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A Frame Work for Traffic Impact Analysis

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***Abstract* — Understanding the demands placed on the community's transportation network by development is an important dimension of assessing the overall impacts of development. All development generates traffic, and it may generate enough traffic to create congestion and to compel the community to invest more capital into the transportation network, whether it is in the form of new roads or traffic signals or turn lanes. Traffic congestion results in a number of problems, including economic costs due to delayed travel times, air pollution and accidents. As one roadway becomes congested, drivers may use others not necessarily intended for through traffic. As a result, traffic impact analyses are becoming more common as a planning tool to fore-see demands on the transportation network and to mitigate any negative impacts. Besides, understanding traffic impacts becomes even more important as budgets for public facility and infrastructure improvements become increasingly strained. In order to reduce the traffic congestion there is a need of traffic impact analysis (TIA) on critical locations of the road network. The traffic impact analysis is a useful tool for early identification of potential traffic problems and shall play an important role for finding the practical solution.**

***Key Words* — Urban development, traffic congestion, travel times, economic cost.**

I. Introduction

One of the fundamental aspects of transportation planning is the interdependency of land use and transportation. The pattern of land use is affected by the level of accessibility provided by the existing transportation system. Any new development leads to the production or attraction of trips and thus creates new travel demands. Hence there is a need for improvement of the existing transportation facilities either in the form of new infrastructure or in the form of improved operational conditions. Such improvements, in turn, make the land more accessible to the existing activity centers and the attractiveness of the land increases. This spurs new development, and the cycle starts again. This process continues until some kind of equilibrium is attained.

II. Purpose For Traffic Impact Analysis

A. Operational Conditions

To ascertain the operational conditions on the adjacent roadway network when a proposed development is accommodated within the existing transportation infrastructure

A. Proposed Development

To determine whether access to the proposed development will hamper traffic operations and safety near the site.

B. Future transportation

To identify present or future transportation system deficiencies without the new development

Thus it is useful in confining the uncontrolled and haphazard developments

III. Questions Addressed By TIA

- Is the study area large enough to include all significant impacts from the development?
- Does it include all critical intersections?
- Were traffic counts taken during the critical time periods?
- Are traffic counts recent?
- Have all the assumptions used in the technical analysis been clearly identified?
- Do calculated levels of service seem reasonable?
- Does the community have acceptable standards for level of service?
- Does the description of the proposed site agree with the site plan submitted?
- Have trip rates been adjusted to account for public transportation, pedestrians or pass-by-trips?
- Does the directional distribution of the site traffic seem reasonable?
- Has pedestrian circulation been accommodated?
- Has adequate parking been provided to meet demand?

IV. Objectives Of The Study

To distribute the additional trips generated from the new development and to assess the possible impacts on transportation network. To analyze the level of service and capacity on all the critical locations of the congested roadway on the study area

V. Traffic Impact Scenario

The Transportation Research Board (1997) suggests that a detailed Site Impact Analysis Study should be performed for each of the following situations:

- All developments that can be expected to generate more than 100 peak hour vehicle trips on the adjacent streets
- A development generating less than 100 new peak hour vehicle trips if it affects local "problem" areas such as high accident locations, currently congested areas or areas of critical local issues

- Any change in the land use or density that will change the site traffic generation by more than 15 percent where at least 100 new peak hour vehicle trips are involved
- Any change that will cause the directional distribution of site traffic to change by more than 20 percent.

VI. Data Collection

Data for use in the traffic impact analysis is classified into two types: Primary data i.e.(field data and survey data) The primary data must be current (within a one-year period). Secondary data or surrogate data. For the secondary data however, in the necessity of forecasting data for the horizon year, historical data such as that for the last 5 to 10 years may be required. Data for street traffic volumes, intersection traffic volumes, speed surveys, traffic signal timing plans, and traffic collisions are available from the Traffic Engineering Center, and the concerned local traffic engineering departments. “Trip Generation”, is a source for trip generation rates. The Evaluator may approve local trip generation rates for similar developments and rates from other sources and pass-by trip data for certain commercial land uses. "Parking Generation," is a source for parking generation rates. The City/Municipal TIA Evaluator may approve local parking generation rates for similar developments and rates from other sources. The other data shall obtained from approved projects for the trip generation, modal split, trip distribution, and trip assignment. They must also furnish a proposed development site plan.

VII. Traffic Impact Analysis Flow Chart

In order to have brief study on the impact of the traffic a basic frame work for site impact analysis is shown in Figure 1. In general, all site impact analysis and reviews can be followed this set of basic procedures.

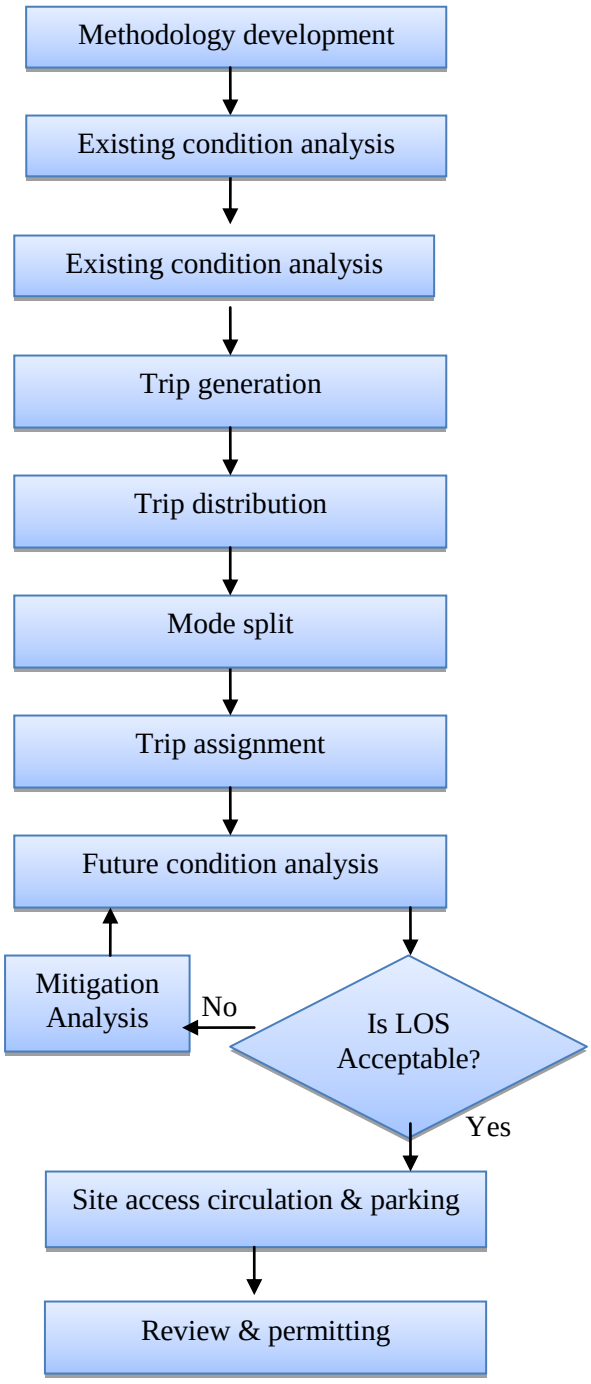

Figure 1 Flow chart for traffic impact analysis

VIII. METHODOLOGY

Before conducting any traffic analysis a minimum technical responsibilities and analysis is to be performed. Some of them are.

A. Study area requirements

The extent of traffic impact study depends on area and location of proposed development and the conditions of traffic at the vicinity of the area.

B. Analysis years

The analysis year should be related in general to the opening date of the new developments and the significant transportation network changes.

C. Analysis periods

The analysis period should be related to known and anticipated peak traffic patterns and developments around.

IX. ANALYSIS

The analysis can be done Pertinent Existing Roadway Information, Existing intersection Geometry, Existing Traffic Volumes, and Existing Level of Service.

D. Trip generation.

Each trip is performed using one or multiple transportation modes for a defined purpose at a given time. Although a trip may involve more than one purpose, it is usually identified by its principal purpose. The following basic steps should be followed in determining the appropriate trip generation rate:

1. Check availability of local trip generation rates for comparable sites.
2. Local data for similar developments are not available, conduct trip generation studies at sites with characteristics similar to those of the proposed development.
3. Check national sources for an applicable range in trip rates.
4. Determine the design level of traffic to be utilized for the analysis and select appropriate rates.
5. Determine any adjustments that may be applied to trip rates to account for the specific characteristics of the development
6. Select the most appropriate trip generation rate

E. Trip distribution models

The purpose of trip distribution is to analyze the trip-making characteristics between the proposed development and off-site areas. The total trips generated by the development must be distributed and assigned to the road network.

*Analogy method***:** One of the most commonly applied manual trip distribution methods used in site impact analysis is to base the trip distribution on existing data collected at sites that are similar to the subject development. This data is usually traffic count and turning movement information

*Gravity model***:** Gravity model is a well known synthetic models based on Newton's concept of gravity proposed by Voorhees (1956). The gravity model assumes that the trips produced at an origin and attracted to a destination are directly proportional to the total trip productions at the origin and the total trip attractions at the destination. The calibrating term or 'Friction Factor' represents the reluctance or impedance of a person to make the trips of various duration or distances. The standard form of gravity model is given by

- $$T_{ij} = \frac{ff_{ij} * P_i * A_j}{\sum_{j=1}^{n} A_j * ff_{ij}}$$

  - T_{ij}= trips from zone i to zone j
  - ff_{ij} = friction factor (adjustment factor) for zone pair ij
  - P_i = productions in zone i
  - A_j = attractions in zone j

- *Traffic count based distribution model***:** This model is based on relationships between the site origin–destination trips and the link traffic counts of the surrounding street system. With this model, the new site-generated trips can be distributed on a particular street link by using a correlation coefficient that is evaluated by the likelihood of traffic patterns of the total trips generated from the study area and the inbound or outbound traffic passing through the street link. Unlike the traditional gravity model, the new model does not rely on land-use data to determine the trip distributions, and is therefore well suited to situations where little or no land-use information is available, such as in developing countries.

F. Mode split

Mode split is the process of estimating the number of travellers between zones that are anticipated to use modes other than automobiles in site impact analysis

G. Traffic assignment

Trip assignment involves estimating the amount of generated traffic allocated to the alternative routes on the road network. The product of this process is the total number of development generated trips by direction and turning movement on each segment of the study area road network

H. Future condition analysis

The purpose of the analysis of future conditions for site impact analysis is to determine the impact of trips generated by the development on the performance of the transportation system. Development-generated trips are evaluated to determine if the impacts are significant and adverse.

I. Mitigation measures

Mitigation of impacts shall be required if the proposed development would cause a facility or traffic movement to exceed LOS-D. Acceptable mitigation measures shall include:

1. Staging of development in order to relate site development to the construction of the required thoroughfare system.
2. Off-site improvements, including the provision of right-of-way and/or the participation in funding for needed thoroughfare and intersection improvement Projects.
3. On-site improvements, including access controls and site circulation adjustments.

J. Level of Service and Capacity Analysis

When the proposed development and other developed projects at the vicinity of the study area which generates the traffic more than the required level of service and capacity their analysis is to be done.

K. Site access, Circulation and Parking

The goal of access management is to ensure the safe and efficient flow of traffic through the road system and access to their destination by limiting the number of conflict points, separating conflict points, and removing turning vehicles and queues from through traffic.

L. Review and Permitting

The final step toward site impact analysis approval is agency review and permitting. All site impact analysis and review should undergo a review and permitting process where all appropriate agencies and department divisions are allowed to comment on the site impact analysis. The department's review shall address the impacts of the proposed development on the significant roadways.

M. Regression analysis

Both linear regression and logarithmic regression equations can be used to derive the relationships between trips generated and the independent variable. If redevelopment is analyzed then the analysis should consider the traffic associated with the existing development for comparison purposes.

X. CONCLUSION

A traffic impact analysis is a study which assesses the effects that a particular development's traffic will have on the transportation network in the community. These studies vary in their range of detail and complexity depending on the type, size and location of the development. Traffic impact studies should accompany developments which have the potential to impact the transportation network. They are important in assisting public agencies in making land use decisions. These studies can be used to help evaluate whether the development is appropriate for a site and what type of transportation improvements may be necessary.

Traffic impact studies help community to:

- Forecast additional traffic associated with new development, based on accepted practices.
- Determine the improvements that are necessary to accommodate the new development.
- Assist communities in land use decision making.
- Assist in allocating scarce resources to areas which need improvements
- Identify potential problems with the proposed development which may influence the developer's decision to pursue it.
- Allow the community to assess the impacts that a proposed development may have.
- Help to ensure safe and reasonable traffic conditions on streets after the development is complete.
- Reduce the negative impacts created by developments by helping to ensure that the transportation network can accommodate the development.
- Provide direction to community decision makers and developers of expected impacts.
- Protect the substantial community investment in the street system.

Traffic impact analysis is only one component of the larger transportation puzzle. In addition, large communities in particular will need to determine appropriate mixes of transportation modes, including public transit options. Community growth pat-terns and characteristics can be substantially affected by highway expansion or re-alignment decisions made at the state and national levels. Traffic impact analysis is focused on the effects of a particular set of developments, but may provide information relevant to these broader plans and decisions. Traffic impact studies should be used as one piece of several kinds of information to judge the suitability of development from a transportation standpoint. The scenarios of rapid urbanization and commercialization of the developing countries has contributed to be additional traffic and has accounted the

need for traffic impact studies. The traffic generated by the commercial establishments while entering the study area and while leaving the study area creates a lot of problems particularly congestion, sometimes leads to the developments of queues. This problem particularly effects during the peak hours. Apart from the inadequate parking providence also leads to the traffic congestion. Hence the necessity and need of study of impact of vehicle and population is a necessary subject of study. A traffic impact analysis is an engineering study which assesses the adequacy of the existing or future transportation infrastructure to accommodate additional trips generated by a proposed development, redevelopment or land rezoning. The purpose of a traffic impact analysis review is to assess potential traffic impacts, identify acceptable mitigation strategic plan for the transportation requirement of future development, and maintain a balance between land use and quality of transportation services. Land use patterns and features of road networks are obtained by using the tool Google earth and by conducting reconnaissance survey. The dynamic characteristics like volume, speed, headway at intersections, turning moments are obtained by conducting respective traffic surveys as per IRC guidelines. The data is purified and compared with standard data like los by principles of highway engineering and traffic analysis and then it is projected on realistic and scientific basis.

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AUTHOR'S PROFILE

DR MIR IQBAL FAHEEM a Doctorate in Civil Engineering is currently Professor of Civil Engineering with Deccan College of Engineering and Technology, Darussalam, Near Animally, Hyderabad (AP), 500001, India. He obtained PhD in Civil Engineering in 2008 and Masters Degree in Transportation Engineering in 1998 both from JNT University of Hyderabad, BS (Engineering) in 1995 from BITS-Pilani, Polytechnic Diploma in Civil Engineering in 1987 from BTE, Bangalore and Masters in Business Administration in 2008 from IASE University, Rajasthan. He is a recipient of Gold Medal for achieving academic distinction in MTech examinations from JNT University of Hyderabad in the year 1998. He started his career as a Laboratory Assistant in the department of Civil Engineering in the year 1988 and subsequently elevated to the rank of Professor of Civil Engineering in the year 2008. He is currently teaching undergraduate and post graduate courses in transportation engineering and supervising several under-graduate and post-graduate thesis. He has published around 30 research papers in various national and international journals. He has participated in various conferences and AICTE sponsored STTP's. His research interests include pavement analysis, Traffic system management, Highway construction planning and management. Applications of fuzzy logic and artificial neural networks in the above areas. He is a recognized research supervisor for doctoral research guidance in the broad area of civil engineering by Osmania University and K.L. University. He has awarded with Fellow from the Institution of Engineers (India), Indian Society of Civil Engineers and Member of Institution of Civil Engineers (India). He has nominated as member editorial board and reviewer of various International Journals.