Ref: GCIO/N98/DE8/2011

Studying Requirements of Goods Vehicle Parking and Loading/Unloading for Data Centres in Hong Kong

Office of the Government Chief Information Officer

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Executive Summary

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AECOM Asia Company Ltd.

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1. INTRODUCTION

1.1 General

1.1.1 AECOM Asia Company Ltd. (AACL) was commissioned by Office of the Government Chief Information Officer (OGCIO) to carry out the Consultancy Service for the N98/ED8/2011 Studying Requirements of Goods Vehicle Parking and Loading/Unloading for data centres in Hong Kong (hereinafter referred to as "**the Study**").

1.2 Study Objective

1.2.1 The objective of this Study is to determine the requirements of goods vehicle (GV) parking and loading/unloading for the specific trade of data centres in Hong Kong, and to recommend, with reference to the Hong Kong Planning Standards and Guidelines (HKPSG), an appropriate guideline for data centres established in buildings for industrial use, industrial/office uses and business use.

1.3 Scope of the Study

Study Coverage

1.3.1 The Study covered the GV parking and loading/unloading requirements with regards to the specific trade of data centres in Hong Kong and for the three categories of data centres:

- Purpose Built Data Centres;
- Data centres of Wholesale Conversion from Industrial Buildings; and
- Data centres of Partial Conversion from Industrial Buildings.

Type of Vehicle Covered

1.3.2 Parking data was collected separately for Light Goods Vehicle (LGV) and Medium/Heavy Goods Vehicle (M/HGV). The data was adopted to determine the requirements of parking and loading/unloading of the LGV and M/HGV for data centre.

1.4 Background

Data Centres

1.4.1 Data centre provides space to accommodate computer systems and associated components, such as telecommunications and storage devises. With reference to operational nature, data centre is, in general, classified into two categories. The first type of data centre is operated by a company to accommodate computer systems for themselves and the second type is to provide services for

clients.

1.4.2 Most large scale data centres in Hong Kong are established in industrial buildings, occupying parts of or the whole buildings through partial as well as wholesale conversion or purpose-built.

1.4.3 Data centre operation involves GV activities, which include:

- Routine goods delivery (e.g. documents, printing paper, distilled water, etc);
- Routine maintenance works;
- Change/upgrade network;
- Server replacement/acquisition; and
- Clients move in/move out data centres.

Current Parking Standard

1.4.4 According to the Second Parking Demand Study (PDS-2) which was carried out in year 2000, most of the data centres are located in industrial or industrial/office uses buildings and PDS-2 indicated that there were not many data centres in Hong Kong, as a result, no separate standards were established for GV parking and loading/unloading for data centres in HKPSG (paragraph 6.6.51, Technical Report, PDS-2).

1.4.5 The buildings in which the data centres are located have to provide the number of GV parking and loading/unloading spaces as specified in the land leases, the requirements of which are adopted from the HKPSG (Chapter 7, Table 11, Section 4: Parking Standards for Industrial and Business Developments). For general industrial buildings, the requirement is one GV parking and/or loading/unloading for every 700-900 m^2 Gross Floor Area (GFA). For business buildings, the requirement is one GV parking and/or loading/unloading for every 800-1,200 m^2 (GFA). In addition, one container vehicle loading/unloading bay with turning circle of 11.6 m outer radius should be provided for a site with dimensions not less than 45 m x 40 m.

1.5 Need of Study

1.5.1 In recent years, the data centre sector has been growing fast in Hong Kong and the demand for data centres in the coming years will continue to increase. The HKSAR Government committed to foster Hong Kong as the prime location for data centres in Asia Pacific.

1.5.2 There is no specific GV parking requirements for data centres, however, the operation of data centres is different from that of other industry and the trade reflected that the GV parking requirement described in paragraph 1.4.5 may be at the high side. Hence, it is necessary to review and determine the

requirements of GV parking and loading/unloading for data centre in Hong Kong. It can ensure that appropriate number of GV parking spaces and loading/unloading bays to be provided in data centres.

2. APPROACH

2.1 General

2.1.1 AACL has developed a study approach with 5 stages, namely (1) Inception Stage, (2) Data Collection, (3) Data Analysis, (4) Proposed Parking Requirements and (5) Implication of Proposed Parking Requirements. The general approach of the Study is shown in **Figure 2.1** and described in the following sections.

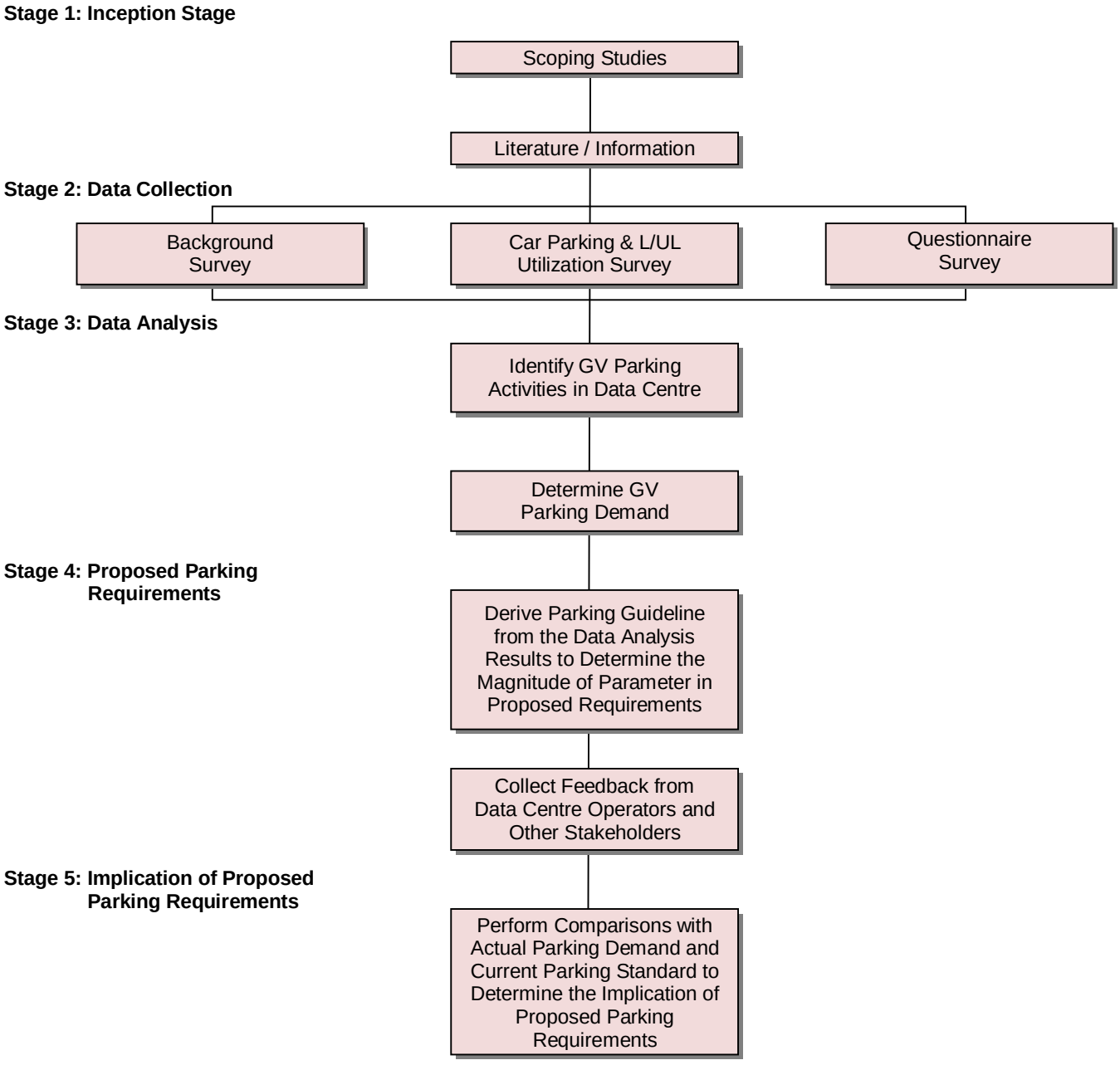

Figure 2.1 Study Approach

2.2 Inception Stage

The study initiation is aimed at enhancing background information. Main tasks included scoping the Study and reviewing relevant information and reports. A scoping study was undertaken to define the scale, scope, resource requirement, the designated approach and issues of particular relevance to the Study. A review of current parking standard for data centres was carried out. A comprehensive review of recent relevant studies related to the current parking standard was undertaken.

2.3 Data Collection

2.3.1 In order to accomplish the study objectives, it is important to have an effective survey method to obtain adequate and accurate information for the examination of existing parking condition and determine parking demand. In this Study, data collection consisted of three main parts: (i) Background Survey; (ii) Car Park and Loading/Unloading Utilization Survey, and (iii) Questionnaire Survey.

2.4 Data Analysis

2.4.1 Attention was given to check the quality and accuracy of data. The analysis would identify GV operational pattern and determine GV parking demand in data centre.

2.5 Proposed Parking Requirements

2.5.1 Due to no separate GV parking requirements for data centre, this study provides a scientific basis to rationalize parking supply avoiding over or under provision for GV parking spaces and loading/unloading bays in data centre. Based on the assessment of GV parking demand, requirements of GV parking and loading/unloading for data centre is proposed.

2.5.2 The views and feedbacks on the proposed requirements of GV parking and loading/unloading from the operators of the sampled data centres were collected and reviewed. AACL has further discussed the views collected with the OGCIO, Transport Department (TD) and Working Group of Parking (WGP), and subsequently enhance the proposed guidelines as appropriate.

2.6 Implication of the Proposed Parking Requirements

2.6.1 Comparisons between the proposed parking requirements with current parking standard and existing parking provision were carried out.

3. DATA COLLECTION

3.1 General

3.1.1 Data collection is one of the most important tasks in this Study. The data collected should be adequate and accurate for use in examination of existing GV parking condition. In order to accomplish the study objectives, it is important to have an effective survey method to obtain adequate and accurate information for the examination of existing parking condition. For this Study, data collection included three main parts: (i) Background Survey; (ii) Car Park and Loading/Unloading Utilization Survey, and (iii) Questionnaire Survey.

3.1.2 To ensure the surveys are carried out smoothly, pilot survey was conducted prior to the main survey to test the data collection forms and fieldwork logistics. Experienced surveyors were deployed to conduct the fieldwork and supervisors were assigned to conduct site checking. Supervisors conducted regular check and random check to ensure the quality of the data collection.

3.2 Background Survey

3.2.1 The general and operational information of data centres was collected directly from the operators of the data centres. The following information was collected:

- General information of data centres:
  - Gross floor area;
  - Number of floors occupied by the data centres;
  - Current GV parking provision; and
  - Number of company GVs stationed in the data centre car park.
- Operational information of data centre:
  - Data centre activities involving GV activities; and
  - Peak periods involving GV activities.

3.3 Car Park and Loading/Unloading Utilization Survey

3.3.1 Car Park and Loading/Unloading Utilization Surveys were conducted at Purpose Built Data Centres and Data Centres of Wholesale Conversion from Industrial Buildings in order to identify the GV activities generated by the data centre through observation.

3.3.2 In order to realize the operation pattern of data centres, the surveys were conducted 24 hours a day over seven days covering working days from Monday to Friday and Saturday and Sunday.

3.3.3 Surveyors were assigned at the access of the car parks of the selected buildings to collect the following information:

- GV registration number;
- GV type (LGV/MGV/HGV);
- Arrival and departure times of the corresponding GV; and
- Irregularities observed (e.g. road side parking and loading/unloading outside and around the buildings).

3.4 Questionnaire Survey

3.4.1 Parking and loading/unloading spaces for Data Centres of Partial Conversion from Industrial Buildings are shared with other companies located in the same industrial building, as a result, the methodology mentioned in **section 3.3** is unable to collect the information of GV activities solely generated by data centres.

3.4.2 In order to identify the GV activities generated by these data centres, Questionnaire Surveys were conducted and interviewers were assigned at the locations near the cargo lift of the data centre to intercept the data centres couriers to collect the relevant information. Formal approvals from the data centre operators were obtained via the assistance of OGCIO before conducting the Questionnaire Survey. The following information was collected during the surveys via face-to-face interview:

- GV registration number;
- GV type (LGV/MGV/HGV);
- Arrival and departure times of the corresponding GV; and
- The parking location of the corresponding GV.

4. DATA ANALYSIS

4.1 General

4.1.1 Based on the data collected from the surveys, data analysis was performed to determine the GV operational characteristics of data centre. The data was collated and analysed to ensure their quality and reliability. The findings established from the collated data were then used to devise proposed guideline for requirements of GV parking and loading/unloading for data centres in Hong Kong.

4.1.2 AACL established a team of in-house checkers to review the collected data on logical consistency, completeness and accuracy to see if the data are acceptable for data coding. The checked data was used to establish the GV parking and loading/unloading profile of the data centres. The following types of analyses were performed:

- Identify parking accumulation peak hour and peak day;
- GV parking utilization;
- Ratio of LGV to M/HGV; and
- Ratio of GV parking to loading/unloading activities

4.2 Characteristics of Surveyed Data Centres

4.2.1 Surveys were carried out at 16 data centres. The number of the surveyed data centres with reference to their categories is shown in **Table 4.1**.

Table 4.1 Number of Surveyed Data Centres in the Three Categories

Data Centre Categories	Number of Surveyed Data Centre
Purpose Built Data Centres	2
Data Centres of Wholesale Conversion from Industrial Buildings	6
Data Centres of Partial Conversion from Industrial Buildings	8
Total	**16**

4.2.2 With reference to the background survey, there was no particular peak season identified for GV activities for data centres. The GV operators reported that the GV activities for data centres were steady and stable.

4.2.3 According to the site observation, GV activities carried out at the data centres were not frequent. Majority of GV activities for data centres involve delivery of

documents and small boxes. The frequency of GV activities involving routine maintenance works, server replacement/acquisition and clients moving in/out was relatively low.

4.3 GV Activities at Data Centres

4.3.1 The result indicates that number of GV trips recorded for data centres of Data Centres of Partial Conversion from Industrial Buildings was very minimal. Consequently, the GV parking and loading/unloading activities were also very minimal.

4.3.2 **Figure 4.1** illustrates the 24 hours parking and loading/unloading profile of the surveyed data centres. The average number of GV parking and loading/unloading of the three categories of data centre during the whole survey period is shown in the figure.

4.3.3 The figure shows that the peak GV parking and loading/unloading activities were taken place at 1000 to 1200 hours. The highest number of GV parking activities was observed in Purpose Built Data Centres. The lowest number of GV parking activities was observed in Data Centres of Partial Conversion from Industrial Buildings.

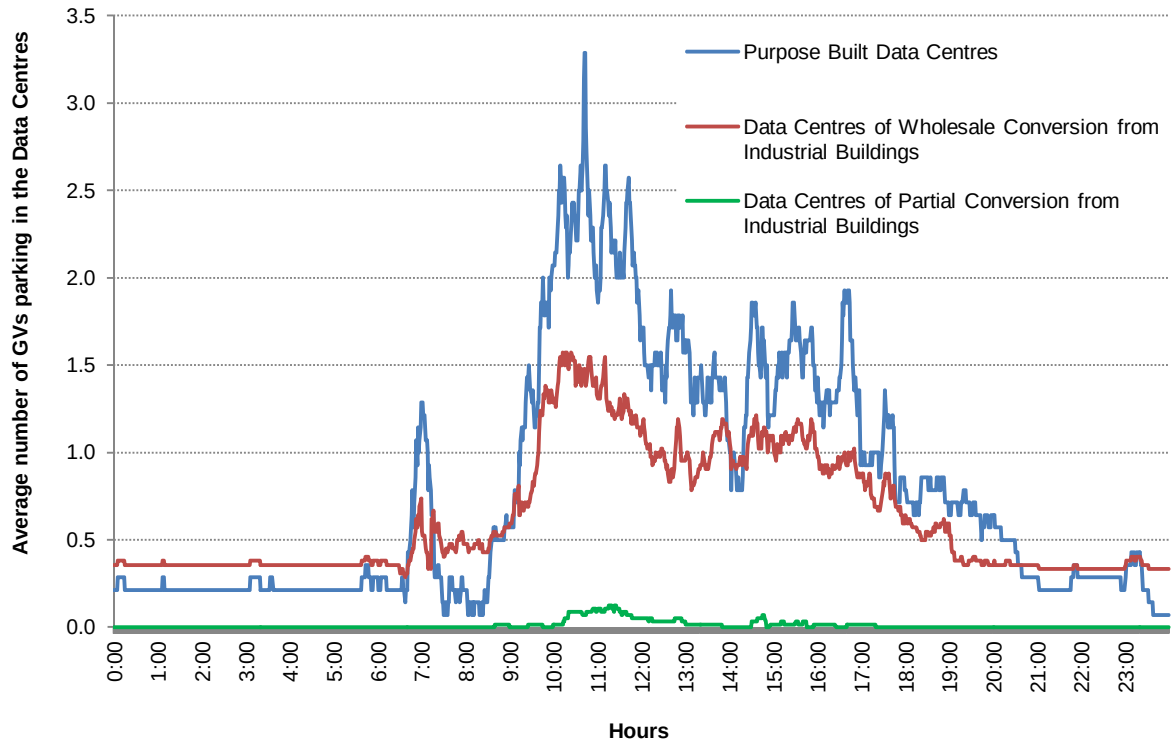

Figure 4.1 24 Hours Parking and Loading/Unloading Profiles of the Surveyed Data Centres

4.3.4 **Figure 4.2** illustrates the average GV parking and loading/unloading activities of the surveyed data centres of the working days from Monday to Friday and Saturday and Sunday. The average number of GV parking and loading/unloading for the whole survey period for the three types of data centre during the whole survey period is shown in the figure.

4.3.5 The figure illustrates that GV parking and loading/unloading activities were observed throughout Monday to Sunday. The highest average number of GV parking and loading/unloading activities was on Monday while the lowest average value was on Sunday.

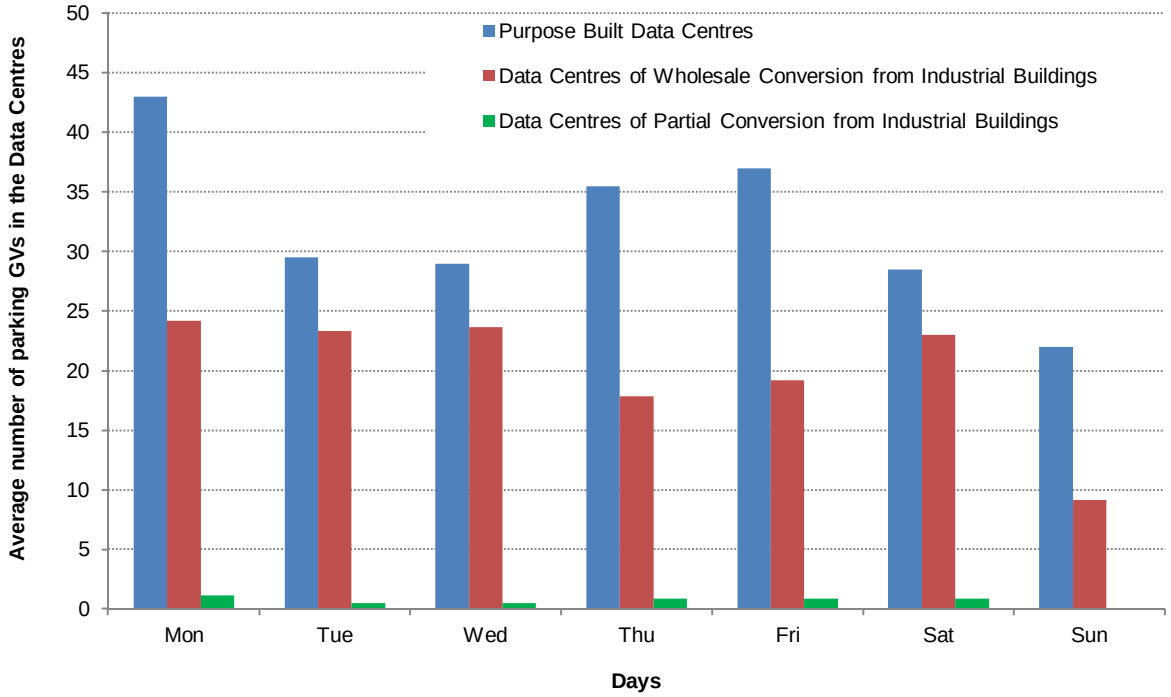

Figure 4.2 Daily Parking Profiles of the Surveyed Data Centres

4.4 Utilization

4.4.1 The number of GVs parking and loading/unloading observed at the peak period was extracted from each data centre. The peak utilization rate[2] of the data centre can be calculated as:

$$\text{Peak Utilization Rate} = \frac{\text{Number of GVs Parking and Loading/Unloading Observed at Peak Period}}{\text{GV Parking Provision at Data Centre}}$$

[2] Due to parking and loading/unloading spaces for Data Centres of Partial Conversion from Industrial Buildings are shared with other companies in the same building, the parking utilization of these buildings is unable to represent the parking utilization of the data centres. Parking utilization rate is, therefore, devised from the collected data of Purpose Built Data Centres and Data Centres of Wholesale Conversion from Industrial Buildings in which the parking and loading/unloading spaces are solely occupied by data centres.

4.4.2 The peak utilization rate of data centres was low (below 50%). It, generally, reflects that there was overprovision of GV parking and loading/unloading spaces in data centres by adopting the current parking standards stated in HKPSG.

4.5 Ratio of LGV to M/HGV

4.5.1 The numbers of LGV and M/HGV observed at the peak period at each data centre for the whole survey periods were extracted. The number of LGV and M/HGV during the peak period is similar to the current HKPSG recommendation for GV in industrial use development which is 65:35.

4.6 Ratio of GV Parking to Loading/Unloading Activities

4.6.1 PDS-2 indicated that the major difference between parking and loading/unloading activities is that loading/unloading activities involves a shorter occupation period in general.

4.6.2 The number of GVs parking (GV stayed in the data centre equal to or more than 1 hour) and number of GVs loading/unloading (GV stayed in the data centre less than 1 hour) at the peak period at each data centre were extracted. The result reveals that the proportion of number of GV loading/unloading activities (less than 1 hour) to parking activities (equal to or more than 1 hour) during the corresponding peak period was about 60:40. In order to optimize GV parking facilities during design phases, the ratio can be adopted to determine the optimal numbers of parking spaces and loading/unloading bays in data centres.

4.7 Parking Demand Analysis

4.7.1 As the parking nature of data centre is usage-related parking, the parking demand is defined as the number of GV parking at the data centres per GFA during the peak period. The numbers of observed GVs parking and loading/unloading at the peak period at the data centres were captured from the survey data.

4.7.2 The parking demand can be calculated as:

$$\text{Peak Demand} = \frac{\text{Number of GVs Parking and Loading/Unloading Observed at Peak Period}}{\text{Gross Floor Area}}$$

4.7.3 The result explicates that parking demand increase with GFA. Two increasing ratios between parking demand and GFA were identified. Data centres can be categorized into two groups with reference to GFA and the corresponding parking demand. The difference of the parking demand of these two groups was significant large and the parking demand of data centres within the group was

similar. The two groups are:

- Data centres with GFA smaller than or equal to 20,000 m^2; and
- Data centres with GFA larger than 20,000 m^2.

5. PROPOSED GV PARKING REQUIREMENTS

5.1 General

5.1.1 Currently, no separate standards were established for GV parking and loading/unloading for data centres in HKPSG (paragraph 6.6.51, Technical Report, PDS-2). According to the PDS-2, most of the data centres are located in either industrial or industrial/office uses buildings and PDS-2 indicated that there were not many data centres in Hong Kong. The buildings in which the data centres are located have to provide the number of GV parking and loading/unloading space as specified in the land leases, the requirements of which are adopted from the HKPSG.

5.1.2 In general, parking standards for Industrial and Business Developments of HKPSG (Section 4, Table 11, Chapter 7 of HKPSG) were adopted to determine the parking requirements for data centres. For general industrial buildings, the requirement is one GV parking and/or loading/unloading for every 700-900 m^2 Gross Floor Area (GFA). For business buildings, the requirement is one GV parking and/or loading/unloading for every 800-1,200 m^2 (GFA). In addition, one container vehicle loading/unloading bay with turning circle of 11.6 m outer radius should be provided for a site with dimensions not less than 45 m x 40 m.

5.1.3 The (1) GV parking demand, (2) ratio between LGV and M/HGV parking and (3) ratio between parking and loading/unloading activities were identified in data analysis. These factors form the base of the proposed requirements for GV parking and loading/unloading for data centre.

5.2 Feedback from Data Centre Operators and Working Group on Parking

5.2.1 Discussions on the proposed requirements were carried out with the data centres operators and WGP to seek the views and feedback on the proposed requirements of GV parking and loading/unloading for data centre. The aim of discussion is to gather views, comments and suggestions on the proposed requirements and subsequently enhance the proposed guideline.

5.3 GV Parking Demand

5.3.1 The result reveals that the GV parking demand of data centre is much less than the existing parking provision for Industrial and Business Developments as recommended in the HKPSG. The difference between the parking demand and the existing parking provision is larger than 50%. As a result, it is proposed to reduce the parking provision by no less than 50% with reference to the existing GV parking requirements of which are adopted from the HKPSG (Chapter 7, Table 11, Section 4: Parking Standards for Industrial and Business Developments).

5.4 Ratio between LGV and M/HGV Parking

5.4.1 With reference to the HKPSG, dimensions for standard parking spaces and loading/unloading bays for LGV and M/HGV are shown in **Table 5.1**.

Table 5.1 Dimensions for Standard Parking Spaces and Loading/Unloading Bays for LGV and M/HGV

Type of Parking Space	Length (m)	Width (m)	Minimum Headroom (m)
LGV	7	3.5	3.6
M/HGV	11	3.5	4.7

5.4.2 Base on the results, there was no container vehicle activities observed during the whole survey period for all the data centres. The findings also indicate that there were more LGV activities than that of M/HGV and the ratio of LGV to M/HGV is similar to that recommended in HKPSG (65:35). As the parking space dimensions for LGV and M/HGV are different, the ratio of parking spaces for LGV and M/HGV is necessary to be assigned in data centres. In order to consistent with HKPSG, it is proposed to adopt the ratio recommended in HKPSG (i.e. 65:35) for data centres.

5.5 Ratio between Parking Spaces and Loading/Unloading Bays

5.5.1 According to HKPSG, the dimensions for parking spaces and loading/unloading bays are the same. PDS-2 revealed that the major difference between parking and loading/unloading activities is that loading/unloading activities involves a shorter occupation period in general. A space for loading/unloading could cater for more turns than a space for parking within the same period. Loading/unloading bays serve the operational needs of a development.

5.5.2 In order to optimize the design of parking facilities of data centre, the ratio between parking spaces and loading/unloading bays were investigated. With reference to the results, the ratio of parking spaces to loading/unloading bays is equal to 40:60.

6. SUMMARY AND RECOMMENTATIONS

6.1.1 This chapter summarizes the findings of the Study and outlines the recommendations on requirements of GV parking spaces and loading/unloading for data centres in Hong Kong.

6.1.2 Totally 16 data centres were investigated in the Study. Three types of surveys, namely Background Survey, Car Park and Loading/Unloading Utilization Survey, and Questionnaire Survey, were carried out to collect information including background information, operational characteristics and GV parking and loading/unloading activities at the data centres. Car Park and Loading/Unloading Utilization Survey, and Questionnaire Survey were conducted for 24 hours a day over 7 days for all 16 data centres to recognize their operational pattern. In addition, interviews were conducted with data centre operators to identify operational characteristics of data centres.

6.1.3 This Study reveals that GV activities for data centres were steady and stable but not frequent. The GV parking utilization rate was low (below 50%). It reflects that there was overprovision of GV parking spaces and loading/unloading bays at data centres when the parking standards for industrial and business developments stated in the HKPSG was adopted.

6.1.4 The results reveal that GV parking demand increases with GFA and parking demand of data centre can be split into two parts with reference to GFA:

- Parking demand for the first 20,000 m^2 GFA; and
- Parking demand above 20,000 m^2 GFA.

6.1.5 According to the results, there were more LGV activities at data centres than that of M/HGV. The ratio of LGV to M/HGV is similar to the ratio recommended in the HKPSG (i.e. 65:35). In addition, there was no container vehicle activity observed over the whole survey period at any of the data centres.

6.1.6 In order to optimize the provision of parking facilities at data centres, the ratio between parking spaces and loading/unloading bays were investigated. The optimum ratio of parking spaces and loading/unloading bays is 40:60.

6.1.7 Consultations and discussions with the OGCIO, TD, WGP and data centre operators were carried out throughout the Study. Views, comments and suggestions on the proposed requirements were collected and AACL subsequently enhanced the proposed guideline.

6.1.8 As the GV parking demand at data centres is different from that of other types of developments, any change of use of data centres in the future may require a change in parking requirements which must be reassessed in accordance with HKPSG to prevent over or under provision of GV parking in the development.

6.1.9 The result reveals that the GV parking demand of data centre is much less than the existing parking provision for Industrial and Business Developments as recommended in the HKPSG. The difference between the parking demand and the existing parking provision is larger than 50%. As a result, it is proposed to

reduce the parking provision by no less than 50% with reference to the existing GV parking requirements of which are adopted from the HKPSG (Chapter 7, Table 11, Section 4: Parking Standards for Industrial and Business Developments).