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GIS based Road Safety Audit

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Abstract: ***All road safety audit process done for Indian condition are effective, but tedious and also time consuming. This paper is intended to illustrate applications of Geographic Information System (GIS) in transportation planning for which authors have made an attempt to simplify road safety audit process by integrating it with a GIS based software "Gram ++". This technique will help the road auditors to differentiate different sites of a road segment having higher accident frequency with sites having low accident frequency which should be potentially improved in a cost effective manner. It will also help road safety audit experts to identify and focus on the real problems at specific site of road segment right from planning stage for which authors have presented the procedure & discussed how it can be applied so that all road features can be considered simultaneously.***

Keywords: Road Safety Audit (RSA), GIS, Digitization, Road Segment

1. Introduction

In India with more than one lakh fatalities per annum accounts for about 10 % of total world's road fatalities. The share of National Highways and State Highways in the total road network is just 6 % but these cater to 70 to 75 % of total road traffic in India. However, the National Highways, which constitute less than 2 % of the total road network, account for 20 % of total road accidents and 25 % of total road traffic fatalities occurring on Indian roads. Further, the severity of road traffic accidents on National Highways is more because of higher speeds as compared to other roads. The road safety situation in India is worsening. Accidents, fatalities and casualties have been increasing dramatically over last 20 years – about 5 % growth rate over last two decades - partly due to exponential growth of vehicles. The death rate per vehicle is 10 to 20 times higher in India as compared to high-income countries like Sweden, Norway, Japan, Australia, UK and USA. It is much higher even when compared to many low-income countries like Brazil, Mexico and Malaysia. Pedestrians, bicyclists and motorized two-wheeler riders are the Vulnerable Road Users (VRU), which constitute 60-80 % of all traffic fatalities in India. This seems logical as this class of road users forms the majority of those on roads. On highways, the proportion of VRU and other motor vehicle occupants are 32 % and 68 % respectively. In addition, they sustain relatively more serious injuries even at low velocity crashes, unlike car occupants who are protected by impact absorbing metallic body of the vehicles [1].

2. Literature Review – Road Safety Audit

The main aim of road safety audit is to ensure that all new road schemes operate as safely as practicable. This means that safety should be considered throughout the entire cycle of design, construction and pre-opening of any project facility and also during operation & maintenance of the highway. Specific aims of RSA are:

a) To minimize the risk of accidents likely to occur/occurring on the project facility and to minimize their severity.
b) To minimize the risk of accidents likely to occur/occurring on adjacent roads i.e., to avoid creating accidents elsewhere on the network.
c) To recognize the importance of safety in highway design to meet the needs and perceptions of all types of road users; and to achieve a balance between needs of different road user types where they may be in conflict with one another.
d) To reduce long-term costs of a project facility, bearing in mind that unsafe designs may be expensive or even impossible to correct at a later stage.
e) To increase awareness about safe design practices among all those involved in planning, design, construction and maintenance of roads.

Road safety audits assess the operation of a road, focusing on road safety as it affects the users of the road. These users include pedestrians, motorcyclists, truck, bus drivers, on-road public transport users, etc. The outcome of a road safety audit is the identification of any road safety deficiencies and formulation of recommendations aimed at removing or reducing those deficiencies [1].

3. Methodology

A road segment of 3Km of National Highway 17 between Panvel and Indapur was taken for the study. All possible features of the road segment where highlighted using GIS tools "Gram++"as a platform as follows.

a. Digitization of all features of road segment was done showing super elevation, chainages and position of sign boards in "Raster Analysis" module. Digitization of super elevation layer is shown in figure 1.

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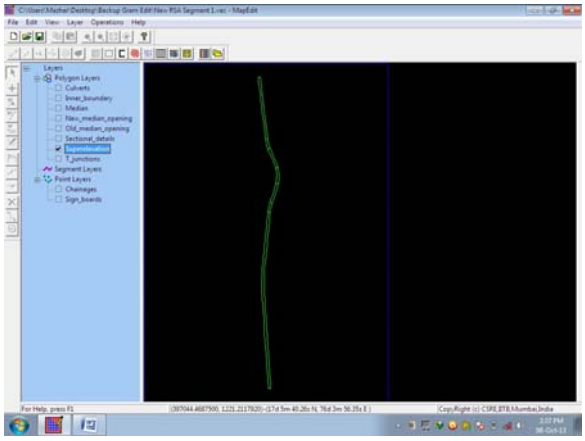

Figure 1: Digitization of Super-Elevation Layer

b. After digitization all respective layer is completed it should be clean with minimum snap distance.
c. Once cleaning of polygons is completed labeling of all polygons.
d. After labeling all polygons table should be created as shown in figure 2.

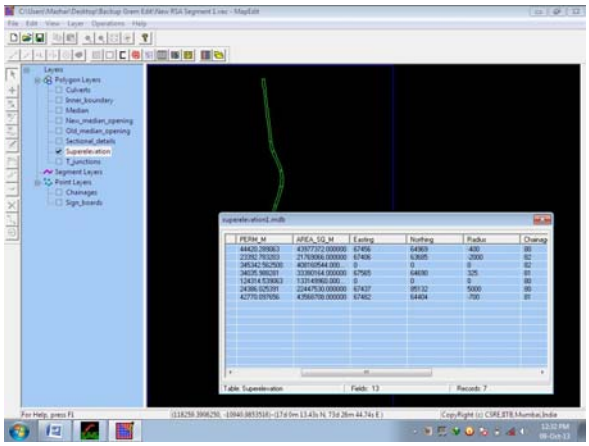

Figure 2: Table formation for Super Elevation Layer

e. Once table is created it can be edited and all new features such as radius, length of curve & variations in super elevation etc. can be added to the table by using "Vector Analysis" module which creates a database for that particular layer as shown in figure 3.
f. After creating a database file queries regarding super elevation layer can be viewed. Examples of query are given below.

Query 1: Super elevation < 5% (Figure 4)
Query 2: Sections having radius < 5000m (Figure 5)

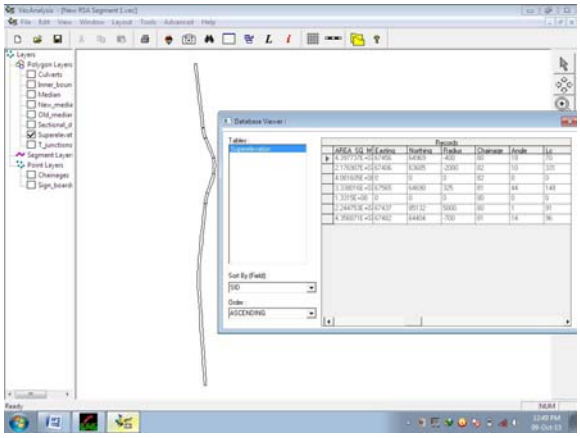

Figure 3: Database formation for super elevation layer

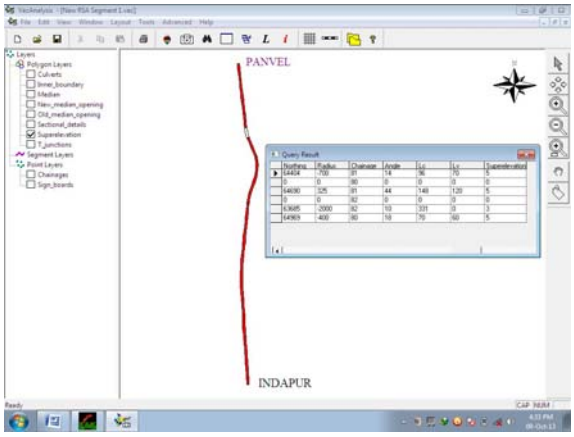

Figure 4: Showing results for Query no.1

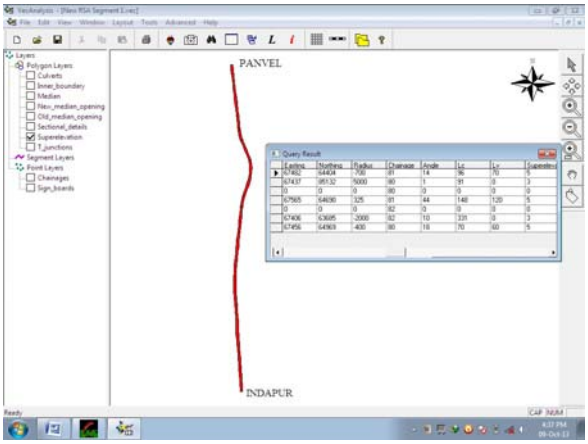

Figure 5: Showing results for Query no.2

g. Figure.4 shows the areas in which super elevation of that segment is less than 5% in red color whereas Figure 5 shows that sections in which radius is less than 5000m in red colour.
h. Similarly other features of this particular road segment can be highlighted such different change positions and sign board positions as per IRC: 67 2010 norms.

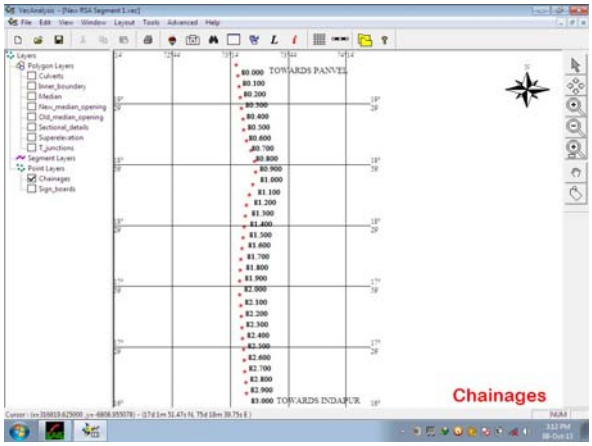

Figure 6: Change points in road segment

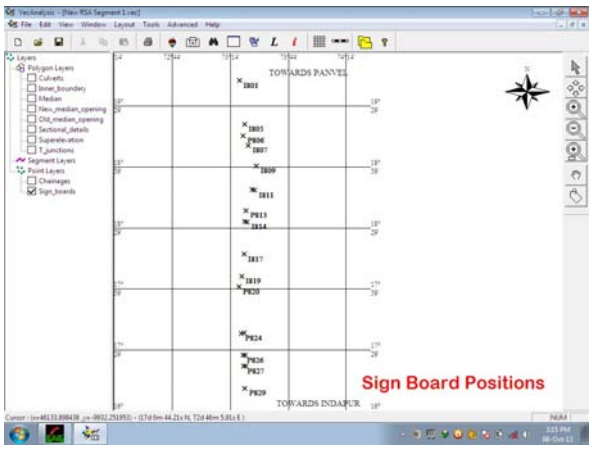

Figure 7: Position of sign boards

4. Conclusion

In this paper authors have shown how different elements of road segment can be highlighted using a GIS based tool right from planning stage so that large number of accidents can averted beforehand. It will help road auditors to analyze all layer segments simultaneously so that recommendations given in preliminary stage can be implemented in consecutive stages of road safety audit process so that corrections can be made instantly.

5. Future Scope

This method of road safety audit can be made more effective and precise by using Global Positioning System (GPS) and Remote Sensing (RS) technologies and integrating it with GIS so that black spot location can be identified and improvements can be suggested using road safety audit procedures.

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