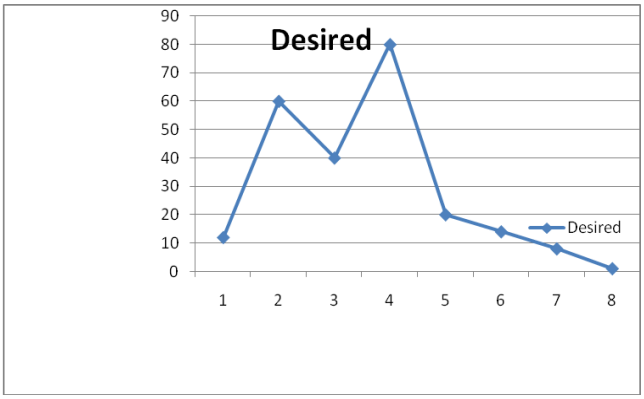


**Figure 8 Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of TT Nagar Tiraha**

Desired parameter indices using developed methodology and figure 8 presents the graph of Desired Value of safety indices of Signalized Intersection of identified signalized intersections on the basis of result obtained using developed methodology.

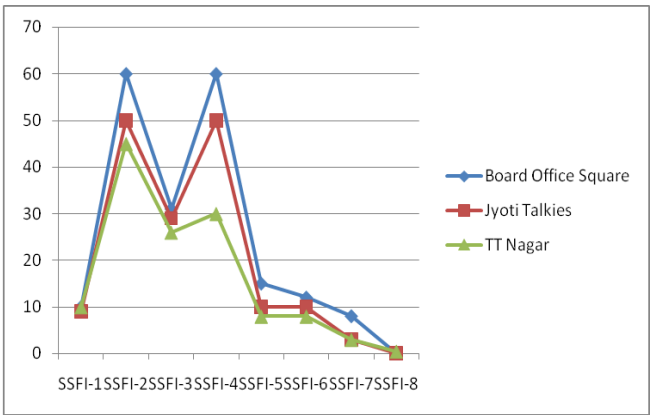


**Figure 9 Comparison graph of Desired Value of safety indices with Actual value (Present value) of Signalized Intersection of TT Nagar Tiraha**

## IV. CONCLUSION

In this paper, the process of development of framework for signalized intersections have been given. The development of framework is based on the methodology described earlier. The framework is implemented over MATLAB to give Safety Index Evaluation Method (SIEM) software. SIEM improves the overall safety of intersections optimally and ranks the intersections on the basis of their overall safety index.

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