STUDY OF THE EFFECT OF TRAFFIC VOLUME FOR INNER RING ROAD, ONGOLE, INDIA

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Abstract

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. In order to achieve some of these goals, a Traffic Volume Survey had been conducted for Inner Ring Road, Ongole, India. Data collected from the survey has been analyzed to get required information regarding Average Daily Traffic, Flow Fluctuation, Vehicle Composition, and Directional Distribution etc., which helps to make some educated guess on characteristics of the existing condition of the road and to recommend some measures to promote the level of service of the road.

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1. INTRODUCTION

Transportation is carrying civilization to a brighter future. Now a day's transportation is one of the most burning issues in every territory of the world. Every country is approaching differently according to their needs and solving their transportation problems within their capabilities. In designing buildings we need to determine loads coming to the structure to calculate reinforcement to be provided for safe functioning of the structure. Here in transportation volume serves the same purpose. For planning, designing and operation of transportation system the first and foremost requirement is volume. Volume is simply the number of vehicles passing a section of a roadway. Expressing traffic volume as number of vehicles passing a given section of road or traffic lane per unit time will be inappropriate when several types of vehicles with widely varying static and dynamic characteristics are comprised in the traffic. The problem of measuring volume of such heterogeneous traffic has been addressed by converting the different types of vehicles into equivalent passenger cars and expressing the volume in terms of Passenger Car Unit (PCU) per hour. The interaction between moving vehicles under such heterogeneous traffic condition is highly complex. Again volume is not constant. It increases with time. So a continuous method of calculating volume is a matter of great importance for smooth functioning of transportation system. If volume data is not found on a continuous basis then the transportation system may fail and the economy of the country may face a great difficulty.

2. METHODOLOGY

Fig 1 shows the methodology. We have selected direct manual counting method for collection of data, because of unavailability of instruments and simplest among all studies. Vehicles can be counted for any duration. Duration of count depends on the objective of data collection. For traffic control and management or operational studies short duration count at peak period is conducted. For planning and design purpose, long duration count is conducted. We have counted data for 20 minutes. And finally we have converted this data into 1 hour calculation.

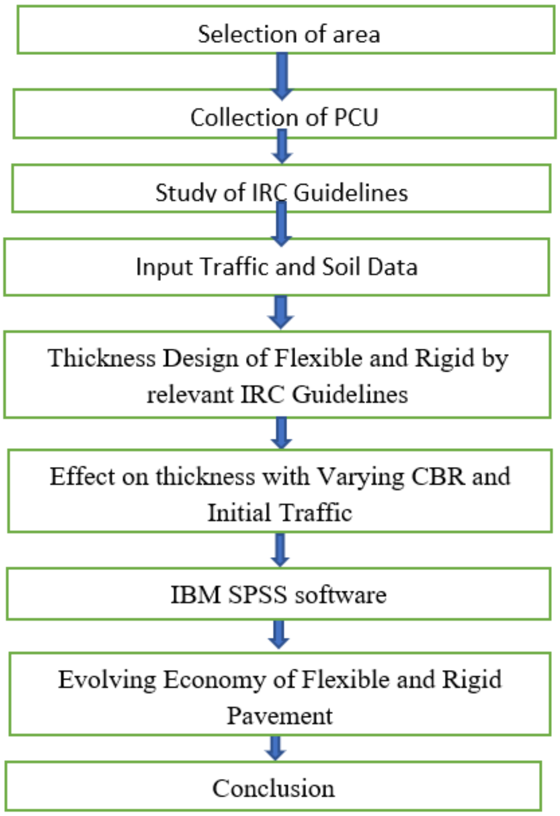

Fig 1 Methodology

Survey procedure consists of (a) Reconnaissance i.e. the military term for exploring beyond the area occupied by friendly forces to gain vital information about enemy forces or features of the environment for later analysis and/or dissemination (b) Survey Design/piloting i.e. before starting survey we have made a guideline to how we will perform the work (c) Trial Survey i.e. before starting the main survey we have made some trial survey, though there is no existence of error in the actual work. Fig 2 shows the data for the time 12:00-12:40. Fig 3 shows the data for the time 1:30-2:00. Fig 4 shows the data for the time 2:00-3:00. Fig 5 shows the data for the time 3:00-4:00. Fig 6 shows the data for the time 4:00-4:30.

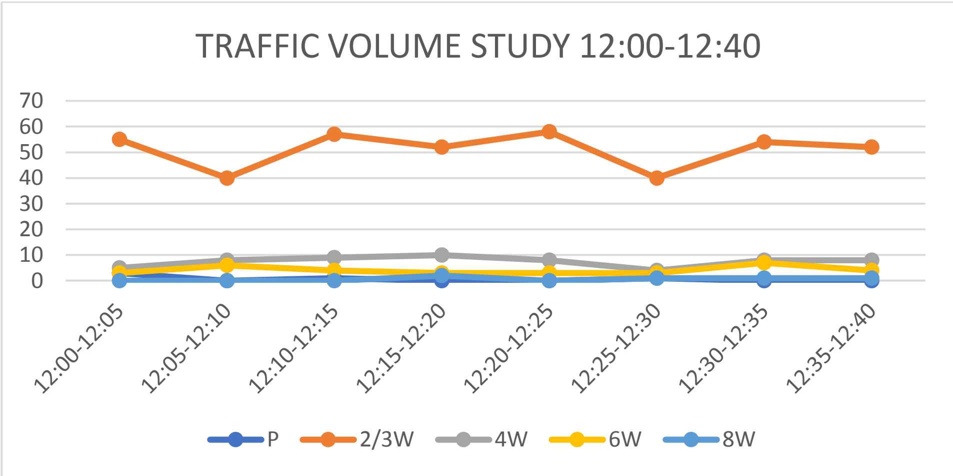

Fig 2 Traffic volume study for 12:00-12:40

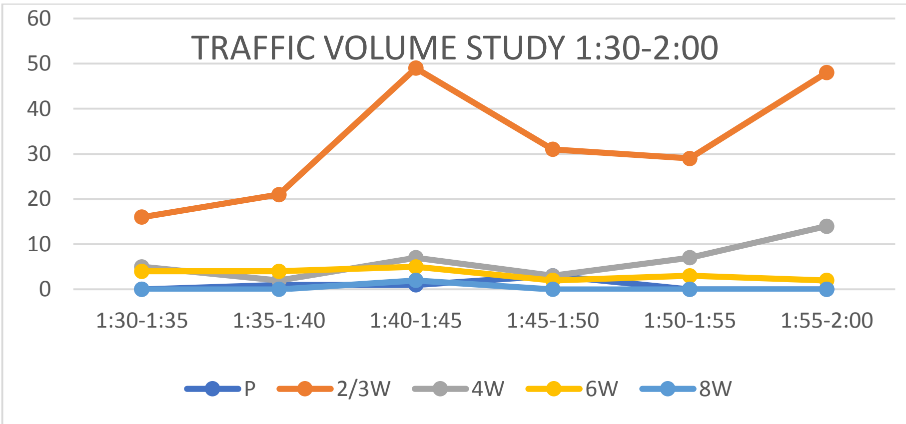

Fig 3 Traffic volume study for 1:30-2:00

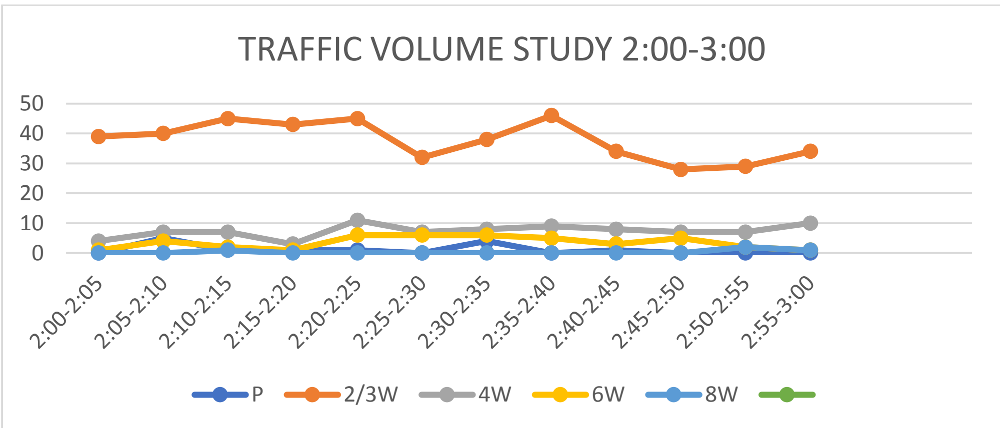

Fig 4 Traffic volume study for 2:00-3:00

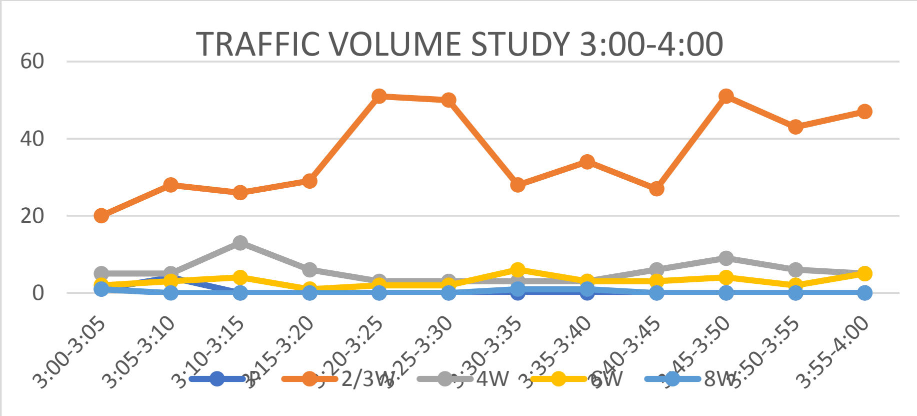

Fig 5 Traffic volume study for 3:00-4:00

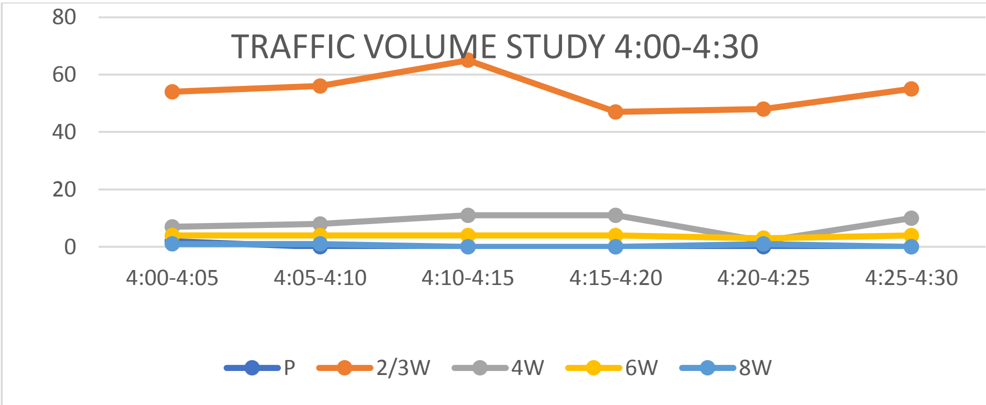

Fig 6 Traffic volume study for 4:00-4:30

3. RESULTS AND DISCUSSIONS

CBR (California Bearing Ratio) test is conducted using standard test equipment. Untreated soil is tested for soaked and un-soaked condition for both light and heavy compaction densities. Whereas, treated soil is tested only for heavy compaction density for soaked and un-soaked condition. Results of CBR test on treated and untreated soil sample are given in Table 1. It can be observed from the table that the CBR of treated soil at un-soaked condition has increased enormously for both the combinations. The un-soaked CBR of soil has increased by 31% and 48% for soil treated. From the results obtained the chemical improves the un-soaked CBR of soil to a great extent and is more effective when fly ash is added. Soil stabilized with fly ash has showed better results because addition of cementations materials like fly-ash further strengthens soil because terrain catalyzes the activation of alumina silicates in soil along with the calcium hydroxide present in cementations binders. But in case of soaked condition there is not much increase in CBR. The maximum CBR at soaked condition for days curing period is 2.3% and 2.55%respectively for soil stabilized CBR values with respect to different curing periods are graphically represented.

Table 1. Results of CBR test on treated and untreated soil sample

Property		**Soil**	**Sample 1**			**Sample 2**		
			1 Day	**7 Days**	**28 Days**	**1 Day**	**7 Days**	**28 Days**
CBR Value (%)	Un-soakedcondition	28.17	33.09	40.25	40.69	47.4	48.74	53.66
	Soaked condition	1.04	0.67	1.34	2.3	1.12	1.57	2.55

In this study, rigid pavement for dual carriageway road consists of dowel and tie bars, without tied concrete shoulders has been designed for varying initial traffic and sub grade strength. The traffic on the road mainly consists of single axle load vehicles, tandem axle load vehicles, tridem axle load vehicles. Details of axle load spectrum of rear single, tandem and tridem axles are given in table 2.

Table 2. Axle load spectrum

Single Axle		**Tandem Axle**		**Tridem Axle**	
Axle Load Class (kN)	**Frequency (% of axles)**	**Axle load class (kN)**	**Frequency (% of axles)**	**Axle load class (kN)**	**Frequency (% of axles)**
185-195	18.15	380-400	14.5	530-560	5.23
175-185	17.43	360-380	10.5	500-530	4.85
165-175	18.27	340-360	3.63	470-500	3.44
155-165	12.98	320-340	2.5	440-470	7.12
145-155	2.98	300-320	2.69	410-440	10.11
135-145	2.62	280-300	1.26	380-410	12.01
125-135	2.62	260-280	3.9	350-380	15.57
115-125	2.65	240-260	5.19	320-350	13.28
105-115	2.65	220-240	6.3	290-380	4.55
95-105	3.25	200-220	6.4	260-290	3.16
85-95	3.25	180-200	8.9	230-260	3.1
<85	14.15	<180	34.23	<230	17.58
	100		**100**		**100**

The axle load category-wise design axle load repetitions for bottom-up and top-down fatigue cracking analysis are given table 3.

Table 3 Axle load category-wise design

Axle Category	Proportion of Axle Category	Category wise Axle repetitions for BUC analysis	Category wise axle repetitions for TDC analysis
Front (steering) single	0.45	498886	411581
Rear Single	0.15	166295	137194
Tandem	0.25	277159	228656
Tridem	0.15	166295	137194

Cumulative fatigue damage analysis for bottom-up cracking due to rear single axles is given in table 4

Table 4. CFD analysis for BUC due to rear single axles

BUC fatigue analysis for day-time (6-hour) traffic & positive temperature differential Rear Single Axles				
Expected Repetitions (ni)	**Flexural Stress MPa**	**Stress Ratio (SR)**	**Allowed Repetitions (Ni)**	**Fatigue Damage (ni/Ni)**
362191	2.502	0.506	589852	0.614
347823	2.416	0.488	1442861	0.241
364586	2.329	0.471	4964384	0.073
259022	2.243	0.453	37080729	0.007
59467	2.156	0.436	Infinite	0.000
32328	2.070	0.418	Infinite	0.000
52283	1.983	0.401	Infinite	0.000
52882	1.897	0.383	Infinite	0.000
52882	1.810	0.366	Infinite	0.000
64855	1.723	0.348	Infinite	0.000
64855	1.637	0.331	Infinite	0.000
282369	1.550	0.313	Infinite	0.000
1995544	**Fatigue Damage from rear single axles**			**0.936**

Cumulative fatigue damage analysis for bottom-up cracking due to rear tandem axles is given in table 5.

Table 5. CFD analysis for BUC due to rear tandem axles

BUC fatigue analysis for day-time (6-hour) traffic & positive temperature differential Rear Tandem Axles				
Expected Repetitions (ni)	**Flexural Stress MPa**	**Stress Ratio (SR)**	**Allowed Repetitions (Ni)**	**Fatigue Damage (ni/Ni)**
40188	2.123	0.429	Infinite	0.000

29102	2.054	0.415	Infinite	0.000
10061	1.984	0.401	Infinite	0.000
6929	1.915	0.387	Infinite	0.000
7456	1.846	0.373	Infinite	0.000
3492	1.777	0.359	Infinite	0.000
10809	1.707	0.345	Infinite	0.000
14385	1.638	0.331	Infinite	0.000
17461	1.569	0.317	Infinite	0.000
17738	1.499	0.303	Infinite	0.000
24667	1.430	0.289	Infinite	0.000
94872	1.361	0.275	Infinite	0.000
277159	**Fatigue Damage from tandem axles**			**0.000**

Cumulative fatigue damage analysis for top-down cracking due to rear single axles is given in table 6.

Table 6. CFD analysis for TDC due to rear single axles

TDC fatigue analysis for night-time (6-hour) traffic & negative temperature differential Rear Single Axles				
Expected Repetitions (ni)	**Flexural Stress MPa**	**Stress Ratio (SR)**	**Allowed Repetitions (Ni)**	**Fatigue Damage (ni/Ni)**
24901	2.113	0.427	Infinite	0.000
23913	2.073	0.419	Infinite	0.000
25065	2.033	0.411	Infinite	0.000
17808	1.993	0.403	Infinite	0.000
4088	1.953	0.395	Infinite	0.000
2223	1.913	0.386	Infinite	0.000
3594	1.873	0.378	Infinite	0.000
3636	1.833	0.370	Infinite	0.000
3636	1.793	0.362	Infinite	0.000
4459	1.753	0.354	Infinite	0.000
4459	1713	0.346	Infinite	0.000
19413	1.673	0.338	Infinite	0.000
137194	**Fatigue Damage from rear single axles**			**0.000**

Cumulative fatigue damage analysis for top-down cracking due to rear single axles is given in table 7.

Table 7. CFD analysis for TDC due to rear tandem axles

TDC fatigue analysis for night-time (6-hour) traffic & negative temperature differential Rear Tandem Axles (Stress computed for 50% of axle load)				
Expected Repetitions (ni)	**Flexural Stress MPa**	**Stress Ratio (SR)**	**Allowed Repetitions (Ni)**	**Fatigue Damage (ni/Ni)**
397862	2.133	0.431	Infinite	0.000
288107	2.093	0.423	Infinite	0.000
99603	2.053	0.415	Infinite	0.000
68597	2.013	0.407	Infinite	0.000
73810	1.973	0.399	Infinite	0.000
34573	1.933	0.390	Infinite	0.000
107011	1.893	0.382	Infinite	0.000
142407	1.853	0.374	Infinite	0.000
172864	1.813	0.366	Infinite	0.000
175608	1.773	0.358	Infinite	0.000
244205	1.733	0.350	Infinite	0.000
939228	1.693	0.342	Infinite	0.000
2743873	**Fatigue Damage from rear tandem axles**			**0.000**

Cumulative fatigue damage analysis for top-down cracking due to rear single axles is given in table 8.

Table 8. CFD analysis for TDC due to rear tandem axles

TDC fatigue analysis for night-time (6-hour) traffic & negative temperature differential Rear Tandem Axles (Stress computed for 33% of axle load)				
Expected	**Flexural Stress**	**Stress Ratio (SR)**	**Allowed**	**Fatigue Damage**

Repetitions (ni)	MPa		Repetitions (Ni)	(ni/Ni)
86103	2.079	0.420	Infinite	0.000
79847	2.039	0.412	Infinite	0.000
56634	1.999	0.404	Infinite	0.000
117218	1.960	0.396	Infinite	0.000
166443	1.920	0.388	Infinite	0.000
197724	1.880	0.380	Infinite	0.000
256333	1.840	0.372	Infinite	0.000
218632	1.800	0.364	Infinite	0.000
74908	1.760	0.356	Infinite	0.000
52024	1.720	0.347	Infinite	0.000
51036	1.680	0.339	Infinite	0.000
289424	1.640	0.331	Infinite	0.000
1646324	**Fatigue Damage from rear tridem axles**			**0.000**

Similarly, Cumulative Fatigue Damage values for different trial thickness has been carried out and given in Table 9.

Table 9. Cumulative Fatigue Damage values for different trial thickness

Slab thickness in m	CFD for BUC case			CFD for TDC case				Total CFD= (BUC+TDC)	Remarks
	Rear single axles	Tandem axles	Total CFD (BUC)	Rear single axles	Tandem axles	Rear tridem axles	Total CFD (TDC)		
0.300	11.056	0.331	11.387	0.016	0.046	0.001	0.063	11.450	**Unsafe**
0.310	5.252	0.054	5.306	0.000	0.008	0.000	0.008	5.314	**Unsafe**
0.320	2.359	0.000	2.359	0.000	0.000	0.000	0.000	2.359	**Unsafe**
0.330	0.936	0.000	0.936	0.000	0.000	0.000	0.000	0.936	**Safe**

Hence, for trial thickness 330 mm, total CFD is coming less than one as given in Table 9. So, slab thickness of 330 mm is safe for the design. Similarly, thickness of slab of a rigid pavement for different CBR of sub-grade as 3%, 4%, 6% and 8% with different initial traffic as 500, 2000, 400and 6000 CVPD has been carried out and given in table 10. However, the thickness of GSB and DLC layers remain unchanged for different sub grade strength and initial traffic. Thickness of both GSB and DLC layers are taken as 150 mm for all given CBR of sub grade and initial traffic.

Table 10. Slab thickness for different CBR and initial traffic

Initial Traffic (CVPD)	CBR 3%	CBR 4%	CBR 6%	CBR 8%
	Thickness (mm)			
500	302	303	301	300
2000	317	321	319	318
4000	323	329	327	326

4. CONCLUSIONS

The depth of different layers for two types of pavements designed for varying CBR of sub grade and initial traffic. In case of flexible pavement, it is observed that the thickness of pavement decreases with an increase in effective CBR of sub grade. The thickness of pavement increases with an increase in traffic. In case of rigid pavement it is observed that there is no significant change in thickness of pavement with an increase in effective CBR of sub grade. However, with an increase in initial traffic, the thickness of the rigid pavement increases.

Lights vehicle (car) occupied 31% of total vehicle. Percentage of NMV (non motorized vehicle) is relatively moderate (21%). Percentage of public transport (bus) is 1%. Which is very low. Percentage of utility vehicle is10%.

It was morning rush hour. So flow was higher towards the city centre. If another vehicle count was done in evening rush hour, opposite scenario might be seen. From the flow fluctuation curve it is seen that the vehicle movement is nearly uniform in that road.

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