CHAPTER 6

STATION AND STATION PLAZA DESIGN STANDARDS

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In the Study, the railway transport in Metro Manila is recognized to be as dominant urban public transport mode and various measures are proposed for establishing an efficient urban transport network based on systematic coordination among the railway lines and between the railway and other transport.

6.1 Necessity of Manual of Station and Station Plaza Planning

6.1.1 Rationale for Station Standards

For maximum benefits from investments in railway transport, it must be integrated with other railway lines as well between the railway and other transport modes. Stations and station plazas provide the desired integrating elements. These facilities are most deficient in Metro Manila; hence, the necessity for addressing their proper planning, design, and construction.

This chapter starts with the fundamentals and presents conceptual designs for five (5) candidate multi-modal stations that have the potentials - aside from being transshipment points - of inducing a reorganization of the urban functions, of intensifying land usage in the adjoining station areas, and of re-structuring public transport services. In the process, the design considerations and standards for such facilities are illustrated.

6.1.2 Necessity of Stations and Station Plazas Planning

Rail, more than any other modes, depends on convenient transfers to attract users. In an integrated transport system, railways are assigned the role of line haul service, with buses and jeepneys performing the 2nd and 3rd tier of complementary services, according to their capacities and inherent advantages. The station plazas of major stations play an intrinsic role in this system. Hence, they should be constructed to achieve smooth interchange between modes of transport now and in the future, aside from supporting other urban activities in the surrounding areas.

Good stations do not happen by accidents. They are products of systematic planning and design. Station layouts have to be user-friendly, with facilities intuitively-understandable to boarding and alighting passengers. Movements between different floor levels should not be a major effort. The quality of station facilities is often associated with the quality of railway services.

6.1.3 Observed Problems and Deficiencies

The main problems that bedevil stations and station plazas in Metro Manila can be summarized as follows:

(1) Lack of consideration to shared use or co-locations, nor of courtesies to commuters.

Planning appears to have overlooked opportunities for the track- and/or station-sharing. Little attention was given to the inter-connection requirements of stations in adjacent sites, thus making it difficult for passengers. In many instances, stations were constructed in areas separated by distance from business and commercial districts of high demand, or far from bus and jeepney terminals, with no corresponding link facilities.

(2) Lack of consideration to changeover, and to height differences, between elevated rail and grade-level road transport

None of the existing facilities could fit the definition of a station plaza. Hence, the discontinuities in inter-modal transfers. Despite the short walking distance to stations (approximately 300 m), passengers are deterred by the large height differences between sidewalks and ticketing platforms. Road traffic is likewise adversely affected when buses and jeepneys convert the lanes below or around the stations into loading/unloading zones.

(3) Discounting of danger signs and trends

Despite the dire forecast of extreme congestion occurring at stations in the future, the rapid increases in the number of boarding and alighting passengers appear to raise no alarm bells among authorities.

(4) Lack of consideration to transfer facilities within stations

In several instances, it has been observed that commuters are forced to negotiate long stairways between ticket barriers and platforms on separate floors, or between ground and railway platforms.

In addition to the major deficiencies mentioned above, stations and station plazas are being built by each rail proponent or operator without the benefit of a common standard to guide their planning.

With a view towards providing the missing standards, and to illustrate the "best practices" in the area of station and station plaza planning, this Study shall prepare a manual for the purpose.

6.2 Manual of Station and Station Plaza Planning

6.2.1 Role of Stations and Station Plazas

Stations and station plazas are nodes between rail transport and road transport and, although their roles differ depending on location on the route network, local characteristics of stations, and size, etc., the basic role of stations is to enable boarding and alighting passengers to use trains, while that of station plazas is to provide safe, convenient and comfortable facilities to enable rail users to transfer to and from buses and jeepneys.

6.2.2 Classification of Stations and Station Plazas, etc.

In planning stations and station plazas, classification shall be carried out as described below in consideration of factors thought to have an effect on the functions and scale of stations and station plazas.

(1) Station geographical characteristics and classification

The geography of stations is generally planned with consideration given to projected demand in 15 years based on following figure. With consideration given to existing conditions, stations are classified as in CBD stations and outside CBD stations based on future land use plans in the station area, nighttime and daytime population, boarding and alighting passengers in the morning rush, and so on(CBD:Central Business District). In CBD stations are located in areas of concentrated business and commercial functions and handle large numbers of alighting passengers during the morning rush and boarding passengers during the evening rush; while outside CBD stations are located in residential land or are surrounded by a certain degree of commercial concentration with residential hinterland, and they handle large numbers of boarding passengers during the morning rush and alighting passengers during the evening rush.

The classification of stations is planned in the same way as geographical characteristics, i.e. based on following figure and with consideration given to the demand forecast in 15 years. The number of station plaza users is computed from the number of boarding and alighting passengers during peak times, and stations are divided into ordinary stations and multi-function stations in consideration of the terminal transport share rate, etc. (see Appendix).

(2) Scale of stations

There are varying numbers of boarding and alighting passengers at stations, and station scale is determined with consideration given to the geographical characteristics and classification of stations.

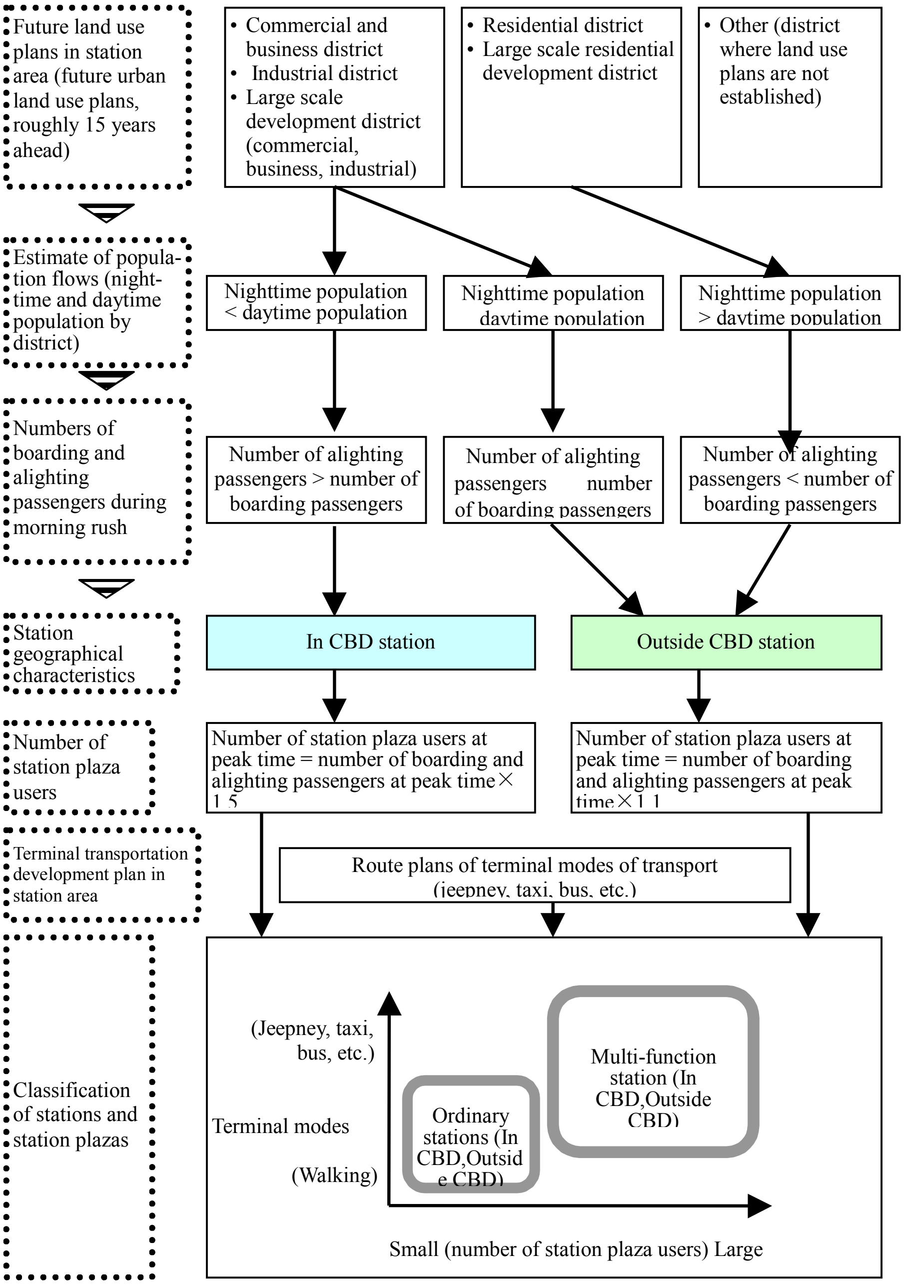


Fig. 6.2.1 Flow for Examining Geographical Characteristics and Classification of Stations

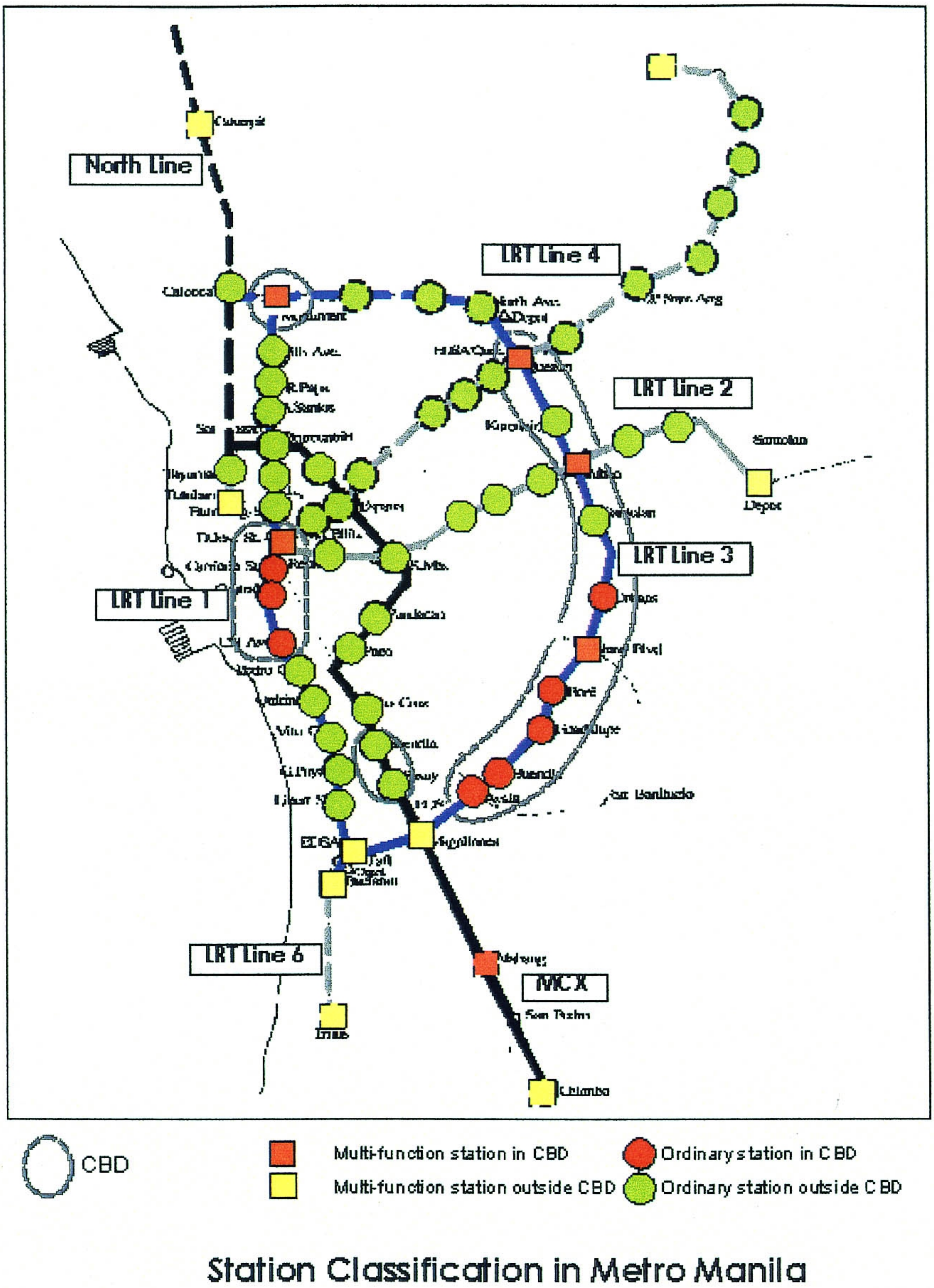


Fig. 6.2.2 Location of Future Stations (Plan)

(3) Classification of stations

Stations are classified into terminal stations, intermediate stations, junction stations, and connecting stations.

1) Terminal station: this generally refers to stations at the end of lines, but includes stations in the middle of networks where most trains terminate their journeys.

① Pass-through type: stations through which trains can pass

② Heading type: stations where all trains come to a stop in terms of route

2) Intermediate station: intermediate stations on route networks. Most stations fall under this heading.

3) Junction station: stations where different lines break off from an intermediate stop on a different line

4) Connecting station: stations where stations on two lines are adjoining or intersect on differing levels.

① Stations where two lines are joined in close proximity are known as connecting stations.

② Stations where two lines cross on different levels are known as intersection stations.

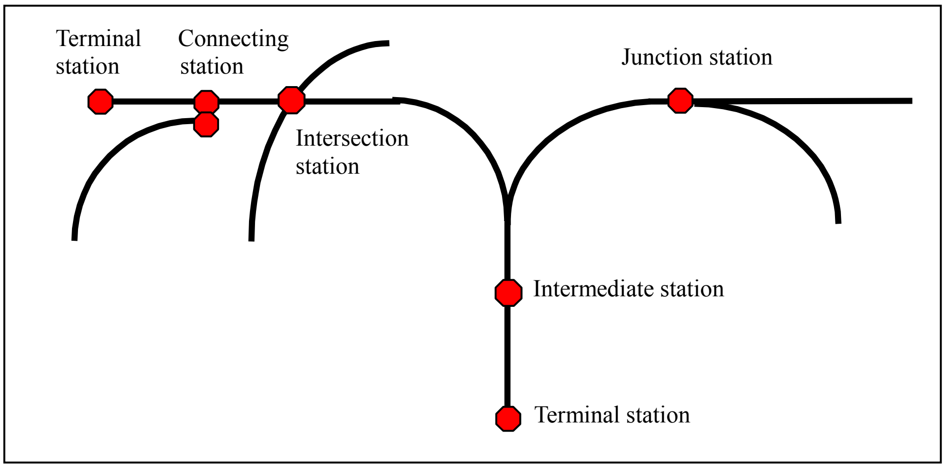


Fig. 6.2.3 Classification of Stations

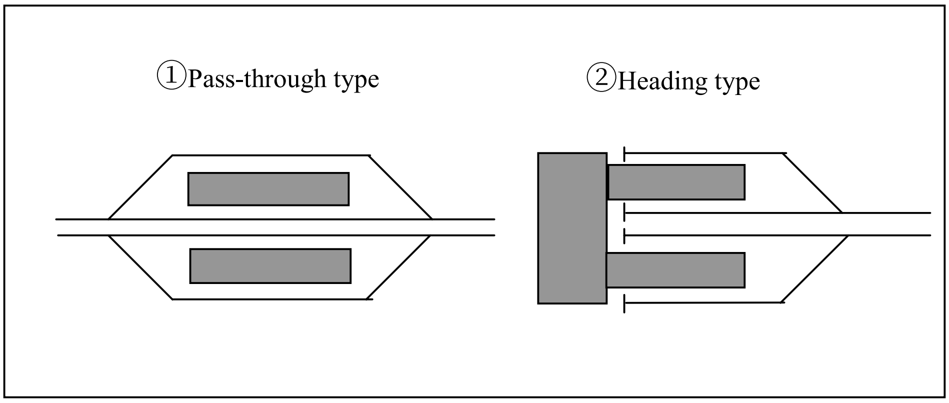


Fig. 6.2.4 Classification of Terminal Station

(4) Station structure

Conceptual drawings of station structure are given below.

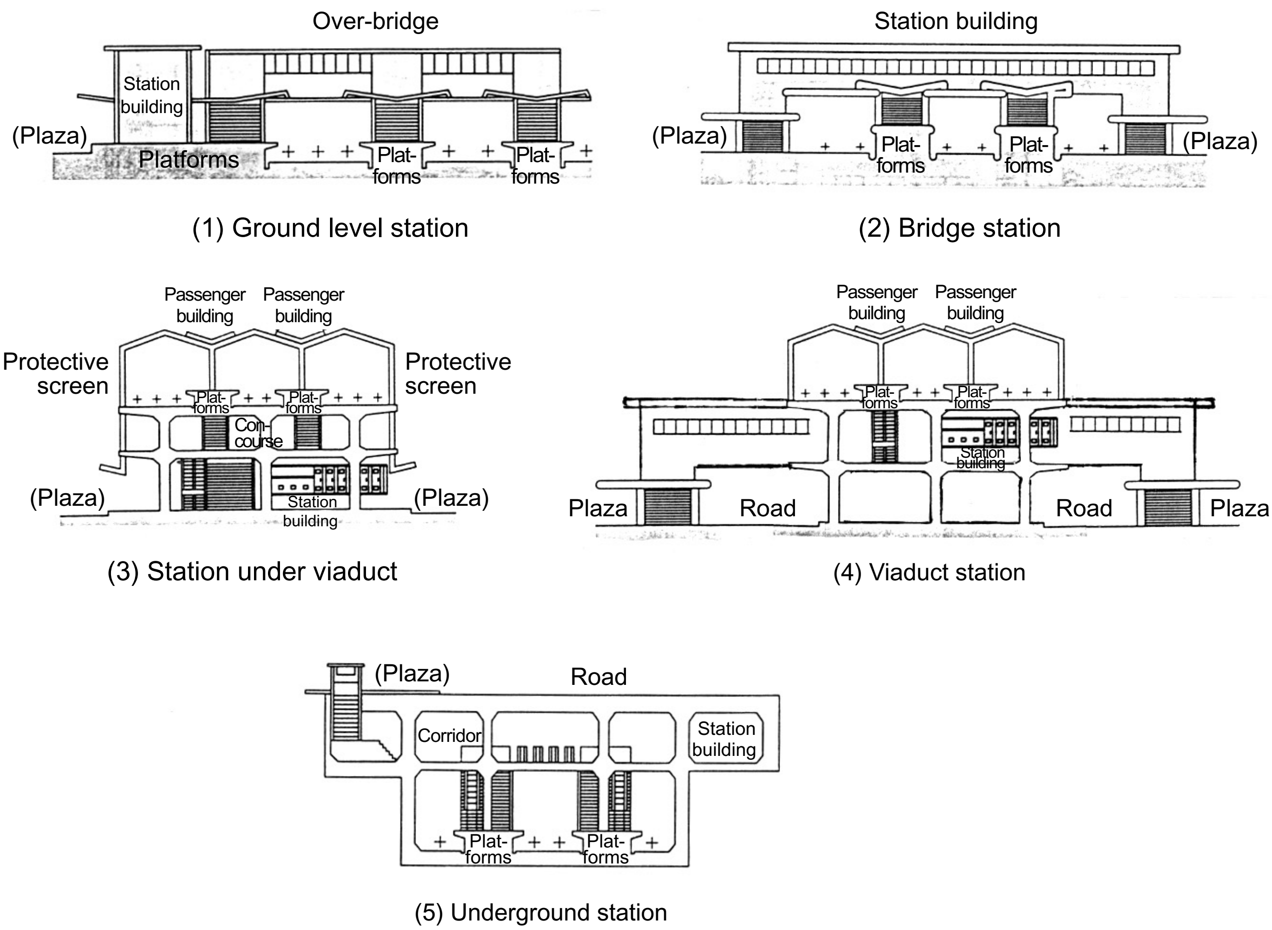


Fig. 6.2.5 Conceptual Drawing of Station Structure

1) Ground level station

① Outline: the station building is on the same level as lines or platforms. This is not suited to integrated urban development to the front and rear of stations.

② Passenger traffic lines: the station and station plaza are connected almost on the same level, but over-bridges or underground corridors are required to reach platforms and traffic lines inside the station are long.

③ Features: since the station is on ground level, works costs are cheap and layout is simple.

2) Bridge station

① Outline: the station building is installed over the lines and platforms, and a free corridor allows passengers and local residents to cross back and forth between the front and rear of the station.

② Passenger traffic lines: since vertical movement is necessary, elevator and escalator facilities, etc. are required. There are also cases of connection with pedestrian decks, etc.

③ Features: because an artificial ground bed is required above lines, works costs are expensive when constructing new station buildings.

3) Station under viaduct

① Outline: the station building is on the same level as roads or the station plaza underneath a viaduct. This type of station is adopted when elevated railways are constructed.

② Passenger traffic lines: the station and station plaza are connected almost on the same level, however, vertical transfer facilities (elevators, escalators, etc.) are required inside the station. There are frequently almost no traffic lines outside the station complex, and traffic lines on the whole are short.

③ Features: works costs are expensive since existing railways need to be elevated, etc.

4) Viaduct station

① Outline: the station building is constructed over roads, etc. and a free corridor allows passengers and local residents to cross back and forth between the front and rear of the station. This type of station is adopted in cases where new railways are constructed over roads, etc.

② Passenger traffic lines: since vertical movement is necessary, elevator and escalator facilities, etc. are required. There are also cases of connection with pedestrian decks, etc.

③ Features: works costs are expensive since existing railways need to be elevated, etc.

5) Underground station

① Outline: the station is constructed underneath roads, etc.

② Passenger traffic lines: since vertical movement is necessary, elevator and escalator facilities, etc. are required.

③ Features: works costs are expensive due to underground excavation; future expansion of facilities is difficult; and disaster prevention facilities must be fully installed. For these reasons, actual cases are limited.

(5) Station type

Stations are divided into island platform types or separate platform types, and the features of each are given below.

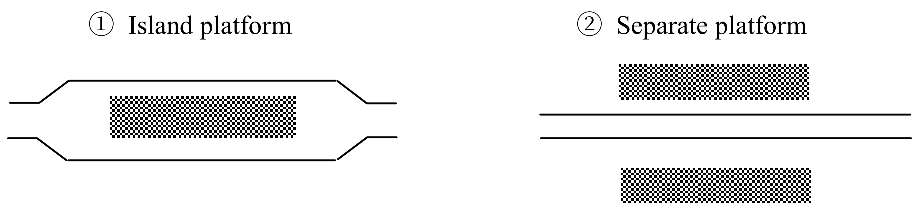


Fig. 6.2.6 Platform Types

Table 6.2.1 Features of Platform Types

Item for Comparison	Island Platform	Separate Platform
Structural facilities	• Future platform widening is difficult. • In cases of intersection with other lines, it is relatively easier to install connecting facilities. • Total width of stairways and finished building area are relatively smaller. • The number of escalators that need to be installed is relatively fewer.	• Future platform widening is relatively easy. • In cases of intersection with other lines, it is relatively more difficult to install connecting facilities. • Total width of stairways and finished building area are relatively larger. • The number of escalators that need to be installed is relatively greater.
Passenger handling	• Congestion is apt to occur when both upward and downward trains are handled during rush hour. • Mistaking of passenger platforms can be averted. • Facilities for aiding movement of physically challenged persons can be limited to one place.	• Separate platforms can be used to handle upward and downward trains during rush hour. • Mistaking of passenger platforms is apt to occur. • Facilities for aiding movement of physically challenged persons are required on each platform.
Station personnel arrangements	• Platform staff can handle upward and downward moving passengers.	• Relatively more platform staff are required.

6.2.3 Thinking Behind Station Positioning

Because the existing intersection and connecting stations of current operating lines, constructed lines and planned lines are inconvenient for transfers, planning shall be carried out with consideration given to the following ①→②→③ in order to ensure smooth transfer between rail transport.

①Mutual trackage
②Construction of stations in same place
③Construction of adjoining stations

Furthermore, to ensure that rail transportation is easy to use, effort shall be made to plan stations close to areas of concentrated business, commercial and residential functions and bus and jeepney terminals, etc., and to improve the level of services by providing facilities which can be used by passengers in safety and comfort.

6.2.4 Station Planning

(1) Basic thinking behind station planning

1) Establishment criteria

When it comes to the planning and construction of new stations, consideration shall be given to the following establishment criteria.

① The station site must not present any problems in terms of transportation and technology.

- Track layout based on transportation plans which incorporate future possibilities must be secured.
- Grade in stations must be 5‰ or less (10‰ or less in unavoidable cases)
- Curve radius of lines along platforms must be 400 m or more.
- Appropriate intervals must be secured between stations.

2) Basic thinking

As for the basic thinking to adopt when planning stations, plans shall be compiled based on the following eight clauses for station facilities with consideration given to simplicity, flexibility, and attention to the needs of disabled persons, etc.

9 Articles for Station Facilities

Chapter 1 Overall Layout

Article 1 Secure easy to understand passenger flow

- Adopt simple traffic lines • Secure visibility.

Article 2 Free corridors shall be provided not to cause division of the area along the line.

Article 3 Adopt a flexible layout which considers space for future expansion and addition of facilities.

- Adopt facilities which respond to increased numbers of users and business expansion, etc.
- Secure maximum width for ticket inspection.

Article 4 Adopt facilities which consider labor saving.

- Seek to integrate ticket inspection. • Seek to integrate duties.
- Introduce automatic ticket inspection.

Article 5 Install escalators, elevators, slopes and passenger toilets (including toilets for physically challenged persons), etc. with a view to catering to physically challenged persons and promoting rail use.

- Install escalators and elevators both inside and outside station compounds.
- Install Braille information and Braille blocks for persons with impaired vision.
- Install continuous and smooth handrails.

Article 6 Install passenger toilets in inconspicuous but easy to find places.

- Remove height differences at entrances and also consider automatic washing.

Chapter 2 Platform level

Article 7 Do not install anything in addition to the minimum necessary facilities.

- Do not place anything except for the minimum necessary facilities.
- Keep benches, etc. to a minimum and avoid placing facilities at platform centers or near exits.
- Move kiosks and other facilities which may obstruct flow to concourse levels as much as possible.
- Make platforms as straight as possible and strive to keep platforms level by raising, etc.

Chapter 3 Station offices, etc.

Article 8 Place offices on one floor.

- Place station offices, ticket inspection rooms, ticket issue rooms, and ticket vending rooms, etc. onto one floor.

Chapter 4 Guide and information displays

Article 9 Make information displays easy to understand.

- Introduce LED displays for train information, time information and accident information.
- Standardize the size, positioning and display contents of information signs.
- Position information boards perpendicular to the flow of passengers and advertisement boards parallel to the flow.
- Consolidate and integrate advertisements so that they don't clash with signs.

3) Station component elements

Station component elements can broadly be divided into the passenger zone and the work zone, and they can be further broken down into four classifications.

Table 6.2.2　　Component Elements of Stations

Passenger zone	Flow facilities	Platforms, concourse, passenger corridors, free corridors, escalators, elevators, etc.	Portion where passengers move around inside the station area
	Passenger facilities	Waiting rooms, passenger toilets, in-station shops	Convenience facilities for passengers inside stations
Work zone	Guest handling facilities	Ticket booths, ticket barriers, information areas, etc.	Facilities where station personnel provide services to passengers using the station
	Station work facilities	Station offices, changing rooms, toilets, etc.	Facilities necessary for station staff to run trains and provide services to passengers

① It is desirable that free corridors and platforms, etc. be positioned in the center of the station premises as much as possible, in order to minimize the walking distances of passengers and secure visibility within stations.

② Ticket issue and inspection barriers shall be placed in areas which are easy to see from customer traffic lines.

(2) Computation of scale of facilities in the station facilities plan

1) Procedure for compilation of facilities plan

Station size is determined according to the number of using passengers, etc., and the procedure for compiling station equipment plans is indicated in the following flow diagram.

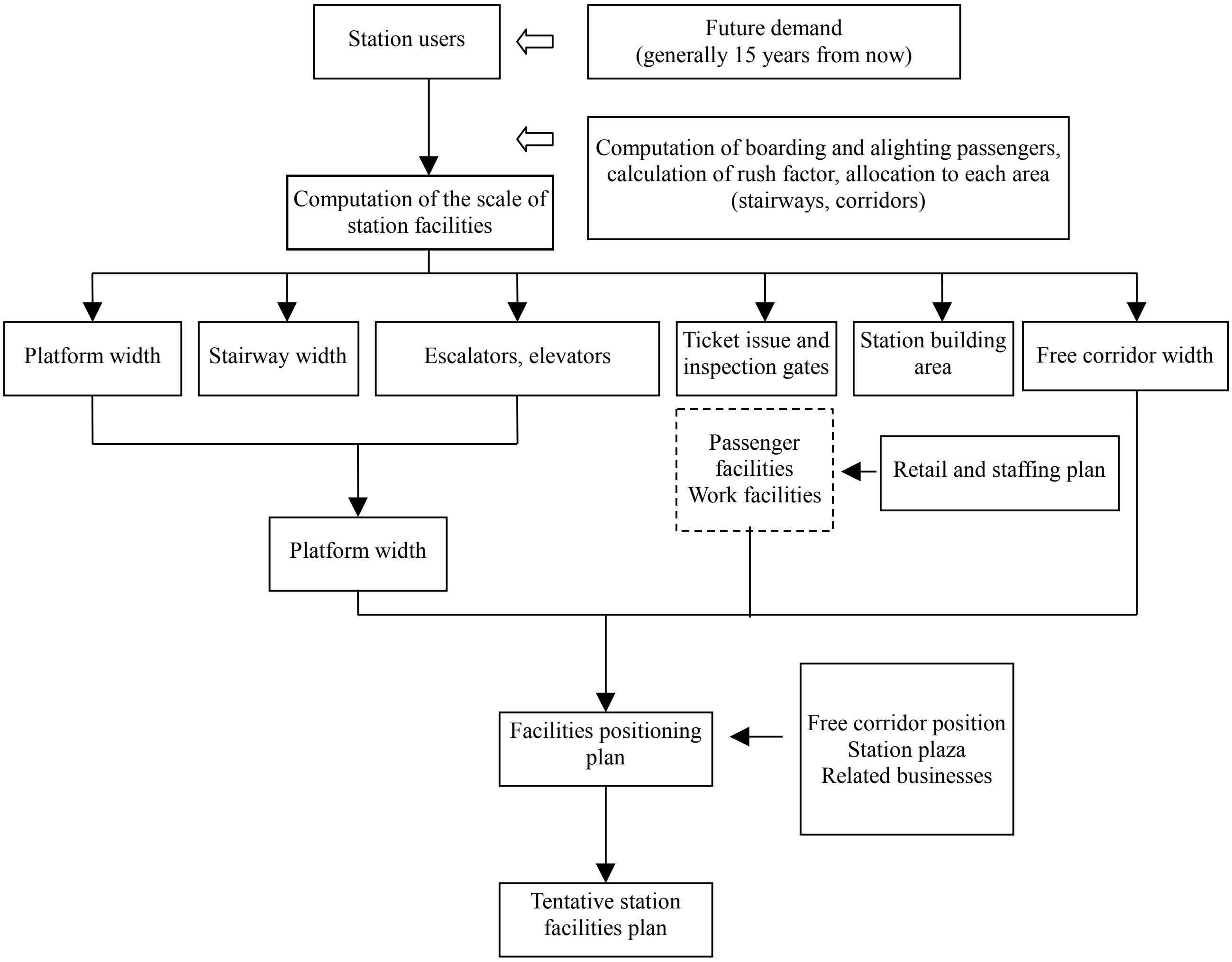


Fig. 6.2.7 Flow of Facilities Plan Compilation

2) Method of advancing facilities planning

① Flow facilities

a) Planning of free corridors, concourses, and passenger corridors, etc.

Station corridors shall be placed so as not to be concentrated around main roads and station plazas.

Concourses shall be divided into interior and exterior facilities. The concourse is the center of passenger flow in the main station building; other facilities are placed around it; and it is often connected to free corridors.

Moreover, as the scale of stations becomes larger, passenger corridors become necessary inside station premises. When planning corridors, it is desirable that simple traffic lines be adopted and that height differences be avoided. In cases where corridors are bent, the best visibility possible is aimed for by using corner cut-offs.

i) Computation of width and ceiling height

- ○ In order to not impede the smooth flow of passengers, width shall be 1.5 m or more.
- ○ Width of 1 m shall be assumed for passenger flow of every 2,000 people per hour when conducting calculation
- ○ Concerning the height of ceilings, in consideration of the hanging of information display equipment, etc., standard height shall be 3.5 m and minimum height 2.5 m.

b) Planning of ticket issue and inspection barriers, and calculation of concourse area

The required area of concourses (outside inner station) is obtained from the following expression by totaling the area before ticket issue and the flow area.

$A = U + T$

A: required area
U: area before ticket issue
T: flow area

i) Area before ticket issue

The area before ticket issue is the space required for passengers to purchase boarding tickets, etc. It is retention area for waiting for purchase.

$U = B_1 \times L_1$

B_1: total width of ticket windows
L_1: standard depth in front of ticket windows shall be 3 m.

ii) Flow area

Flow area refers to the concourse area necessary for passenger flow in boarding and alighting.

$T = B_2 \times L_2$

B_2: flow width (but minimum width shall be 4 m)

$B_2 = (L_3 \times N) + B_3$

L_3: Unit width of ticket inspection and collection gate

N: Calculation value of number of ticket inspection and collection gates

B_3: flow width value shall be 2 m.

L_2: depth in front of ticket collection and inspection gates

L_2 shall be 3 m standard, and depth behind the ticket collection and inspection gates (B_2) shall be 0.5 m or more.

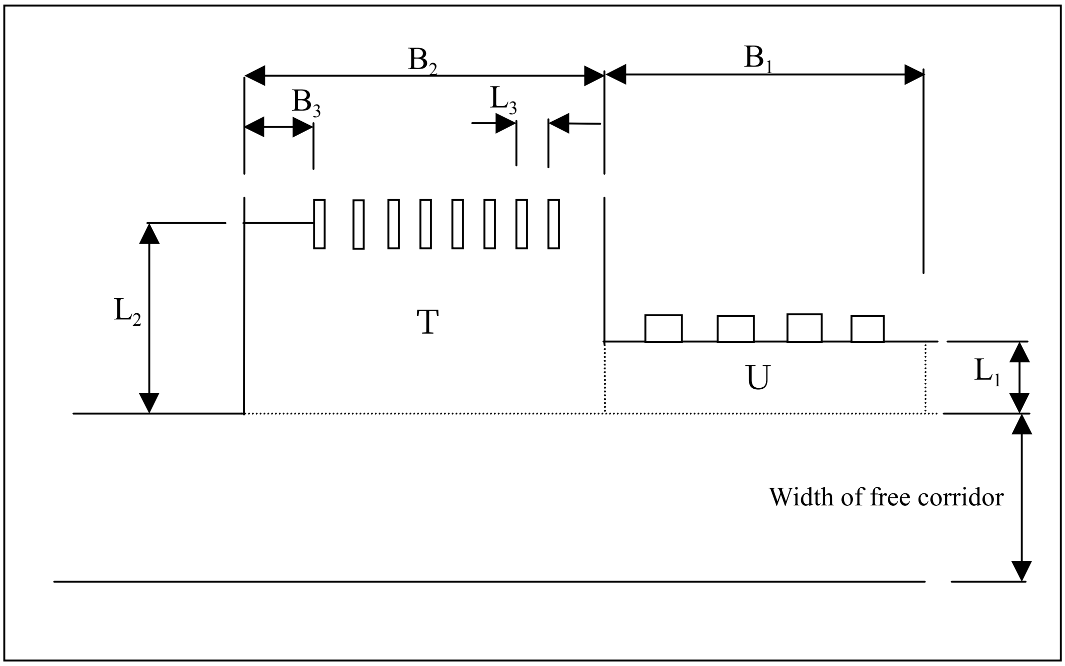


Fig. 6.2.8 Planning of Ticket and Inspection, etc.

c) Stairway plan

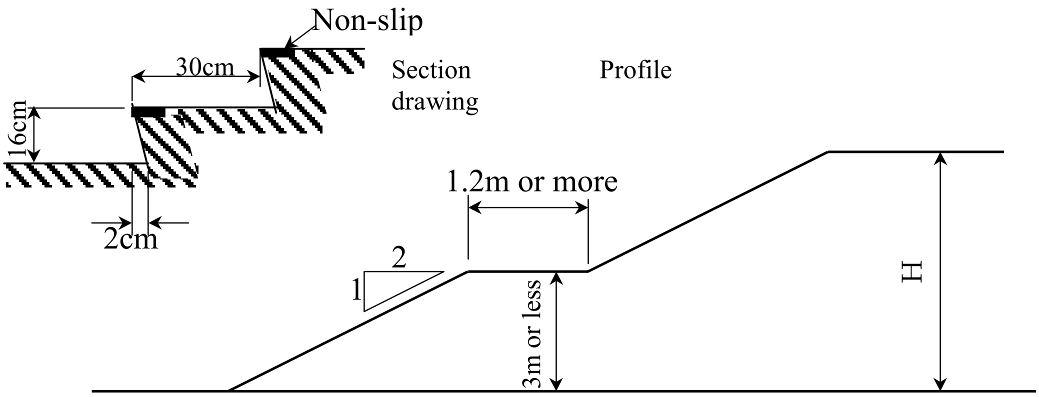
i) Stairways shall have a minimum width of 1.5 m, and a width of 1 m shall be assumed for passenger flow of every 1,500 people per hour when conducting calculation.

ii) Concerning stairways which have a height of more than 3 m, one passing area of at least 1.2 m in length shall as a rule be provided at a height of 3 m or less (see drawing below).

iii) Stairways must be planned to possess a grade of 2:1 (see drawing below).

iv) Concerning standard dimensions for step width and step height, height shall be 16 cm and width shall be 30 cm to ensure that the flow of passengers is not hindered (see drawing below).

v) Hand rails shall be provided on passenger stairways



Note: A wide area is required if this is above 3 m

Fig. 6.2.9 Layout of Stairway Dimensions

d) Escalators and Elevators, etc.

i) Stations where escalators should be installed and number of escalators to be installed

○ New stations or stations undergoing major renovation

- In new stations or stations undergoing major renovation, escalators are installed as basic station facilities on graded passages between walkways and free corridors, between free corridors and platforms, and between platforms, etc., in order to assist users with impaired mobility and to promote use of railways.

- As a rule, concerning separate graded corridors, upward and downward escalators shall be installed on at least one corridor.

Note) Major renovation refers to station-wide works in cases of the relocation of stations, elevation of stations or underground expansion of stations, etc. This refers to rebuilding of station buildings and comprehensive renovation which includes corridors and stairways.

○ Existing stations

- In existing stations which fulfill the following conditions, escalators shall be installed as soon as possible. Generally speaking, effort shall be made to carry out planned installation within around 10 years with consideration given to number of users, level of cooperation from the local community, topography, station structure, and so on.

- In stations where the daily number of boarding and alighting passengers is 5,000 or more, upward and downward escalators shall be installed on at least one corridor in the following cases:
  - Where the aggregate height in the upward direction between the platform and public corridor is 5 m or more
  - Where the aggregate height in the upward direction between platforms is 5 m or more

- In cases where escalators cannot be installed in both directions, escalators shall be installed in at least one direction.

- It is desirable to install escalators on corridors which have particularly large numbers of users.

○ Structure of escalators

In stations which do not have elevators or slopes, the structure of escalators shall as a rule be designed so that wheelchair users can board them.

○ Types and transportation capacity of escalators

The following table shows the types and transportation capacity of escalators used when computing the number of escalators to be installed.

Table 6.2.3 Types and Transportation Capacity of Escalators

Type	Speed (m/minute)	Nominal capacity (people/hour)	Effective capacity (people/hour)	Efficiency
1200 type (for 2 people)	30	9,000	6,750	75%
800 type (for one person)	30	6,000	4,500	75%

ii) Stations where elevators, etc. should be installed and installation sites

○ In new stations or stations undergoing major renovation, where height differences cannot be overcome by means of slopes, at least one elevator each shall be installed between walkways and free corridors, between free corridors and platforms, and between platforms.

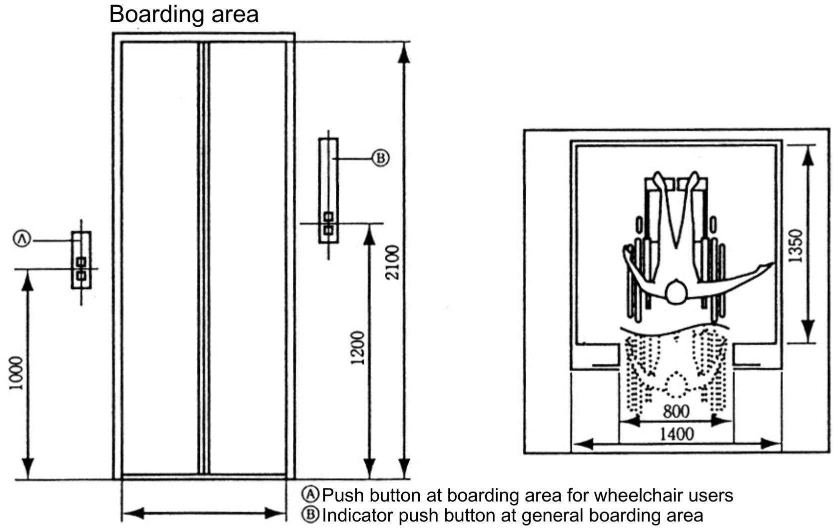
○ Concerning existing stations where there is a height difference of at least 5 m and the daily number of users is 5,000 or more, effort shall be made to successively carry out planned installation with consideration given to number of users, level of cooperation from the local community, topography, station structure, and so on.

○ Structure and installation position of elevators

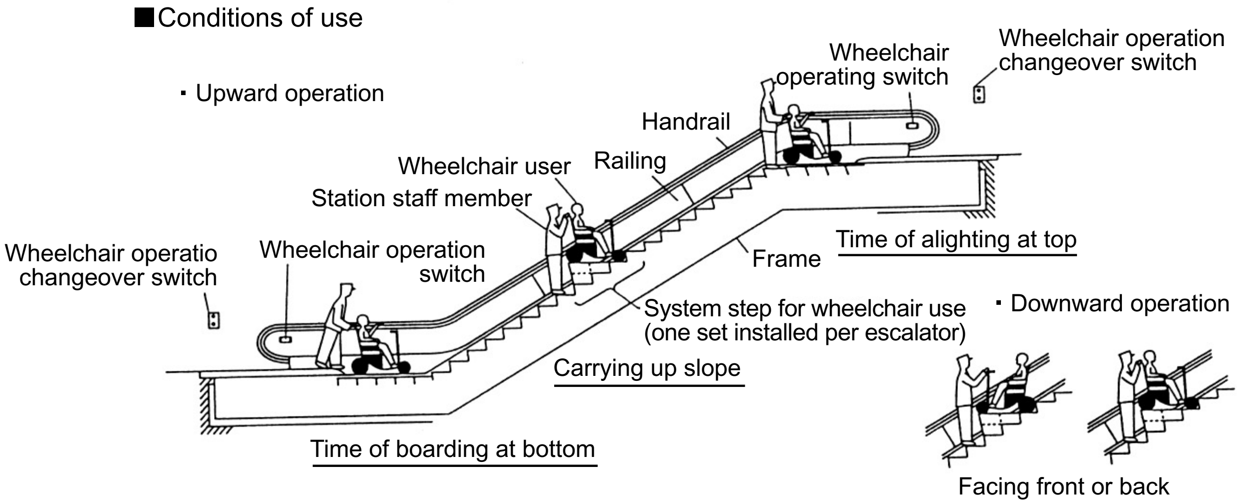
- The structure of elevators shall be such that wheelchair users can utilize them.

- Providing there are no problems in terms of structure, elevators shall be installed in easy to use positions so that other persons apart from wheelchair users can utilize them.

iii) Examples of escalator and elevator installation



Elevator for Ordinary and Wheelchair Use



Escalator for Ordinary and Wheelchair Use

Fig. 6.2.10 Examples of Escalator and Elevator Installation in Station Premises

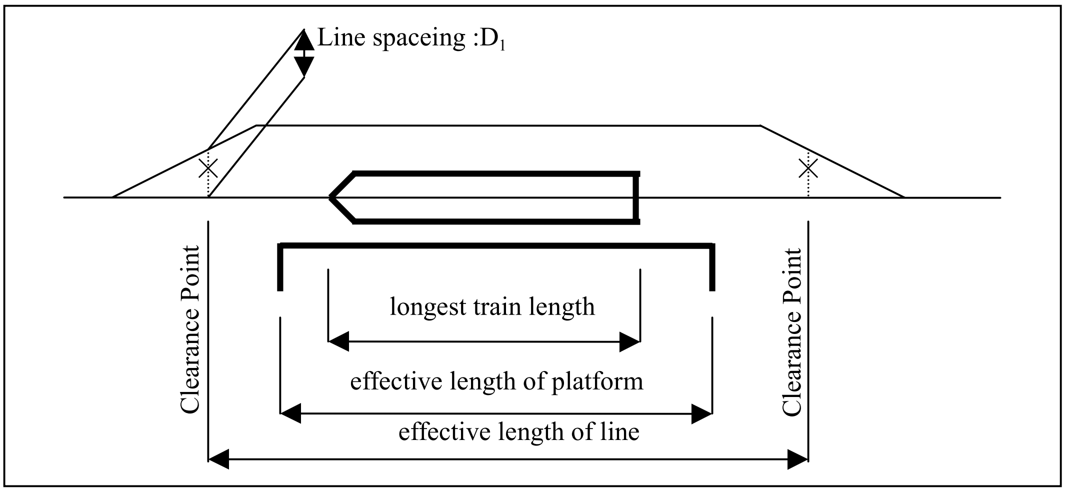
e) Platform Planning

Since it is necessary for large numbers of passengers to safely and rapidly board and alight trains during limited train stop time, straight lines are desirable and designated height, width and length are required.

i) Platform dimensions

○ Length

The effective length of platforms shall comfortably accommodate the longest trains that arrive at and depart from each platform in question. effective platforms length =longest train length + allowance(generally 10m)



Notice）The effective length of line

Fig. 6.2.11 Platform Planning

The effective length of line in stations shall be enough to accommodate the longest train at a stop in the station .

To allow trains to pass the adjacent track without any problem, the effective length of line shall be sufficient enough to accommodate the longest train operating on the line concerned. effective length of line= longest train length + allowance(generally 35m)

Train Limit markers shall be positioned where the line spaceing is equivalent to the total of the specified construction gauge and the displacement(α) caused by curves and cant. The line spaceing D_1 = construction gauge + α

D_1: Center-to-center distance of adjacent tracks at points where clearance posts are erected

○ Width

The width of platforms shall be sufficient not to hinder the flow of passengers.

- On platforms where both sides are used, standard width shall be 3 m in the center and 2 m at ends
- On platforms where only a single side is used, standard width shall be 2 m in the center and 1.5 m at ends.

Moreover, distances between platform structures and platform edges shall be as follows:

- The standard distance between edges and pillars on platforms shall be at least 1 m.
- The standard distance between edges and overpasses and entrances to underground passages on platforms shall be at least 1.5 m.

According to 2) through 4) above, minimum dimensions for islands platforms shall be as shown below (see drawing).

Platform width = 1.5×2 + maximum width of structures on platform

However, from the viewpoint of wheelchair users and risk prevention on platforms, width of at last 2.0 m is desirable. In this case, the above expression will be converted as follows:

Platform width = 2.0×2 + maximum width of structures on platform

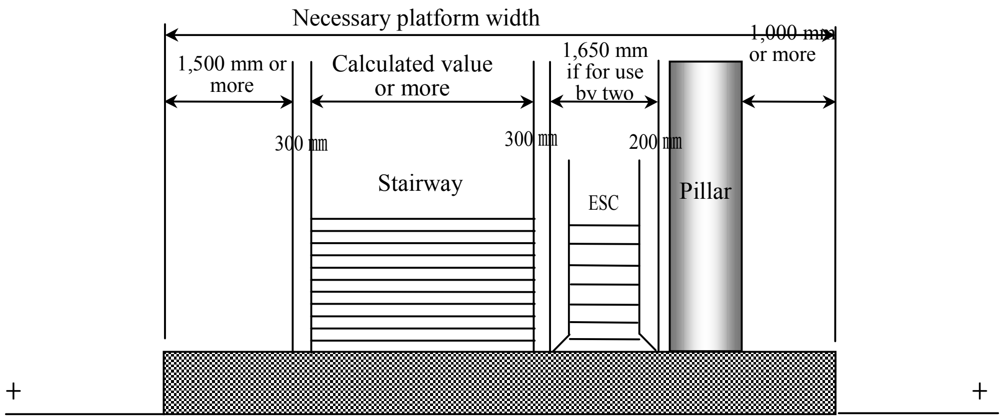


Fig. 6.2.12 Required Platform Width, etc.

○ The following expression is used to calculate platform width:

$$B = B_1 + B_2 + \gamma$$

B : required platform width

B_1 : width occupied by boarding passengers at rolling stock entrances when boarding trains

B_2 : width occupied by alighting passengers when flowing onto the platform

γ : width required for pillars and train waiting, etc.

Waiting width : generally 0.8 m

$$B_1 = 0.2 \times (P_a/n)^{1/2}$$

$$B_2 = 2P_b/31n \text{ (in case of } P_b/n < 6.41n\text{) or}$$
$$13n/3 \text{ (in case of } P_b/n > 6.41n\text{)}$$

P_a : maximum number of boarding passengers per train (assuming one train on average every 30 or 60 minutes during rush hour)

P_b : maximum number of alighting passengers per train (assuming one train on average every 30 or 60 minutes during rush hour)

l : 1 train length n : number of cars

In this expression, required width for upward and downward lines shall be calculated and totaled in the case of island platforms, while required width shall be calculated separately by upward line and downward line in the case of separate platforms.

Moreover, there are cases where the platform width is determined by the above-mentioned stairway width and distances from platform edges.

○ Other

The standard gradient of platforms shall be 1/100 in consideration of drainage and so on.

However, since platforms are level in the parts where stairways and escalators are installed, it is necessary to ensure that there are no grades of more than 1/100 for the sake of preventing danger.

Moreover, in order to prevent passengers from coming into contact with incoming or outgoing trains, warning blocks shall be installed 800 mm from the ends of platforms as train avoidance targets and as a measure for disabled persons.

ii) Platform equipment

The following kind of equipment is installed on platforms.

Platform roof, information equipment (broadcasting equipment, electric displays), safety equipment (safety fences, ITV system, train protection switches, fall detection system)

The platform roof is generally constructed over the whole platform length in order to protect passengers and luggage from rain and direct sunlight.

② Passenger Facilities

a) Important points to consider in planning waiting rooms

In urban area commuter stations, since ticket inspection and collection work is taking place all the time, waiting rooms are frequently not provided. However, waiting rooms are required in stations which don't handle so many trains.

In terms of layout, it is desirable for waiting rooms to be positioned so that passengers can confirm the coming and going of trains. Moreover, information displays and broadcasting equipment, etc. are the minimum required facilities, and it is also desirable to install air conditioning, etc.

b) Important points to consider in planning passenger toilets

Since passenger toilets are used by large numbers of persons and much time and effort is spent on cleaning, it is necessary to consider the following points when carrying out planning.

i) Important points to consider in planning passenger toilets

○ Pay sufficient attention to ease of cleaning and maintenance.

○ Avoid height differences in floors (including approaches) and keep on the same level as concourses.

○ Select non-slip materials for floors.

○ Select materials which are not prone to break.

○ Select materials which do not become dirty so easily.

Use large tiles as much as possible and keep joints to a minimum.

○ Provide handrails for aid purposes.

○ When installing toilets for use by wheelchair users, determine upon carrying out ample examination of the installation position.

③ Passenger handling facilities

a) Required number of ticket barriers

Since ticket barriers often create bottlenecks in the flow of passengers in stations, the number of ticket barriers shall be determined so as not to hinder passenger flow.

The required number of ticket barriers is calculated based on the number of boarding and alighting passengers at congested times and speed of passage.

[Manned ticket barriers]

$$N = \frac{1}{T}\left(\frac{n_1}{P_1} + \frac{n_2}{P_2}\right) + A$$

N : number of ticket barriers
T : 1 hour (3600 seconds)
n_1 : boarding passengers during busiest hour
n_2 : alighting passengers during busiest hour
P_1 : boarding passengers passing by per unit hour (1.0 person/second)
P_2 : alighting passengers passing by per unit hour (1.0 person/second)
A : 1 or more standby ticket barrier (depending on station conditions)

[Automatic ticket barriers]

$$N = \frac{n_1}{40 \times S} + \frac{n_2}{40 \times S} + A$$

N : number of ticket barriers
n_1 : boarding passengers during busiest S minute
n_2 : lighting passengers during busiest S minute
40 : number of passengers passing by per minute
S : busiest time (depending on line conditions)
A : standby ticket barriers (depending on station conditions)

In the case of automatic ticket inspection, since each ticket barrier basically deals with passengers going in one direction, when calculating the required number of barriers, it is necessary to decide the final number upon examining other times too.

b) Ticket issue facilities

Ticket issue facilities are divided into ticket windows and automatic ticket vending machines. It is desirable that boarding tickets for short distance sections (inexpensive tickets) be sold through vending machines.

[Required number of automatic vending machines]

$$N = \frac{n}{0.0333 \times n + 667}$$

N : required number of vending machines
n : estimated total number of sold tickets

[Number of ticket windows]

$$N = \frac{n \times 1.5}{\text{Number of tickets sold per hour} \times \text{Effective hours}}$$

N : required number of ticket windows
n : estimated number of total tickets sold

[Reference] Ticket issue and inspection facilities

In this system, ticket issue and inspection work can be handled by one station staff member. This system is adopted in stations which handle relatively few passengers, or during times when the flow of passengers is small.

④ Station Work Facilities

Station work facilities, where station running and train operation control are carried out, are generally placed to the rear of passenger handling facilities. The rooms that are required depend on the scale of the station in question, but these generally consist of station offices, conference rooms, rest rooms, changing rooms, toilets, and so on. When planning these rooms, it is necessary to achieve an effective linkage between them.

a) Station offices

Although offices depend on the scale of the station in question, generally speaking, in order to handle the efficient operation of station work and changes in the future operating setup, consideration shall be given to placing offices on the same flow and avoiding partitioning.

b) Changing rooms, toilets, etc.

When planning changing rooms and toilets, etc., it is necessary to pay attention to calculation of scale and to integrate rooms as much as possible.

Moreover, since there are cases where control is difficult, it is necessary to examine methods for controlling entry by outside persons, etc.

⑤ People Friendly Station Building

a) Thinking behind facilities for people with impaired mobility, etc.

Since stations are constructed over multiple levels, height differences with outside footpaths are large, and vertical movement can be a burden, boarding and alighting passengers including those with impaired mobility are discouraged from using railways. Therefore, it is becoming more and more important to provide station areas that are safe and pleasant for all station users to utilize.

i) Persons with impaired mobility in stations

When it comes to utilizing station facilities, it is mainly the following kinds of people who are placed at a disadvantage.

○ Elderly persons

- It is difficult for elderly people to use stairways, move up and down height differences, and walk continuous long distances.
- It is difficult for elderly people to understand how to use new equipment.
- Information awareness decreases in line with declining sight and hearing.

○ Physically challenged persons

● Persons with limb disabilities

(Wheelchair users)

- Height differences and steep slopes cannot be climbed.
- Passage and rotation are difficult in narrow places.
- The range of hand movement is limited.

(Non-wheelchair users)

- Movement over height differences and slopes is difficult and there is risking of falling over.

- It is difficult for people using walking sticks to move in narrow areas.
- It is difficult to do fine movements.

● People with hearing difficulties

- People with hearing difficulties must depend on step width and the feeling and sound of sticks and heels, etc.
- It is difficult to confirm the shape and position of facilities and equipment.
- Reading of information displays and signs, etc. is impossible or difficult.

● People with hearing and language disabilities

- It is difficult or impossible to understand sound information.
- There is danger because alarm sounds and buzzers, etc. cannot be heard.
- It is difficult to hold conversations with people.

○ People with temporarily impaired movement (injured persons, pregnant women, adults accompanying children, people carrying bulky luggage, etc.)

- Walking continuously over long distances is difficult.
- Climbing and descending stairs and grades is difficult.

○ Foreigners

- Confirmation of traffic line routes is difficult.
- Foreigners cannot understand information transmitted at times of accidents or disasters.

In relation to persons with impaired mobility, consideration is generally given to wheelchair users with heavy physical disabilities, persons with weak constitutions including elderly people, and persons with impaired sight and/or hearing.

However, since persons with sound bodies also experience impaired movement , for example, people with temporarily impaired movement and foreigners, it is necessary to aim for station facilities that are safe and pleasant for all users.

Measures for aiding physically challenged persons were previously based on medical recognition of physical handicap or on the level of functional handicap recovery achieved in rehabilitation; however, the current trend throughout the world is to eliminate social disadvantage through not questioning the level of functional disability but clarifying areas of inconvenience in everyday living and removing or augmenting these. In other words, even if both legs are incapacitated, it should be possible to travel on railways providing that a wheelchair is used. The trend of removing obstructions (barriers) which are a cause of social inconvenience is called barrier-free thinking. This thinking is based on the concept of normalization, whereby physically challenged persons are able to take part in ordinary social activities and can share in rights and duties just as much as other people. In other words, this thinking does not call for physically challenged persons to be protected or kept separated, but it aims to support the social independence of such persons.

ii) Facilities for aiding persons with impaired mobility (see Appendix)

Facilities for aiding various kinds of persons with impaired mobility are as follows.

○ Facilities for persons with impaired sight

- Guide and warning blocks
- Braille tape
- Guide chimes
- Fall prevention fences

○ Facilities for persons with impaired hearing

- Station information signs as fixed information
- LED displays which enable variable information (effective at times of accident or emergency) to be provided

• Train approach indicators, etc.

○ Facilities for wheelchair users

• Wheelchair toilets

• Handrails, etc.

• Slopes (1/12 or less indoors)

• Escalators (for wheelchairs) and elevators

• Securing of corridor width (ticket barriers 900 mm)

• Non-slip finishing

• Height of counters, etc.

○ Elderly persons and children

• Hand rails, etc.

b) Thinking behind station sign systems

Since passengers using stations for the first time experience difficulties, a sign system which includes pictographs shall be proposed.

i) Purpose of the sign system

Sign systems provide appropriate guiding information at various points to ensure that passengers can smoothly move around in the station space in safety and comfort. In order to give priority to making train boarding and alighting (the most basic function) easy to understand, boarding signs and alighting signs are installed on concourses inside and outside inner station premises, and platforms based around boarding traffic lines and alighting traffic lines.

It is proposed that green-based signs be used to guide boarding passengers from ticket barriers to platforms, and that yellow-based signs be used to guide alighting passengers from platforms to exits.

ii) Pictographs

Pictographs refer to picture symbols with meanings which can be understood immediately anywhere in the world without prior learning.

As pictographs for use in this sign system, the international standard system of ISO (International Standards Organization) is proposed.

c) Station disaster prevention facilities

The following table summarizes disaster prevention facilities generally adopted in stations.

Table 6.2.4 General List of Station Disaster Prevention Facilities

<table>
<tr><th colspan="3" rowspan="2">Purpose of use / Facilities</th><th rowspan="2">Concourse</th><th colspan="2">Station work portion</th><th rowspan="2">Shops</th><th rowspan="2">Platforms</th><th rowspan="2">Notes</th></tr>
<tr><th>Occupied rooms</th><th>Other rooms</th></tr>
<tr><td rowspan="2">Detectors, etc.</td><td colspan="2">Automatic fire warning system</td><td>□</td><td>○</td><td>○</td><td>○</td><td>□</td><td></td></tr>
<tr><td colspan="2">Gas leak alarms</td><td>—</td><td>◎</td><td>◎</td><td>◎</td><td>—</td><td>Note[1]</td></tr>
<tr><td rowspan="5">Evacuation</td><td colspan="2">Emergency lighting</td><td>○</td><td>○</td><td>—</td><td>○</td><td>□</td><td></td></tr>
<tr><td colspan="2">Guide lights</td><td>○</td><td>○</td><td>□</td><td>○</td><td>□</td><td></td></tr>
<tr><td colspan="2">Guide signs</td><td>○</td><td>○</td><td>○</td><td>○</td><td>□</td><td></td></tr>
<tr><td>Emergency warning system</td><td>Emergency bells, etc.</td><td>○</td><td>○</td><td>○</td><td>○</td><td>□</td><td></td></tr>
<tr><td colspan="2">Smoke ventilation system</td><td>○</td><td>○</td><td>—</td><td>○</td><td>—</td><td></td></tr>
<tr><td rowspan="4">Fire fighting equipment</td><td colspan="2">Indoor fire hydrants</td><td colspan="4">○</td><td>□</td><td></td></tr>
<tr><td colspan="2">Sprinklers</td><td colspan="4">□</td><td>—</td><td></td></tr>
<tr><td colspan="2">Interior finishing restrictions</td><td>○</td><td>○</td><td>○</td><td>○</td><td>—</td><td></td></tr>
<tr><td colspan="2">Fire limits</td><td>□</td><td>○</td><td>○</td><td>○</td><td>—</td><td></td></tr>
<tr><td rowspan="6">Other</td><td colspan="2">Short circuit fire alarms</td><td colspan="5">○</td><td></td></tr>
<tr><td colspan="2">Connecting water conveyance pipes</td><td colspan="5" rowspan="3">○</td><td></td></tr>
<tr><td colspan="2">Outdoor fire extinguishers</td><td></td></tr>
<tr><td colspan="2">Emergency sockets</td><td></td></tr>
<tr><td colspan="2">Special fire extinguishing equipment</td><td colspan="5">○</td><td></td></tr>
<tr><td colspan="2">Emergency power supply</td><td colspan="5">◎</td><td></td></tr>
</table>

[Legend] ○: Installation based on ordinance ◎: Installation partly over legal criteria
□: Installation depending on conditions —: Items not determined in legal criteria

Note[1]: Rooms using gas are targeted.

[Commentary]
Concourses : portions introduced on floor area according to fire fighting law (depending on screening criteria)
Occupied rooms: including station work rooms, conference rooms, rest rooms, corridors leading to occupied rooms, stairways, etc.
Other rooms : store rooms, storage areas, machine rooms, etc.
Shops : commercial shops on station premises, etc.
Platforms : portions introduced on floor area according to fire fighting law (depending on screening criteria)

d) Lighting Facilities

Lighting facilities shall be provided inside and under the stations to facilitate the boarding/alighting of passengers and toguide passengers to safety in case of emergency.

The purpose of lighting is to secure the boarding and alighting of passengers and train operation and to ensure safe execution of railway work.

With regard to illumination intensity, mandatory standards are not advisable because of varying conditions. However, appropriate intensity shall be provided in relation to the state of railway facilities in question, conditions of use, and extent of railway works.

Table 6.2.5 Example of Required Illumination Intensity

Place	Required Intensity (lx)		Notes
	General lighting	Emergency lights	
Platforms	300~250	Minimum 2	
Plazas, corridors, entrance/exit corridors	300~250	Minimum 2	General lighting also includes entrance/exit buildings
Ticket barriers, ticket windows	○800~600	Minimum 2	General lighting shall have work illumination intensity
Season ticket sales areas	500~400	Minimum 2	
Wash basins, toilets	250~200	Minimum 2	
Evacuation corridors	150~100	Minimum 2	

1. Required illumination intensity shall be the intensity on the floor surface.
2.○ mark indicates that localized lighting is OK.

Since the power load requirements of general lighting does not have an impact on train operation, this power should be separated from the power used for train operation.

<u>Lighting equipment</u> Power for train operation must be separate from power used for general lighting, e.g., line and platform lights, station signs, display lights, etc.

6.2.5 Station Plazas Planning

(1) Basic Thinking Behind Station Plaza Planning

Station plazas serve two roles: first of all they are transportation zones for allowing changeover with road traffic such as buses and jeepneys, etc., and secondly they are environmental zones for supporting activities and exchange of shoppers and waiting passengers and contributing to the urban landscape, etc. In addition to laying out facilities for fulfilling these roles in a manner which enables them to function organically, it is necessary to secure a scale that can be used smoothly and in comfort when planning station plazas.

At major stations in Metro Manila, numbers of boarding and alighting passengers are increasing in line with greater population influx from the suburbs to the city center. Moreover, since there is a higher demand for pedestrian and vehicular traffic around stations due to the higher level of land use around stations, congestion is becoming more and more intense on roads and footpaths around stations. In order to promote use of railways, it is necessary to secure smooth changeovers and, in addition to roads, it is necessary to secure separate station plazas and construct alighting zones and stops for buses and jeepneys, etc. Moreover, station plazas where many citizens gather are considered to be gateways to different areas and precious open spaces, and it is also necessary to develop them as relaxation zones for pedestrians and as assets to the urban landscape.

1) Station plaza functions and planning procedure

① Thinking behind station plaza functions

The functions of station plazas can broadly be divided into transportation node functions (handling traffic as transportation nodes) and exchange and landscape functions. Exchange and landscape functions refer to the following kinds of functions: i) exchange functions whereby people can relax, gather and communicate, ii) landscape functions whereby greenery, trees and monuments, etc. are used to enhance the urban landscape, iii) service functions whereby various services are provided to users, iv) disaster prevention functions whereby station plazas act as core points of disaster prevention activity during disasters such as earthquakes, and so forth. Space required to achieve transport node functions is defined as transportation space, and space required to achieve exchange and landscape functions is environmental space.

The functions of station plazas differ greatly according to characteristics of the station, immediate urban area and whole city, and it is necessary to secure the necessary space while at the same time appropriately combining transportation space and environmental space to ensure that the required functions are secured.

② Transportation space functions

Station plazas act as transportation nodes between railway transport and road transport and as access transportation points for people using districts around stations, and their basic transportation handling function is to smoothly and efficiently handle transfers and access.

However, transportation space functions are not uniformly defined but should be appropriately planned with consideration given to characteristics of the city and each station in question.

a) Basic transportation handling functions

Station plazas, acting as connecting nodes between railways (medium-large volume mode of transport) and roads (mode of transport with relatively small transportation units), not only serve the role of smoothly and efficiently handling transfers between railways and pedestrians and vehicles (buses, jeepneys, tricycles, taxis, private cars), etc., they also fill the role of smoothly handling traffic for facilities around stations.

b) Facilities provided

Major facilities for handling transportation space functions are footpaths, roads, boarding and alighting zones (buses, jeepneys, tricycles, taxis, private cars, etc.), and parking spaces (buses, jeepneys, tricycles, taxis, private cars, etc.). Concerning these facilities, the necessary area, etc. shall be secured to enable an appropriate level of services to be provided.

③ Environmental space functions

In addition to transportation space functions, station plazas also have environmental space functions. These environmental space functions can broadly be divided into four areas, i.e. exchange functions, landscape functions, service functions, and disaster prevention functions, and it is necessary to plan station plazas with consideration given to these environmental space functions.

a) Exchange functions

In order for station plazas to serve as areas for people to rest, gather and communicate, examination shall be given to the introduction of rest space and plazas according to the characteristics of each station in question.

b) Landscape functions

When planning station plazas, it is necessary to achieve harmony with the surrounding environment and to promote beautiful plaza development. In order for the people who use plazas not to be given a visual sense of oppression, it is desirable that examination be carried out on the relationship between the height of surrounding buildings and size of the plaza. Moreover, it is possible to achieve aesthetic station plazas in terms of landscape by securing uniformity of design throughout the whole station plaza, and establishing trees and fountains, monuments and other symbolic facilities.

c) Service functions

Basic facilities for upholding urban services are toilets, post boxes and telephone boxes, etc. in the area of public services, information centers and information boards in the area of information provision, and other facilities deemed to be necessary in consideration of conditions around station plazas.

d) Disaster prevention functions

In central urban areas where concentrated land use takes place, station plazas, together with parks and roads, etc., play an important role as public open spaces for disaster prevention in the inner city. Not only do station plazas serve as temporary evacuation areas in the event of earthquake and so on, there is a strong possibility that they can be used as centers for rescue activities, etc.

④ Station plaza planning procedure

The following factors need to be sorted out in order to plan station plazas.

- Status and expected functions of the station plaza in question (see sections 6.2.2 (1) and 6.2.5 (1) 1) ⑤).
- Station district and future transportation demand (see 6.2.2 (1)).

• Required plaza area (see section 6.2.5 (2)) and facilities layout planning (see section 6.2.5 (3)).

The planning procedure for station plazas is indicated in the following flow.

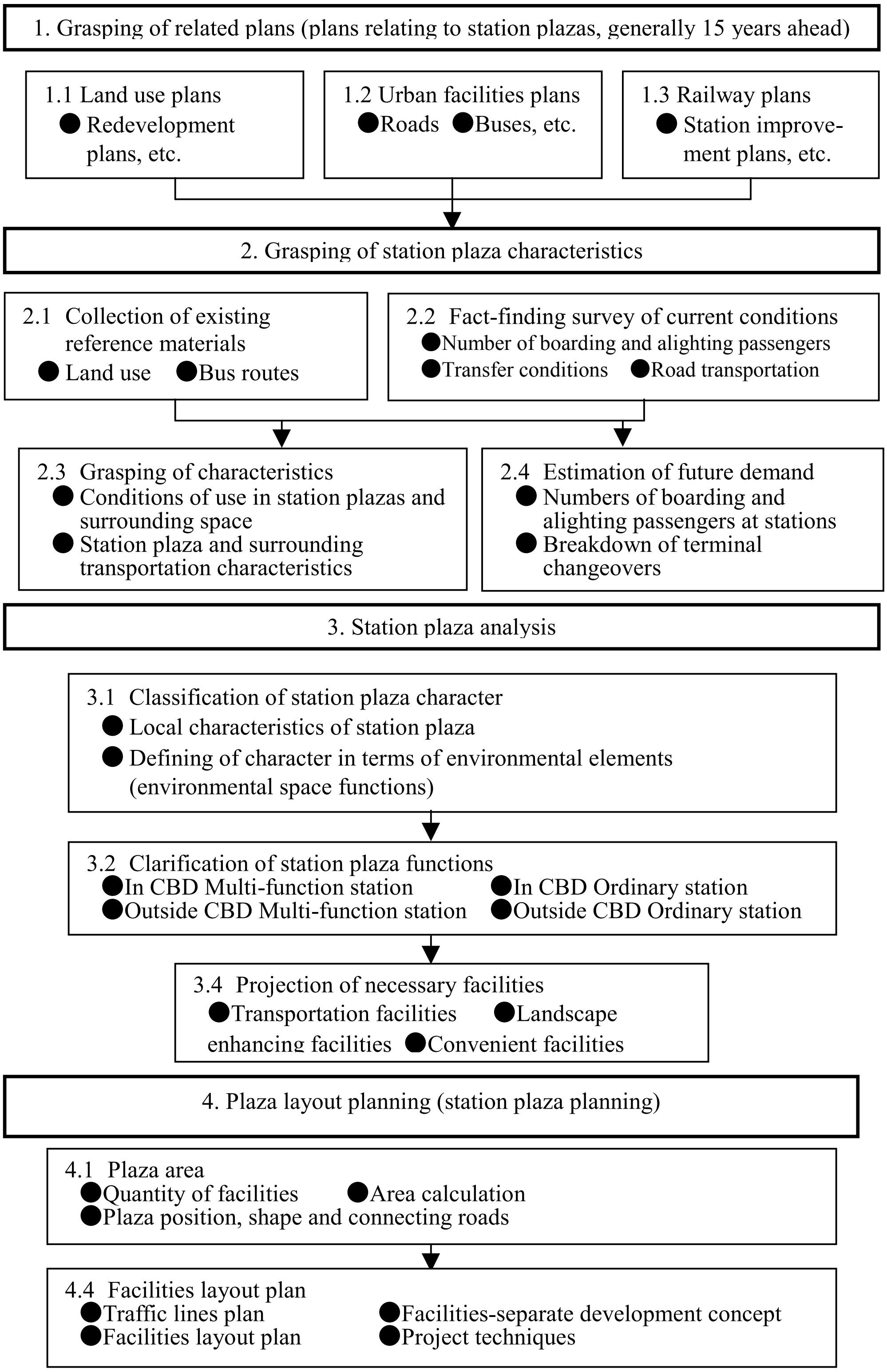


Fig. 6.2.13 Planning Procedure for Station Plazas

Station plaza development projects require compilation of comprehensive plans, selection of development techniques, coordination with related agencies, consultation with transportation operators, coordination with landowners, and know-how extending in various directions. In particular, because development projects for station plazas belonging to existing stations incur great costs due to surrounding urbanization, it is necessary to conduct ample examination into feasibility and problems of development techniques, etc.

⑤ Patterning of station plaza development functions

Facilities which should be introduced to station plazas are roughly divided into transportation facilities, landscape enhancing facilities, and convenience facilities. Concerning the necessity and contents of these facilities, these are set upon considering the characteristics of transportation used around targeted station plazas, site form, and conditions of land use in the surrounding area. As station plaza functions, the necessity of each facility in cases where stations are classified as inner in CBD stations, outside CBD stations, multi-function stations, and ordinary stations are as shown in the following table.

Table 6.2.6 Necessity of Station Plaza Facilities in terms of Station Character

Zoning and Facilities \ Station pattern			In CBD Multi-function station	In CBD Ordinary station	Outside CBD Multi-function station	Outside CBD Ordinary station
Transfer zone and Transportation facilities	Footpaths		◎	◎	◎	◎
	Roadways		◎	○	◎	○
	Boarding and alighting areas	Bus	○	—	◎	—
		Jeepney, taxi, tricycle	◎	◎	◎	◎
		Private vehicle	△	△	△	△
	Parking areas	Bus	△	—	△	—
		Jeepney, taxi, tricycle	△	△	△	△
		Private vehicle	△	△	△	△
	Various signs		◎	◎	◎	◎
	Traffic directing islands, etc.		○	△	○	△
	Bus stop shelter		○	—	◎	—
Environment zone	Landscape enhancing facilities	Flower beds, planters	◎	◎	◎	◎
		Monuments	○	△	○	△
		Street lights	◎	◎	◎	◎
	Convenience facilities	Telephone boxes	◎	◎	◎	◎
		Benches, stools	△	△	△	△
		Post boxes	○		△	
		Information boards	○	△	◎	△

◎: Indispensable ○: Generally necessary items △: Install where necessary

Table 6.2.7 Station types (proposal)

Location of station / Scale of station	In CBD	Outside CBD	Remarks
Multi-function	Monumento D.Jose Quezon Aven Cubao Shaw Blvd Alabang	Tutuban Calumpit Quirino Katipunan Magallanes Taft Baclarant Calanba Imus	A large number of passenger use the station plaza.
Ordinary	Small stations	Small stations	A small number of passenger use the station plaza.
Remarks	Most passenger select walking as the terminal transportation.	Most passenger do not select walking as the terminal transportation.	

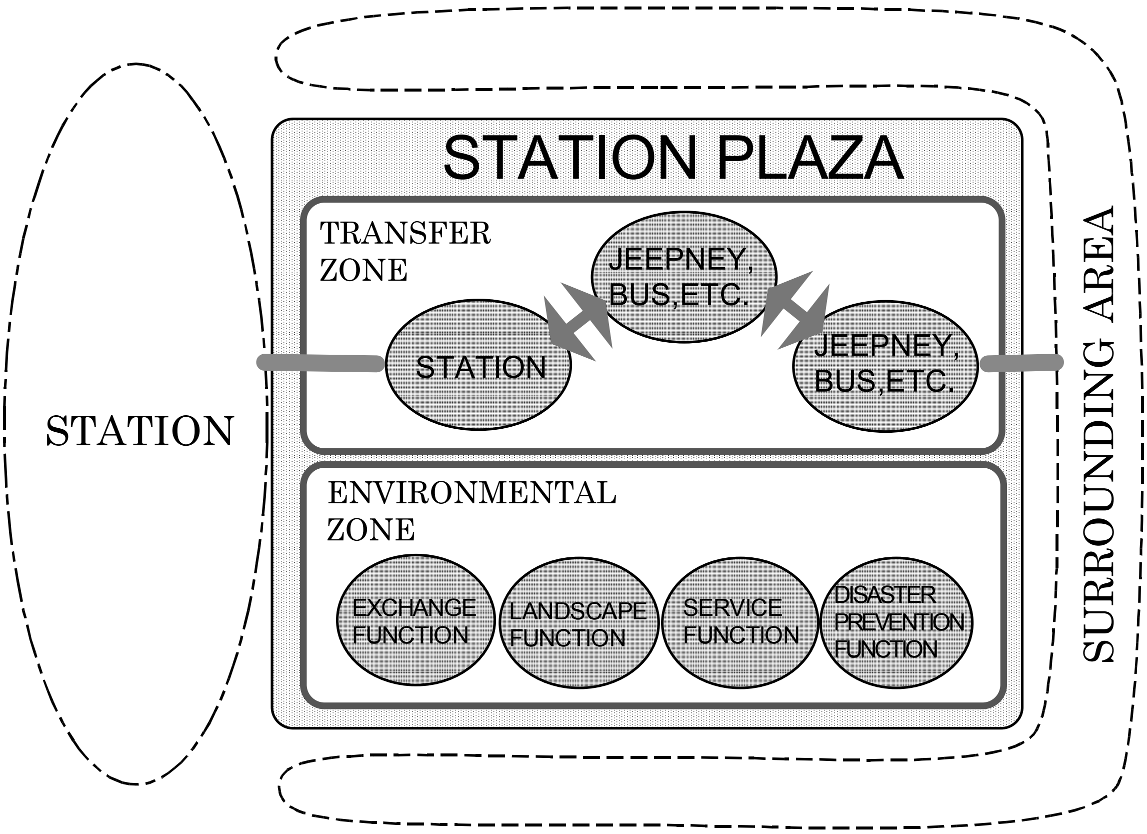


Fig. 6.2.14 Zoning and Functions at station plaza

<Remarks>

(Functions in Environmental zone)

a) Exchange functions

To serve as areas for people to rest, gather and communicate

b) Landscape functions

To achieve harmony with the surrounding environment and to promote beautiful plaza development. For the people who use plazas not to be given a visual sense of oppression, it is desirable that examination be carried out on the relationship between the height of surrounding buildings and size of the plaza. Moreover, it is possible to achieve aesthetic station plazas in terms of landscape by securing uniformity of design throughout the whole station plaza, and establishing trees and fountains, monuments and other symbolic facilities.

c) Service functions

Toilets, post boxes and telephone boxes, etc. in the area of public services.

Information centers and information boards in the area of information provision, and other facilities deemed to be necessary in consideration of conditions around station plazas.

d) Disaster prevention functions

As public open spaces for disaster prevention in the inner city.

(2) Calculation of Station Plaza Area

1) Method of station plaza area calculation

When calculating the area of station plazas, the quantity of facilities required in the future shall be secured in line with the characteristics of station plaza use and necessary service level.

When examining the area of station plazas, the station plaza reference area is obtained by combining the area that should be secured for transportation space functions with the area that should be secured for environmental space functions, and the area is determined upon giving overall consideration to the composition of functions and layout plan, etc.

Furthermore, in order to secure station plaza functions, depending on the layout conditions of facilities, examination which includes multi-leveling shall be conducted and area appropriate for the district in question shall be adopted.

2) Transportation space area

Transportation space consists of footpaths, roadways, bus boarding and alighting zones, jeepney boarding and alighting zones, taxi ranks, tricycle ranks and parking spaces, etc. And, when it comes to calculating the required area of each, status of the target station plaza in urban transportation plans shall be clarified, required functions and facilities contents shall be grasped, the future number of station plaza users shall be estimated, and space fully capable of handling these modes of traffic shall be secured.

① Forecast of station plaza users

a) Number of users to forecast

People who use station plazas are divided into station users and non-station users. Station users, starting from passengers boarding the first trains of the day and ending with passengers alighting from final trains, are counted as station plaza traffic. Passengers changing between different train lines at a station are not included in the target traffic, however, it is necessary to include them in cases where they use the connecting corridors of station plazas.

Moreover, non-railway users are classified into terminal-related traffic and station peripheral flow traffic. Out of trips to buildings around stations for purposes of commuting and shopping, terminal-related traffic refers to traffic which utilizes station plazas by means of transport such as buses, etc.

Meanwhile, concerning station peripheral flow traffic, this refers to traffic which passes through station plazas on its way to the station building and other buildings around stations for shopping and waiting purposes, etc.

Furthermore, at stations in city centers, since numbers of such non-railway users increase according to the level of commercial and business concentration around stations and this is largely linked to the setting of station plaza area, it is necessary to carry out projection of future station plaza users including non-railway users.

b) Concerning future number of station plaza users by facility at peak times

In order to calculate the standard area of transportation space, it is necessary to forecast future numbers of users at each facility.

Future number of bus users at peak time (N^{P}_{B})
Future number of jeepney users at peak time (N^{P}_{J})
Future number of taxi users at peak time (N^{P}_{T})
Future number of tricycle users at peak time (N^{P}_{TR})
Future number of automobile users at peak time (N^{P}_{C})
Future number of pedestrians at peak time (N^{P}_{W})

Concerning the users of these facilities, basically speaking, the peak number of users at each facility should be adopted.

Concerning these figures, the number of users at peak time in each facility should be adopted. Moreover, in cases such as morning rush hour at commuter stations where it is thought that peak usage of each facility generally coincides with the peak in overall station plaza users, the number of users of each facility at the overall peak time is sometimes adopted.

Moreover, the peak number of pedestrians in the future not only refers to people traveling on foot but includes pedestrians in the process of transferring between railways, buses, jeepneys, taxis and tricycles, etc., and this figure is gauged as the peak number of station plaza users in the future (railway users and non-railway users).

The flow for projecting the number of station plaza facilities users at peak time is indicated below.

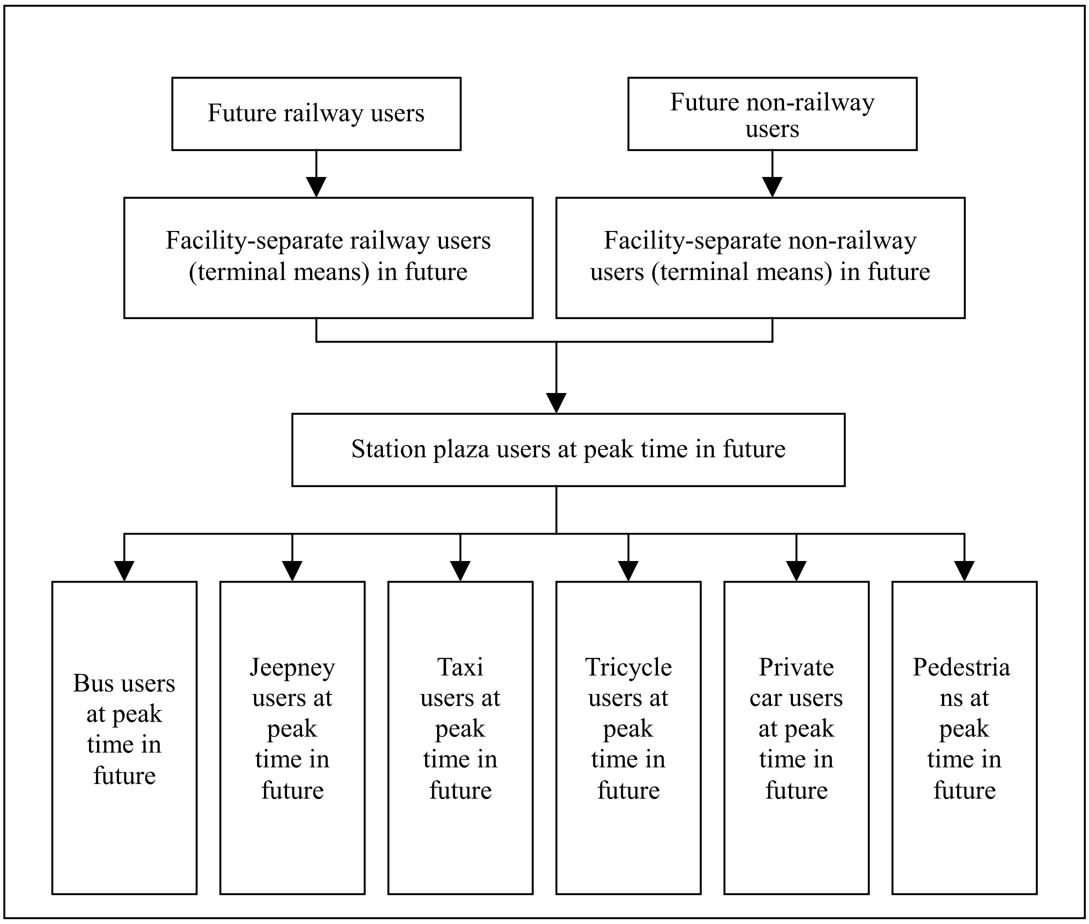


Fig. 6.2.15 Flow for Projecting the Number of Station Plaza Facilities

c) Burden by terminal means of transport

It is desirable to set the burden of each means of transport by station based on future estimates, however, since it is not realistic to carry out estimates according to each state of development of the route network, and since disparities are larger between station classifications, it is allowable to make settings with reference given to the standard burden by station and by terminal means of transport based on fact-finding survey of current conditions.

Table 6.2.8 Standard Burden by Station Classification and by Terminal Means of Transport (%)

Means	In CBD Multi-function station	In CBD Ordinary station	Outside CBD Multi-function station	Outside CBD Ordinary station	Remarks
Bus	5	0	5	0	
Jeepney	53	35	40	35	
Taxi	2	0	15	0	
Private car	0	0	0	0	
Bicycle	0	5	10	5	
Walking	40	60	30	60	

② Setting of design traffic volume by facility

With respect to the obtained number of facilities users at peak time, design traffic volume by facility and the number of facilities are set based on the following kind of thinking.

a) Thinking behind setting of design traffic volume by facility

i) Design traffic volume and number of facilities concerning bus berths

○Number of bus boarding berths (B_{IB})

The number of bus boarding berths (B_{IB}) is obtained from the following expression.

In other words, the required number of buses to handle boarding passengers per hour is obtained from the peak number of boarding passengers and the average number of passengers per bus (n_B). When these figures are multiplied by the bus service time (bus departure interval: S_B), the bus boarding handling time per hour is calculated, and from this the required number of bus boarding berths (B_{IB}) is obtained.

Moreover, the peak number of boarding passengers is obtained by multiplying the peak number of bus users (N^P_B) by the boarding rate (boarding passengers/boarding and alighting passengers) (k_{IB}).

B_{IB} = (boarding passengers at peak time)/(average boarding passengers per bus)×(bus service time)/60

$= (N^P{}_B \bullet k_{IB})\ (S_B)/(n_B \bullet 60)$

○ Bus alighting berths (B_{OB})

Concerning the number of bus alighting berths (B_{OB}), the bus alighting handling time per hour is obtained from the peak number of alighting passengers and required alighting time per person, and from this the required number of bus alighting berths per hour is obtained.

B_{OB}= (peak bus alighting passengers)×(required alighting time per person)/60

$= (N^P{}_B \bullet k_{IB})\ (t_{OB})/60$

○ Design traffic volume of passengers waiting for buses (N_{BW})

The design traffic volume of passengers waiting for buses, i.e. the number of passengers waiting for buses per unit hour (N_{BW}), can be obtained from the peak number of bus boarding passengers ($N_{PB} \bullet k_{IB}$) and the bus service time (S_B).

N_{BW} = (peak number of bus boarding passengers)×(bus service time)/60

$= (N^P{}_B \bullet k_{IB})\ (S_B)/60$

ii) Design traffic volume and number of facilities concerning jeepney berths

○ Number of jeepney boarding berths (B_{IJ})

Concerning the number of jeepney boarding berths (B_{IJ}), the jeepney boarding handling time per hour is obtained from the peak number of boarding passengers and required boarding time per person (t_{IJ}), and from this the required number of jeepney boarding berths per hour is obtained.

Moreover, the peak number of boarding passengers is obtained by multiplying the peak number of jeepney users ($N^P{}_J$) by the boarding rate (boarding passengers/boarding and alighting passengers) (k_{IJ}).

B_{IJ} = (boarding passengers at peak time) × (required boarding time per person)/60
= $(N^P{}_J \bullet k_{IJ})\ (t_{IJ})/60$

○ Jeepney alighting berths (B_{OJ})

The hourly number of jeepney alighting berths (B_{OJ}) is obtained by the following expression from the peak number of alighting passengers and required alighting time per person (t_{OJ}).

Moreover, the peak number of alighting passengers is obtained by multiplying the peak number of jeepney users ($N^P{}_J$) by the alighting rate (alighting passengers/boarding and alighting passengers) (K_{OJ}).

B_{OJ} = (peak jeepney alighting passengers) × (required alighting time per person)/60
= $(N^P{}_J \bullet k_{OJ})\ (t_{OJ})/60$

○ Design traffic volume of passengers waiting for buses (N_{JW})

The design traffic volume of passengers waiting for jeepneys, i.e. the number of passengers waiting for jeepneys per unit hour (N_{JW}), can be obtained from the peak number of jeepney boarding passengers ($N^P{}_J \bullet K_{IJ}$) and the jeepney service time (S_J).

N_{JW} = (peak number of jeepney boarding passengers) × (jeepney service time)/60
= $(N^P{}_J \bullet k_{IJ})\ (S_J)/60$

iii) Design traffic volume and number of facilities concerning taxi ranks

○ Number of taxi boarding berths (B_{IT})

Concerning the number of taxi boarding berths (B_{IT}), the taxi boarding handling time per hour is obtained from the peak number of boarding passengers and required boarding time per person (T_{IT}), and from this the required number of taxi boarding berths per hour is obtained.

Moreover, the peak number of boarding passengers is obtained by multiplying the peak number of taxi users (N^P_T) by the boarding rate (boarding passengers/boarding and alighting passengers) (k_{IT}).

$$B_{IT} = \text{(boarding passengers at peak time)} \times \text{(required boarding time per person)}/60$$
$$= (N^P_T \bullet k_{IT})\ (t_{IT})/60$$

○ Taxi alighting berths (B_{OT})

The hourly number of taxi alighting berths (B_{OT}) is obtained by the following expression from the peak number of alighting passengers and required alighting time per person (t_{OT}).

Moreover, the peak number of alighting passengers is obtained by multiplying the peak number of taxi users (N^P_T) by the alighting rate (alighting passengers/boarding and alighting passengers) (k_{OT}).

$$B_{OT} = \text{(peak taxi alighting passengers)} \times \text{(required alighting time per person)}/60$$
$$= (N^P_T \bullet k_{OT})\ (t_{OT})/60$$

○ Design traffic volume of passengers waiting for taxis (N_{TW})

The design traffic volume of passengers waiting for jeepneys, i.e. the number of passengers waiting for jeepneys per unit hour (N_{TW}), can be obtained from the peak number of taxi boarding passengers ($N^P_T \bullet k_{IT}$) and the taxi service time (S_T).

$$N_{TW} = \text{(peak number of taxi boarding passengers)} \times \text{(taxi service time)}/60$$
$$= (N^P_T \bullet k_{IT})\ (S_T)/60$$

iv) Design traffic volume and number of facilities concerning tricycle berths

○ Number of tricycle boarding berths (B_{ITR})

Concerning the number of tricycle boarding berths (B_{ITR}), the tricycle boarding handling time per hour is obtained from the peak number of boarding passengers and required boarding time per person (t_{ITR}), and from this the required number of tricycle boarding berths per hour is obtained.

Moreover, the peak number of boarding passengers is obtained by multiplying the peak number of tricycle users (N^P_{TR}) by the boarding rate (boarding passengers/boarding and alighting passengers) (k_{ITR}).

B_{ITR} = (boarding passengers at peak time)×(required boarding time per person)/60

= (N^P_{TR} • k_{ITR}) (t_{ITR})/60

○ Tricycle alighting berths (B_{OTR})

The hourly number of tricycle alighting berths (B_{OTR}) is obtained by the following expression from the peak number of alighting passengers and required alighting time per person (t_{OTR}).

Moreover, the peak number of alighting passengers is obtained by multiplying the peak number of tricycle users (N^P_{TR}) by the alighting rate (alighting passengers/boarding and alighting passengers) (k_{OTR}).

B_{OTR} = (peak tricycle alighting passengers)×(required alighting time per person)/60

= (N^P_{TR} • k_{OTR}) (t_{OTR})/60

○ Design traffic volume of passengers waiting for tricycles (N_{TRW})

The design traffic volume of passengers waiting for tricycles, i.e. the number of passengers waiting for tricycles per unit hour (N_{TRW}), can be obtained from the peak number of tricycle boarding passengers (N^P_{TR} • k_{ITR}) and the taxi service time (S_{TR}).

N_{TRW} = (peak number of taxi boarding passengers)×(taxi service time)/60

= (N^P_{TR} • k_{ITR}) (S_{TR})/60

v) Design traffic volume and number of facilities concerning private car berths

The number of private car boarding and alighting berths (B_C) is obtained from the following expression by obtaining the private car boarding handling time per hour from the peak number of private car users (N^P_C), average number of private car passengers (n_C) and average stop time of private cars (t_C):

B_c = (peak number of private car users)/(average number of private car passengers) (average stop time of private cars)/60

= $(N^P_C/n_C)(t_C)/60$

Moreover, boarding and alighting space for welfare shall be secured separately from the above-mentioned berths.

vi) Design traffic volume concerning parking areas

○ Number of parked jeepneys

The design traffic volume of parked jeepneys (P_J) is obtained from the following expression using the average number of passengers per jeepney (n_J). This approach comes from the idea of securing jeepneys that are equivalent to the design traffic volume of passengers waiting for jeepneys (N_{jw}).

P_J = (design traffic volume of passengers waiting for jeepneys)/(average number of passengers per jeepney)

= $(N_{JW})/n_T$

○ Number of parked taxis

The above approach is used to obtain the number of parked taxis as follows.

P_T = (design traffic volume of passengers waiting for taxis)/(average number of passengers per taxi)

= $(N_{TW})/n_T$

○ Number of parked tricycles

The above approach is used to obtain the number of parked tricycles as follows.

P_{TR} = (design traffic volume of passengers waiting for tricycles)/(average number of passengers per tricycle)
= $(N_{TRW})/n_{TR}$

vii) Design traffic volume on footpaths

The design traffic volume on footpaths (C_W) is the number of pedestrians at peak time (N^P_W) and is obtained as the number of people using the station plaza at peak time (railway users + non-railway users).

In other words, the design traffic volume on footpaths not only refers to pedestrian traffic in and out of station plazas, but it includes traffic transferring from railway to bus or jeepney within station plazas.

viii) Design traffic volume on roadways

Design traffic volume on roadways (C_C) is obtained by totaling peak traffic volume by each means of transport.

$$Cc = (N^P{}_B/n_B)\cdot\gamma_B + (N^P{}_J/n_J)\cdot\gamma J + (N^P{}_T/n_T) + (N^P{}_{TR}/n_{TR}) + (N^P{}_C/n_C)$$

γ_B: bus (large vehicle) boarding conversion factor (= 1.7)
γ_J: jeepney (medium vehicle) boarding conversion factor (= 1.3)

③ Thinking behind indicators used for setting design traffic volume

Concerning the various figures used for setting design traffic volume by facility, the following values shall be used as rough guides for services which should be provided when estimating the plaza area.

a) Average number of passengers per bus (n_B): current figure is 50 passengers/bus

- As the current figure in the MMUTIS survey, the average number of passengers shall be 50 passengers/bus.

b) Bus service time (S_B): 3 minutes (design service time)

- This is the bus service which will be provided (departure frequency). In consideration of the fact that there are many bus routes in Manila, this has been set at 3 minutes (20 buses/hour) as a rough guide.

c) Bus alighting time per passenger (t_{OB}): 2/60 minutes/passenger (design service time)

- This varies depending on the method of fare payment and can actually be done in a short time, however, it shall be assumed that something like the above service level is secured.

d) Jeepney service time (S_J): 1.5 minutes (design service time)

- This is the jeepney service which will be provided (departure frequency). In consideration of the fact that there are many jeepney routes in Manila, this has been set at 1.5 minutes (40 buses/hour) as a rough guide.

e) Jeepney boarding time per passenger (t_{IJ}): 10/60 minutes/passenger (design service time)

- This can actually be done in a shorter time, however, it shall be assumed that something like the above service level is secured.

f) Jeepney alighting time per passenger (t_{OJ}): 1.5/60 minutes/passenger (design service time)

- Since alighting from jeepneys is easy, it shall be assumed that this service level is secured.

g) Taxi service time (S_T): 5 minutes (design service time)

- This is the taxi service which will be provided (departure frequency) and has been set at 1.5 minutes as a rough guide.

h) Taxi boarding time per passenger (t_{IT}): 10/60 minutes/passenger (design service time)

- This can actually be done in a shorter time, however, it shall be assumed that something like the above service level is secured.

i) Taxi alighting time per passenger (t_{OT}): 10/60 minutes/passenger (design service time)

- This can actually be done in a shorter time, however, it shall be assumed that something like the above service level is secured.

j) Tricycle service time (S_{TR}): 5 minutes (design service time)

- This is the tricycle service which will be provided (departure frequency) and has been set at 5 minutes as a rough guide (since the approach to services differs between urban areas and regional areas).

k) Tricycle boarding time per passenger (t_{ITR}): 10/60 minutes/passenger (design service time)

- This can actually be done in a shorter time, however, it shall be assumed that something like the above service level is secured.

l) Tricycle alighting time per passenger (t_{OTR}): 10/60 minutes/passenger (design service time)

- This can actually be done in a shorter time, however, it shall be assumed that something like the above service level is secured.

m) Average number of passengers in private cars (n_C): 2.0 passengers/vehicle

- Basically speaking, current values based on survey should be used, but two passengers per vehicle shall be adopted as a rough guide.

n) Average stop time of private cars (t_C): 1 minute (design service time)

- This is stop time for boarding and has been set at 1 minute as a rough guide to provided services.

o) Average number of passengers per jeepney (n_J): 15 passengers/jeepney

- As the current figure in the MMUTIS survey, 15 passengers/jeepney shall be adopted.

p) Average number of passengers per taxi (n_T): 2.2 passengers/txi

- As the current figure in the MMUTIS survey, 2.2 passengers/taxi shall be adopted.

q) Average number of passengers per tricycle (n_{TR}): 2.0 passengers/tricycle

- Basically speaking, current values based on survey should be used, but two passengers per vehicle shall be adopted as a rough guide.

④ Setting of transportation space reference area

a) Base unit of facilities

Standard base units by facilities are as follows.

i) Bus boarding and alighting berths (a_B): 70 m^2/bus

- Area obtained by adding space between vehicles to the required area for parking

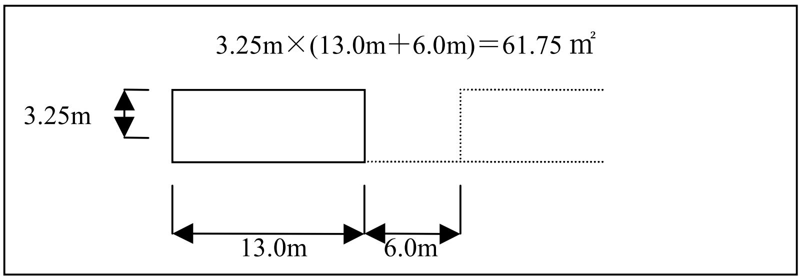


Fig. 6.2.16 Bus Boarding and Alighting Berths

ii) Assembly space for passengers waiting to board buses and jeepneys, etc. (a_W): 1.0 m^2/passenger

- The mutual distance between people standing and waiting is the upper limit of density within the scope of pleasant buffer space for human beings.

iii) Jeepney boarding and alighting berths (a_J): 30 m^2/jeepney

- Area obtained by adding space between vehicles to the required area for parking

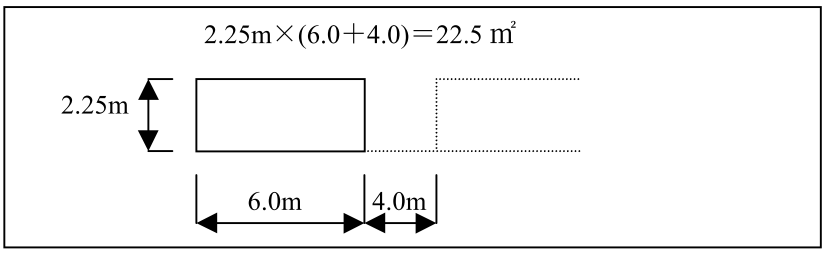


Fig. 6.2.17 Jeepney Boarding and Alighting Berths

iv) Taxi and private car boarding and alighting berths (a_T): 20 m^2/vehicle

- Area obtained by adding space between vehicles to the required area for parking

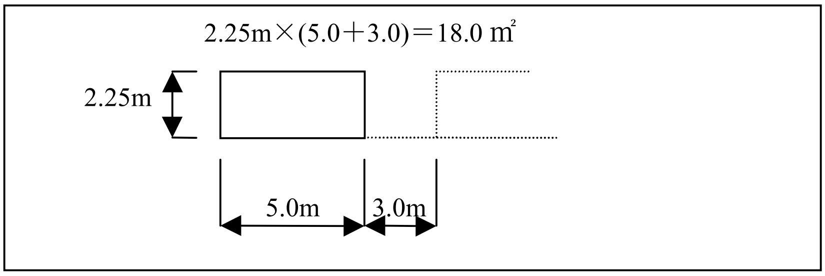


Fig. 6.2.18 Taxi and Private Car Boarding and Alighting Berths

v) Tricycle boarding and alighting berths (a_{TR}): 5 m^2/tricycle

- Area obtained by adding space between vehicles to the required area for parking

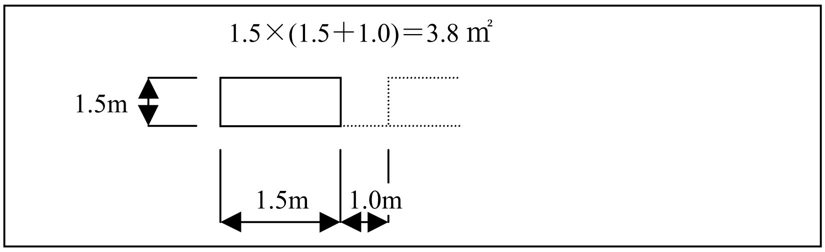


Fig. 6.2.19 Tricycle Boarding and Alighting Berths

vi) Jeepney parking area (a_{PJ}): m^2/vehicle

Private car parking area (a_{PC}), taxi parking area (a_{PT}): 30 m^2/vehicle

vii) Tricycle parking area (a_{PTR}): 5 m^2/vehicle

viii) Pedestrian density (D_W): aim for 27 people/minute/m (1,600 people/hour/minute)

- Upper limit of density which enables pedestrians to walk at normal walking speed, ensures freedom of walking movement and avoids physical contact.

ix) Design roadway length (L_C) $L_C = 0.4\ C_C + 36.1$

- Design roadway length for handling automobiles, excluding bus departure and arrival berth space, etc.
- Express by simple expression from roadway length at stations where the ratio of environmental space is around 0.5.

x) Average walking distance (L_W) $L_W = 0.009\ A_O + 82.4$

- The average walking distance of station plaza users shall be expressed by setting the diagonal line length across the station plaza and using a simple expression.
- Ao is the station plaza area calculated upon excluding the footpath area.

xi) Design traffic lane width (W_C) W_C = 3 m + width allowance 2 m

- This is the distance obtained by adding passing width to the traffic lane width.

b) Calculation of transportation space reference area

The transportation space reference area is obtained by multiplying the base units of each facility by each design traffic volume described above.

Transportation space reference area =

i) Bus berth-related area: (boarding berths B_{IB} + alighting berths B_{OB})× base units of bus berths a_B + design traffic volume of waiting passengers N_{BW}×waiting space per bus boarding passenger a_W

+ii) Jeepney berth-related area: (boarding berths B_{IJ} + alighting berths B_{OJ}) ×base units of jeepney berths aJ_W + design traffic volume of waiting passengers N_{JW}×waiting space per jeepney boarding passenger a_W

+iii) Taxi berth-related area: (boarding berths B_{IT} + alighting berths B_{OT})× base units of bus berths a_{TW} + design traffic volume of waiting passengers N_{TW}×waiting space per taxi boarding passenger a_W

+iv) Tricycle berth-related area: (boarding berths B_{ITR} + alighting berths B_{OTR})×base units of tricycle berths aT_{RW} + design traffic volume of waiting passengers N_{TRW} × waiting space per tricycle boarding passenger a_W

+v) Private car berth-related area: number of boarding berths B_C × base unit of private car facilities ac

+vi) Parking area-related area: design traffic volume of parked jeepneys P_J × base unit of jeepney parking facilities a_{JW} + design traffic volume of parked taxis P_T × base unit of taxi parking facilities a_{TW} + design traffic volume of parked tricycles P_{TR} × base unit of tricycle parking facilities a_{TRW}

+vii) Footpath area: (design traffic volume on footpaths $N^P{}_W$ ÷ pedestrian density D_W) × average walking length L_W

+viii) Roadway area for handling traffic: design roadway length L_C × design traffic lane width W_C

+ix) Area of supplementary facilities

⑤ Minimum plaza area for traffic

The minimum area which should be secured at comprehensive stations shall be that which allows buses to turn and one bus to park.

This is indicated specifically below:

- (Setting conditions: roadway width 3.25 m → 1 bus, turning radius 12 m, minimum footpath width 6 m, one entrance/exit)

3) Environmental Space Area

In the environmental space plan, environmental space area which considers station status, surrounding land use, local characteristics, history and unique character, etc. and is consistent with functions, shall be secured in accordance with the station plaza scale.

Particularly concerning stations where attention should be directed towards urban and station characteristics, in addition to the area required for transportation functions, sufficient area to reflect the characteristics of the city and station in question shall also be secured.

① Basic thinking

When planning environmental space, as well as judging station status in terms of urban and transportation systems and land use around the station, it is important to pay attention to local characteristics (natural conditions, etc.), city history and uniqueness, and to secure environmental space area that complies with these functions and is in accordance with station plaza size.

② Thinking behind securing of area

Using the standard environmental space ratio as a rough guide, enough area shall be secured to enable scale and space to be planned for each environmental space facility according to the environmental space functions of each station in question.

③ Definition of environmental space ratio

The environmental space ratio is an indicator for grasping how much environmental space has been secured. Out of station plaza area, all area except for roadways (but including decorated traffic islands) shall be viewed as environmental space area, and the share of this within the station plaza area is defined as the environmental space ratio.

④ Standard environmental space ratio

0.5 shall be used as the standard environmental space ratio. This is the value adopted in cases where standard environmental space functions are secured at stations where the station plaza reference area based on the area calculation model is around 4,000－10,000 m^2.

⑤ Applicable scope of standard environmental space ratio

The applicable scope of the standard environmental space ratio shall be stations in large cities or regions where there are medium numbers of boarding passengers and where the station plaza reference area based on the area calculation model is approximately 4,000－10,000 m^2.

Stations not included in the applicable scope are stations in large cities or regional core cities where there are large numbers of boarding passengers and where the station plaza reference area is roughly 10,000 m^2 or more. At these stations, even if the standard environmental space ratio is not attained, the adopted ratio shall be enough to maintain the scale of necessary environmental space facilities and secure standard environmental space functions (0.2-0.3 or more). Meanwhile, concerning stations where numbers of boarding and alighting passengers are few and space is calculated from minimum traffic handling capacity (rather than using station plaza reference area based on the area calculation model), these are excluded because it is not possible to secure the desirable minimum environmental space functions by using the standard environmental space ratio.

Moreover, the standard environmental space ratio is not used in cases of multi-level utilization either. This is because the environmental space ratio tends to grow in stations which are used on multiple levels.

⑥ Area of desired minimum environmental space

At stations where numbers of boarding and alighting passengers are few and space is calculated from minimum traffic handling capacity (rather than using station plaza reference area based on the area calculation model), it is desirable to generally secure at least 600-800 m^2 as area for plaza and symbolic facilities, etc. (not including footpaths) as the minimum desired environmental space functions.

4) Flow of station plaza area calculation

In determining the station plaza area, the standard area for calculation (station plaza reference area) is first obtained by combining the area required to secure transportation space functions (transportation space reference area) with additional area for securing environmental space functions.(note)

Based on this, the general layout plan shall be examined and comprehensive assessment carried out to determine whether or not conditions are satisfied in terms of transportation facilities layout and whether functions are secured according to the environmental space ratio and actual conditions in the district concerned, and finally the station plaza area shall be set.

Note) In cases where additional area for securing plaza and symbolic facilities, etc. cannot be determined, as a rough guide to securing the standard environmental space ratio, station plaza reference area shall be adopted assuming a 20% increase in the transportation space reference area.

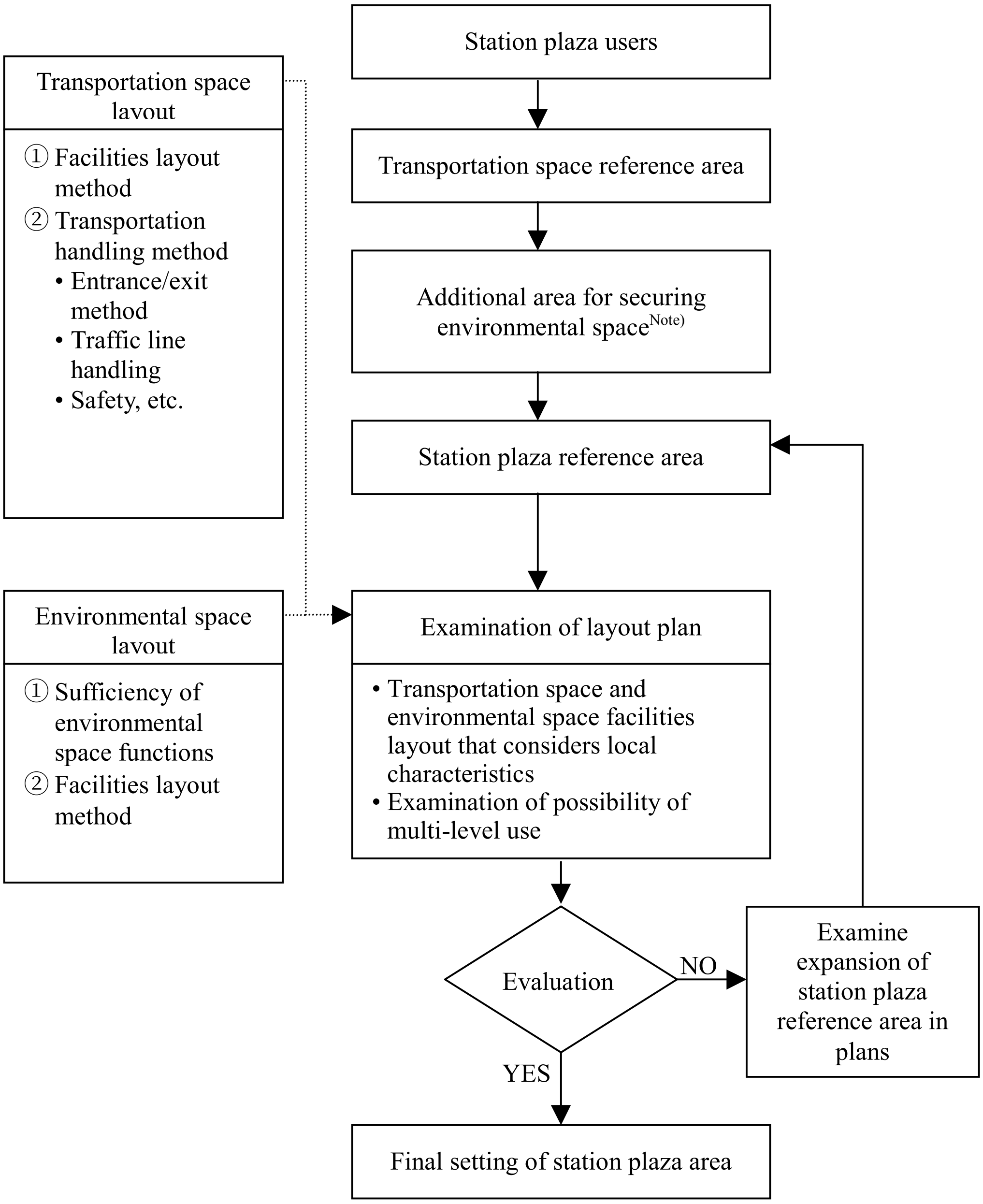


Fig. 6.2.20 Flow of Station Plaza Area Calculation

(3) Station Plaza Layout

1) Thinking behind overall layout

Items which should be examined in the overall layout plan are the relationship of surrounding roads with the plaza, shape of the plaza, and layout of transportation space and environmental space. In consideration of the character of each station, quantities of people and vehicles using each plaza, and methods of plaza use, etc., overall layout shall be planned upon taking transportation safety and smoothness of flow, landscape formation and environmental space into account.

① Relationship between surrounding roads and plaza

a) Basic items to consider when planning

In areas around station plazas, vehicles and pedestrians generally concentrate (even for in city centers) and traffic lines converge. In order to safely and smoothly handle traffic in station plazas and their surrounding areas, it is necessary to pay attention to the following points when compiling plans:

- Exclusion of transit vehicular traffic in station plazas
- Simplification, smoothing and shortening of traffic lines
- Separation of human and vehicular traffic lines

b) Shape of plaza

i) Aspect ratio

It is necessary to shape station plazas so that traffic lines, etc. are simplified and made smoother. Concerning the short side to long side ratio (aspect ratio) of station plazas, this is often planned in the range of 1:1 to 1:3. In large scale station plazas, it is necessary to pay attention to separation of traffic lines by vehicle type and length of walking distances, and to flexibly deal with the aspect ratio. Furthermore, it is desirable to plan layout so that pedestrians crossing plazas do not experience any discomfort.

ii) Minimum dimensions

At the station plazas of comprehensive stations, it is desirable to secure 40-50 m in the longitudinal direction and 50-60 m across.

iii) Plaza size and shape and height of surrounding buildings

Since the plaza shape is an important element for landscape planning, examination shall be especially carried out on the balance between station plaza size and shape and the height of surrounding buildings, etc.

c) Form of plaza

Station plazas as a rule are level plazas, however, in cases where elevated traffic lines are required in view of the structure of station facilities, relationship with adjoining buildings, restrictions on site land and convenience for pedestrians, etc., multi-level station plazas shall be examined. In specific terms, it is necessary to plan multi-level station plazas in the following kinds of cases.

i) Securing of traffic lines with surrounding buildings

Cases where convenience for pedestrians is greatly improved by pedestrian traffic line connections with surrounding buildings (including station buildings).

ii) Site restrictions

Cases where land use around stations is already highly concentrated and it is extremely difficult to secure station plazas on the level plane in view of land acquisition.

iii) Shape and scale of station plazas

Cases where the large area or limited shape of station plazas make walking distances longer and hinder convenience for pedestrians.

2) Transportation space layout

In the layout of transportation space, since people and vehicles such as buses, jeepneys, taxis and general automobiles, etc. concentrate in station plazas as transportation nodes, effort shall be made to simplify traffic lines and ensure smooth handling. Moreover, planning and design shall be carried out with consideration given to use by elderly people and physically challenged persons, etc.

① Basic thinking

In planning the layout of transportation space facilities, examination shall be carried out with consideration given to character of the station in question, quantities and methods of use of people and vehicles using the plaza, scale and form of plaza, positioning of access roads, and so on.

At this time, examination of layout shall be carried out based roughly on the quantity of facilities (bus berths, parking spaces, etc.) obtained during setting of the station plaza area, and with consideration given to specific bus routes and traffic handling, etc. Here, the area of each facility as obtained during the setting of area shall be referred to when examining balance of the overall facilities layout in the station plaza.

② Type of facilities layout

In layouts where facilities such as roadways and bus boarding and alighting areas, etc. are placed in the center of generally used plazas, since bus berths, etc. are placed along footpaths, pedestrians and vehicles can be easily separated and this arrangement is convenient for changeovers, however, since traffic inside and outside plazas becomes chaotic as the car traffic volume increases, this type of layout is suited to small station plazas.

Moreover, in cases of large openings such as at large station plazas where rail passenger and related vehicle traffic volume is large, it is possible to separate traffic lines for people, buses, jeepneys, taxis and general cars, etc. by providing pedestrian sections in the center of the plaza and arranging traffic handling facilities in series.

3) Environmental space layout

Not only is environmental space intended to act as the 'face of the city' in accordance with city and station characteristics, environmental space facilities layout is planned in a manner which ensures that environmental space functions are fully functioning with consideration given to harmonization with surrounding land use and pedestrian traffic lines.

Moreover, consideration shall also be given to elderly people, physically challenged persons and natural conditions, etc.

① Basic thinking

Concerning facilities layout planning in environmental space, it is necessary to achieve mutual harmonization between functions and to conduct comprehensive examination to ensure that the said space acts as the 'face of the city' in accordance with city and station characteristics, etc.

When planning the layout of facilities, care shall be taken to ensure that main pedestrian traffic lines are not hindered, and plans shall be compiled so that harmonization is sought with surrounding land use and the installed facilities are able to function sufficiently.

Moreover, consideration shall be given to removing barriers to the movement of elderly people and physically challenged persons as much as possible and securing smooth mobility for users.

② Important points to consider by function

a) Urban area focal point functions

Concerning decks and underground spaces which are facilities to enable station plazas to further strengthen surrounding urban functions as centers of urban activity, it is desirable to plan their layout so that station buildings and surrounding buildings are mutually linked by the shortest distances. Moreover, in consideration of convenience for elderly people and physically challenged persons, etc., it is desirable to appropriately place elevators and escalators, etc.

b) Exchange functions

Concerning spaces used for exchange activities such as resting, gathering and talking, it is desirable to establish gathering areas and green areas and strive to create peaceful and tranquil spaces.

In planning layout, it is necessary to take care in making sure that main pedestrian traffic lines are not obstructed.

c) Landscape functions

It is desirable to enhance landscape by planting vegetation around open spaces and on traffic islands, etc.

With respect to planting of greenery, layout and tree planting shall be planned with consideration given to separation of landscape and spaces and the role of buffer zones, etc.

Concerning monuments, etc., designs which consider city history and individuality shall be adopted, and visibility from surrounding areas shall be taken into account. Moreover, it is desirable to adopt layout which does not hinder pedestrian traffic lines.

d) Service functions

Concerning facilities which provide public services, for example, administrative services, police boxes, toilets and public telephone boxes, etc., it is necessary to examine installation sites including station buildings, etc. Within station plazas, it is desirable to adopt layout which does not hinder main pedestrian traffic lines.

As for information centers, information boards and other information providing facilities, it is desirable to place these around station entrances which are easy to understand for users and to adopt layout which does not hinder pedestrian traffic lines.

e) Disaster prevention functions

Station plazas are vital open spaces in cities and have a role to play as disaster prevention spaces. Particularly in cases where station plazas are included in disaster prevention plans, it is desirable to design and plan environmental space so that flat and open spaces are secured in consideration of use during emergencies.

③ Important points to consider in planning and design concerning welfare

It is desirable to plan station plazas so that they are easy to use for all people including elderly and physically challenged persons, in order to increase opportunities for use in everyday living.

When planning station plazas, it is necessary to adequately examine convenience and safety for all people including elderly and physically challenged persons, and to take care in planning easy to understand traffic lines and creating spaces which are easy to use (through use of guide signs, etc.), impose little vertical movement or height differences on users and are kind to people.

Moreover, in giving consideration to the various needs of elderly and physically challenged persons, it is desirable to vigorously regard this area as a single design component and to aim for spaces which have an overall balance.

4) Thinking behind multi-level use (conditions, thinking, important points to consider in multi-level use)

When planning multi-level use of station plazas, it is first necessary to examine the main users, form and layout of multi-level facilities. The layout of multi-level facilities shall be planned so that station plaza functions are ample fulfilled, with consideration given to the mutual positional relationship between station ticket barriers and transport boarding and alighting areas (buses, jeepneys, taxis, etc.), the position of roads connected to the station plaza, and relation with entrances and exits to and from surrounding buildings, i.e. traffic lines with surrounding buildings, shape and scale of station plaza, and site limitations.

① Conditions for multi-level use

Station plazas are usually used on a single level, however, in cases where multi-level traffic line handling is required in view of the structure of station facilities, relationship with adjoining buildings, convenience for pedestrians, and site limitations, etc., examination shall be given to multi-level use. The following cases can be considered as specific examples of multi-level use planning.

a) Traffic lines with surrounding buildings

In cases where land use around stations is highly concentrated and it is possible to ensure smooth flow of pedestrians in plazas, secure safety, improve convenience, attain smoother traffic flow, and promote vitalization of station districts by linking elevated or underground stations to surrounding buildings by elevated or underground pedestrian traffic lines, multi-level use shall be examined while seeking to achieve compatibility with urban development in surrounding areas.

b) Site limitations

In cases where land use around stations is highly concentrated and it is extremely difficult to acquire land for level station plaza use, multi-level use shall be carried out while giving overall consideration to the status of target facilities in transportation plans in districts around stations.

However, in these cases too, care shall be taken to secure as large an area on the level plane as possible and to allow as many pedestrian and vehicle traffic lines as possible to be handled on the level plane.

c) Shape and scale of station plazas

In cases where station plazas are large in scale or where there are restrictions on shape, it is possible that walking distances become overly long between station buildings and public transport boarding and alighting areas (bus, jeepney, taxi, etc.), or between station buildings and surrounding districts; and in instances where pedestrian convenience and safety can be greatly improved through adopting multi-level station plazas, multi-level use shall be examined.

(4) Determination of scale of station plaza and Design Standard by Classification

For each type of station plaza, the quantity and area of each facility should be calculated.

1) Concentration and separation of facilities at station plaza

Since conveniences are required for the station plaza, all the necessary facilities should be basically gathered around the station, and the land area necessary for these facilities should be secured.

However, concentration of all the facilities to one point may cause traffic jam around the station due to wrong location of the station, railroad track, or roads around the station. In this case, reduce the number of facilities necessary for the station plaza, or separate the station plaza into two. After that, determine the quantity and area for each facility.

Nowadays, in the Manila metropolitan area, about 30 to 50 percent of railway passengers use Jeepneys, about 10 to 20 percent of them use tricycles, and about 10 percent of them use busses (result of JICA's research in 2000). In the near future, however, more people will have their own cars, and the railroads will be further extended to the suburban areas. For this reason, the kiss-and-ride rate and the park-and-ride rate of the privately-owned cars will be increased, and the railway use rate of the privately-owned cars will be also increased.

Among these railway feeder transportations, Jeepneys are exclusively used particularly on the back streets near the stations because they run at a low speed and can easily make sharp turns. However, Jeepneys are not permitted in the most sections of the EDSA road, a trunk road. They can only cross the EDSA road. The lightweight tricycles travel only back streets, and crossing highways are restricted. Regarding taxis, waiting for passengers on the EDSA road is restricted, but getting out of the taxis are not restricted.

Considering the features of the feeder transportations, scale of the station, and the locations of the trunk roads, determine the feeder transportations to be introduced to the station plaza and their scales as follows:

■ Considering the traffic restriction on the trunk roads around the station, properly select a location closest to the station for each transportation facility so that the introduced feeder transportation does not prevent the smooth traffic on the trunk roads. If the location of a transferring facility is away from the station, construct a pedestrians' passage to ensure smooth access to the facility.

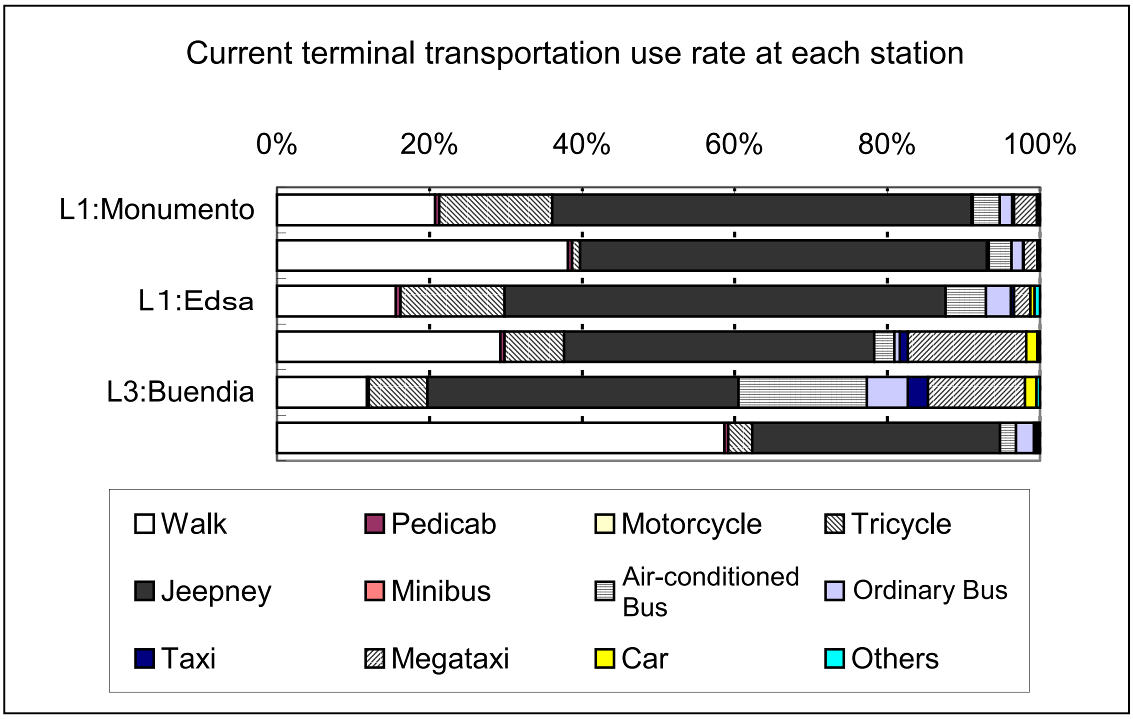
■ If the scale of the station is large, the demands for the feeder transportations and the area of the station plaza will be large. In this case, separate the bus zone from the other short-distance transportation zones because buses need a wide area. Or separate the bus zone to both sides of the station depending on the destinations. If the scale of the station is small (number of railway passenger is small), the number of necessary berths (number of bus stops, taxi stands, etc.) will be small. In this case, gather all the necessary transferring facilities at one point near the station.

■ For a subway station or an elevated railroad station, effectively use the ground above the station or space under the station to gather the transportation facilities to one point.

■ The number of long-distance bus users are comparatively large. For this reason, some stations may not have many terminal bus users. In this case, consider a compact layout of bus routes, and adopt loop-line bus systems (buses start from a station and returns to the same station). By the way, if the railroad is extended in the future, the number of terminal bus uses will be increased at main suburban stations particularly. If a station has a possibility of increase in the terminal bus users, preliminarily secure spaces for the future bus stops.

Jeepneys will be important means of transportation also in the future. For this reason, smooth access to/from the station should be ensured. If a scale of a station is large, demands for Jeepneys will be considerably large. To establish a Jeepney facility at such a station or within 50 m of such a station, a considerably large area will be necessary. In addition, parking so many Jeepneys will affect the traffic conditions on the roads. In this case, separate the Jeepney facility into two or three depending on the destinations, etc.

Tricycles are important means of transportation, too. They are compact and lightweight, and do not need a large area. However, they travel at a low speed. For this reason, if tricycles are introduced to a large-scale station plaza, they may cause traffic jam or traffic accidents because many buses and Jeepneys bigger than tricycles are traveling at higher speeds and are likely to cross low-speed tricycles. Considering such a point, if the scale of a station is small and the traffic is not heavy, introduce tricycles. However, if the scale of a station is large, the tricycle parking lot should be established on a narrow street near the station as usual.



（JICA SURVEY 2000）

Fig. 6.2.21 Current Transferring Transportation Use Rate at Each Station

2) Estimation of number of railway passengers at each station plaza

The future number of railway station feeder transportation users at each station should be estimated for each pattern while determining the number of railway passengers, rate of station plaza users to passengers, and rate of each transportation users to station plaza users as shown in the table below.

To calculate the future number of station plaza users, multiply the future number of railway passengers by the rate of station plaza users to passengers. The future number of passengers was determined for each pattern while referring to the values estimated by SIRNMN, and the rate of station plaza users to passengers was determined to 1.1 to 1.5 for each pattern while referring to the examples in Japan. The rate of railway station feeder transportation users to station plaza users was determined for each transportation while referring to the research result.

For each mode of transferring, the estimated number of future users is shown in the following table:

Table 6.2.9 Future Number of Feeder Transportation Users for Each Modes of Transportation at Each Type of Station (estimated from number of train passengers)

Pattern	Future number of passengers (persons/day)	Rate of station plaza users to passengers	Future number of station plaza users (persons/day)	Mode of transferring	Rate of feeder transportation users to station plaza users	Feeder transportation users (persons/day)	Remarks (reference station name)
Multi-functionstation in CBD	250,000	1.5	375,000	Bus	5	18,750	LRT1.-D.JOSE
				Jeepney	53	198,750	
				Taxi	2	7,500	
				Private car	0	0	
				Tricycle	0	0	
				Walking	40	150,000	
Ordinary station in CBD	50,000	1.5	75,000	Bus	0	0	PNR.BUENDIA
				Jeepney	35	26,250	
				Taxi	0	0	
				Private car	0	0	
				Tricycle	5	3,750	
				Walking	60	45,000	
Multi-functionstation outside CBD	120,000	1.5	180,000	Bus	5	9,000	MRT3.CUBAO
				Jeepney	40	72,000	
				Taxi	15	27,000	
				Private car	0	0	
				Tricycle	10	18,000	
				Walking	30	54,000	
Ordinary station outside CBD	50,000	1.1	55,000	Bus	0	0	PNR.BUENDIA
				Jeepney	35	19,250	
				Taxi	0	0	
				Private car	0	0	
				Tricycle	5	2,750	
				Walking	60	33,000	

Note:
- The future number of passengers was determined for each station while referring to the estimated future numbers of passengers of main stations.
- The rate of station plaza users to passengers was determined while referring to the examples in Japan.
- The rate of feeder transportation users to station plaza users was determined for each transportation while referring to the value estimated for the future. However, the rate of walking was determined while referring to the current value.
- To draw a plan actually, calculate each value after selecting the transportation facilities to be introduced to the corresponding station plaza as described later.

Table 6.2.10 Estimated Number of Passengers for Each Pattern (persons/day)

Pattern	Station	Estimated number of passengers	Subtotal
Multi-function in CBD	Monumento	260,695	
	D. Jose(NR)	325,615	939,272
	D. Jose	167,541	
	Recto(2)	150,773	
	Old Bilibid(4)	295,343	
	EDSA/Quezon Ave.(4)	129,790	240,523
	EDSA/Quezon Ave.	110,733	
	Cubao	159,469	387,584
	Cubao(2)	228,115	
	Shaw Blvd.	178,770	
	Alabang	255,492	
Multi-function outside CBD	Marilao(NR)	258,291	
	Tutubang		
	Quirino(4)	73,592	
	Katipunan(2)	107,851	
	EDSA(MCX)	122,681	200,207
	Magallanes(3)	77,526	
	EDSA(1)	95,640	250,953
	EDSA/Taft Ave.(3)	155,313	
	South Terminal(1)	266,464	435,113
	Baclaran(6)	168,649	
	Cabuyao(MCX)	156,579	
	Niog(6)	221,831	

Note: Since the scales of ordinary stations are small, no estimated values are shown in the above table.
Each subtotal shows the total number of passengers of several adjacent stations. For the subtotal values, the passengers who change the trains were counted twice.
The above values have been calculated assuming that trains directly go through from LRT Line 1 to LRT Line 3, or vice versa, at Monumemto Station.
(Based on the estimated number on Oct. 23)

3) Determination of scale of station plaza

① Transportation facilities

Transportation facilities are basic facilities necessary for station plazas. Based on the peak demands for each transportation facility to be introduced to the corresponding station plaza, calculate the quantity and area of each transportation facility.

If the other station is close to a station, many people will change the railroad lines. In this case, calculate the area necessary for the junction passage.

For the berths of buses, Jeepneys, tricycles, etc., consider the current traveling routes and future reorganization plan. Do not determine the necessary number of berths from the number of users, but determine the necessary number of berths from the number of necessary routes (construct a berth for each route). In the latter case, the number of berths will be larger than the former case. However, the latter case will ensure smooth transfer to the other line and convenience.

② Environment facilities

The station plaza will create a city base, and should include the transportation facilities, landscape enhancing facilities, service facilities, and disaster preventive facilities. These facilities should not be the same for each station plaza, but necessary facilities should be determined for each station plaza considering the features of the corresponding station and city.

In Japan, there are two methods to determine the space for the environment facilities. One of the methods is the recently-introduced method. If this method is used, the area excluding the roadway area should be regarded as the environment space area, and the environment space rate (rate of environment area to entire station plaza area) should be 0.5 (standard value). The other method is the conventionally-used method. If this conventional method is used, the area excluding the transportation facility area (roads, sidewalks, berths, parking lots, etc.) should be regarded as the general public space, and the rate of general public space to the transportation facility area should be 0.2 to 0.3.

Even if the environment space rate (or general public space rate) is lower than the standard rate at a large-scale station having many passengers, an appropriate space can be secured for the environment facilities.

③ Total area

For each station pattern and number of berths, determine the total area necessary for the station plaza as shown in the following table. Note that these values are reference values.

Table 6.2.11 Total Area Necessary for Station Plaza for Each Station Pattern and Number of Facilities
(If all the facilities should be gathered into the station plaza)

Station pattern	Number of station plaza users (persons/day)	Number of bus berths	Number of Jeepney berths	Number of taxi berths	Number of tricycle berths	Approximate area (m^2)	Remarks
Multi-function station in CBD	375,000	2	10	2	(None)	11,000	The area of the transfer deck should be separately estimated.
Ordinary station in CBD	75,000	(None)	6	(None)	(None)	1,400	
Multi-function station outside CBD	180,000	2	5	7	(None)	7,000	The area of the transfer deck should be separately estimated.
Ordinary station outside CBD	55,000	(None)	4	(None)	(None)	1,000	

Note:
- Considering the future use, the peak rate shown in the research result was used.
- The rate of passengers getting on trains to getting off trains at the peak was determined while referring to the reference values in Japan.
- The service time of each facility at the peak was determined as follows while referring to the reference values in Japan and current conditions in Manila:
  Bus : Getting on = Every 3 minutes (20 buses/hr for each berth) / Getting off = 2 sec/person
  Jeepney : Getting on = Every 1.5 minutes (40 Jeepneys/hr for each berth) / Getting off = 1.5 sec/person
  Taxi : Gettin on = Every 1 minute (40 taxis/hr for each berth / Getting off = Every 1 minute (40 taxis/hr for each birth)
  Berth area : Bus = 70 m^2/berth / Jeepney = 30 m^2/berth / Taxi = 20 m^2/berth
  Passengers' waiting area : 1 m^2/person
- Environment space rate:
  Determined to 20 to 30% while referring to the example in Japan (included in the total area)

4) Draft of design standard

For each type of station plaza, the draft of the design standard is shown below:

(i) Layout

As a traffic nodal point, the layout of the station plaza should be carefully determined. Since people and various vehicles, such as buses, gather at the station plaza, the traffic circulation lines should be simplified and smooth traffic should be ensured at the station plaza. In addition, to ensure safety and convenience of the aged people or physically handicapped people, traffic on the street should be improved and the plaza should command a fine view.

The concept for the basic layout is described below:

① Layout of traffic facilities

- Sidewalk

The pedestrian circulation lines and the vehicle circulation lines should not be level-crossed as far as possible (the number of pedestrian crossings should be reduced).

If the area is large and the walking distance is long, or if the traffic conditions at the station should be improved for smooth transportation, the multi-level crossing should be adopted.

Including the circulation lines of pass-through pedestrians living near the station, minimize the length of each circulation line so that walking distance can be minimized for the pedestrians.

- Roadway

Adopt one-way traffic for the roadways to ensure smooth traffic flow. Reduce the crossings and junction points as far as possible. As a rule, construct at least 2 lanes for each roadway. Near bus berths and other berths, 3 lanes (2 lanes + bus parking lane) are recommended.

It is also recommended that the number of entrances/exits of streets should be reduced at the station plaza.

- Bus and Jeepney berths

For a small-scale or medium-scale station plaza, the same berth can be used for both getting on and getting off. For a large-scale station plaza, however, the getting-on berth and getting-off berth should be separated.

Construct berths near the ticket gate of the railroad station to ensure convenience for the passengers.

- Taxi berths

Those who have a poor sense of direction, are in a hurry, or have a handicap often use taxis. The taxi berth, therefore, should be close to the ticket gate of the railroad station.

If a taxi pool is necessary, select an appropriate location for the taxi pool so that the taxis waiting for their turns can easily see the flow of the taxis to the passengers.

For the passengers waiting for a taxi, the sidewalk should be so wide that they cannot prevent smooth walking of the pedestrians.

- Tricycle berth

  Tricycles travel at a low speed. If a tricycle berth is introduced to a station plaza, locate the tricycle berth near the tricycle way so that the tricycles do not have to cross the roads of other high-speed vehicles as far as possible.

- Privately-owned car parking lot

  If a privately-owned car parking lot is introduced to a station plaza, locate the parking lot at an appropriate place so that the privately-owned cars can smoothly go in and go out and the drivers getting off their own cars do not have to cross any roadway at the station plaza (or if they have to cross a roadway, take measures to ensure their safety in crossing the road).

② Layout of environment facilities

- Considering the features of the city or station, make the station plaza to the “symbol of the city”. For the “symbol of the city”, consider what facilities are needed and make an adjustment between the facilities from the total point of view.

  The environment facilities should not prevent smooth circulation of the pedestrians, and should be in harmony with the other facilities around the station. In addition, the environment facilities should function well.

  In addition, considering various natural conditions, adopt the optimum layout for the environment facilities in order to ensure smooth flow of the users. Note that these facilities should ensure smooth flow of even the aged people or handicapped people.

- Since decks and underground spaces are the facilities that support the city functions, they should connect the station to each nearby buildings by the shortest route.

  At the exchange space where people gather, talk, or have a rest, be sure to secure a gathering space and green zone so that people can enjoy the relaxing and refreshing atmosphere.

  It is recommended that around the open space, such as a plaza, or transportation island, there should be green belts so that people can enjoy a fine view.

  Considering the history and features of the city, adopt an optimum design for each monument, etc. Considering the visibility, carefully locate the monuments, etc. In addition, they should be at the optimum locations so that they do not prevent smooth circulation of the pedestrians.

  If the station plaza is specified as the disaster preventive space (space for refugees from flood, earthquake, etc.) by the disaster preventive scheme, be sure to secure a flat and spacious ground for this scheme and carefully design the plaza.

(ii) Multifunction station

① Scheme for urban multifunction station plaza

Since an urban multifunction station is a main station in the business area at the center of the city and connected to the other railroad lines, a large number of people use the station.

For the railroad users and nearby business facility users, ensure safe and comfortable walking at the station plaza, and be sure to secure a gathering space and pedestrian space to ensure smooth flow.

If two or more stations gather at the same place, many people will walk between the stations to change the lines. In addition, many people will walk between the stations and nearby buildings. In this case, construct multi-level passages (consisting of an overpass and underpass) to ensure smooth flow for the pedestrians.

At such a station, many people use Jeepneys and buses. For this reason, many berths are necessary for these terminal transportations. To ensure smooth getting on and off for the passengers, properly locate the berths considering the destinations, etc. Construct sidewalks between the station and the roadways to ensure pedestrian safety. Also construct roadways having enough number of lanes to ensure smooth flow of vehicles. In addition, install signals to ensure safety and smooth flow.

If there are many pedestrians around the station, install escalators, etc. to ensure smooth flow and to relieve the congestion. Also install guide plates and nameplates so that people can easily go to the desired facilities or roads.

② Scheme for suburban multifunction station plaza

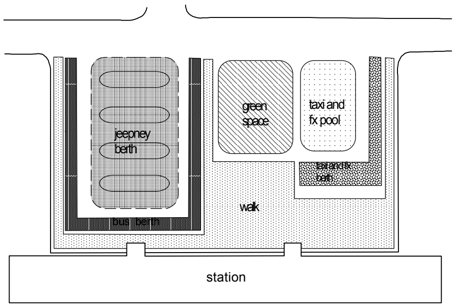
Since a suburban multifunction station is a main station in the outskirt or suburb of the city and connected to the other railroad line, a large number of people use the station.

If there is a station near this station, many people will walk between the stations to change the lines. In this case, secure a gathering space and pedestrian space to ensure smooth flow of people.

If the stations are separated from each other, construct a multi-level passage between the stations in addition to the multi-level passage between the station and nearby area.

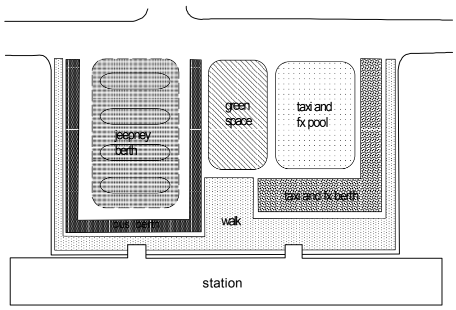
At such a station, many people use buses, taxis, and Jeepneys. For this reason, properly locate the berths considering the destinations, etc. so that people can easily use these transportations.

Since many people walks between the station and the berths for terminal transportations, install escalators, etc. to ensure smooth flow.



Urban multifunction station

■ Multi function station's plaza inside of CBD



Suburban multifunction station

Fig. 6.2.22 Standard Design for Multifunction Station Plaza
(In CBD and outside CBD)

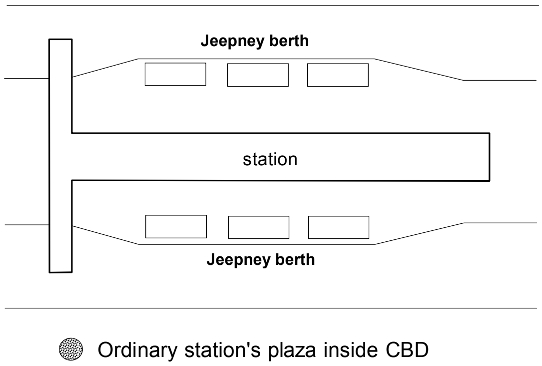
(iii) Ordinary station

An ordinary station in the city area or suburban area does not have many passengers, and does not have many facilities around the station. For this reason, a small number of people use the station plaza.

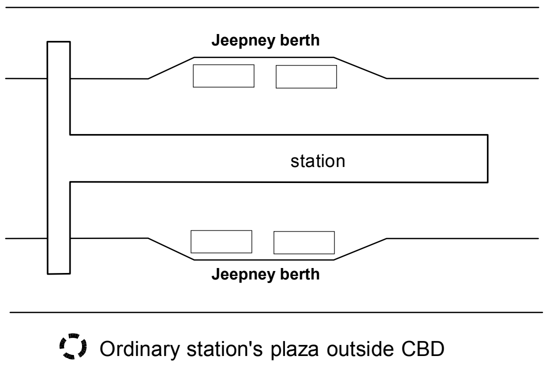
After getting off a train, most people walk or use tricycles or Jeepneys. For this reason, considering the traffic of the nearby area, construct an optimum station plaza that can ensure smooth circulation of people and vehicles.

Jeepneys are the most popular vehicles, but they are small. For this reason, construct a Jeepney berth that can be used for both purposes; getting on and off. If the road is narrow, partially widen the road to construct the berths so that smooth flow of vehicles can be ensured.

For the pedestrians, install escalators or elevators to ensure easy walking.



(Urban ordinary station)



(Suburban ordinary station)

Fig. 6.2.23 Standard Design for Ordinary Station Plaza

5) Designing circulation

① Designing circulation between station and peripheral road

If the scale of a station is large, the roads around the station have heavy traffic, and the station plaza also has heavy traffic. To design a flow line that connects the station to a peripheral road, be careful not to worsen the current traffic condition.

To design a left turn lane on a peripheral road to connect the road to the station plaza, select a crossing wide enough to construct a left turn lane or extend the waiting zone. If necessary, widen an existing crossing. In addition, as a rule, install a signal.

To construct a new crossing having a signal, ensure enough distance between the new crossing and the adjacent existing crossing so that the vehicle line waiting for left turn will not reach the adjacent crossing.

If the distance between the crossings is short, unify the signal indication of the consecutive crossings to control the traffic.

As described above, to design a flow line between the station and a peripheral road, check the traffic condition of the station plaza and the peripheral road, and estimate the traffic volume and calculate the congestion degree for each crossing having a signal. In addition, improve the traffic condition by constructing a new left turn lane on the road.

② Designing circulation in station plaza

Regarding Jeepneys, etc., determine the zone in the station plaza as described before. For these vehicles, adopt the one-way traffic system, as a rule, and minimize the circulation crossing points.

Regarding pedestrians, estimate the number of users for each pedestrian source facility, such as the station, berth, peripheral road, exchange space, and rest house, and then estimate the pedestrian flow rate between the facilities. After that, estimate the pedestrian flow rate of each passage while referring to the layout plan, and then determine the width of each passage so that the traffic service level specified for pedestrians can be satisfied.

Estimation of number of facility users

↓

Estimation of Pedestrian Flow Rate between Facilities

O – D	Station	Jeepney	Taxi	Tricycle	Bus	Walking	Total
Station							
Jeepney							
Taxi							
Tricycle							
Bus							
Walking							
Total							

↓ ← Traffic service level for pedestrians

Estimation of pedestrians' demand level for each passage and determination of necessary width for each passage

Fig. 6.2.24 Procedure for Determination of Pedestrians' Passage Width in Station Plaza