Geopathic Stress: A Possible Cause for Pavement Distresses and Road Accidents

Salgude Rohit, Pimplikar Sunil, Sonawane Gaurav

Abstract*: *India loses 3% of its GDP due to road accidents. Significance of Geopathic stress as a causative factor of road accidents has been studied by few researchers; however its effect on Pavement distresses and hence road accident is yet unexplored. The aim of this research is to determine the correlation between average number of accidents, Pavement Condition Index (PCI) values and Geopathic stress. Accident data was collected from Pune traffic department for 3 years period from 2015-16 to 2017-18. Based on the number of accidents during this period accident blackspots were found. On each black spot pavement distresses survey was carried out and its condition was analyzed by Indian Road Congress (IRC) 82:2015 code method. At these accident blackspots detection of geopathic stress was done by using 2 copper L-rods, lecher antenna. Intensity was measured in terms of electrical and magnetic field. Electrical field reading was measured using Esmog-spion and magnetic field reading was measured by magnetometer. Data was analyzed using Karl Pearson's correlation coefficient and a linear regression model is developed for average number of road accidents ($\bar{A}$) with Pavement Condition Index (PCI). Utility of the equation is for forecasting the number of fatal accidents at similar black spots based on their pavement distress condition. A further attempt is to investigate the effect of electric and magnetic characteristics of geopathic stress on road accidents.

Key words: Accident blackspots, geopathic stress, magnetic field, electrical field, pavement distresses, pavement condition index.

I. INTRODUCTION

Road accidents result in high fatalities and serious injuries. India loses 3% of its GDP due to road accidents. Studies on the road performance accident blackspot identification which have been conducted in past few years are mentioned below. Pimplikar (2017) has prepared an accident prediction model based on geopathic stress; Nega (2015) generated Statistical Downscale Model (SDSM) to predict temperature of pavement and analyze cost of distresses. Veluru (2015), Agyemang (2013) have generated accident analysis models to predict accidents; Dhamaniya (2013) generated accident prediction model under mixed traffic conditions. Mohammad (2017), Magdi (2016), Soram (2014), Yao (2014), Baek (2014), Vishwanath (2013), Parida (2005), Roger (1998), Carlos (1990) have studied various types of pavement distresses, measured them using automated and manual methods.

Significance of geopathic stress as a causative factor of road accidents has been studied by few researchers; Sorte (2015) concluded that majority of accidents whose causes are unknown occur on geopathic stress zone only. Kharat (2012), through his empirical investigations at some spots on National Highway observed that reaction time of drivers changes on geopathic stress zone leading to road accidents. Dharmadhikari (2012) detected geopathic stress using dowsing and georesistivity meter. Chafekar (2012) has conducted the empirical investigations for detection of geopathic stress zone location on road using magnetic field detector. This investigation indicated that presence of geopathic stress affects soil and also road pavements. Dharmadhikari (2011) observed that the human body voltage increases and skin resistance decreases on geopathic stress zone as compare to non-geopathic stress zone, copper L-rods get deflected and electrical resistivity decreases as water content increases. Pimplikar (2011) has investigated effect of geopathic stress on human body system in motion while driving cars at high speeds. He also developed simple models that identify the relationship of subterranean features and human body system in motion on highways and expressways. This investigation revealed that geopathic stress is one of the cognigible, natural and scientific phenomenon in the infrastructure development of built environment. He further observed visible pavement distresses at the accident locations, particularly even in newly constructed pavements. Dharmadhikari (2010) used light inference technique to study nature of geopathic stress.

II. OBJECTIVES OF STUDY

1. To determine the Pavement Condition Index (PCI) values at accident blackspots, using Indian Road Congress method.
2. To determine the Karl Pearson correlation coefficient between average numbers of accidents on black spots and pavement condition index (PCI), also between average number of accidents and electric voltage, magnetic field on geopathic stress zones.

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3. To formulate a linear regression model between average numbers of road accidents and pavement condition index (PCI), and to analyze effect of electrical, magnetic characteristics of geopathic stress on road accidents.

III RESEARCH METHODOLOGY

1. Accident data from Pune traffic department is collected for 3 years period from 2015-16 to 2017-18. Based on the number of accidents occurring during this period total 30 accident blackspots were found.
2. For each spot 150 m length with 3.5m width was considered for pavement distress survey. All distresses were recorded as per standard format of IRC 82:2015 and categorized as poor, fair and good based on pavement conditions.
3. On each blackspot the geopathic stress was detected using 2 copper L-rods and lecher antenna. It's intensity is measured in terms of electrical and magnetic field. The electrical field is measured in µVolts using Esmog Spion and magnetic field in µTesla by magnetometer.

If five and more accidents have occurred at the same spot within a period of three years then it is considered as a black spot. The common types of distresses are alligator cracking, transverse cracking, longitudinal cracking, potholes, bleeding, patching, ravelling, rutting. All 30 accident black spots are divided in two categories as major and minor accident black spots in table no. 1 and table no. 2 respectively. Major accident black spots were considered as those where more than 10 number of average accident have occurred. Corresponding average number of accidents at black spots are then correlated with Pavement Condition Index (PCI) values.

Table-1: List of major accident blackspot with average number of accidents, electrical, magnetic field, PCI, and type of distresses

Sr. No.	Location Of Black-Spots	Pavement Condition	Co-ordinates	PCI by IRC	Magnetic Field (µ Tesla)	Electrical Field (µ Volts)	Combine Field (μ^2 Tesla-Volts)	Average No. of Accidents	Type of Distress extent on spot
1	Katraj Chowk	Poor	18°26'52.7"N, 73°51'31"E	1.004	43.5	4000	174000	22	Patching
2	Dighi Magzin Chowk	Poor	18°37'59.9"N, 73°52'30.0"E	0.943	41	1500	61500	20	Patching
3	Wakad Bridge	Poor	18°35'30.6"N, 73°45'25.7"E	1.071	39	2000	78000	28	Ravelling
4	Punawale	Poor	18°38'03.7"N, 73°44'27.1"E	0.981	36	2500	90000	13	Patching
5	Fursungi Railway Flyover	Poor	18°28'15.80"N, 73°57'34.74"E	0.97	39	2000	78000	22	Loose Rock
6	Maimangeh Hospital	Poor	18°29'5.0"N, 73°47'58.4"E	0.995	46	1000	46000	32	Cracking+Patching
7	Nawale Bridge	Poor	18°27'34.4"N, 73°49'24.4"E	1.032	42	4000	168000	20	Cracking
8	Walvekar Chowk	Fair	18°28'52.3"N, 73°51'26"E	1.544	41.5	1500	62250	12	Patching
9	Ganga Dham Chowk	Fair	18°28'50.7"N, 73°52'20.0"E	1.34	42	1500	63000	14	Settlement/ Depression
10	Gadital, Hadapsar	Fair	18°30'3.00"N, 73°56'14.84"E	1.685	40	2500	100000	12	Patching
11	Khadimachine Chowk	Fair	18°27'09.6"N, 73°53'27.8"E	1.323	42.5	2000	85000	17	Patching
12	Telachi Mori	Fair	18°34'19.36"N, 73°57'18.42"E	1.558	43.4	3000	130200	23	Shoving
13	Sadal Baba Chowk	Fair	18°32'41.7"N, 73°52'37.5"E	1.714	45.8	4000	183200	11	Edge- Breaking
14	Sangamwadi Parking	Fair	18°32'03.9"N, 73°51'40.6"E	1.654	33.2	3000	99600	14	Patching
15	Mutharivar Bridge	Fair	18°28'28.4"N, 73°48'33.8"E	1.65	29	3000	87000	11	Ravelling
16	Wadgaon Bridge	Fair	18°27'58.3"N, 73°49'1.2"E	1.521	39	2000	78000	18	Segregation
17	Dukkar Khind	Fair	18°29'46.5"N, 73°47'16.1"E	1.58	40	3000	120000	14	Patching

Table-2: List of Minor accident blackspot with average number of accidents, electrical, magnetic field, PCI and type of distresses

Sr. No.	Location Of Black-Spots	Pavement Condition	Co-ordinates	PCI by IRC	Magnetic Field (μ Tesla)	Electrical Field (μ Volts)	Combine Field (μ^2 Tesla-Volts)	Average No. of Accidents	Type of Distress extent on spot
1	Dayas Plot	Poor	18°29'47.3"N, 73°52'09.4"E	0.83	44.5	4000	178000	8	Patching
2	CME Gate	Poor	18°34'45.14"N, 73°50'6.35"E	0.962	39.5	2875	113563	5	Edge- Breaking
3	Bhakti Shakti Chowk	Poor	18°39'52.5"N, 73°46'20.7"E	0.933	35	3000	105000	7	Loose Rock+Settlement
4	Karishma Chowk	Fair	18°30'15.1"N, 73° 49' 16.3"E	1.387	40	4000	160000	6	Patching
5	Jedhe Chowk	Fair	18°30'02.2"N, 73°51'30.9"E	1.63	44.5	1500	66750	6	Patching
6	Jagtap Dairy Chowk	Fair	18°35'32.2"N, 73° 47' 6"E	1.5	42	2500	105000	8	Ravelling+Patching
7	Balewadi Stadium	Fair	18°34'30.3"N, 73° 45' 47.8"E	1.775	38	3000	114000	9	Ravelling
8	Bavdhan	Fair	18°30'26.3"N, 73°47'10.9"E	1.41	40	2000	100000	7	Cracking
9	Bhumkar Chowk	Fair	18°36'20.5"N, 73°45'08.2"E	1.781	43.5	2000	87000	9	Shoving
10	Dhavade Wasti	Fair	18°37'49.6"N, 73°51'2.2"E	1.21	40.5	3500	141750	8	Patching
11	Nashik Phata	Fair	18°36'24.48"N, 73°49'20.13"E	1.733	44	4000	176000	6	Patching
12	Kharadi Bypass	Fair	18°33'44.2"N, 73°56'18.9"E	1.754	37.4	4000	149600	7	Ravelling
13	Hyatt Hotel Chowk	Fair	18°33'16.5"N, 73°54'14.8"E	1.671	38.4	4000	153600	9	Patching

IV DATA ANALYSIS

Figure 1 shows the distribution of the common type of the pavement distresses. It is observed that the most prominent distresses are patching, cracking, raveling, edge breaking, settlement/depression and shoving, out of which cracking, edge braking, settlement indicate structural distress in pavements based on structural deformations. The continuous exposure of the pavement to the existence of weak electrical and weak magnetic fields arising due to geopathic stress also causes these deformations, is therefore hinted at.

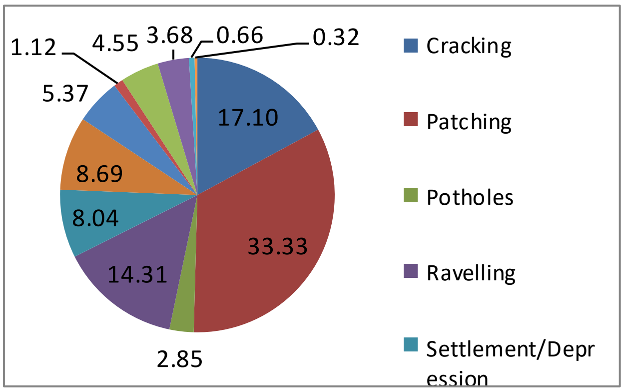

Figure 1. Pie chart showing % distribution of common distresses

From table 1, it is observed that on all the 17 major accident black spots, the pavement condition as determined from the PCI values is not good, moreover varies from poor to fair. In fact the maximum numbers of accidents have occurred at these locations of severely distressed pavement, poor condition.

From Table 2, it is again observed that on all the 13 minor accident black spots, the pavement condition as determined from the PCI values is not good. However, whether the condition is fair to poor, it does not have a distinct impact on the number of accidents; hence these spots are not considered for further analysis. It may therefore be inferred that poor category of the distressed pavement exhibits maximum number of accidents on major black spots whereas on minor accidents spots there is no specific impact. This implies that apart from the known engineering causes of accidents, there may exist a further unknown parameter causing accidents; geopathic stress.

From figure 2, the Karl Pearson correlation coefficient between the average number of accidents per year on major accident black spots and the Pavement Condition Index (PCI) as determined by IRC method is – 0.641 i.e. close to a "Strong" Correlation. The negative sign indicate that as the PCI values reduce, the number of accidents increase. Thus a link between pavement distresses and road accidents is hinted at. The coefficient of determination is 41.1%. It is obvious that there are other reasons which cause road accidents than only pavement distresses. The regression equation for the data shown in table 1 Average number of accidents/year

$\bar{A}$= 35.26 – 13.17 PC…………………...……Equation 1

This equation will be useful in predicting the number of accidents on similar type of roads, after determining their pavement condition index. This, in turn will enable road authorities to control and minimize accidents.

A. Data Analysis for Correlation and Regression Model for Accidents with Pavement Surface Condition in terms of PCI as per IRC

FOR MAJOR ACCIDENT SPOTS
Correlation: -0.641

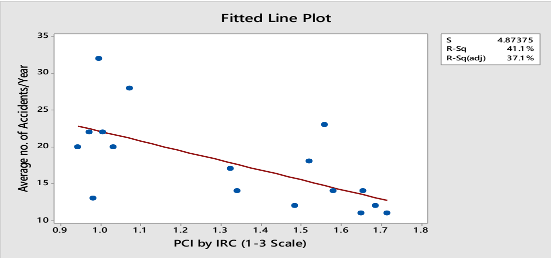

Figure 2. Average number of accidents/year verses PCI for major accident spots

B. Data Analysis for Correlation coefficient for Accidents with Magnetic field at major accident spots :

Correlation: 0.220

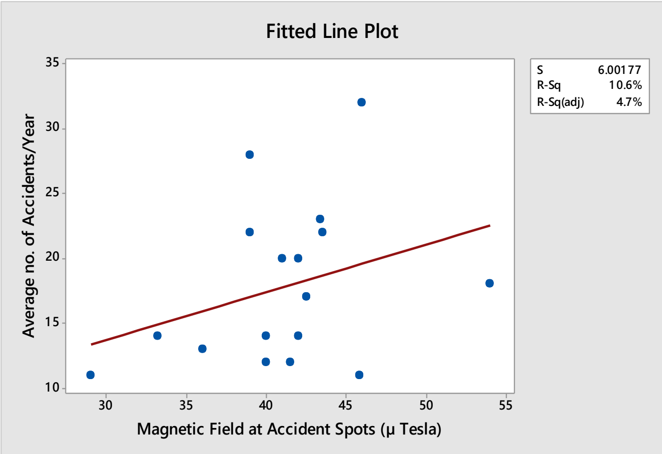

Figure 3. Average number of accidents verses Magnetic field of major accident spots.

From figure 3, a weak correlation is obtained between the number of accidents and the weak magnetic field. The positive sign indicates that as the weak magnetic field increases, the number of accidents increase. It is important to note that, though statically weak correlation exists, the probability of variation in magnetic field being a cause of road accidents in not ruled out. Hence further investigation in this regard needs to be continued.

C. Data Analysis for Correlation coefficient for Accidents with Electric voltage at major accident spots :

Correlation: - 0.283

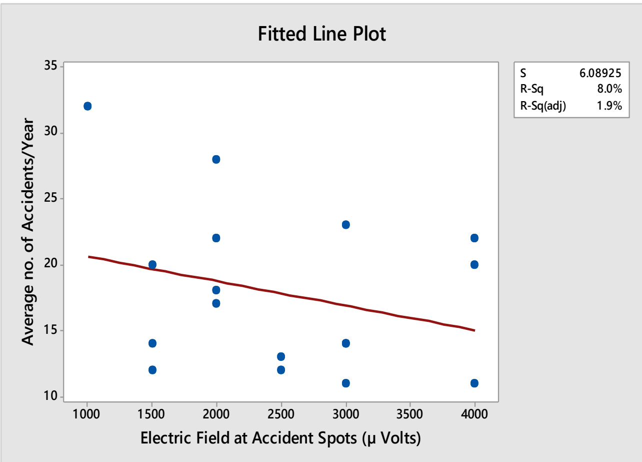

Figure 4. Average number of accidents verses Electric voltage of major accident spots.

Comparing figure 3 and 4, it may be inferred that at a geopathically stressed zones, a part of electric filed is getting converted to magnetic field; in any case, the possibility of variation in weak electrical field also being responsible for causing road accidents is not ruled out. At a geopathic stressed zone since weak electric and magnetic fields act simultaneously; a further plot of average number of accidents with combined field is suggested and plotted in figure no. 5

Correlation coefficient is -0.169

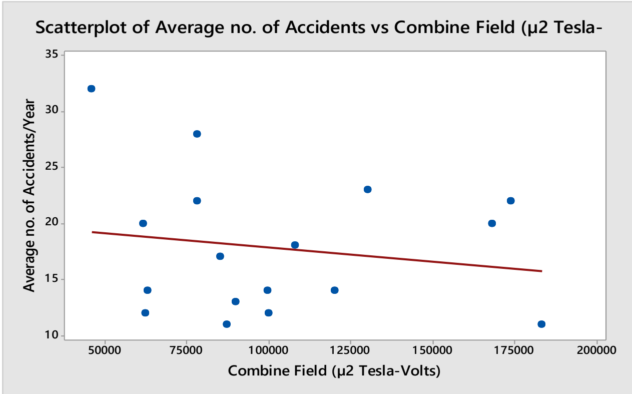

Figure 5. Average number of accidents/year verses combined fields on major accident spots.

D. Data Analysis for Correlation coefficient for Magnetic field with Pavement Condition Index Magnetic field at major accident spots :

Correlation: -0.07

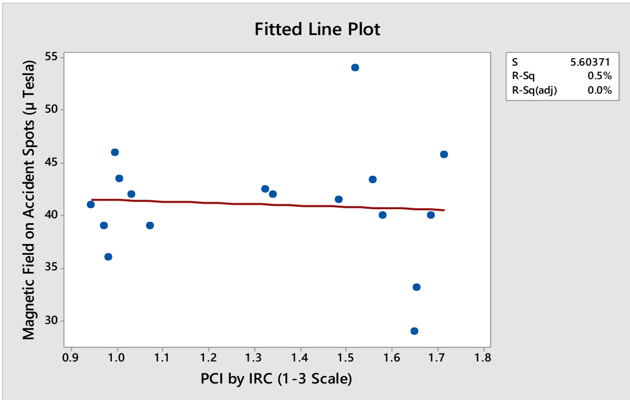

Figure 6. Magnetic field verses PCI by IRC

From figure 6 it appears that the variation in the weak magnetic field is not causing any significant effect on the pavement distress. This aspect also needs to be investigated further, with more statistical data.

E. Data Analysis for Correlation coefficient for Electric voltage with Pavement Condition Index at major accident spots:

Correlation: 0.225

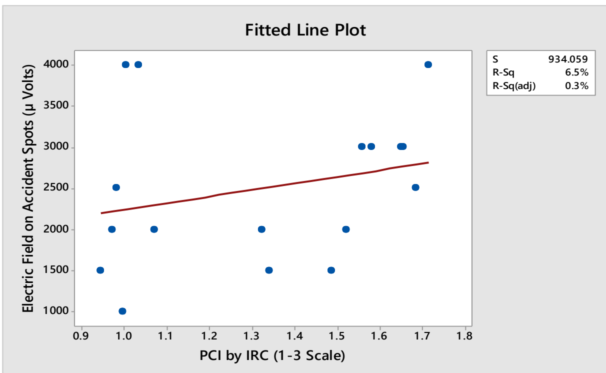

Figure 7. Electric voltage verses PCI by IRC.

From figure 7 it appears that the variation in weak electrical field is a possible reason for generating distresses condition in pavement materials.

This is possibly because construction materials as a general rule are not tested for effect of sustained weak electrical, magnetic fields. Thus, this aspect also needs further investigation.

V CONCLUSION

The results obtained and the discussion done indicate the following:-

1. As the pavement distresses increase, the road accidents increase.
2. Electrical and magnetic characteristics of Geopathic stress may affect pavement distresses, road accidents, however further research in this regards needs to be carried out.
3. The regression equation formulated in this study may be useful in predicting the number of road accidents, once the PCI is determined.

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