Abridgment

Space Allocation Guidelines for Off-Street Loading Facilities

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This report summarizes the results of the third and final year of a study related to the facilitation of urban goods movement. The first year of study dealt with data acquisition, the second year developed and validated the methodology, and the third year sought to develop guidelines for the efficient allocation of curbside and off-street space for urban goods movement. Brief descriptions of the data sources and the developed methodologies (1,2) and a detailed description of the guidelines with application examples for off-street loading requirements, primarily in downtown areas, are presented here.

DATA SOURCES

The source of information used to develop pickup and delivery (P/D) descriptions, such as generation, arrival temporal distributions, parking patterns, and dwell times, was data collected in downtown Brooklyn and in lower Manhattan in 1974 and 1975. Approximately 2500 samples were collected from 74 typical downtown land use sites. These sites included office buildings, department stores, light industrial establishments, and many retail and commercial establishments characteristic of downtown areas (3,4).

For each P/D operation sampled, information was obtained on carrier and vehicle type; time of arrival and time components of the stop; parking patterns; shipment size, weight, and commodity; mode of transportation from vehicle to destination; delays in the operation; and engine-idling time.

Using attributes of the data generators, various models were developed for describing P/D operations. Such models include trip generation (5), temporal distribution, and parking models (1,2).

SPACE ALLOCATION METHODOLOGY

The procedures used allocate space for goods movement in such a way as to minimize societal costs. These societal costs include traffic delays, carrier's delays, developer's costs, parking costs, health-related costs, and environmental costs, depending on whether the area of interest is at the curb (on-street) or at a loading dock (off-street). The total cost of allocating S spaces, on-street or off-street, for goods movement can be expressed in the following general form:

$$C(s) = c_{1(s)} + c_{2(s)} + c_{3(s)} + \ldots + c_{n(s)}$$

where C(s) is the total societal cost and $c_{i(s)}$ is the cost to interest group i of allocating S spaces to urban goods movement.

The objective is to find the number of off-street berths that minimizes some total cost function. There are costs to the several components of the moving traffic stream that can be adversely affected by a blockage of a moving lane (lines at loading docks and backing-in maneuvers); carrier costs are included as each vehicle waits for its turn to use the off-street berths. This, in turn, means that developer's costs go up as traffic and carrier costs go down. Developer's costs go up because rentable space is assigned to goods-vehicle loading and unloading, which does not produce revenue. The procedure in this space allocation model is to find the number of off-street berths that minimizes total annualized cost in dollars for all impartial groups.

Further detailed description of the analysis, as well as the sensitivity of the methodology, is found in Crowley and Habib (4). It should be noted, however, that no problems identified that would affect application of the standards are presented here.

DEFINITIONS

There are two basic on-street traffic flow patterns, an arterial pattern and a city street pattern. The arterial pattern has the severe peaks in the morning and evening work-travel periods. The city street pattern reflects the relatively high off-peak (local) traffic flows. These different patterns also affect the guidelines for off-street loading. It should also be noted that there is a different effect on traffic depending on whether a disruption occurs in the upstream, mid-block, or downstream sections of a block. These differences are reflected in Tables 1-3.

Three different land uses were considered with respect to off-street vehicle space requirements. They are office building, department store, and light industrial and warehousing.

APPLICATION OF STANDARDS

In referring to Tables 1, 2, and 3, the street and traffic characteristics on which a facility is to be developed must be considered. The size and use of the generator are determined, and then the estimated rentable value of the space slated for off-street facilities is computed. The planner may enter the variables defined on the appropriate table in order to retrieve the number of docks required to minimize societal costs using method 6—the recommended method—and assuming that all goods-vehicles generated use the off-street facility. In certain land uses, such as department stores, this assumption is rational. In others, such as office, assuming that no goods will be delivered across the curb—even though off-street facilities are provided—can be inaccurate.

To consider a particular percentage utilization of off-street dock facilities, the planner should either (a) conduct selected surveys in the central business district (CBD) to determine percent utilization of existing off-street facilities or (b) make rational assumptions on the basis of experience. The research discussed in this paper indicates:

1. For department stores, 90 percent compliance can be assumed;
2. For light industry, 80-90 percent compliance can be assumed; and
3. For office buildings, 70-90 percent compliance can be assumed.

Of course, 100 percent compliance might be achieved by strict enforcement of parking regulations in the vicinity of the generator. However, considering some noncompliance appears to be a more practical approach.

Table 1. Recommended number of off-street berths for office buildings.

Effective Size (m²)	Upstream Access					Mid-Block Access					Downstream Access				
	$10	$15	$20	$25	$30	$10	$15	$20	$25	$30	$10	$15	$20	$25	$30
Arterial streets															
18 600	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
37 200	3	3	3	3	3	3	3	3	3	3	5	3	3	3	3
55 800	6	6	5	5	5	5	5	5	5	5	6	6	6	5	5
74 400	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
93 000	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
111 600	9	8	8	8	7	8	8	8	7	7	9	9	8	8	8
130 200	10	10	10	8	8	10	10	8	8	8	10	10	10	10	9
148 800	11	11	11	11	11	11	11	11	11	11	12	11	11	11	11
Downtown streets															
18 600	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
37 200	4	3	3	3	3	3	3	3	3	3	5	4	4	3	3
55 800	6	5	5	5	5	5	5	5	5	5	6	6	6	5	5
74 400	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
93 000	7	7	7	7	7	7	7	7	7	7	9	8	7	7	7
111 600	9	8	8	8	8	8	8	8	8	7	10	9	9	8	8
130 200	10	10	10	9	9	10	10	9	9	9	11	11	11	10	9
148 800	12	11	11	11	11	12	11	11	11	11	12	12	12	11	11

Notes: $0.09\ m^2 = 1\ ft^2$.
Dollar values refer to annual suitable value per square meter of space.

Table 2. Recommended number of off-street berths for a department store.

Number of Vehicle Arrivals per Day	Upstream Access					Mid-Block Access					Downstream Access				
	$10	$15	$20	$25	$30	$10	$15	$20	$25	$30	$10	$15	$20	$25	$30
Arterial streets															
20	4	4	3	3	3	3	3	3	3	2	4	4	4	3	3
30	4	4	3	3	3	4	3	3	3	3	4	4	4	4	3
40	5	5	5	5	5	5	5	5	3	3	5	5	5	5	5
50	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
60	6	6	6	5	5	6	5	5	5	5	6	6	6	6	6
70	6	6	6	6	6	6	6	6	5	5	6	6	6	6	6
Downtown streets															
20	4	3	3	3	3	3	3	3	2	2	4	4	3	3	3
30	4	3	3	3	3	3	3	3	3	2	4	4	4	3	3
40	5	5	5	5	5	5	4	3	3	3	5	5	5	5	5
50	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5
60	6	5	5	5	5	5	5	5	5	5	6	6	6	5	5
70	6	6	6	6	6	6	6	5	5	5	6	6	6	6	6

Notes: $0.09\ m^2 = 1\ ft^2$.
Dollar values refer to annual suitable value per square meter of space.

Example 1

Consider a 74 322-m^2 (800 000-ft^2) office building to be constructed on a four-lane downtown street with the expected access point in the downstream third of the block. Evidence indicates that 25 percent of all goods-vehicles serving this type of building will not utilize the constructed off-street facility.

To find the required number of off-street berths, the planner should calculate the effective building size (or effective generation) of the subject. In this case it is approximately 55 742 m^2 (600 000 ft^2).

Table 1 shows a range from six to five in the number of berths recommended for the various rental values given. From the developer's viewpoint, if the proposed office building is at the highest value location in the downtown area, the highest annual rentable value should be used. The lowest would be used for a building on the fringe of the CBD or possibly even outside the downtown area.

Example 2

Consider a department store to be developed on a six-lane arterial where the access point is expected to be at mid-block. It is calculated that the docks will have an effective (after noncompliance) generation of 40 goods-vehicles daily (4,5). Table 2 shows a range from five to three in the recommended number of off-street berths. The planner should consider where the site would be located with respect to the peak commercial activity center in the downtown area. This refines the selection of a recommended dock size. Light industrial buildings may be treated similarly to department stores as outlined in example 2.

To compare the findings of the examples shown here to actual standards now in use in selected downtown areas, the following text table was developed.