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THE EFFECT OF SUPPLY SIDE OF THE TRANSPORTATION SYSTEM ON CONGESTION AS WELL AS LEVEL OF SERVICE

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Abstract: Metropolitan cities in India are highly witnessing the population growth and consequently the increase in traffic volume in their transport corridors. For smooth running of the transportation system it is necessary to assess the Level of Service of arterial roads, intersections, mid-block sections etc. on periodic basis. The Level of service is the range of operating conditions within the traffic stream. The Level of Service is a function of freedom to manoeuvre, speed, comfort and convenience, safety etc. The highway capacity manuals defines the level of service in six categories ranging from A to F with LOS A as best operating condition (Free-Flow) and LOS-F as worst operating condition. (Forced-Flow) The level of service is inversely related to the congestion on road stretches. Inadequacy of supply side of the transportation system, uncontrolled growth of vehicular traffic, static and dynamic encroachment are some of the key parameters affecting the congestion on road sections. The national highways run across the bread and the length of the India measuring 70,934 kilometers. The development of a particular country highly depends upon the interconnectivity of the national highways, state highways, MDR and other roads of that country. The transport sector plays a dominant role in the development of country. However its contribution towards the development is influenced by the efficiency of road network. Therefore it is not only necessary to provide adequate road network but also it should run efficiently. The level of service of a transportation facility depends upon the vehicular traffic composition and corresponding average speed of traffic stream. The increase in vehicular traffic, inadequacy of the supply side of the transportation system, static and dynamic encroachment etc. are some of the factors responsible for congestion on a road facility. The congestion on road ultimately leads to the decrease in speed of the traffic stream, increase air pollution and noise pollution.

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INTRODUCTION

The traffic in India is highly heterogeneous comprising of different types of vehicles (Auto rickshaws, bus, truck, bicycle, etc.) plying on the same facility. The lifeline of the country i.e. the highway (both state and national) runs along and across the different parts of country. The development of a particular country highly depends upon its interconnectivity and accessibility to the different parts of the country. Therefore for a country to develop the first and foremost thing is the interlinking between the different modes of transport systems. In a developing country like India the vehicular growth over a period of time is of considerable amount.

The vehicular traffic growth on urban arterial roads, state highway, and national highways is witnessing a concern for transport planning engineers due to its uncontrolled growth resulting in increase in fuel cost, increase in journey time, additional fuel consumption consequently leading to the increase in air and noise pollution and deteriorating the environmental conditions. The Level of Service is used as a measure of effectiveness of highways arterial roads etc. The HCM-2000 defines the Level of Service as the range of operating conditions within a traffic stream i.e. freedom to manoeuvre, speed comfort convenience, safety and environmental compatibility. The six level of services are defined in Highway Capacity Manual ranging from A to F, with A as the best operating condition i.e. free flow and F as a worst operating condition i.e. forced flow or break-down flow.

The congestion on highways passing through cities refers to the congestion at midblock sections or congestion at the intersections. The level of service is the best fit to quantify the congestion at midblock as well as at intersections. The primary goal of transportation engineers is to mitigate this congestion by means of applying the suitable policy directives on long term as well as on short term basis. In developing countries like India the heterogeneity of traffic is one of the main reasons of congestion as the same facility is utilized by the different category of vehicles. The modeling of congestion is one of the key parameter in order to provide the remedial measure against the deterioration in the Level of Service caused by the excessive vehicular traffic. In order to have a complete understanding about the congestion it is necessary to have a definite relationship amongst the macroscopic flow parameters like speed, flow, density etc

1.1 Objective:-

The main objective of this research is to find out the main causes of traffic congestion and relationship between different flows parameters and to assess the level of service of highways at intersection.

1) To study traffic flow parameters (Speed, Flow and Density).
2) To check the adequacy of supply side of the transportation system.
3) To find out the limiting service volume of different highways passing through urban areas.
4) To suggest the suitable policy directives for mitigating the congestion and provide smooth and efficient transportation network.
5) To study the effect of Level of Service on Traffic volume as well as on average spot speed of traffic stream.
6) To observe the effect of roadway, traffic conditions on congestion levels.

LITERATURE REVIEW

2.1 Level of Service (LOS)

Level of Service is defined as a qualitative measure describing operational conditions within traffic stream, and their perception by drivers and passengers. Level of Service definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions comfort and convenience and safety. Six Level of Services are recognized commonly, designated from A to F, with Level of Service A representing the best operating condition and the Level of Service F as worst.

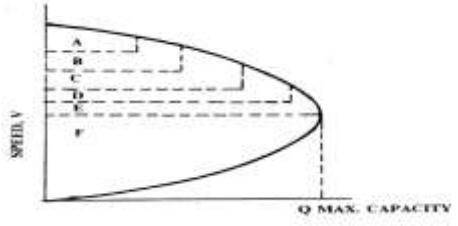

Fig. 2.1 Speed Volume Curve Showing Level of Service.

2.1.1 Significance of Level of Services (LOS)

LOS A: - Represents the best operating condition within the traffic stream. The travelling on a facility is unaffected by the presence of other traveller on the road. Freedom to manoeuvre in case of Level of Service A is high as compared to other Level of Services. The comfort and convenience provided by this LOS is of superior quality.

LOS B: -The quality in terms of freedom to manoeuvre comfort and convenience provided by level of service B is somewhat less than level of service A because the freedom to manoeuvre of one traveller is affected by the presence of another traveller.

LOS C: - The Parameters of Measure of effectiveness i.e. speed, comfort, convenience are affected by the presence of another vehicle in a traffic stream. The individual has to depend on the other traveller in the stream for deciding the desired speed. The flow in this level of service falls in the stable zone.

LOS D: -Level of Service D is the boundary line between the stable and unstable flow. Density of traffic becomes significant parameter while deciding the speed. The parameters safeties, convenience, comfort, experienced in this flow are of poor quality as compared to that of LOS A, LOS B, LOS C.

LOS E: - The Level of Service E is generally happens to be when the volume to capacity ratio approaches near the unity. Due to high volume the speed of vehicles is low, resulting in more loss to freedom to manoeuvre, less comfort and convenience leading to the drivers. The flow corresponding to this LOS is generally characterized as an unstable flow. The minor disturbances to the traffic stream may lead to the breakdown situation in the LOS E, indicating extreme loss to freedom to manoeuvre.

LOS F: - Level of Service F is the worst operating condition i.e. forced flow or breakdown flow. The Level of Service F is obtained when the volume to capacity ratio exceeds 1. The flow is usually highly unstable. Due to less freedom to maneuver the flow occurs in platoons, indicating maximum deterioration in the comfort and convenience, as the flow occurs in platoons, the overtaking maneuver becomes extremely difficult

2.2 Previous Research study.

Antony Stathopoulos et.al proposed a methodology for finding out the time period of congestion on a selected road stretch. He also estimated the probability of diminishing a

congestion during a given time period and also found that if the congestion exceeds 21 minute it was caused by some external parameters to the traffic stream.

Rahman et. al. modelled Level of Service as a function of passing and overtaking manoeuvres taking into account the macroscopic stream parameters such as traffic volume and also considered the effect of percentage of rickshaw in a traffic stream. Based on the effect of Percent of rickshaws he proposed five levels of services with level of service A as best and Level of Service E as worst. He also studied the effect of percentage of rickshaws to the traffic stream.

Chetan Patel et.al.(2012) proposed an empirical relationship between traffic stream parameters such as traffic volume and traffic stream speed. However the relationship holds well for the access controlled urban roads.

Eleonora Papadimitriou proposed the level of service taking into account the qualitative measures of effectiveness and not the quantitative measures of effectiveness. He related the drivers personal characteristics with traffic conditions and concluded that the relationship between perceived level of service and personal characteristics of driver is linear.

Milica Selmic developed a model for the mitigation of congestion. He proposed the best strategy from road users as well as from supply side of transportation system for management of the traffic demand and consequently the reduction n traffic congestion

2.4 Limitation of Existing Research

Volume and operational; characteristics are not taken into account for defining the LOS. The LOS defined in HCM takes into account the qualitative measures and not the quantitative measures. A lot of research work is carried out to quantify the congestion at intersections but very less research work is carried out to quantify the congestion at midblock. Therefore it is necessary to quantify the congestion and assess the level of service at midblock. Conventional literature does not take into account the variation of speed for modelling the congestion and assessment of level of service, so an attempt is made to quantify the congestion based on speed variation and accordingly 10 Level of Services are provided. The researchers have modelled the congestion based on the qualitative parameters however an effort is made to quantify the congestion taking into account the quantitative parameter as a average spot speed for estimating the congestion. To have a profound idea of congestion, congestion is expressed in terms of percentage of difference between average spot speed and minimum speed prevailed during unstable traffic operations.

EXPERIMENTAL SETUP AND PROCEDURE

3.1 Setup for videography:-

Traffic data was collected on state highways (i.e. MSH-248, MSH-255, MSH-260) at highway midblock sections. The traffic flow is counted by means of counting the number of vehicles passing a particular line marked on the highway midblock section. The camera was kept stationary at the side of road section where entire view of section in one direction is observed. A 30 meter road stretch was considered for the measurement of average spot speed of vehicles passing a section. However for the measurement of spot speed the selection of vehicles is done randomly in order to have generalized average spot speed. The similar arrangement was done for all the three highways for the measurement of spot speed as well as traffic count.The data is collected for morning peak hour, morning off-peak hour, evening peak hour and evening off peak hour covering the both peak and off-peak hours. The selected road stretch was highway midblock section. The data obtained by videography technique is analyzed by playing the video in vlc media player in order to count the traffic flow. The number of vehicles of all types passing through a section is counted from video for each five minutes. not taken into account while assessing the level of service for that particular peak or off peak hour.

FUTURE SCOPE

The Level of Service is a function of time and space. The Level of Service assessed here is based on the daily variation of traffic, however the traffic may vary weakly, monthly, seasonally, and yearly.

RESULT AND DISCUSSION

5.1 General

The Level of Services obtained using HCS-2000 clearly indicates that the level of service vary temporally as well as spatially. The traffic data collected for three different highways shows that the level of service deteriorates with increase in volume and reduction in average spot speed.

Study shows that for MSH-248 during morning peak hour LOS b and LOS C are observed frequently, while during morning peak hour LOS C and LOS D is observed most frequently.

For MSH-255 LOS D and LOS E observed most frequently indicating the considerable loss in freedom to manoeuvre and is a consequence of failure of supply side of the transportation system however LOS C and LOS Dare predominant during morning off peak hour.

CONCLUSION

This research presents the effect of the supply side of the transportation system on congestion as well as on Level of Service for highway midblock sections. The Level of Service varies with both average spot speed and volume exponentially. The congestion at midblock sections is modelled using the difference of free flow speed and minimum average speed for a particular midblock section during peak hour. The loss in freedom to manoeuvre is expressed in terms of the difference between the free flow speed and minimum speed during off-peak hour and accordingly 10 Level of Services are provided with LOS A as best operating condition i.e. free flow and LOS J as worst operating condition i.e. forced flow or breakdown flow.

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