

ANALYSIS OF DIFFERENT PARKING SPACE AND ITS COMPARISON

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FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN CIVIL
ENGINEERING

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CERTIFICATE

It is certified that the work contained in the thesis entitled “*Analysis of different parking space and its comparison*” submitted by Ms. Kumari Pratibha, has been carried out under my supervision and this work has not been submitted elsewhere for a degree.

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ABSTRACT

In the “Analysis of different parking space and its comparison” we collected data from different parking space of our institute N I T Rourkela. Initially we figured out what is the variation of pcu with a certain time and then we compared all these data with the help of “t- test“ to find out whether these parking pattern and demand are same or different. In another part we find out the “spatial and temporal distribution” of main road traffic vehicle, here “spatial distribution” is the variation of PCU(passenger car unit) with distance and in “temporal distribution” variation of PCU with time. in last section we decoded the data from a market video of Rourkela main road in which we got the variation of pcu with speed and flow.,

TABLE OF CONTENTS

ABSTRACT.....	4
TABLE OF CONTENTS.....	5
LIST OF TABLES.....	6
CHAPTER 1: Introduction.....	7-10
CHAPTER 2: Literature Review.....	11-13
CHAPTER 3: Empirical Study.....	14-30
3.1 Data Collection Site.....	14
3.2 Data Collection Methodology.....	14
3.3 Data Analysis and Methodology.....	15
CHAPTER 4: CONCLUSION.....	31
REFERENCES.....	32

LIST OF TABLES

Table1. PCU factor for different type of vehicle.....	9
Table 3.1 PCU for Main Building.....	16
Table 3.2 PCU for Library.....	17
Table 3.3 PCU for Ceramic Department.....	18
Table 3.4 PCU for Central Workshop.....	19
Table 3.5 PCU for Student Activity Center.....	20
Table 3.6 Comparison of Mean of PCU by t-test.....	21
Table 3.7 Comparison of Parameters of Straight line.....	22
Table 3.8 Total Number of Vehicle for Stretch-1.....	24
Table 3.9 Total Number of Vehicle for Stretch-2.....	25
Table 3.10 Total Number of Vehicle for Stretch-3.....	25
Table 3.11 Total Number of Vehicle for Stretch-4.....	26
Table 3.12 Flow, Speed and PCU of Market video.....	28

CHAPTER 1

Introduction

Proper design of parking space is very important for good transporting system. If there will be lack of parking space and facility then it will be a chaotic condition for everyone. But designing of any parking space is not a easy job. It seeks a lot of parameters which we need to know, we need to find out with the help of simple data by applying some technique. There are two type of parking pattern:

1.1.1 On street parking

It is having two types:

- a.) Parallel parking
- b.) Angle parking

1.1.2 Off street parking

Off street parking are having five types:

- a.) Surface car parking
- b.) Multistory car parking
- c.) Roof parking
- d.) Mechanical car parking

e.) Underground car parking

1.2 Parking demand characteristics

There are four type of characteristic demand. This is having full impact on parking demand.

1.2.1 Parking accumulation

It is defined as the number of parked vehicle at a specified time is called Parking accumulation.

1.2.2 Parking duration

Parking duration is defined as the length of time for which vehicle uses the facility.

1.2.3 Parking volume

Parking volume means number of vehicle involved in parking activity is called parking volume.

1.2.4 Occupancy

It is defined as the ratio of number of vehicles using parking facility to the number of parking facility available at a specified time.

1.3 PCU (Passenger car unit)

PCU is an interference value which is being used to change a vehicle in to its equivalent passenger car unit. The equivalent PCUs of different vehicle categories does not remain same under different circumstances. According to IRC-106 following are the PCU value of different vehicles.

Table1. PCU factor for different type of vehicle

Vehicle type	PCU
Fast vehicle	
1. Two wheeler motor cycle or scooter etc	0.5
2. Passenger car pick up van	1.0
3. Auto rickshaw	1.2
4. Light commercial vehicle	1.4
5. Truck or Bus	2.2
6. Agricultural tractor trailer	4.0
Slow vehicle	
1. Cycle	0.4
2. Cycle Rickshaw	1.5
3. Tonga (horse drawn vehicle)	1.5
4. Hand cart	2.0

1.4 Data collection methodology

There is two type of data collection methodology for study of parking survey.

1.4.1 Beat survey:

To accommodate at least six to eight beats the data is analyzed to determine(for each vehicle) the number of beats 'n' in which they are present. The parking duration of 'I'th

vehicle is taken as nI *beat duration. If such a vehicle pass through n_j beats then the parking duration will be at least n_j *beta duration. The arrival rate of vehicle between second and third beats with the beat duration is 't'.

1.4.2 Continuous survey:

In continuous survey initially we use to note down the distinguish feature of the vehicles. Then we note down its arrival time and departure time at the entry place. Then parking duration will be equal to the difference between departure time and arrival time. Then we have to find out dimension of the shopping area. We should measure the approximate length and width of the shopping area. Now with the help of length and width we can find out the shopping area then parking space for vehicles.

CHAPTER 2

Literature Review

AN ANALYSIS OF THE SPATIAL DISTRIBUTION OF PARKING SUPPLY POLICY AND DEMAND:

Young, Beaton, Satgunarajah (department of civil engineering, Monash university, Victoria, Australia,2010) studied the spatial distribution of parking of Melbourne City. Parking facility is one of the important transport facility in urban area specially the central districts having high retail activity & employment opportunities. Parking policies & pricing impacts the entire city transportation & land use. Transport planner & Land use planner look for parking places differently. Spatial integration of parking, land use & transport facility is ignored. Parking influences the spatial distribution of transport use & viability of development. Parking should be considered as at metropolitan level than to consider for a particular region.

BEHAVIORAL CHARACTERISTICS OF CAR PARKING DEMAND(A CASE STUDY OF KOLKATA):

Generalized parking rates are assumed for estimating the parking demand & other parameters are ignored. *Chakrabarty & Mazumdar* (Institute of town planner, India journal 7-4, of December 2010) in this paper took into consideration various behavioral characteristics of parking demand for various trips, location & with various urban areas. Various factors influencing the parking demand & also their influence on each other was tried to find out.

ANALYSIS ON PARKING DEMAND OF THE COMMERCIAL BUILDINGS CONSIDERING THE PUBLIC TRANSPORT ACCESSIBILITY:

Qin, Xiao, Gan, Pan (nature and science. 2010; 8(3): 63-68), [ISSN: 1545-0740] analyzed the parking demand of shopping centre & markets from the data obtained by conducting parking demand survey at various locations of Beijing. Relationship between parking demand & transport accessibility was analyzed. Parking demand decreases with good & efficient transport facility. Parking demand rate with different public transport accessibility was determined & a parking demand model with different accessibility was provided.

ATTITUDES AND BEHAVIORAL RESPONSES TO PARKING MEASURES:

Warden, Borgers, Timmermans (Urban planning group, Eindhoven university of technology, March 2006) studied attitude & behavioral responses of car drivers to planned parking measures at campus of the Eindhoven University of Technology, the Netherlands. In an on-street questionnaire, car drivers were asked their opinion about restricting access to the campus area for cars of non-university car drivers through (i) a barrier, (ii) proper identification when entering the campus area, and (iii) payment. The response of more than 700 car drivers was used in multinomial logit analysis. Most drivers wanted to continue into the University campus by car. Half of the car driver responded they would change their mode of transport or park car outside the campus if they have to pay parking fee.

CHARACTERIZING PARKING SPACES USING SURVEY DATA:

Parking spaces are strategic commodities of modern day transport facility. Few dataset allows precisely measuring the use of spaces in terms of population, segments, activity types & duration. *Morency & Trepainer* (Interuniversity Research centre on enterprise networks, logistics and transportation (CIRRELT) 2008) proposed empirical measures & methods

regarding the use of parking space in a strategic urban area. Large survey was conducted representing 5% of the population of Montreal. Car driver heading towards the area enquired regarding the type of parking space. Parking spaces were classified according to their jurisdiction (private/public), location (indoor/on the street/outdoor) and rates (free/fee charging/subsidized by the employer). Using these data, statistics describing the use of these spaces are developed. On the one hand, people benefiting from the various types of parking spaces are described in terms of residence location, demographic attributes and type of activity. On the other hand, parking accumulation profiles are developed and summarized by key indicators.

PARKING SITE SELECTION MANAGEMENT USING FUZZY LOGIC AND MULTI CRITERIA DECISION MAKING:

Population growth, sprawling of cities and increasing of vehicles result in heavy traffic and prolonged city trips. Utilizing public parkings regarded as an effective approach to abate traffic load in city centers, in that spaces designated for vehicles parking along the roads would be freed, and consequently the usable space of the roads would increase, which in turn would contribute to the smooth flow of traffic. Farzanmanesh, Ghaziasgari and Abdullah (Department of environmental sciences, university Putra Malaysia 2008) described an ideal method for parking site selection by the use of GIS, fuzzy logic and weighting criteria to determine proper parking sites. Suitable place for parking is selected for one of the high traffic regions of Esfahan city in Iran.

CHAPTER 3

Empirical Study

3.1 Data Collection site

We collected data from different site in N I T Rourkela and main road of Rourkela.

N I T Rourkela Site

- Ceramic department parking space
- Central workshop parking space (CW)
- SAC front side parking space (SAC)
- Main building parking space (MB)
- Library parking space

Rourkela main road

3.2 Data collection methodology

First we will discuss about the N I T data, we collected all these data from different site in N I T Rourkela at the same time from 10 am to 12 pm. We surveyed all the the above given parking place, from this survey we got how many two wheeler motorized and non motorized vehicle is being parked at a specified parking place.

Then come to the Rourkela main road here we did survey in two parts. In one part we divided the 1km Main road in four parts each stretch is having length 250 meter, our survey duration was of 2 hr. (4.45 pm to 6.45 pm).we divided this two hour time in eight slot each of having 15 minutes. In each slot we get how many vehicle (4 wheeler, 3 wheeler, 2 wheeler, non motorized each individually) is crossing here.

In other part we captured a video of same road but its stretch was 5 meter and width was 7 meter we took this video on 14th October 2011 . data we have collected data from different site of our institute N I T Rourkela.

3.3Data analysis and methodology

N I T Rourkela data: From all these five site we have collected the data. After collection of data we convert all these vehicles in terms of PCU(Passenger car unit) by multiplying it with its corresponding pcu factor which is described in IRC-6.

a.)Main building parking space: we did survey at this site on 16th January 2012 from 10.00 am to 12.00 pm.

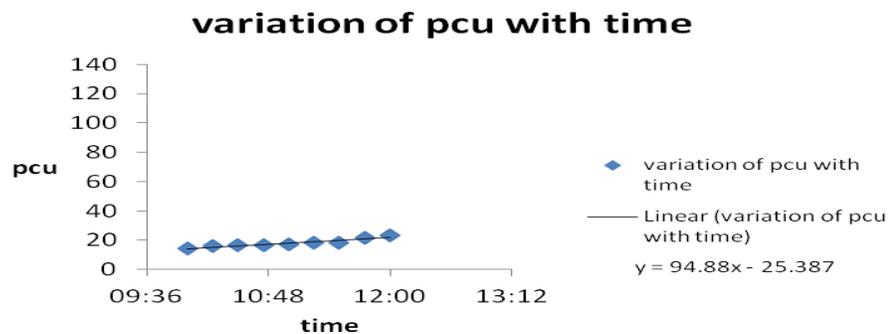


Fig.1

Table 3.1 PCU for Main building

TIME	CYCLE	TWO-WHEELER	FOUR- WHEELER	PCU
10:00	16	8	3	14.6
10:15	18	9	3	15.9
10:30	18	10	3	16.4
10:45	17	11	3	16.5
11:00	18	12	3	17.4
11:15	20	12	3	18.2
11:30	20	10	4	18.6
11:45	20	11	6	21.9

b.) **Library parking space:** here we did survey on 17th january 2012 at same time 10.00 am to 12.00pm. data are:

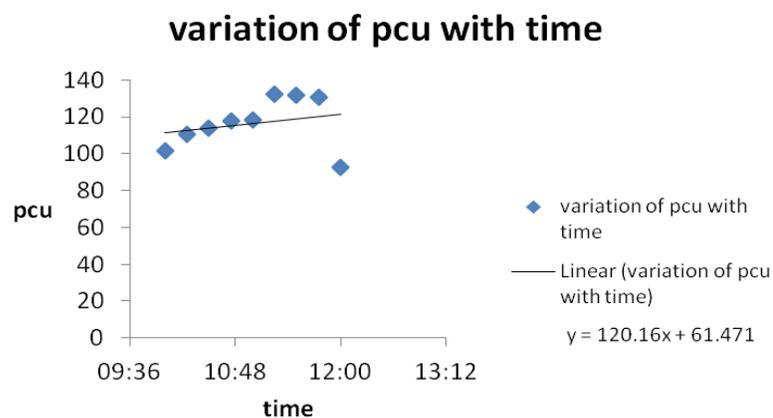


Fig 2

Table 3.2 PCU for library

Time	Cycle	two wheeler	PCU
10:00	222	26	101.8
10:15	241	28	110.4
10:30	248	29	113.7

Table 3.3 PCU for ceramic department

Time	Cycle	Two wheeler	PCU
10:00	29	19	38.9
10:15	26	19	35.9
10:30	19	20	29.4
10:45	21	21	31.9
11:00	27	21	37.9
11:15	45	24	57.4
11:30	55	29	69.9
11:45	61	22	72.4
12:00	57	21	67.9

d.)Central workshop parking space: here we did survey on 19th january 2012.

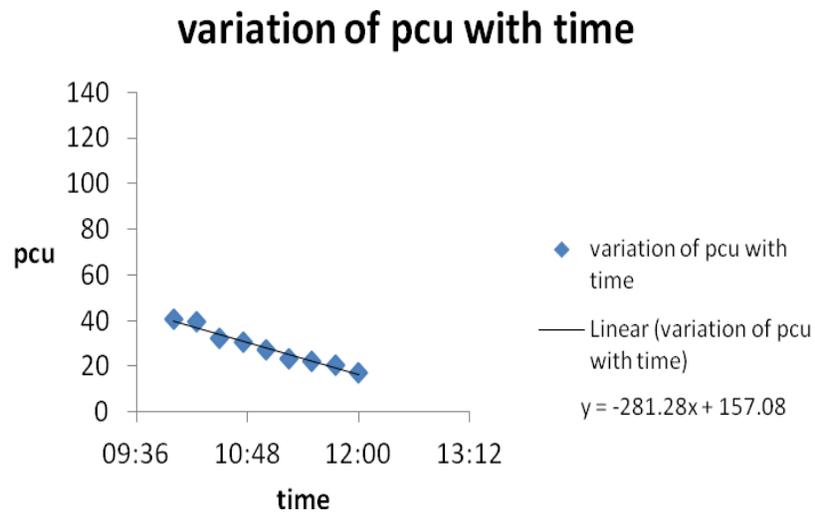


Fig.4

Table 3.4 PCU for central workshop

Time	Cycle	Two wheeler	PCU
10:00	76	20	40.4
10:15	74	20	39.6
10:30	54	21	32.1
10:45	51	20	30.4
11:00	47	17	27.3
11:15	37	17	23.3
11:30	36	16	22.4
11:45	35	13	20.5
12:00	31	10	17.4

e.)SAC front side parking space: we did survey here on 21st january 2012.

variation of pcu with time

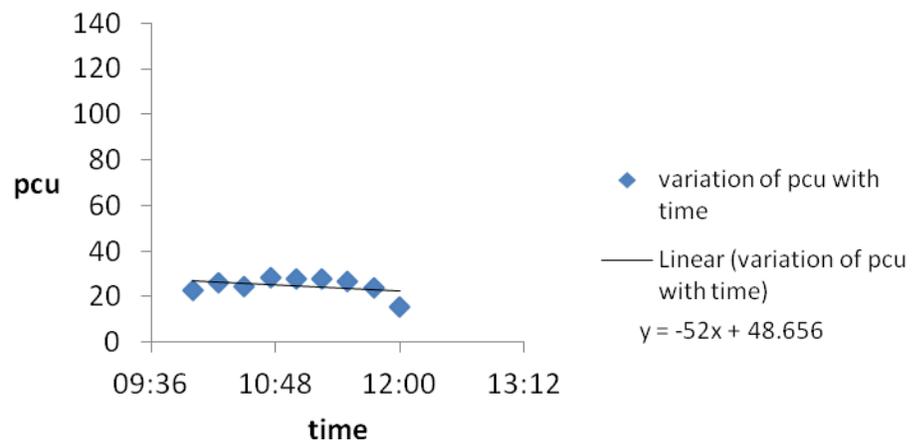


Fig.5

Table 3.5 PCU for SAC

Time	Cycle	Two wheeler	PCU
10:00	26	25	22.9
10:15	34	25	26.1
10:30	30	25	24.5
10:45	38	26	28.2
11:00	37	26	27.8
11:15	40	24	28.0
11:30	40	21	26.5
11:45	35	20	24.0
12:00	21	14	15.4

Comparison of all these data: we compared all these data with each other to find out that either these parking pattern are different or not.. Now question is which test we should apply. Here we are applying “t-test”, the reason behind this is we have less number of samples so we cannot go for any other test.

t-test:

$$t = \frac{a_1 - a_2}{\sqrt{s_1^2 - s_2^2}}$$

$$df = \frac{(s_1^2 + s_2^2)^2}{\frac{s_1^4}{n_1 - 1} + \frac{s_2^4}{n_2 - 1}}$$

't'-indicates the t-value, while 'a' denotes the parameters, parameters included mean and intercept, 's' indicates standard error. First we find out the value of degree of freedom (i.e. df) for finding out this 'df' we need number of sample ('n') so we will get the value of 'df'. After that we will find the 't'-value (this will be t-critical value) and from t-table we will fix a certain confidence interval and with the help of t-table will get the value of t-critical. Now if t-stat will be greater than t-critical then our parking pattern is different otherwise it will not be different.

So, here we compared all of the above data for mean of PCU's and for the intercept of the straight lines.

Table 3.6 Comparison of mean of the PCU by t-test

Place	t-critical	t-stat	type of parking
SAC and library	2.306004	24.6048	Different
SAC and MB	2.306004	3.2727	Different
SAC and Ceramic dept.	2.306004	3.7206	Different
Ceramic dept. and MB	2.306004	6.0515	Different
Ceramic dept. and library	2.306004	10.7429	Different
MB and Library	2.306004	21.1119	Different
CW and SAC	2.306004	1.25676	Not different
CW and Library	2.306004	14.7275	Different
CW and MB	2.306004	2.7927	Different
CW and Ceramic dept.	2.306004	2.5438	Different

table 3.7 Comparison of parameters of straight line by t-test

Place	t-critical	t-stat(a)	t- stat(b)	Type of parking
SAC and library	12.71	11.66	0.868	Not different
SAC and MB	12.71	35.82	18.06	Different
SAC and Ceramic dept.	12.71	56.01	23.34	Different
Ceramic dept. and MB	12.71	45.08	8.979	Different
Ceramic dept. and library	12.71	23.95	14.91	Different
MB and Library	12.71	1.774	6.096	Not different
CW and SAC	12.71	77.76	25.29	Different
CW and Library	12.71	28.07	6.685	Different
CW and MB	2.776	197.7	95.90	Different
CW and Ceramic dept.	12.71	83.26	36.02	Different

In case of comparison for mean we got that parking pattern of central workshop and student activity center are not different while others are having different pattern. When we did the comparison for parameters like intercepts and slope then we got different result it was quite obvious. So, here we got that parking pattern of student activity center and library are not different and same case is with main building and library.

Rourkela main station road: Section of the Main Road From Station square to Daily market was surveyed. Around 1km stretch of the road was surveyed by dividing it into 4 continuous stretches. We did survey and for finding out the impact of on street parking on flow and speed of the traffic. But first we will discuss about the survey of 1km long road.

Data collection procedure:

- Study section of road was divided into 4 different stretches.
- Total duration of study of 2hours was divided into 8 time slots.

- Each beat duration was 15min.
- Each stretch was surveyed by an observer.
- At start of each time slot each individual observer recorded the partial registration number of vehicles parked in that particular stretch of road assigned to him
- Same Procedure was repeated for each time slot; in our case 8times.
- The Vehicle Registration number was recorded into 3 different groups i.e Four Wheeler, 3wheeler, 2 Wheeler & Non motorized Vehicle(NMV)
- For NMV only number was counted instead of recording partial registration number

Details of survey:

- Location: Rourkela Main Road
 - Survey technique adopted: BEAT Survey
 - Length :1 kilometer
 - Date:18th October 2011,Wednesday
 - Time:4.45pm-6.45pm
 - Number of stretch:4 (250m length)
 - Number of time slots: 8(15min duration)
 - Number of observer:4
 - Type of vehicle surveyed:4 (Four wheeler,3Wheeler,2Wheeler,NMV)
- We have converted the entire vehicle in one unit with the help of passenger car unit. This will help us in considering the peak demand at a specific time. So here you can see that

for every stretch with respect to slot we have drawn a table which is having the number of vehicle in terms of passenger car unit.

➤ From this data we got two important thing :

1. Temporal variation

2. Spatial variation

➤ Temporal variation:

Its showing the variation of number of vehicles with the time. And from the graph we are getting that stretch 1 is having parking demand at its peak point while stretch 2 is having at the lowest level.

➤ Spatial variation:

It is showing the variation of number of vehicle with the length of stretch that mean up to what distance demand is more and in other way you can say that at what distance traffic is more. Obviously at that place we have to provide a parking space that will be on-street, off-street, or multistory simple that we will get in next phase of project work.

Table 3.8 Total number of vehicle for stretch-1

Vehicle	Slot-1	Slot-2	Slot-3	Slot-4	Slot-5	Slot-6	Slot-7	Slot-8
4w	8	5	6	5	5	6	4	6
3w	12	10	10	10	8	9	11	10
2w	14	14	14	7	7	13	11	11
Nmw	66	74	78	83	87	81	93	90
Total	100	103	108	105	107	109	119	117

Vehicle	Slot-1	Slot-2	Slot-3	Slot-4	Slot-5	Slot-6	Slot-7	Slot-8
PCU	62.4	61	64	62	61.6	63.8	69.2	68.5

Table 3.9 Total number of vehicle for stretch-2

Vehicle	Slot-1	Slot-2	Slot-3	Slot-4	Slot-5	Slot-6	Slot-7	Slot-8
4w	9	6	8	5	5	5	8	8
3w	2	2	4	4	2	4	2	2
2w	18	16	16	15	15	14	16	19
Nmw	63	93	87	117	98	117	111	102
Total	92	117	115	141	120	140	137	131
PCU	51.9	62.9	64.3	75.8	63.9	75.3	73.9	70.9

Table 3.10 Total number of vehicle for stretch- 3

Vehicle	Slot-1	Slot-2	Slot-3	Slot-4	Slot-5	Slot-6	Slot-7	Slot-8
4w	1	1	4	4	1	2	4	6
3w	1	1	1	4	2	2	3	4
2w	23	25	23	23	23	25	28	27
Nmw	21	27	21	38	30	32	47	57
Total	46	54	49	69	56	61	82	94
PCU	24.2	28.2	27.2	44.3	29.9	32.9	45.1	52.8

Table 3.11 Total number of vehicle for stretch-4

Vehicle	Slot-1	Slot-2	Slot-3	Slot-4	Slot-5	Slot-6	Slot-7	Slot-8
4w	4	4	4	4	4	6	8	8
3w	3	3	4	3	1	4	2	3
2w	20	22	23	26	29	35	36	39
Nmw	30	39	44	45	54	42	54	63
Total	57	68	75	78	88	87	100	113
PCU	32.6	42.1	42.3	43.1	46.7	49.3	55.4	62.6

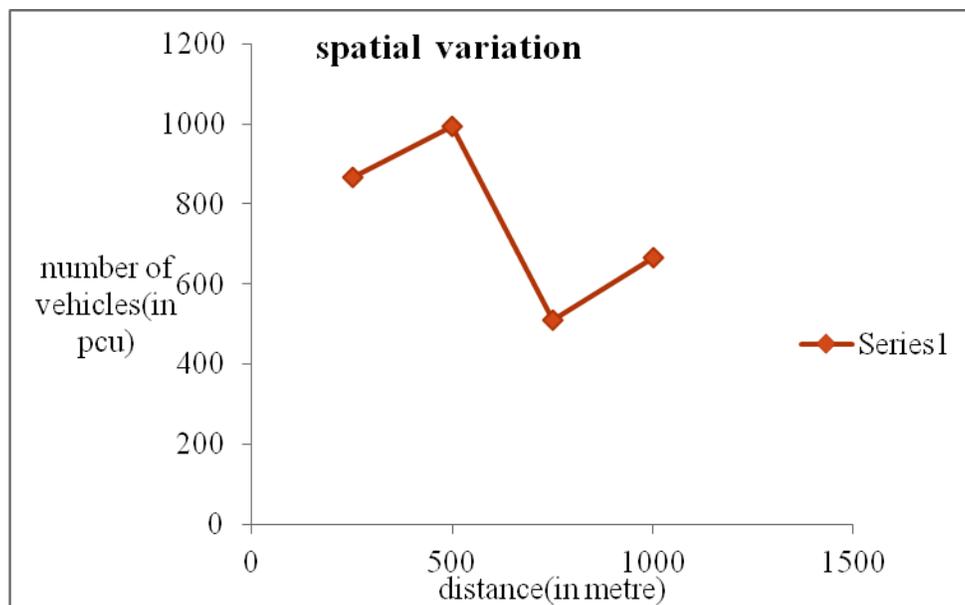


Fig .6

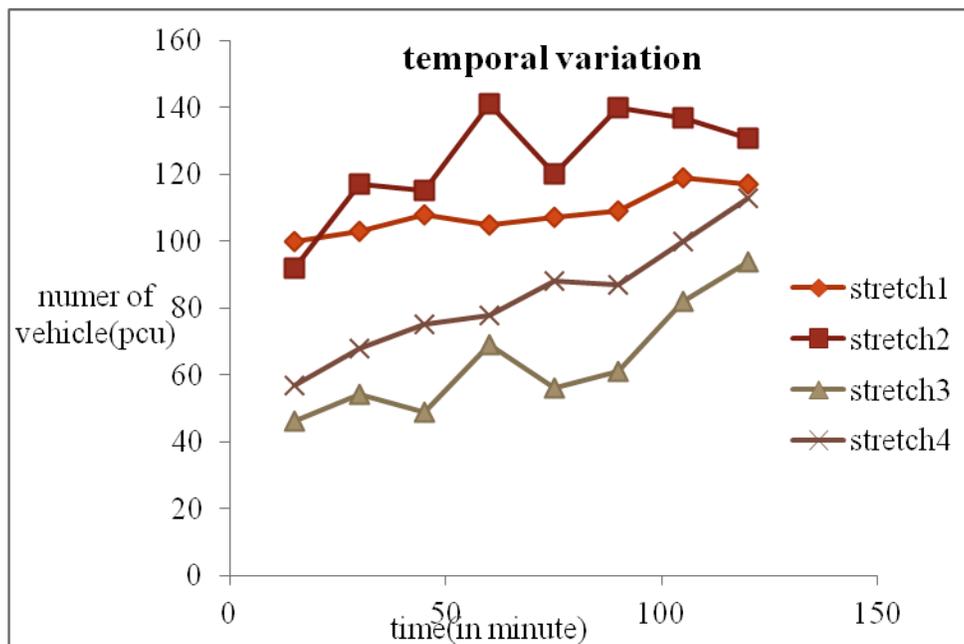


Fig. 7

Rourkela Main market video: In the other part of Rourkela Main market we captured the video of traffic for 45 minutes. From that video we decoded the data . the process is like:

We selected the 7 metre length of road and as we have measured the width of the road then we got it was 5 metre . now with help of video we got how many motorized vehicle is crossing that 7 metre stretch in how much time then by dividing it with 7 metre we got the speed of each motorized vehicle.and we also knew the flow(i.e. number of vehicle per hour)

Besides these things first of all we note it down how many vehicle has been parked on the street(or road) . so, whenever we are counting the number of vehicel crossing that stretch we have to take care of the number of parked vehicle here because the whole idea behind this analysis is to find out the “impact of on street parking on the flow and speed of vehicle crossing that street.” So, the observation table and graph we got is given below:

Table 3.12 Flow, Speed and PCU of market video

Flow	Speed	PCU
10	1.351351	5.5
2	1.111111	6.5
9	2.04918	5.5
2	2	5
7	1.754386	4.5
7	1.845018	5
5	1.470588	6
18	1.52439	6.5
3	1.25	7.5
4	1.818182	6.5
2	2	6
6	1.305483	7.5
5	1.785714	6
6	1.592357	6.5
3	1.154734	7
8	1.428571	6.5
1	1	7.5

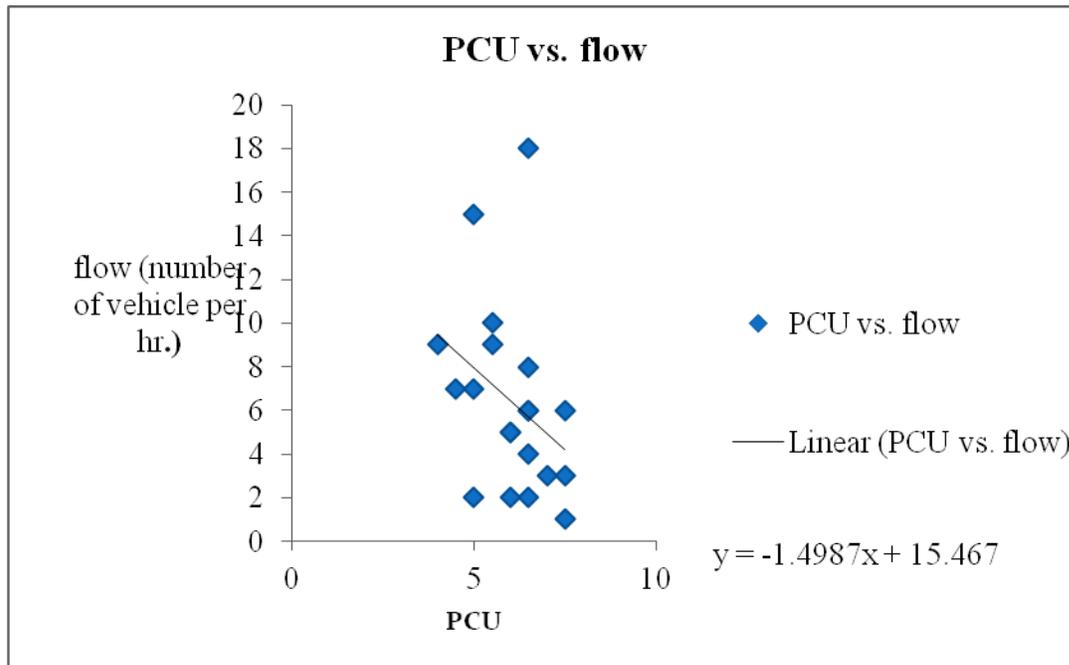


Fig. 8

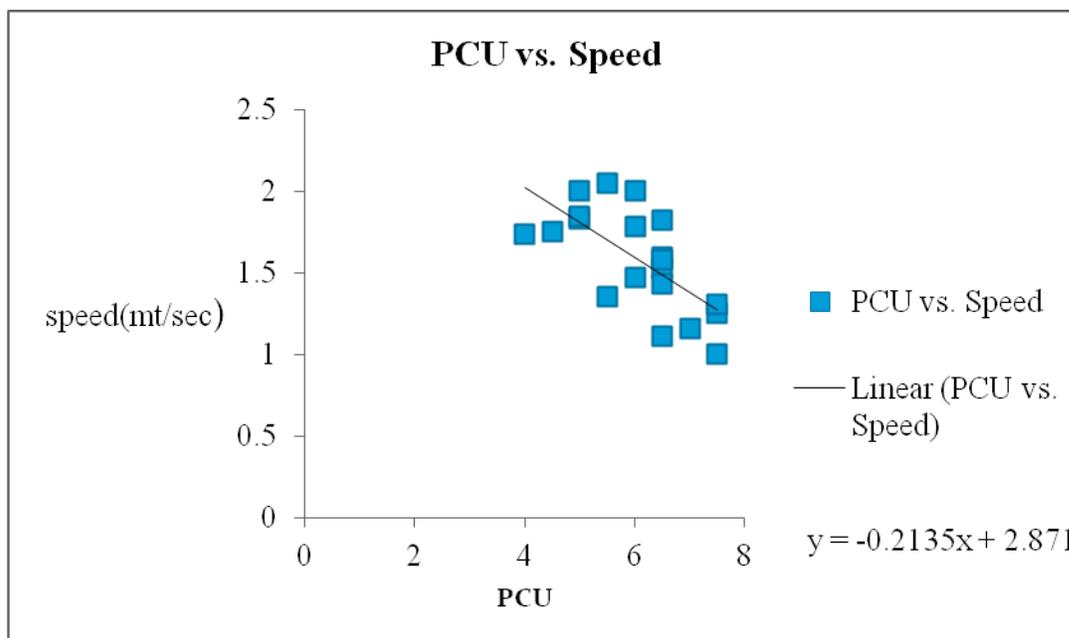


Fig.9

In the above graph we can see that as the PCU (on street parked vehicle) is increasing flow is decreasing and in same pattern speed of the vehicle is also decreasing. So, it creates a lot of problem for vehicle.

CHAPTER 4

Conclusion

For the Rourkela Main road we got two variations one is temporal variation and another one is spatial variation. These two variations will help us when we will go for any modification of parking pattern here or if we will go for construction of any new parking place.

While from Rourkela Main market video we got that how on street parking give its impact on the flow and speed of the vehicle and it will also help us in the finding out demand analysis of parking place.

In other part we compared all the parking pattern of N I T Rourkela (inside) with each other with the help of 't-test' .and we got that in case of comparison for mean the parking pattern of Central Workshop and Student Activity Centre is not different while others are different.

In case of comparison for parameters we got different result here we got that parking pattern of Student Activity Centre and Library is different and same is the case with Central Workshop and Student Activity Centre. Now if original graph will be almost coincides with the straight line then we will go for parameters comparison otherwise we will go for mean comparison

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