Scientific Journal of Impact Factor(SJIF): 3.134

e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 5, May -2015

Flexible Pavement Distresses- A Case Study

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Abstract - *The integral development of India is highly influenced by the development of highways. Flexible pavements form considerable part of the highways because of the comparatively low construction cost involved. But the flexible pavement deteriorates at faster rate, due to various distresses, shortening the service life. Periodic upkeep and maintenance are needed for the preservation of these roads.*

In the present paper, five road segments of SH-60 between Samarkha and Lingda in Anand district were selected. The length of each study segments is taken as 1 km. The main distresses observed were alligator cracks, longitudinal cracks, potholes, patching, ravelling, and rutting. The distresses observed are in terms of their extent or their measurements. The distresses that are observed in current study were due to the inability of the road to satisfy the demands of traffic and also due to environment.

Keywords*: Flexible Pavement, Distresses, Alligator Cracking, Rutting, Ravelling, Potholes, Patching.*

I. INTRODUCTION

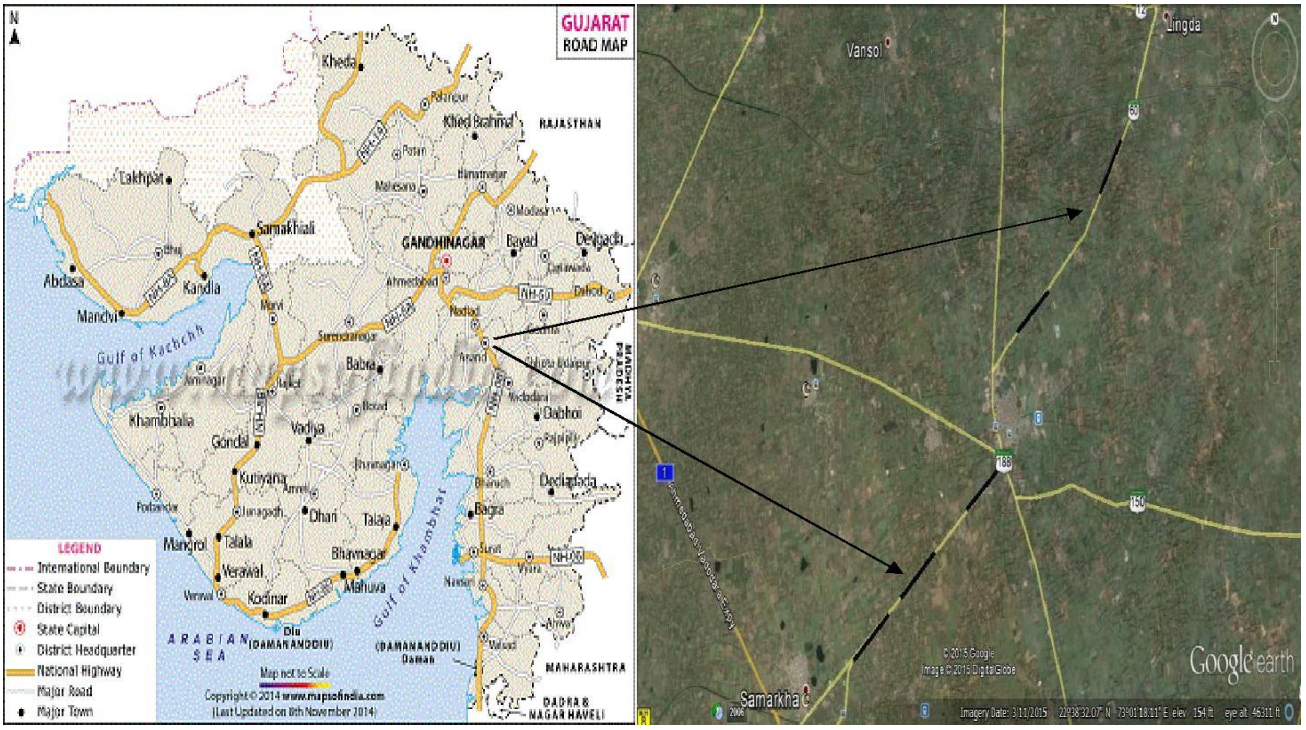
It is necessary to provide a good road network for the development of any country. India has the second largest highway and road networks system in the world. India has a road network of over 46,89,842 kilometers in 2013. Out of which flexible pavements covers about 90% of the highways.

II. OBJECTIVES

- To identify the various distresses observed on the selected Links with the help of Visual Distress Survey.
- To correlate distresses with soil type and CBR.

III. STUDY AREA

The scope of the study is limited to five segments of SH-60 from which three segments were between Samarkha and Bhalej and remaining two segments were between Bhalej and Lingda. Study segments were selected based on road category and traffic conditions.



IV. DATA COLLECTION AND ANALYSIS

The detailed data collection was carried out with the help of visual distress survey. The detailed pavement condition survey was carried out with the help of 4 enumerators.

- The visual inspection of all the links was completed and the links were divided into subsections of 50 m each.
- Assessment of different distresses was done.
- Depth of rutting was measured with the help of 3-m Straight Edge.
- Other types of pavement deterioration were observed.

The equipment needed by the team, after the road has been marked is,

1. Traffic control sings
2. Distance measure
3. 3-m Straight Edge

4.1 Visual Distress Survey on Link-1

- The different flexible pavement distresses observed on Link-1 and their extent are shown in Table-1 and visually it can be shown in Figure-1
- From the table below, it can be seen that alligator cracks and ravelling are predominant on the selected link.
- Also the potholes are in large number.
- In some sections of 50m, longitudinal cracks are also predominant.
- In some sections of 50m, rutting and patching are also high.
- From table-1 and figure-1, it can be seen that distresses are more in the starting of the study link around 100m to 300m. where CBR is 10.25 and soil type is ML CL.

Table-1 Visual Distress Survey on Link-1

Chainage	Longitudinal Cracks (m)	Alligator Cracks (m^2)	Rutting (mm)	Ravelling (m^2)	Patching (m^2)	Potholes		CBR	Soil Type
						No.	Area (m^2)		
0 m - 50 m	17	10.5	12	15.4	12.52	2	0.0689	10.60	ML CL
51 m - 100 m	9.5	18.3	10	9.6	21.3	2	0.14		
101 m - 150 m	0	15.4	15	18.5	19.45	1	0.075		
151 m - 200 m	14.5	23.4	8	28.5	15	3	0.1325		
201 m - 250 m	8	29	12	25.4	2	0	0		
251 m - 300 m	0	23.5	20	12.5	0	1	0.04	10.25	ML CL
301 m - 350 m	0	9	8	15	2.5	1	0.03		
351 m - 400 m	5	15	5	9.5	0	0	0		
401 m - 450 m	0	10	7	13.5	5.5	2	0.155		
451 m - 500 m	7	6	9	16.5	3.5	1	0.1575	10.05	SM SC
501 m - 550 m	0	21	18	22.5	2.5	0	0		
551 m - 600 m	0	10	9	11	0	3	0.1094		
601 m - 650 m	0	14	6	10	0	0	0		
651 m - 700 m	0	12	8	8	1.5	0	0		
701 m - 750 m	5	12	13	15.5	5.5	1	0.024	9.75	ML
751 m - 800 m	0	10	10	24.5	3.5	0	0		
801 m -850 m	0	15	12	18	0	0	0		
851 m -900 m	0	22	12	13	0	0	0		
901 m - 950 m	8	18	15	18.5	2.4	0	0		
950 m -1000 m	0	10	5	12	0	1	0.028	9.9	ML

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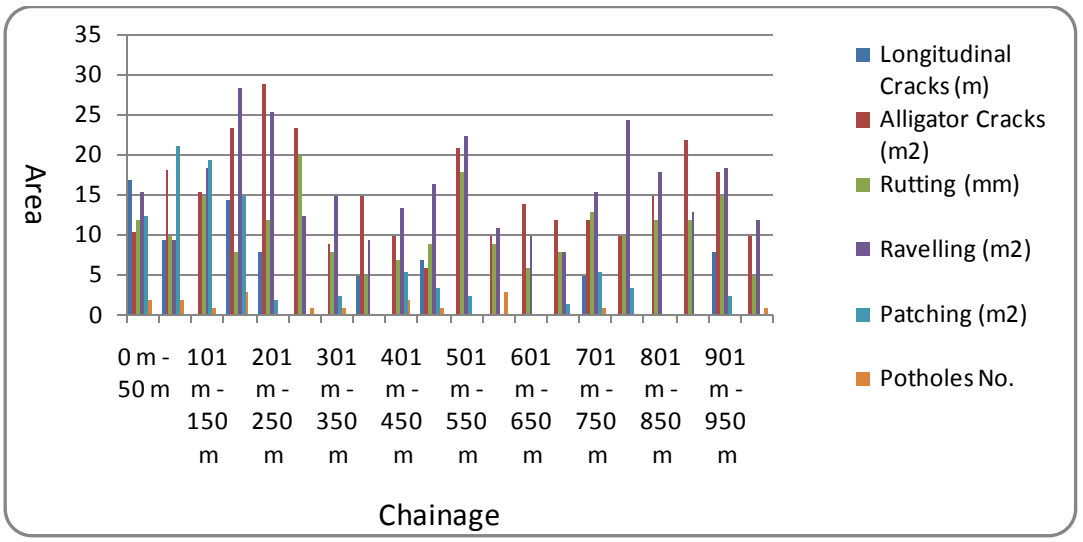

Figure-1 Area Variation on Link-1

4.2 Visual Distress Survey on Link-2

- The different flexible pavement distresses observed on Link-2 and their extent are shown in Table-2 and visually it can be shown in Figure-2.
- From the table below, it can be seen that alligator cracks and ravelling are predominant on the selected link.
- The potholes are in small number.
- Patching is also more in some of the sections of the Link.
- Rutting is also more in some sections of the Link.
- We can also see longitudinal cracks on some sections of the Link.
- From table-2 and figure-2, we can see that distresses are more at the starting of the link from 0m to about 200m, where CBR is 12.10 and soil type is ML CL soil.

Table-2 Visual Distress Survey on Link-2

`Chainage	Longitudinal Cracks (m)	Alligator Cracks (m^2)	Rutting (mm)	Ravelling (m^2)	Patching (m^2)	Potholes		CBR	Soil Type
						No.	Area (m^2)		
0 m - 50 m	14.5	7.5	9	11.5	9.45	0	0	12.10	ML CL
51 m - 100 m	11	10.4	11	10.6	14.5	2	0.13		
101 m - 150 m	4	11.5	17	15.4	11.6	1	0.06		
151 m - 200 m	0	9.5	14	18.5	12.8	3	0.1575		
201 m - 250 m	5	15	7	22	3	0	0		
251 m - 300 m	6	13.6	15	16	11.9	0	0	11.75	SM SC
301 m - 350 m	0	7	10	19	0	0	0		
351 m - 400 m	0	12.9	7	8.4	2.5	0	0		
401 m - 450 m	0	10	9	18	6.3	0	0		
451 m - 500 m	9	5.5	5	14	2.9	2	0.12	12.62	ML CL
501 m - 550 m	7	14.9	15	25	4.6	2	0.1075		
551 m - 600 m	0	12.7	12	12.5	10.5	1	0.04		
601 m - 650 m	0	7.5	7	13	11.6	0	0		
651 m - 700 m	12	9.3	6	15	0	1	0.052		
701 m - 750 m	7	5.6	11	17.5	2.5	1	0.028	13.46	SM SC
751 m - 800 m	13	17.8	9	10.5	0	0	0		
801 m -850 m	9	21	13	15	7.4	0	0		
851 m -900 m	0	17	15	11	2.6	2	0.15		
901 m - 950 m	0	13.2	10	14	0	3	0.1625		

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950 m -1000 m	7	11	8	9	0	0	0	11.2	CL

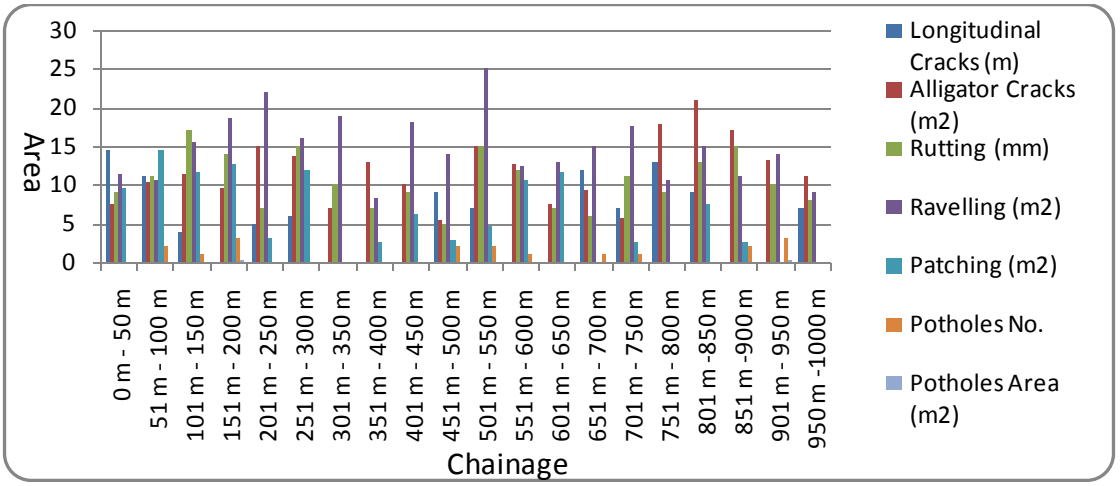

Figure-2 Area Variation on link-2

4.3 Visual Distress Survey on Link-3

- The different flexible pavement distresses observed on Link-3 and their extent are shown in Table-3 and visually it can be shown in Figure-3.
- From the table below, it can be seen that alligator cracks and ravelling are predominant on the selected link.
- The potholes are in small number.
- Patching is also more in some of the sections of the Link.
- Rutting is also more in some sections of the Link.
- We can also see longitudinal cracks on some sections of the Link.
- From table-3 and figure-3, we can see that distress are more around 500m to 650m, where CBR value is about 12.45 and soil type is SM SC.

Table-3 Visual Distress Survey on Link-3

Chainage	Longitudinal Cracks (m)	Alligator Cracks (m^2)	Rutting (mm)	Ravelling (m^2)	Patching (m^2)	Potholes		CBR	Soil Type
						No.	Area (m^2)		
0 m - 50 m	0	8.5	4	9.5	5.4	1	0.075	11.25	ML
51 m - 100 m	7	11	8	5.6	10.3	0	0		
101 m - 150 m	13	9.5	9	12.6	11.5	0	0		
151 m - 200 m	11	5.5	12	11	13.4	0	0		
201 m - 250 m	0	12	7	16.5	6.3	0	0		
251 m - 300 m	0	10	9	13	9.5	1	0.09	10.7	SM SC
301 m - 350 m	0	11	6	18	6	1	0.105		
351 m - 400 m	5	18.5	3	5.5	3.5	2	0.14		
401 m - 450 m	9	14	6	13	0	1	0.06		
451 m - 500 m	0	9.5	11	21	10.4	2	0.15	13.1	SM SC
501 m - 550 m	0	6.5	13	22.2	8.5	1	0.1125		
551 m - 600 m	14	12	17	18.4	0	1	0.05		
601 m - 650 m	12	8	12	14.3	0	0	0		
651 m - 700 m	8	8.5	11	17.5	5.5	0	0		
701 m - 750 m	0	4.5	6	10.4	9	0	0	12.45	SM SC
751 m - 800 m	17	15.5	7	8	7.5	0	0		
801 m -850 m	0	17	13	12	0	0	0		
851 m -900 m	0	11	18	13	0	0	0		
901 m - 950 m	0	21	11	10	0	0	0		

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950 m -1000 m	0	10	7	7.5	4.5	0	0	14.05	ML

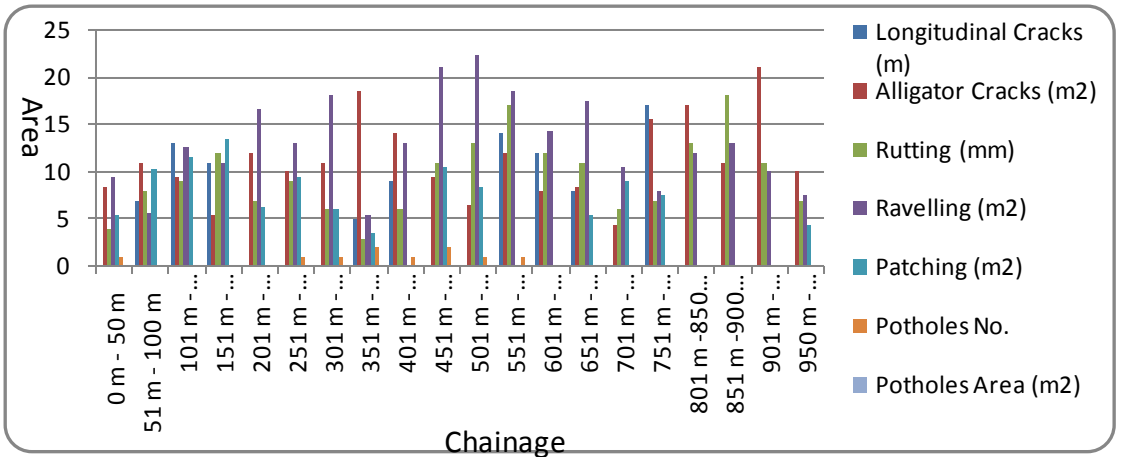

Figure-3 Area Variation on Link-3

4.4 Visual Distress Survey on Link-4

- The different flexible pavement distresses observed on Link-4 and their extent are shown in Table-4 and visually it can be shown in Figure-4.
- From the table below, it can be seen that alligator cracks are mostly predominant on the selected link.
- There is considerable ravelling on the selected link.
- The potholes are in small number.
- Patching is also less in the sections of the Link.
- Rutting is in acceptable range in most of the sections of the Link.
- Longitudinal cracks are present in some sections of the link and absent on the other sections of the link.
- From table-4 and figure-4, we can see that distresses are more at the starting of the link from about 50m to 300m, where CBR is 12.15 and soil type is ML soil.

Table-4 Visual Distress Survey on Link-4

Chainage	Longitudinal Cracks (m)	Alligator Cracks (m^2)	Rutting (mm)	Ravelling (m^2)	Patching (m^2)	Potholes		CBR	Soil Type
						No.	Area (m^2)		
0 m - 50 m	5	19	6	4.5	0	0	0	12.15	ML
51 m - 100 m	8	25.5	4	10.5	8.4	0	0		
101 m - 150 m	6	16.5	9	9.6	6.5	0	0		
151 m - 200 m	11	18	3	12.5	0	1	0.044		
201 m - 250 m	8.5	13	10	14.6	10.5	1	0.056		
251 m - 300 m	4	22.5	7	10	9.2	2	0.1075	11.7	SM SC
301 m - 350 m	0	20.5	11	12.8	0	1	0.064		
351 m - 400 m	4.5	17	7	13.5	0	0	0		
401 m - 450 m	12.5	19	6	10.4	0	1	0.036		
451 m - 500 m	0	26	4	8.5	12.5	0	0	11.91	SM SC
501 m - 550 m	0	21.5	6	13	4.6	0	0		
551 m - 600 m	0	18.5	6	7.5	0	2	0.12		
601 m - 650 m	4	17.5	4	8.6	5.5	0	0		
651 m - 700 m	6.5	21.5	8	10.8	5.8	0	0		
701 m - 750 m	10	25.5	9	4.5	6.3	0	0	10.39	SM SC
751 m - 800 m	13.5	22	7	6.2	0	0	0		
801 m -850 m	0	17	10	11.2	10.2	0	0		
851 m -900 m	0	20.5	11	6.5	2.5	2	0.156		

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901 m - 950 m	0	24	13	9.4	0	0	0		
950 m -1000 m	0	21.5	9	5.5	0	0	0	12.72	ML

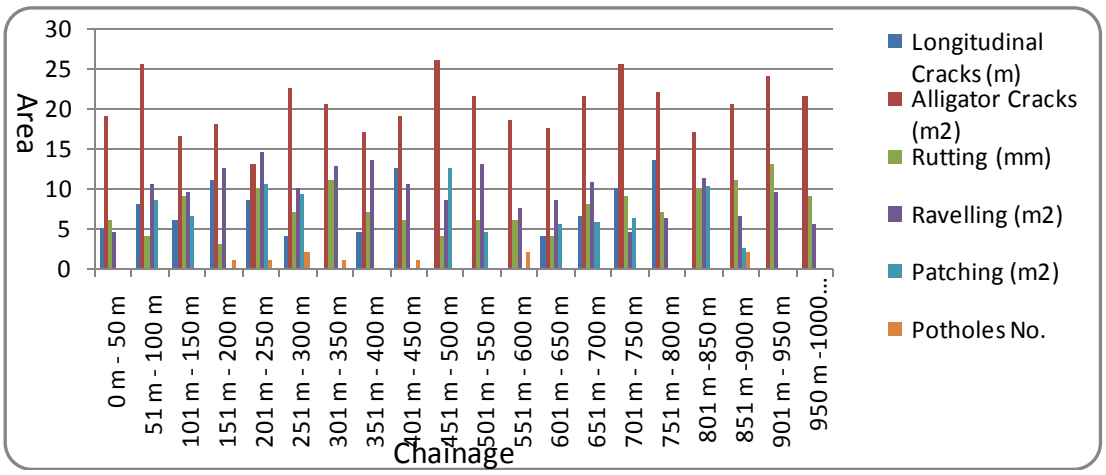

Figure-4 Area Variation on Link-4

4.5 Visual Distress Survey on Link-5

- The different flexible pavement distresses observed on Link-5 and their extent are shown in Table-5 and visually it can be shown in Figure-5.
- From the table below, it can be seen that alligator cracks are predominant on the selected link.
- Ravelling is also more on the selected Link..
- The potholes are very less in number.
- In some sections, patching is present and in some section, patching is absent on the Link.
- Rutting is in acceptable range in most of the sections of the Link.
- Longitudinal cracks are present in some sections of the link and absent on the other sections of the link.
- From table-5 and figure-5, we can see that distresses are more between 150m-300m and 700m-900m, where CBR values are 11.26 and 13.41 respectively and soil types are SM SC and ML respectively.

Table-5 Visual Distress Survey on Link-5

Chainage	Longitudinal Cracks (m)	Alligator Cracks (m^2)	Rutting (mm)	Ravelling (m^2)	Patching (m^2)	Potholes		CBR	Soil Type
						No.	Area (m^2)		
0 m - 50 m	6.5	18.5	8	6	4.2	1	0.025	10.45	ML CL
51 m - 100 m	9	23	6	8.5	6.3	1	0.038		
101 m - 150 m	8	24.5	9	5.6	0	1	0.05		
151 m - 200 m	12.5	21	7	11.4	10.5	0	0		
201 m - 250 m	14	15.5	3	15.2	9.3	0	0		
251 m - 300 m	6	19.5	10	11.3	7.5	0	0	11.26	SM SC
301 m - 350 m	0	24	4	13.8	4.9	1	0.045		
351 m - 400 m	0	21	6	10.1	0	0	0		
401 m - 450 m	0	22	11	12.9	0	0	0		
451 m - 500 m	6.5	24.5	2	7.5	0	0	0	10.98	ML
501 m - 550 m	9.5	18.5	9	10.3	2.9	0	0		
551 m - 600 m	4	14	4	5.1	0	1	0.06		
601 m - 650 m	10.5	16.5	7	2.5	6.6	0	0		
651 m - 700 m	11	22	6	4.6	0	0	0		
701 m - 750 m	13.5	26.5	9	8.4	10.8	0	0	13.41	ML
751 m - 800 m	0	21	8	12.3	0	1	0.054		

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801 m -850 m	4.5	17	12	15.4	11.6	1	0.07		
851 m -900 m	0	20	10	14.2	0	0	0		
901 m - 950 m	0	21	13	9.1	12.5	0	0		
950 m -1000 m	2.5	23.5	9	6.3	9.2	1	0.028	12.88	SM SC

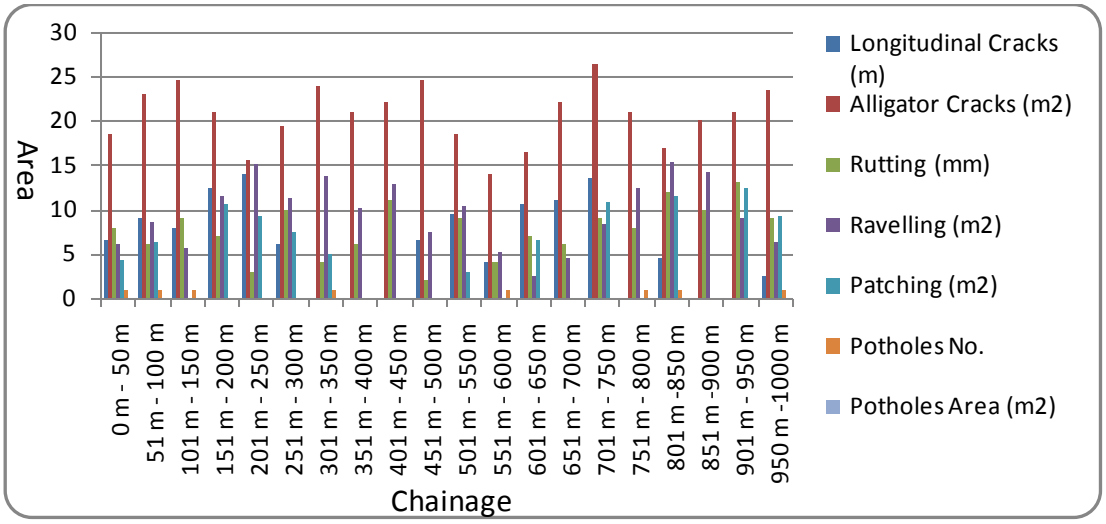

Figure-5 Area Variation on Link-5

V. CONCLUSIONS AND RECOMMENDATIONS

- The main flexible pavement distresses observed in the present study were longitudinal cracks, alligator cracks, rutting, ravelling, patching and potholes.
- These distresses results in poor riding quality of the vehicle and the lowering of the speed of the vehicle thereby reducing LOS of the road.
- The distresses are more where there is ML soil.
- Periodic maintenance of the roads will result in decreasing of the pavement distresses.
- If the distresses observed are in large quantity, overlaying should be done.

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