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### ABSTRACT

This research describes essential characteristics of certain existing truck freight service areas and operational aspects of the facilities based on field study. Sampled study projects whole sale stores (Minami kyuhoji Str.) in Osaka city. Also a theoretical determination of space requirements is presented which can be used as a guide line to determine the required spaces for loading to be allocated at curb in shopping centres in order to decrease the traffic congestion.

### ANALYSIS OF LOADING CHARACTERISTICS

In Aug. and Dec. 1981, a survey was carried out to investigate the nature and scope of truck stops.

**TYPE OF VEHICLES :** From the observations, 95% of arrival vehicles were trucks. Fig.1 shows the percentage of truck arrivals by type. 48% of arrivals were of the big type ( $T_1$ ), 17% of the medium type ( $T_2$ ), and 35% light van ( $T_3$ ). **LEGAL AND ILLEGAL PARKING :** Minami kyuhoji Str. has only 3 lanes, parking is allowed on both sides with maximum parking time 30 mins. The street is opened only to one-way through traffic west to east and often busy. Fig. 2 shows the percentage of legal and illegal parking for different type of trucks,

**PURPOSE OF VISIT :** The percentage of arrivals by purpose such as delivery (D), pickup (P), and others is shown in Fig. 3. **DURATION OF CALL :** Loading time dist. for all purposes is shown in Fig. 4. A comparison between theoretical and observed loading time distribution showed that the exponential dist. provides an acceptable approximation of the actual distribution for the mean loading time (3.9) considered.

**ARRIVAL TIME DISTRIBUTION :** Arrival time distribution for trucks was fitted at 0.95% degree of confidence. Fig. 5 shows both of observed and theoretical dist. at average arrival time equal 2.4 minutes.

**GROSS FLOOR AREA VS. TOTAL ARRIVALS :** The regression line for gross floor area with total arrivals was calculated from the observations, this relationship is shown in Fig. 6.

### THEORETICAL DETERMINATION OF SPACE REQUIREMENTS

In order to determine the required spaces, SIMULATION model was structured to examine the efficiency of loading system, considering the effect of truck arrivals and service (loading) time.

#### MAIN PROGRAM OF MULTI-CHANNEL MODEL:

Consider a system consisting of  $n$  service stations (Fig. 7). When an input unit (truck) arrives at the system, the  $n$  service stations are checked to determine whether any one of them is vacant at the moment. If all  $n$  are occupied, then service time will be checked, if it is less than 3 minutes, the unit would be allowed to do loading in the second lane (DP), otherwise will be one of the through traffic. When service station becomes vacant before another unit arrives, idle time occurs until a unit arrives and enters the vacant service st. Two cases of study were carried out.

#### A CASE OF TRUCKS ONLY

The following items describe the main steps to calculate the space requirements for only trucks.

- Arrivals corresponding to gross floor area were determined for 4 different areas from Fig. 6.
- For every case, loading spaces were increased from 1 to 5, and computer program was run to

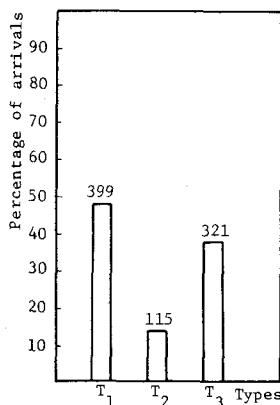


Fig. 1. Arrival by type

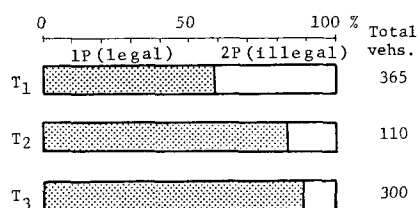


Fig. 2. Percentage of legal and illegal parking (Dec., 1981)

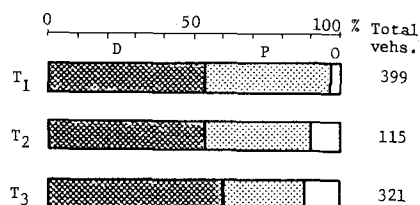


Fig. 3. Percentage of arrivals by purpose (Dec., 1981)

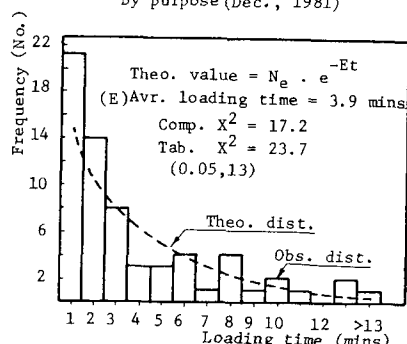


Fig. 4. Loading time distribution

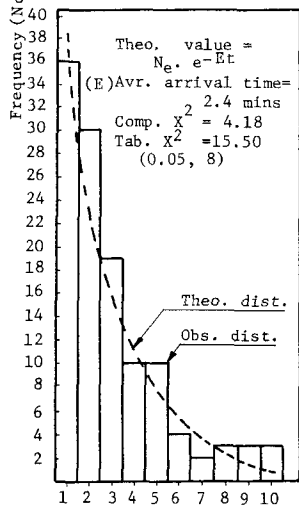


Fig. 5. Arrival time dist.

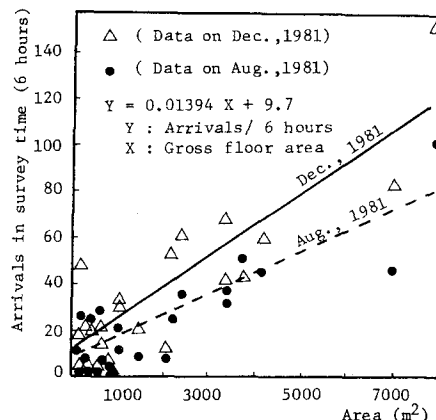


Fig. 6. Reg. line for gross floor area with total arrivals

determine the relations between No. of spaces and percentage of double parking (DP) as shown in Fig. 8. Since the areas corresponding to the arrivals are known, the relationship between the area and the space requirements could be drawn at 0%, 5%, 10%, 15%, 20%, 25% double parking as shown in Fig. 9.

**B CASE OF ALL VEHICLES ( TRUCKS & PASSENGER CARS )**

The following steps describe the calculations of required spaces for all vehicles.

- This step is the same as in case A, but in this case only 3 floor areas were considered.
- For every case, loading spaces were increased from 1 to 35, also parking time was assumed to be 10, 15, 20, 25 minutes to study the effect of parking time on loading space requirements. One of the relations of the 3 cases is shown in Fig. 10
- Space requirements for shopping centres were calculated for every suggested parking time, two of these relationships are shown in Figs. 11,12.

**GENERAL CONCLUSIONS**

From the foregoing observations, the following conclusions appear to be the characteristics in one of the typical commercial areas for truck facilities.

- Average loading time is 3.9 minutes.
  - Turn-over rates from 6 to 25 trucks/bay/hour
  - Average maneuvering time is 1.5 minutes
  - Rate of stops per 10000 sq. m. ranging from 60 to 416 trucks/day
  - The required spaces for trucks only is suggested to be 2.4 spaces per 10000 m<sup>2</sup>.
  - The required spaces for loading and parking is recommended to be 17 spaces per 10000 m<sup>2</sup>. in case of considering 25 minutes for parking time and 5% of arrived trucks will do loading in the second lane (double parking).
  - How to use the figures 9(for loading only) and 11,12 (for parking and loading).
- Determine the area at the considered block.
  - Determine the possible No. of spaces can be allocated at curb
  - Using Fig. 12, determine the required spaces for loading and parking
  - Compare both of calculated No. of spaces and actual ones. If the calculated spaces are less than the actual ones, this means that the actual ones are enough for both loading and parking. If the required spaces (calculated) are more than the actual ones, in this case, required spaces for loading can be determined using Fig. 9 and allocated for only truck usage, or decreasing parking time and use another graph in order to decrease the required spaces for both of loading and parking.

**ACKNOWLEDGEMENTS**

I wish to thank the Union of Minami kyuhoji whole sale stores for their co-operation and assistance.

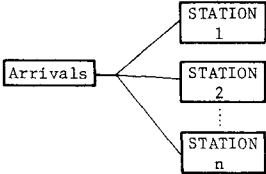


Fig. 7. Multi-channel queueing system

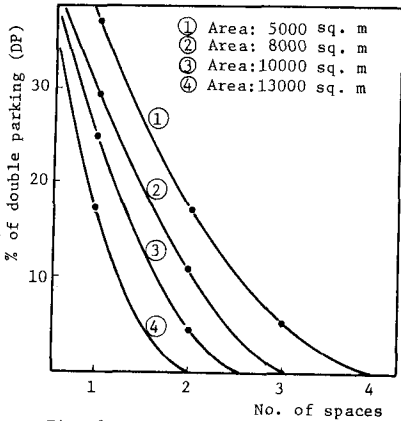


Fig. 8. Relation between No. of spaces vs. % of DP

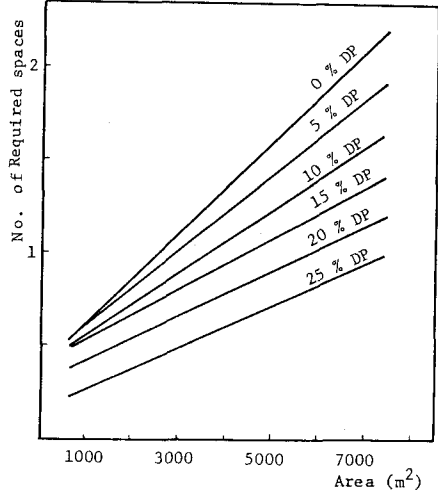


Fig. 9. Loading space requirements at shopping centres

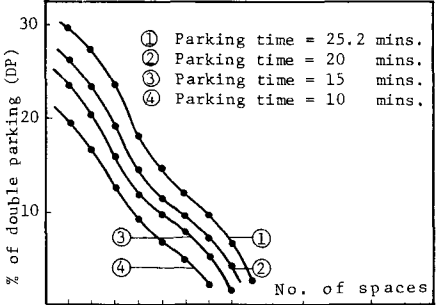


Fig. 10. The effect of parking time restriction on the % of DP

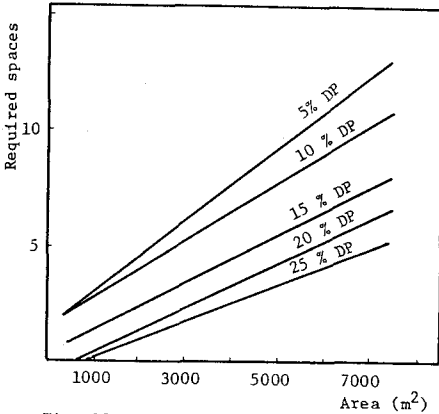


Fig. 12. Parking & loading required spaces at shopping centres (for 25 mins. parking time)

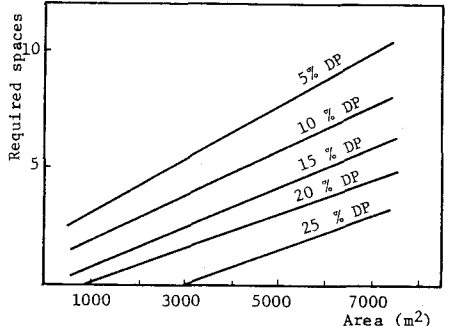


Fig. 11. Parking&loading req. spaces at shopping centres (for 15 mins parking time)