# A Review on Development of Commodity Carrier Vehicle Trip Generation Model for Residential Area -A Case Study of Ahmedabad City

**Rutwi Parmar[1] Dr. H.R. Varia[2]**
[1]P.G. Student [2]Principal
[1,2]Department of Civil Engineering
[1]L.D College of Engineering, Ahmedabad [2]Tatva Institute of Technological Studies, Modasa

*Abstract*— The performance of the transportation is a derived demand, both for passengers and freight transport alike. Goods movement, transportation things other than people, is addressed as a separate element. Goods movement covers all transportation methods by which freight and commodities are transported into and out of place of country. Trucking is an essential part of the goods movement system. Urban freight transport typically has an average share of 10% in the total urban transport. The aim of this paper is to provide a literature review and discuss about the researchers view who analyzed and developed the commodity based truck trip generation model. Various methods and analysis have been adopted by all the researchers to study and investigate the commodity carrier vehicle movements.

***Key words:*** Trip Generation, Trip Production, Origin-Destination, Goods Vehicles Trip Generation

## I. INTRODUCTION

Ahmedabad is the largest city in Gujarat and seventh largest metropolitan area in India. According to the 2011 census, it has a population of 5.5 million, with 3.5 million residing within the municipal limits. Taking Ahmedabad as a case study, attempt is made to understand urban freight transport pattern, i.e. location and characteristics of urban freight generating areas, transport infrastructure linkages and freight movement.

The urban freight movements are classified as follow:

1) External flows (External–External (E–E)) include movements which have both origin and destination outside the urban/study area.
2) Inter-urban flows (External–Internal (E–I) Or Internal–External (I–E))
3) Include movements which have either origin or destination inside the urban/study area.

Assuming a 6% compounded annual growth rate 48,485 trucks/day was estimated to enter/leave Ahmedabad in 2012 (Swamy & Sharma, 2007). About 29% of truck trips were internal to external trips and 34% were external to internal trips. A significant number of trips are transits through Ahmedabad (37% of total freight trips) and add to the urban freight mobility within the city. For the freight vehicles that were entering the city, 60% of the trucks were observed to be running with a full load, 10% with half load, and 30% of the trucks involve empty runs. This is comparable to the UK figures where empty runs of heavy goods vehicles (HGVs) from 1984 to 2007 fell from 31.4% to 27.4% (Allen & Brown, 2010).

In terms of commodity trade, the origin-destination of trucks indicated that food grains, textiles, industrial products, oil, and oil-based products, and consumer goods were the predominant goods traded in Ahmedabad. In the case of consumer products, construction material, oil & oil-based products and textiles, import is much more than export. In the case of other goods, import and export are more or less balanced. This suggests that a significant proportion of truck movement occurs for re-distribution within the western region rather than consumption within the city.

## II. REVIEW OF LITERATURE

McCormack, E. et al. (2010) have derived the truck trip generation by glossary stores. Trip generation information can also improve the modeling of truck trips and their impacts on the transportation system and contribute to an understanding of the factors that affect freight movements. Grocery stores were selected because they are a common land use present in most metropolitan neighborhoods. Because grocery stores require frequent re-supply, they generate a number of daily truck trips that affect all parts of the transportation roadway network, including local roads, arterial connectors, and highways. Trip generation is largely determined by using zones with land-use concentrations or larger industry sectors, the results of this study suggest that collecting truck trip rates may require disaggregation of traditional land-use concentrations and industry sectors, starting from the level of the vehicle (as opposed to deducing vehicle trips and numbers of vehicles from volume and tonnage data).The grocery stores in our study generated an average of 18 trucks trip per day in peak hours. With the possible exception of the store's distribution network and store size, few grocery store characteristics that could be directly related to truck trip generation were identified.

Munuzuri, J. et al. (2010) they have concluded Modeling the complexity of urban freight transport requires large amounts of data related to supply chain management, delivery practices, tour configuration, time windows, etc., but when all this detailed data is not available local authorities still need models that represent this type of transport and its contribution to congestion and environmental impacts. They have present an improvement on other recent works, consisting of a demand model for wholesaler to retailers and retailers to home deliveries during the morning peak hour that uses only very limited data to estimate the number of delivery vehicles entering and leaving each zone of the city. Then calculate the trip distribution using an entropy maximization approach, and solve the resulting model using simulated annealing.

$$\alpha^k = 1/s\ \Sigma_{s\text{-}1}\ \frac{Vs}{\Sigma\ ds\ el}$$

Where,

S = No. of survey carried out

 

ds = No. of freight receiver retailers of type *l*
e*l* =No. of daily delivery received

Holguín-Veras, J. et al. (2010) have apply this model to a case study in the city of Seville, in Spain, and compare its results to those produced freight generation (FG) and freight trip generation (FTG) model. The estimates obtained for FG are of major importance as they are based on the largest and most complete establishment based freight survey in the world. These models are an extraordinary contribution to the freight transportation modeling community and for practitioners, as they provide accurate estimates of FG for a good number of industries at the establishment level.

Another important finding is the importance of treating FG and FTG as two different concepts. While FG is the amount of cargo generated by an establishment, FTG is the number of freight vehicle trips required to transport the cargo. Larger businesses are expected to produce proportionally more FG than small ones, thus FG increases with business size. This is not necessarily the case for FTG, since logistics decisions on shipment size, vehicle (and mode) choice and frequency of distribution come into play when determining the number of truck trips generated. The FTG estimates were found to be transferable across different geographic contexts; this is not the case for FG models.

Asuncion, J. et al. (2012) have analyzed the truck trip generation characteristics of supermarkets and convenience stores. They have conducted study on the 8 stores in one town in New Zealand aims to capture the dynamics behind the different distribution patterns of different kinds of stores in the country. They tested the link between the truck trip generation rates of different food distribution systems such as supermarkets, convenience stores, and Farmer's market and bulk food store with physical and operational characteristics of the store, employment information, and distribution patterns from its origin of loading.

The retail trading area and parking space of the stores present the strongest factor in determining the number of trucks generated but new parameters such as product variation and trip-length and truck-type distribution are also analyzed. Product variation has a strong correlation with the number of trucks because as more deliveries are needed for specialized brands that a store carries. Supermarkets owing to their larger customer based, shown by their bigger store dimensions.

Sanchez-Diaz, I. et al. (2013) have conducted the study on Assessing the Role of Location and Spatial Effects on Freight Trip Attraction (FTA). They have evaluated that Freight generation data is spatial in nature, but traditional modeling techniques neglect spatial effects. Local Indicators of Spatial Association (LISA) reveal clusters for most of the sectors. For all industry sectors, FTA is better modeled as a nonlinear function of employment; But FTA is not merely a function of employment. For construction, establishments with high FTA are located in wider streets. For accommodation and food, land-value plays an important role on FTA. Only retail stores exhibit statistically significant spatial autocorrelation: there is a cluster effect. Establishments surrounded by large establishments of the same sector tend to have larger Freight trip generation (FTG). The application of this models require geo-locating all establishments challenging for large scale. FTG estimation plays a crucial to enhance current models to assess correctly impacts of freight activity and improve efficiency of urban planning policies. FTA model equation is shown below:

$$FTA = 1.08 * (\text{Employment})^{0.23} * \prod_{j=1}^{n}(\text{Employement j})^{0.69}_{\text{Wij}}$$

Where,
Wij = distance between establishments
$\prod_{j=1}^{n}(\text{Employement}) =$ production of employement in zone j to n.

Divya Priya, C. et al. (2014) has developed the Freight Trip Generation Models for Chennai, India. The main purpose of this paper is to study freight demand through the estimation of freight trip generation models developed with disaggregated survey data at the establishment level. The survey gave significant insight into the freight trip generation characteristics in Chennai city. From the data collected it is seen that on an average about 3 freight trips are made to an establishment and 6 trips leave an establishment every day. Predominantly bikes and small pick-up vans are used for carrying goods in the city. None of the variables had significant impact on trips generated in retail sector probably indicating the heterogeneous mix of establishments under retail sector. This can be improved by studying in detail the different type of businesses dealing with different products. In comparison with the study in New York, it has been seen that the models developed are similar, while the trips attracted to establishments of Food sector are much higher in Chennai. Overall establishment in Chennai attract more trips than in New York. This is in contrast to what is observed in the passenger trip rates where Indian cities have lesser value compared to western countries. In the models developed for trip productions it is seen that establishments' number of employees has a significant effect only among establishments belonging to Non-durable, Miscellaneous and Grocery stores. Detail analysis on when, why, and to where trips are produced could improve our understanding. The availability of smaller vehicles encourages disaggregation of potential multi-stop tours to to-and-from trips. A larger vehicle would have larger capacity and may require more planning resulting in several stops.

Kulpa, T. (2014) has concluded that Freight truck trip generation is a crucial part of a 4-stage model, especially in regional freight model development. Based on results of roadside surveys O-D matrices for freight vehicles were estimated. In the next step, using large set of traffic measurements on national road and regional road; O-D matrices were calibrated. In order to calculate trip generations a step backwards was made. Additionally, the results of comprehensive travel studies and secondary data were used. Developed data sets were used to estimate trip generation equations, applying linear and nonlinear regression as well as artificial neural networks (ANN). The aim of this paper is to develop freight truck trip generation equations at regional level using different data sources, secondary data and indirect approaches. Equations of trip generation for light truck and heavy truck shown below:
For Light truck, $P=A=0.077 \cdot LM + 0.303 \cdot LPU$
For Heavy truck, $P=A=0.102 \cdot LPP + 0.406 \cdot LPU$
Where,

LM= Number of inhabitants
LPU= Employment in services
LPP= Employment in industry

In model development different methods were used: trip generation rates, multiple regression and artificial neural networks. Although the easiest to apply are the trip generation rates, it may not reflect commune characteristic.

## III. CONCLUSION

Based on the studied literature, it can be concluded that many researchers have conducted various studies on commodity based trip generation model. Number of freight trip generation is depends on shipment size, vehicle (and mode) choice and frequency of distribution, travel distance, travel time .The freight trip generation estimates were found to be transferable across different geographic contexts. Freight vehicle trips may be affected by Location, Spatial Effects, land-values and employments of sector. Linear regression and multiple regression and other various modeling techniques like artificial neural networks (ANN), simulation etc. are used to developed freight trip generation model.

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