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Vellore Institute of Technology

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SPEED STUDY USING CUMULATIVE FREQUENCY CURVE

School of Civil Engineering

CLE 2005 TRANSPORTATION ENGINEERING

J COMPONENT PROJECT

Submitted By:

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CERTIFICATE

This is to certify that the project work entitled “PERCENTILE SPEED STUDY ” that is submitted for Transportation Engineering (CLE2005) is a record of bonafide work done under my supervision. The contents of this project work, in full or in parts have neither been taken from any other source nor have been submitted for any other course.

Signature of the faculty

Place: Vellore

(Dr.Vasantha Kumar S)

Date: 28th April, 2022

Slot: B1

ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude and we are very thankful to our teacher Dr. Vasantha Kumar S for guiding us immensely throughout the course of the project. His constructive advice and constant motivation have been responsible for the successful completion of the project. We are grateful that we got an opportunity to explore practical field of this course with this project.

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INTRODUCTION

Speed of vehicles in one the factor causing various accidents causing loss of human life and property. In this project, we studied about the speed of vehicles within our VIT university (in front of Technology Tower VIT) and calculated the percentile speed of vehicles.

Different types of vehicles like four wheelers (cars, van etc.) and two wheelers (scooter, bike, bicycle etc.) entering the location at particular time were considered. The study was done at the peak hour i.e., 9 am-10 am. The location chosen in this project was strictly free of speed brakers. Study of percentile speed and cumulative frequency curve was done.

OBJECTIVE

- **To study the speed of vehicles passing in respective distance and time.**
- **To determine the average speed limit of vehicles.**
- **To analyze the vehicles with high speed**.

METHODOLOGY

- **Video shooting**
- **Vehicle observation and corresponding time data**
- **Calculation and graph plotting using Excel sheet**

LOCATION-9 (Study Area)

STEPS INVOLVED

1. First, two points are marked on the study area and length between them is measured.
2. Time taken by the vehicles to pass the two points is noted.
3. Then, speed is calculated using

   Speed = Distance/Time taken

4. Then a graph is drawn keeping Mid speed as X – Axis and Cumulative Frequency as Y - Axis

Consolidated data according to the distance taken i.e., 13.5m and time taken by the vehicle to cover the respective distance and calculation of speed with the formulae;

Speed=Distance/time

S.No.	Time (s)	Speed (m/s)	Speed (km/hr)
1	2.76	4.89	17.61
2	4.49	3.01	10.82
3	2.6	5.19	18.69
4	2.1	6.43	23.14
5	2.09	6.46	23.25
6	1.9	7.11	25.58
7	2.06	6.55	23.59
8	3.16	4.27	15.38
9	2.13	6.34	22.82
10	3.28	4.12	14.82
11	2.39	5.65	20.33
12	2.36	5.72	20.59
13	4.05	3.33	12.00
14	2.72	4.96	17.87
15	2.42	5.58	20.08
16	2.19	6.16	22.19
17	2.99	4.52	16.25
18	2.73	4.95	17.80
19	2.89	4.67	16.82
20	3	4.50	16.20
21	2.79	4.84	17.42
22	3.45	3.91	14.09
23	2.91	4.64	16.70
24	2.45	5.51	19.84
25	2.95	4.58	16.47
26	3.13	4.31	15.53
27	3.01	4.49	16.15
28	2.56	5.27	18.98
29	2.42	5.58	20.08
30	5.17	2.61	9.40
31	2.85	4.74	17.05
32	2.96	4.56	16.42
33	1.56	8.65	31.15
34	2.62	5.15	18.55
35	3.6	3.75	13.50
36	3.58	3.77	13.58
37	2.45	5.51	19.84
38	7.77	1.74	6.25
39	2.94	4.59	16.53
40	2.51	5.38	19.36
41	2.15	6.28	22.60
42	3.51	3.85	13.85
43	3.02	4.47	16.09
44	5.22	2.59	9.31
45	3.03	4.46	16.04
46	3	4.50	16.20
47	3.26	4.14	14.91
48	2.44	5.53	19.92
49	2.56	5.27	18.98
50	2.86	4.72	16.99
51	2.75	4.91	17.67
52	3.27	4.13	14.86
53	2.25	6.00	21.60
54	3.32	4.07	14.64
55	2.62	5.15	18.55
56	2.48	5.44	19.60
57	2.36	5.72	20.59
58	2.35	5.74	20.68
59	4.73	2.85	10.27
60	4.38	3.08	11.10
61	3.88	3.48	12.53
62	2.36	5.72	20.59
63	3.08	4.38	15.78
64	3.93	3.44	12.37
65	2.77	4.87	17.55
66	2.95	4.58	16.47
67	2.67	5.06	18.20
68	2.79	4.84	17.42
69	2.56	5.27	18.98
70	2.63	5.13	18.48
71	2.67	5.06	18.20
72	2.92	4.62	16.64
73	2.45	5.51	19.84
74	4.36	3.10	11.15
75	2.85	4.74	17.05
76	2.69	5.02	18.07
77	2.95	4.58	16.47
78	2.85	4.74	17.05
79	2.2	6.14	22.09
80	2.48	5.44	19.60
81	2.67	5.06	18.20
82	2.92	4.62	16.64
83	2.45	5.51	19.84
84	4.36	3.10	11.15
85	2.85	4.74	17.05
86	2.69	5.02	18.07
87	2.95	4.58	16.47
88	2.85	4.74	17.05
89	2.2	6.14	22.09
90	2.5	5.40	19.44

91	2.48	5.44	19.60
92	2.67	5.06	18.20
93	2.81	4.80	17.30
94	2.23	6.05	21.79
95	2.55	5.29	19.06
96	3.03	4.46	16.04
97	2.77	4.87	17.55
98	4.24	3.18	11.46
99	2.06	6.55	23.59
100	3.06	4.41	15.88
101	3.42	3.95	14.21
102	2.82	4.79	17.23
103	3.21	4.21	15.14
104	2.89	4.67	16.82
105	2.72	4.96	17.87
106	2.95	4.58	16.47
107	2.5	5.40	19.44
108	2.26	5.97	21.50
109	2.8	4.82	17.36
110	2.4	5.63	20.25
111	3	4.50	16.20
112	2.99	4.52	16.25
113	2.35	5.74	20.68
114	3.09	4.37	15.73
115	2.89	4.67	16.82
116	1.98	6.82	24.55
117	5.93	2.28	8.20
118	3.05	4.43	15.93
119	6.82	1.98	7.13
120	2.62	5.15	18.55
121	2.45	5.51	19.84
122	2.71	4.98	17.93
123	3.3	4.09	14.73
124	2.45	5.51	19.84
125	2.03	6.65	23.94
126	2.6	5.19	18.69
127	2.35	5.74	20.68
128	2.37	5.70	20.51
129	2.75	4.91	17.67
130	2.33	5.79	20.86
131	2.2	6.14	22.09
132	2.64	5.11	18.41
133	3.26	4.14	14.91
134	2.45	5.51	19.84
135	2.37	5.70	20.51
136	3.12	4.33	15.58
137	2.71	4.98	17.93

138	2.82	4.79	17.23
139	2.69	5.02	18.07
140	2.78	4.86	17.48
141	2.36	5.72	20.59
142	2.56	5.27	18.98
143	1.91	7.07	25.45
144	3.45	3.91	14.09
145	2.56	5.27	18.98
146	2.1	6.43	23.14
147	2.75	4.91	17.67
148	2.09	6.46	23.25
149	3.73	3.62	13.03
150	2.5	5.40	19.44
151	2.56	5.27	18.98
152	4.5	3.00	10.80
153	3.55	3.80	13.69
154	2.9	4.66	16.76
155	3.55	3.80	13.69
156	2.65	5.09	18.34
157	2.18	6.19	22.29
158	1.8	7.50	27.00
159	1.93	6.99	25.18
160	2.73	4.95	17.80
161	2.45	5.51	19.84
162	4.58	2.95	10.61
163	5.46	2.47	8.90
164	2.17	6.22	22.40
165	2.49	5.42	19.52
166	2.82	4.79	17.23
167	3.15	4.29	15.43
168	3.2	4.22	15.19
169	2.49	5.42	19.52
170	2.3	5.87	21.13
171	2.69	5.02	18.07
172	1.97	6.85	24.67
173	2.29	5.90	21.22
174	2.43	5.56	20.00
175	2.95	4.58	16.47
176	2.55	5.29	19.06
177	2.61	5.17	18.62
178	2.79	4.84	17.42
179	2.56	5.27	18.98
180	5.58	2.42	8.71
181	2.55	5.29	19.06
182	2.45	5.51	19.84
183	1.71	7.89	28.42
184	6.12	2.21	7.94

185	2.75	4.91	17.67
186	2.36	5.72	20.59
187	2.15	6.28	22.60
188	2.5	5.40	19.44
189	2.15	6.28	22.60
190	2.3	5.87	21.13
191	2.56	5.27	18.98
192	2.29	5.90	21.22
193	2.3	5.87	21.13
194	3.28	4.12	14.82
195	3.22	4.19	15.09
196	3.02	4.47	16.09
197	2.17	6.22	22.40
198	2.49	5.42	19.52
199	4.65	2.90	10.45
200	2.62	5.15	18.55
201	2.63	5.13	18.48
202	2.54	5.31	19.13
203	1.91	7.07	25.45
204	2.11	6.40	23.03
205	2.59	5.21	18.76
206	2.56	5.27	18.98
207	3.09	4.37	15.73
208	2.59	5.21	18.76
209	2.62	5.15	18.55
210	3.74	3.61	12.99
211	2.9	4.66	16.76
212	2.75	4.91	17.67
213	2.58	5.23	18.84
214	2.76	4.89	17.61
215	2.18	6.19	22.29
216	2.3	5.87	21.13
217	2.56	5.27	18.98
218	2.36	5.72	20.59
219	2.56	5.27	18.98
220	2.44	5.53	19.92
221	2.18	6.19	22.29
222	2.3	5.87	21.13
223	2.56	5.27	18.98
224	2.36	5.72	20.59
225	2.56	5.27	18.98
226	2.44	5.53	19.92
227	2.18	6.19	22.29
228	2.3	5.87	21.13
229	2.68	5.04	18.13
230	3.49	3.87	13.93
231	2	6.75	24.30

232	5.57	2.42	8.73
233	2.9	4.66	16.76
234	2.06	6.55	23.59
235	1.93	6.99	25.18
236	3.81	3.54	12.76
237	1.85	7.30	26.27
238	2.56	5.27	18.98
239	3.05	4.43	15.93
240	2.48	5.44	19.60
241	2.7	5.00	18.00
242	2.38	5.67	20.42
243	3.41	3.96	14.25
244	3.48	3.88	13.97
245	2.7	5.00	18.00
246	2.13	6.34	22.82
247	2.76	4.89	17.61
248	1.93	6.99	25.18
249	4.01	3.37	12.12
250	3.08	4.38	15.78
251	3.34	4.04	14.55
252	4.08	3.31	11.91
253	1.7	7.94	28.59
254	1.93	6.99	25.18
255	2.5	5.40	19.44
256	2.25	6.00	21.60
257	2.24	6.03	21.70
258	1.93	6.99	25.18
259	2.7	5.00	18.00
260	2.13	6.34	22.82
261	2.65	5.09	18.34
262	2.06	6.55	23.59
263	2.7	5.00	18.00
264	3.35	4.03	14.51
265	3.04	4.44	15.99
266	4.66	2.90	10.43
267	2.25	6.00	21.60
268	2.35	5.74	20.68
269	2.69	5.02	18.07
270	2.71	4.98	17.93
271	2.46	5.49	19.76
272	4.52	2.99	10.75
273	2.84	4.75	17.11
274	5	2.70	9.72
275	2.83	4.77	17.17
276	3.23	4.18	15.05
277	2.84	4.75	17.11
278	2.36	5.72	20.59

279	2.88	4.69	16.88
280	2.29	5.90	21.22
281	2.82	4.79	17.23
282	2.62	5.15	18.55
283	2.56	5.27	18.98
284	2.35	5.74	20.68
285	2.42	5.58	20.08
286	3.33	4.05	14.59
287	2.62	5.15	18.55
288	3.66	3.69	13.28
289	2.95	4.58	16.47
290	3	4.50	16.20
291	3.61	3.74	13.46
292	1.86	7.26	26.13
293	2.25	6.00	21.60
294	2.42	5.58	20.08
295	2.56	5.27	18.98
296	2.5	5.40	19.44
297	2.88	4.69	16.88
298	4.02	3.36	12.09
299	2.49	5.42	19.52
300	2.11	6.40	23.03
301	3.15	4.29	15.43
302	2.24	6.03	21.70
303	1.86	7.26	26.13
304	2.37	5.70	20.51
305	2.37	5.70	20.51
306	3.22	4.19	15.09
307	2.17	6.22	22.40
308	1.91	7.07	25.45
309	2.82	4.79	17.23
310	4	3.38	12.15
311	2.23	6.05	21.79
312	2.11	6.40	23.03
313	1.91	7.07	25.45
314	2.89	4.67	16.82
315	2.82	4.79	17.23
316	2.56	5.27	18.98
317	2.18	6.19	22.29
318	2.76	4.89	17.61
319	2.76	4.89	17.61
320	3.08	4.38	15.78
321	1.92	7.03	25.31
322	2.83	4.77	17.17
323	2.56	5.27	18.98
324	2.17	6.22	22.40
325	2.04	6.62	23.82

326	1.91	7.07	25.45
327	2.5	5.40	19.44
328	1.32	10.23	36.82
329	4.56	2.96	10.66
330	1.99	6.78	24.42
331	2.23	6.05	21.79
332	2.24	6.03	21.70
333	2.3	5.87	21.13
334	2.31	5.84	21.04
335	2.5	5.40	19.44
336	3.16	4.27	15.38
337	3.06	4.41	15.88
338	2.49	5.42	19.52
339	1.97	6.85	24.67
340	2.11	6.40	23.03
341	1.85	7.30	26.27
342	2.76	4.89	17.61
343	3.12	4.33	15.58
344	1.65	8.18	29.45
345	3.23	4.18	15.05
346	2.24	6.03	21.70
347	2.23	6.05	21.79
348	2.51	5.38	19.36
349	2.62	5.15	18.55
350	2.24	6.03	21.70
351	3.59	3.76	13.54
352	3.22	4.19	15.09
353	2.89	4.67	16.82
354	2.96	4.56	16.42
355	3.56	3.79	13.65
356	2.89	4.67	16.82
357	1.71	7.89	28.42
358	3.36	4.02	14.46
359	3.15	4.29	15.43
360	4.25	3.18	11.44
361	2.5	5.40	19.44
362	2.29	5.90	21.22
363	2.63	5.13	18.48
364	2.49	5.42	19.52
365	2.23	6.05	21.79
366	2.03	6.65	23.94
367	2.5	5.40	19.44
368	2.55	5.29	19.06
369	2.77	4.87	17.55
370	2.48	5.44	19.60
371	2.64	5.11	18.41
372	2.3	5.87	21.13

373	2.96	4.56	16.42
374	4.5	3.00	10.80
375	2.56	5.27	18.98
376	1.71	7.89	28.42
377	2.62	5.15	18.55
378	2.11	6.40	23.03
379	1.91	7.07	25.45
380	3.03	4.46	16.04
381	2.62	5.15	18.55
382	2.96	4.56	16.42
383	3.13	4.31	15.53
384	3.15	4.29	15.43
385	2.17	6.22	22.40
386	2.03	6.65	23.94
387	3.48	3.88	13.97
388	2.58	5.23	18.84
389	2.16	6.25	22.50
390	2.69	5.02	18.07
391	2.12	6.37	22.92
392	2.8	4.82	17.36
393	2.49	5.42	19.52
394	6.11	2.21	7.95
395	2.83	4.77	17.17
396	3.41	3.96	14.25
397	4.07	3.32	11.94
398	2.96	4.56	16.42
399	2.7	5.00	18.00
400	3.61	3.74	13.46
401	3.29	4.10	14.77
402	2.88	4.69	16.88
403	2.38	5.67	20.42
404	2.82	4.79	17.23
405	2.75	4.91	17.67
406	2.76	4.89	17.61
407	3.41	3.96	14.25
408	4.07	3.32	11.94
409	2.89	4.67	16.82
410	3.44	3.92	14.13
411	3.45	3.91	14.09
412	2.9	4.66	16.76
413	2.5	5.40	19.44
414	2.37	5.70	20.51
415	3.1	4.35	15.68
416	2.31	5.84	21.04
417	3.35	4.03	14.51
418	3.46	3.90	14.05
419	2.83	4.77	17.17

420	2.7	5.00	18.00
421	3.35	4.03	14.51
422	3.03	4.46	16.04
423	3.12	4.33	15.58
424	3.89	3.47	12.49
425	4.44	3.04	10.95
426	3.41	3.96	14.25
427	4.21	3.21	11.54
428	2.49	5.42	19.52
429	2.43	5.56	20.00
430	2.63	5.13	18.48
431	2.63	5.13	18.48
432	2.43	5.56	20.00
433	2.7	5.00	18.00
434	3.09	4.37	15.73
435	3.89	3.47	12.49
436	1.96	6.89	24.80
437	2.75	4.91	17.67
438	4.58	2.95	10.61
439	2.11	6.40	23.03
440	2.96	4.56	16.42
441	2.37	5.70	20.51

CONSOLIDATED DATA

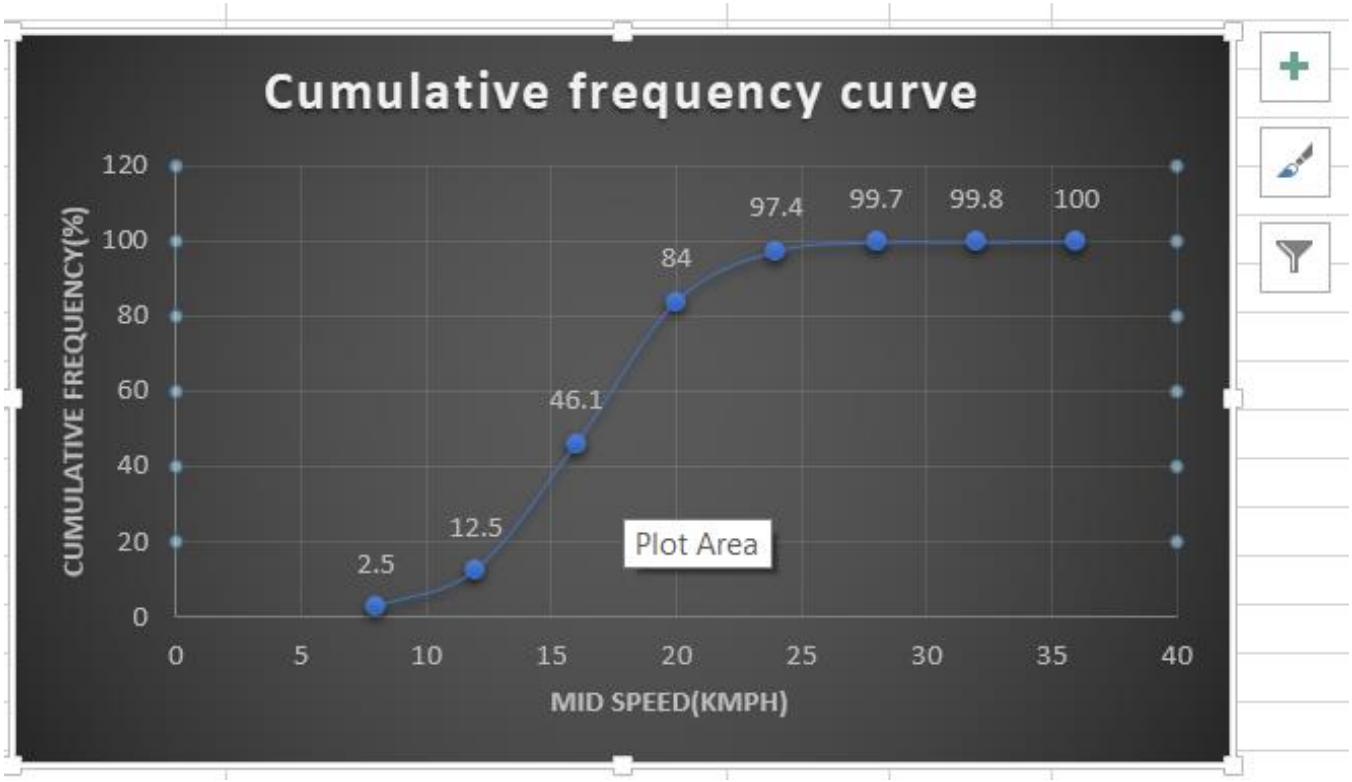
Class	***Count(No. of vehicles)***
6.0 - 10.0	11
10.0 - 14.0	44
14.0 - 18.0	148
18.0 - 22.0	167
22.0 - 26.0	59
26.0 - 30.0	10
30.0 - 34.0	1
34.0 - 38.0	1

FREQUENCY DISTRIBUTION TABLE

Speed Range	Mid Speed	Frequency	Frequency (%)	Cumulative Frequency (%)
6.0 - 10.0	8	11	2.5	2.5
10.0 - 14.0	12	44	10	12.5
14.0 - 18.0	16	148	33.6	46.1
18.0 - 22.0	20	167	37.9	84
22.0 - 26.0	24	59	13.4	97.4
26.0 - 30.0	28	10	2.3	99.7
30.0 - 34.0	32	1	0.1	99.8
34.0 - 38.0	36	1	0.2	100
	Total	441	100	

GRAPH

A graph is plotted between mid-speed (kmph) calculated from the speed range of vehicle Vs. cumulative Frequency (%) as shown below:



PERCENTILE CALCULATION

Class	Frequency f	cf
6 - 10	11	11
10 - 14	44	55
14 - 18	148	203
18 - 22	167	370
22 - 26	59	429
26 - 30	10	439
30 - 34	1	440
34 - 38	1	441
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	n = 441	--

Here, $n = 441$

P_{25} class :

Class with $\left(\frac{25n}{100}\right)^{th}$ value of the observation in cf column

$= \left(\frac{25 \cdot 441}{100}\right)^{th}$ value of the observation in cf column

$= (110.25)^{th}$ value of the observation in cf column

and it lies in the class 14 - 18.

$\therefore P_{25}$ class : 14 - 18

25-Percentile

The lower boundary point of 14 - 18 is 14.

$\therefore L = 14$

$$P_{25} = L + \frac{\frac{25n}{100} - cf}{f} \cdot c$$

$$= 14 + \frac{110.25 - 55}{148} \cdot 4$$

$$= 14 + \frac{55.25}{148} \cdot 4$$

$= 14 + 1.4932$

$= 15.4932$

The 25th Percentile is 15.4932 Km/hr

50^{Th} Percentile:

P_{50} class :

Class with $\left(\frac{50n}{100}\right)^{th}$ value of the observation in cf column

$= \left(\frac{50 \cdot 441}{100}\right)^{th}$ value of the observation in cf column

$= (220.5)^{th}$ value of the observation in cf column

and it lies in the class 18 - 22.

$\therefore P_{50}$ class : 18 - 22

The lower boundary point of 18 - 22 is 18.

$\therefore L = 18$

$$P_{50} = L + \frac{\frac{50n}{100} - cf}{f} \cdot c$$

$$= 18 + \frac{220.5 - 203}{167} \cdot 4$$

$$= 18 + \frac{17.5}{167} \cdot 4$$

$$= 18 + 0.4192$$

$$= 18.4192$$

The 50^{th} Percentile is 18.4192 Km/hr

75^{TH} PERCENTILE

P_{75} class :

Class with $\left(\frac{75n}{100}\right)^{th}$ value of the observation in cf column

$= \left(\frac{75 \cdot 441}{100}\right)^{th}$ value of the observation in cf column

$= (330.75)^{th}$ value of the observation in cf column

and it lies in the class 18 - 22.

$\therefore P_{75}$ class : 18 - 22

The lower boundary point of 18 - 22 is 18.

$\therefore L = 18$

$$P_{75} = L + \frac{\frac{75n}{100} - cf}{f} \cdot c$$

$$= 18 + \frac{330.75 - 203}{167} \cdot 4$$

$$= 18 + \frac{127.75}{167} \cdot 4$$

$$= 18 + 3.0599$$

$$= 21.0599$$

The 75^{th} Percentile is 21.0599 Km/hr

INFERENCES

- The total number of vehicles observed (on the date of observation) was 441.
- It was seen that most vehicles had the speed between 18 – 22 kmph.
- The lowest speed of vehicles observed was 6 kmph and highest speed observed was 36 kmph.
- Speed of 84% of vehicles were within the speed limit.
- 25^{th} ,50^{th} and 75^{th} percentile was calculated using the formula which was quite similar to the value obtained from the graph.

CONCLUSION

Thus, speed study was done for 1 hour at the study area (In front of Technology Tower, VIT Vellore) between 9 am to 10 am on 6^{th} April, 2022 and speed of different vehicles in the road was calculated marking two points as a reference.