IV-49 CHARACTERISTICS OF LOADING ACTIVITIES & SPACE REQUIREMENTS IN SUB-URBAN COMMERCIAL AREAS

IBRAHIM MABROUK, Post graduate student of Osaka Univ.
MASAMITSU MŌRI, Prof. of Osaka University
HIROSHI TSUKAGUCHI, Research assist. of Osaka Univ.

ABSTRACT
This research explains the main loading characteristics of certain sub-urban existing truck freight service areas based on investigation and field study. This study included whole sale stores in Osaka Textile Center(OTC) which is considered as one of the main sub-urban commercials in Osaka prefecture. The result of this analysis was used for the purpose of calculating theoretically, loading space requirements in order to decrease the traffic congestion and loading problems in sub-urban areas.

DATA COLLECTION
In November 1982, questionaire has been distributed to the owners of 161 buldings. Only 126 owners of them have sent back their filled forms. The purpose of this questionaire was to get some data about the distribution system of goods, gross floor area, number of employees, existing loading areas, co-operation system between whole sale stores, delivery & pick-up system, max. & min. truck arrivals (daily, weekly, monthly, yearly),..etc. In 16th of Dec. 1982, observation survey was carried out in 5 buildings in OTC to investigate the nature and scope of truck stops, in addition, the survey was carried out also in co-operation center. Evaluations were made of the relations of number and frequency of truck arrivals, duration of stay, vehicle types, generation rates based on number of service vehicles and floor areas. Some of these characteristics are explained in the following sections.

CHARACTERISTICS FROM THE QUESTIONAIRE

A) CO-OPERATION SYSTEM

Whole sale stores in OTC are using co-operation system in order to reduce mainly the transportation cost paid to transportation companies. The idea of this system is to pick-up the goods from many whole sale stores by medium trucks and then, these goods are delivered once again in big trucks parked in a certain area i.e. one truck do transport the goods for more than one whole sale store, also, in some cases, big trucks pick-up the goods directly from whole sale stores and transport these goods to else where. This helped for reducing the number of trucks owned by the owners and reducing congestion resulting from truck arrivals owned by many transport companies. From the investigation, it was found that 80% of whole sale stores are using co-operation system and 20% are transporting by other transport companies or by their owned trucks. As shown in Fig. 1 , stores using co-operation system are using also their owned trucks and transportation companies for some reasons concerning co-operation system.

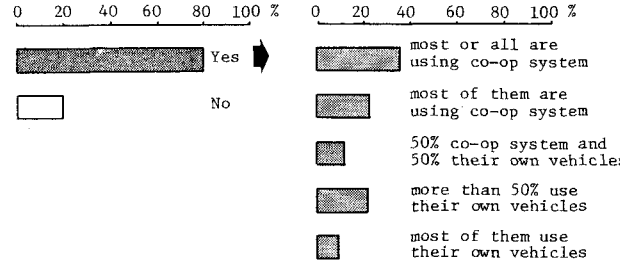

Fig.1 Percentage of buildings using co-operation system

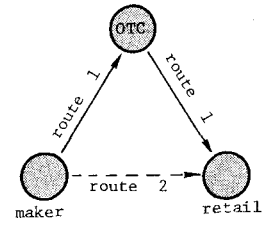

Fig. 2 Goods transportation system

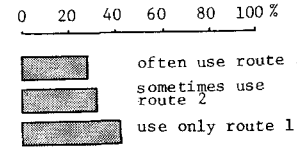

Fig. 3 Percentage of whole sale stores using route 1 & 2

B) GOODS TRANSPORTATION SYSTEM

There are two main systems for goods transportation in OTC area, first one, the goods are transported from maker to OTC and then from OTC to retail stores. The second one, the goods are transported directly from the maker to retail stores, these two systems are shown in route 1 and 2 in Fig. 2. From the questionaire, all whole sale stores are using route 1 but some of them are using route 2 as shown in Fig. 3. Also, owners were asked if they will use this system much more or not, the answer showed that about 40% have the willing to increase, 37% want to increase but have not enough ability to do, 23% will not do at all or have not willing to do. It was interesting also to study the frequency of whole sale stores against number of transportation companies used in goods transportation with excluding number of companies used in co-operation system. This was done for two types of whole sale stores, one of them is A type where this type is using co-op. system most of time, the other one is B type which is using co-operation system fairly. This is shown in Fig. 4. In this graph, the effect of co-op. system is clearly shown, where the % of A type is bigger than the perc. of B type in the case of using few transportation companies.

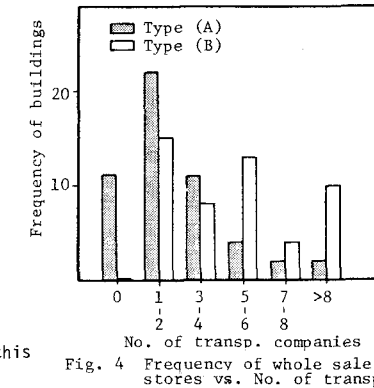

Fig. 4 Frequency of whole sale stores vs. No. of transportation companies

C) PEAK DELIVERIES BY CO-OPERATION SYSTEM

Fig. 5 shows the deliveries (by co-operation system) of goods in different months through the period of Dec. 1981 - Nov. 1982. As shown in this graph, max. and min. peaks were occured in Dec. and Sept., this result showed to be the same as whole sale store case study in urban

areas. In this graph, the value of deliveries in January was considered to be the unity, and other values representing the times of this value. It should be noticed that the survey was done in Dec. which represent the peak arrivals in the year.

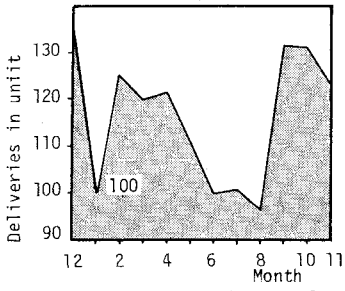

Fig. 5 Monthly deliveries for the building use co-op. system

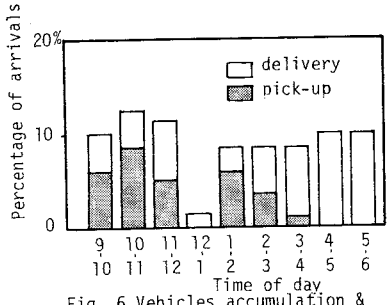

Fig. 6 Vehicles accumulation & purpose of visit

CHARAC. FROM OBSERVATION SURVEY

A) VEHICLES ACCUMULATION

Fig. 6 shows the accumulation of vehicles in one building of the 5 buildings. The peak arrivals occur from 10:00-11:00 (same as urban areas). In the same figure, the purpose of arrivals was also indicated. The period from the morning to afternoon, deliveries showed big activities but from after noon, the activities showed that the pick-up having a significant value. The result was almost the same in other 4 stores.

B) TYPES OF ARRIVALS

The percentage of arrivals by type was found to be 79% of the big type, 12% of medium type and 5% light vans. In urban areas values are (48%, 17% and 35%) respectively [1].

C) LOADING TIME DISTRIBUTION

Observations showed that the average loading time in different buildings is ranging from 4.4 - 12.9 mins. with total average loading time equal 9.23 mins. This time is longer than the corresponding one in urban areas [1], that is because the absence of loading space. Loading time distribution is shown in Fig. 7.

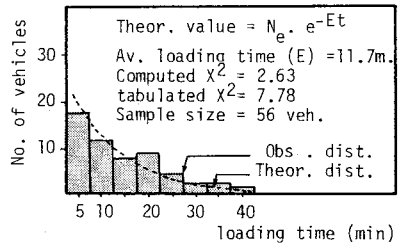

Fig. 7 Loading time distribution

D) EFFECT OF GOODS'TYPE, FLOOR AREA AND CO-OP. SYSTEM ON TOTAL ARRIVALS

The effect of goods' type, floor area and co-operation system on total arrivals was carried out by means of quantitative analysis(TYPE I). According to the value of range, it was found that the area is the main factor affect the total arrivals, second factor is goods' type, co-operation system was found to be the last factor affecting the total arrivals.
Though, the number of arrivals based on floor area will be changed due to the condition of goods transportation system and goods' type,..etc., the generation ratio of arrivals for 4 buildings was calculated, and this value is 10.9 vehicles per 1000 square meters in the existing condition. This value was used in the calculations of space requirements as follow.

LOADING SPACE REQUIREMENTS

The purpose now is to calculate theoretically, space requirements which provides sufficient spaces to yield daily capacity equal to the number of trucks arriving during the average day at peak time of the year. Simulation technique was used for procedural analysis. In this study, for every building, number of service stations (spaces) were increased from 1-6 for calculating the suitable required number of spaces. In this model, both of arrival time and loading time was considered as a stochastic variate. For every number of spaces, the corresponding max. waiting vehicles and average waiting vehicles were calculated when the last vehicle arrived to the system. Also, the same procedural analysis was followed to calculate the required spaces but the peak arrivals was used instead of average one.

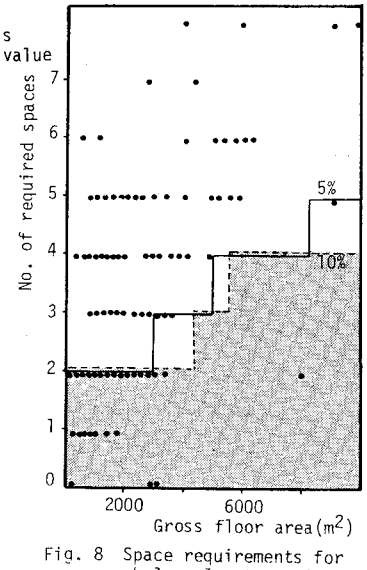

Fig. 8 Space requirements for whole sale stores in sub-urban area.

RESULTS AND ANALYSIS

From the output results, two relations were drawn out, one of them, the relation between gross floor area and max. waiting vehicles corresponding to the assumed space. The other one, the relation between gross floor area and average waiting vehicles. From these graphs, relation between gross floor area and required space was determined at average waiting vehicles equal 5%, 10% and max. waiting vehicles equal 1-5 veh. In this paper, Fig. 8 shows space requirements at only 5%,10% average waiting veh., in this case the max. waiting veh. will be 2 , 3 veh. respectively. In the same figure, existing loading space in OTC buildings are plotted also. Comparing both of existing and required loading spaces, the results showed that there are scarely loading space problems. The space requirements at the peak hour is not represented here, but calculations showed that required space at the peak hour must be increased by only one space for the corresponding gross floor area.

ACKNOWLEDGEMENTS

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[1] I. MABROUK, M. MŌRI, H. TSUKAGUCHI, A study on loading space requirements in commercial areas, Abstract of Siminar talk of the Society of Civil Engineers through over Japan, 1982, IV-149, pp 297.