ABSTRACT
Road accident is being one of the most challenging issue in Indian transportation system till date. The number of vehicles are increasing rapidly day by day, thereby increasing the rate of accidents. Keeping in view such problems India has adopted the iRAP (International Road Assessment Programme) methodology to fulfill the needs of road users, thereby reducing the risk potential. Risk Assessment Model (RAM) is a part of iRAP. Though iRAP Methodology is new concept for India for the deceleration of fatalities and serious injuries. The survey is carried out along a stretch (Banarpal to Manguli Chowk) of 94 km having high traffic corridor as this stretch is connecting most of the industrial areas. So the flow of heavy commercial freight carriers is maximum throughout the year. That’s why the number of road accidents like major and minor in this particular stretch is 300 to 350 accidents per annum.

There will be implementation of RAM & we have generated in 4 different Group Rating (GR) of roads such as group-4 roads being the safest ones while group-1 roads being least safe. To predict risk potential for safety aspects are required for the implementation of “Transportation Infrastructure Management Strategies” (TIMS) like development of Attributes (e.g. proper delineation, signage, Operating Speed, property access point, elevation profile, Intersection of traffic volume etc.). The Observed data defines there will be spontaneous reduction of percentage of risk potential for safety which may be further reduced to a minimum value if there will be some maintenance work.

Keywords−Group Rating, International Road Assessment Programme, Risk Assessment Model, Risk score, Transportation Infrastructure Management Strategies.

INTRODUCTION
Risk assessment is a modern era of a Transportation Infrastructure Management Strategies (TIMS) planning process. India experience development of socioeconomic at last decades, thereby increasing of vehicle ownership that predict utility of roads. The statistical view of fatality rate 1,41,526 persons was killed and 4,77,731 injured in road traffic crashes in India [8] in the year of 2014(TRIPP). There will be enforcing on information related to risk assessment on roads towards the development of modern transportation infrastructure.

This paper review on monitoring of risk potential with the help of Risk Assessment Model [4]. The
model has demonstrated how road attributes [2] should be continuous, comprehensive and co-operatively by the user towards national safety.

**INTERNATIONAL ROAD ASSESSMENT PROGRAMME**

iRAP evolved out of works of existing Road Assessment Programme of developed countries (EuroRAP, AusRAP, usRAP and KiwiRAP) and expertise of leading road safety research organisations. Currently it serves as the umbrella organisation for all RAP’s throughout the world. iRAP was established to help tackle the devastating social and economic cost of road crashes majority of them taking place in low income countries.

**Table 1. Differences between iRAP, AusRAP and EuroRAP**

<table>
<thead>
<tr>
<th>iRAP</th>
<th>AusRAP</th>
<th>EuroRAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focused on vehicular, motorcyclists, cyclist and pedestrian safety.</td>
<td>Focused on vehicular safety.</td>
<td>Focused on vehicular safety.</td>
</tr>
<tr>
<td>Each link or section was of fixed length of 100m.</td>
<td>Link length varied from 10 to 600km.</td>
<td>Link is of usually 20 km.</td>
</tr>
<tr>
<td>No preconditions for selection of risks.</td>
<td>Only links having 20 or more fatal accidents over 5 years period considered</td>
<td>Only links which had 20 or more death or injuries over 3 year period</td>
</tr>
<tr>
<td>Generates only, Star Rating Score</td>
<td>Generates individual risk and collective risk score.</td>
<td>Generates individual risk and collective risk score.</td>
</tr>
</tbody>
</table>

The various RAP’s help to identify and prioritize higher risk location where the road authorities can implement road safety measures in order to address the safety concerns. iRAP has developed four globally-consistent protocols to assess and improve the safety of roads as mentioned below.

- Risk Maps uses thorough crash data to exemplify the actual number of deaths and injuries on a road network.
- Star Ratings provide a simple yet objective measure of the level of safety provided by a road’s design.
- Safer Roads Investment Plans rely on around 90 road improvement options to generate affordable and economically viable infrastructure options.
- Performance Tracking enables the use of Star Ratings and Risk Maps to track road safety performance.

Currently iRAP organisation is operative in more than 50 countries, particularly in developing countries. In India iRAP methodology [3] has been implemented for star rating of roads in Assam, Gujarat, Andhra Pradesh and Karnataka.

**RISK ASSESSMENT MODEL**

Risk Assessment Model (RAM) enables the accidents and risk occurring different parts of roads [4]. It predicts risk potential for safety aspects required for the forecasting of future travel demand on the way of convenience traffic pattern. The development of risk model is dealing with degree of safety and behavior of driver, there by addressing of utility of roads.

The requirement to enable development of risk model [7] is aimed at developing country like India and the models choose reflected the following characteristics are:

- The death of traveler increasing widely in urban, semi-urban and rural roads, there by extended to all
these roads. In heterogeneous traffic condition
majority of accidental death not necessarily involve
car occupants, so RAM were needed for pedal
cyclists, pedestrians and motorcyclists as well.

- Observed accident data were very limited, and thus
  model estimates of casualties were likely to be the
  main tool by which to evaluate countermeasures.
- The huge accident toll meant that uncertainty in
  casualty estimates was not critical and models
  focused on the main accident factors would be useful,
even if some of the safety relationships were only
  poorly understood.

**Group Rating**
Road safety engineering makes a direct contribution
to the reduction of road death and injury. Well-
designed intersections, safe roadsides and appropriate
road cross-sections can significantly decrease the risk
of vehicular crashes and its severity. Footpaths,
pedestrian crossings and bicycle paths can also help
in minimising the risk of pedestrians and bicyclists
being killed or injured in accidents. RAP model
generates group rating [5] for all the four users of
roads namely; Vehicle occupants, motorcyclists,
pedestrians, and bicyclists.

**Table 2. Group Rating for relative risk**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Relative risk score for band</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 – 2.9</td>
</tr>
<tr>
<td>2</td>
<td>3.0 – 5.9</td>
</tr>
<tr>
<td>3</td>
<td>6.0 – 10.9</td>
</tr>
<tr>
<td>4</td>
<td>&gt;10.9</td>
</tr>
</tbody>
</table>

**TRANSPORTATION INFRASTRUCTURE MANAGEMENT STRATEGIES**
TIMS is a system or ordered way of doing things
which allows for and encourages effective integrated
planning and efficient management [1] of a system of
transport infrastructure. It predicts the management
of attributes on the road.

It gives an appropriate performance indicator for
deciding whether, and to what extent, the objectives
of the strategies have been achieved in Transportation
Infrastructure. and it also intended to ensure value for
money for resources applied to the construction,
maintenance and operation of transport infrastructure.

**METHODOLOGY**
For this stretch, Banarpal to Manguli Chowk of
National Highway -55 was selected and the covered
stretch found to be 94 km. The selection behind the
study stretch was heavy traffic flow of heavy vehicles
and it is shortest path of connected to industrial area.

**Data Collection**
The data were collected during road survey which
was conducted. The data having collection of all
attributes and the road attributes were video recorded
with the help of test vehicle at a speed of 40-50
kmph.

![Image](image-url)  
**Figure 1. Identified study stretch of NH – 55**
At the time of survey elevation profile and speed
profile also recorded with the help of GPS (Global
Positioning System) [6]. The study stretch is selected
from Banarpal to Manguli Chowk(NH-55) having 94
km connecting to high density traffic corridor.

**Analysis of Data**
The total study stretch is 94 km and it is divided
94,000 sections, each measuring section is 100 m. the
collection of data with the help of test of vehicle
analysis all the attribute corresponding to each sections. Following analysis of all Risk attributes that effect TIMS are:

**Proper Delineation**

Delineation is a measure of the road attributes that inform drivers of road conditions to keep them within the driven lane and forewarn them with changing nature of road. It encompasses advance warning signs, chevron alignment markers, intersection warning signs, advance direction signage, painted edge and Centre lines, guideposts, and pavement markers. The risk factor assigned to it, if adequate is 1.0 and 1.2 if poor for run-off and head-on Loss of Control (LOC) cases.

The study stretch lacked proper delineation throughout the total length. It lacked pavement edge markings, centerline marking also. At some places proper delineation was recorded due to relatively new construction. About 99% of section leaked proper delineation as evident from following figure 2.

![Delineation](image)

**Figure 2. Delineation throughout the study stretch**

**Signage**

Signage is a vital parameters of transportation planning process, it predicts vehicle occupancy on roads. The signage throughout stretch having 15% lost due to construction of roads and 5% lost due to accidents of vehicles.

**Riding Surface**

The study stretch having effect of road surface due to unsealed surfaces, slippery surfaces, crossing of railway lines, sloping surfaces in high crowned roads, high density of traffic volume etc. Figure 3 shows the percentage of Good riding surface on those sections.

![Riding Surface](image)

**Figure 3. Details of Good riding surface throughout the sections**

**Operating Speed**

Operating speed is directly proportional to the utility of road. Normally, operating speed assumed as 80-90 kmph and for the operating speed of rural and urban roads about 50 kmph. Refer to figure 3 and figure 4 for graphical presentation of operating speed.

![Operating Speed](image)

**Figure 4. Detailed graphical view of speed profile with respect to distance**

![Operating Speed](image)

**Figure 5. Detailed graphical view of speed profile with respect to time**
Table 3. Details of speed throughout the study stretch

<table>
<thead>
<tr>
<th>Observed Condition</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum speed</td>
<td>0.7 km/h</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>61.1 km/h</td>
</tr>
<tr>
<td>Average climbing speed</td>
<td>37.1 km/h</td>
</tr>
<tr>
<td>Average descent speed</td>
<td>37.2 km/h</td>
</tr>
<tr>
<td>Average flat speed</td>
<td>38 km/h</td>
</tr>
<tr>
<td>Average speed</td>
<td>37.4 km/h</td>
</tr>
</tbody>
</table>

Table 4. Details of time throughout the study stretch

<table>
<thead>
<tr>
<th>Observed Condition</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start time</td>
<td>04:20:07</td>
</tr>
<tr>
<td>End time</td>
<td>07:21:59</td>
</tr>
<tr>
<td>Total track time</td>
<td>3h 01m 52s</td>
</tr>
<tr>
<td>Climbing time</td>
<td>1h 10m 06s</td>
</tr>
<tr>
<td>Descent time</td>
<td>49m 55s</td>
</tr>
<tr>
<td>Flat time</td>
<td>1h 01m 51s</td>
</tr>
</tbody>
</table>

Property Access Points

- Residential
- Commercial
- Educational
- NA

Figure 6. Property access points recorded in identified stretch

Apart from these all road attributes, there was complete absence of shoulder rumble strip, paved shoulder, centerline rumble strip, differential speed. The intersections lacked in sight distance, street lights, intersection channelization and speed management. At property access points, nothing could be recorded for median type and service road because of their sheer absence.

Also due to the inability to measure skid resistance grip, everywhere it has been assumed to be in sealed-medium state. External flow influence factor property access has been assumed as default flow in the absence of pedestrian flow count. This value has been assumed as .01.

Elevation Profile

Elevation profile provides the diagnostic view of road user with respect time and distance. Figure 7 and 8 shows the study of elevation on stretch have increases elevation with increase of distance and time and Here 43% of plane terrain on the road section.
Figure 7. Detailed graphical view of Elevation profile with respect to distance

Figure 8. Detailed graphical view of elevation profile with respect to time

Table 5. Detailing of elevation throughout the study stretch

<table>
<thead>
<tr>
<th>Observed Condition</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum elevation</td>
<td>-5 m.s.l.</td>
</tr>
<tr>
<td>Maximum elevation</td>
<td>104 m.s.l.</td>
</tr>
<tr>
<td>Average elevation</td>
<td>49.9 m.s.l.</td>
</tr>
<tr>
<td>Maximum difference</td>
<td>109 m</td>
</tr>
<tr>
<td>Total climbing</td>
<td>4157 m</td>
</tr>
<tr>
<td>Total descent</td>
<td>4099 m</td>
</tr>
<tr>
<td>Start elevation</td>
<td>27.1 m.s.l.</td>
</tr>
<tr>
<td>End elevation</td>
<td>85 m.s.l.</td>
</tr>
<tr>
<td>Final balance</td>
<td>57.9 M</td>
</tr>
</tbody>
</table>

Intersection of traffic volume

The rate of intersection of traffic volume directly proportional to risk on the place that will be found accident. Figure 9 shows intersection of traffic flow on identified stretch.

Figure 9. Present scenario of traffic volume at an Intersections

Assigning of Group rating on Road sections

The assigning of group rating on road section are divided into 94,000 section, each section has 100 m. The group Rating Score on the basis of which road sections were rated from 1 to 4 group. Figure 8 shows the distribution of group Ratings obtained by following the iRAP methodology for all sections.

Figure 10. Detailing view of Group rating score on road section

The factors which lead to poor star rating have been identified. This study section lacked many basic safety necessities. There was complete absence of road markings throughout the stretch. The road surface condition was also very poor, full of pot
holes. The line of sight was obstructed at several curves. The intersections were poorly planned and were often uninformed thereby increasing accident potentials. Nowhere paved shoulders could be observed. At several places the road side hazards were within 1 m range. Lower group ratings (3 and 4 group) increases the risk of accidents as compared to higher group ratings. Thence these high risk roads must be equipped with adequate countermeasures to improve the group ratings.

**Assigning of Risk score on Road sections**

The assigning of risk score on road sections clearly evident that about 2.73 and 4.12 are group 1 and group 2 predict minimum risk on those road sections while group 3 and group 4 have maximum risk on those road sections. Figure 11 provides the relative risk on road sections.

**Figure 11. Detailed view of Relative Risk score on road sections**

**CONCLUSION**

This paper provides that the study of risk at road section that should effect on Transportation Infrastructure Management Strategies (TIMS). On the road section are basically improvements in the road attribute which lower the risk factor associated with it. These counter measures include basic road requirements (proper road markings, signage, road surface conditions etc.) apart from other new installations like addition of lane, crash barriers, clearing roadside hazards etc.

In this study, Group rating have been adopted to enhance risk on road sections. The application of these countermeasures will enhance the safety aspects along with decrease in accident potential of hazardous sections. The resulting group ratings are 14%, 11%, 29%, and 46% for group 1, 2, 3 and 4.

To identifying the risk score with the help of group ratings are 2.73, 4.12, 8.95, 10.1 for group 1, 2 3, and 4. Here group 1 and group 2 have 23,500 sections on road are relatively low risk while group 3 and group 4 have 70,500 sections are higher relative risk. The effect of these attributes along the development of TIMS effect 25% of group 1 and group 2 while 75% are group 3 and group 4 on this study stretch.

**ACKNOWLEDGMENTS**

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**REFERENCES**


