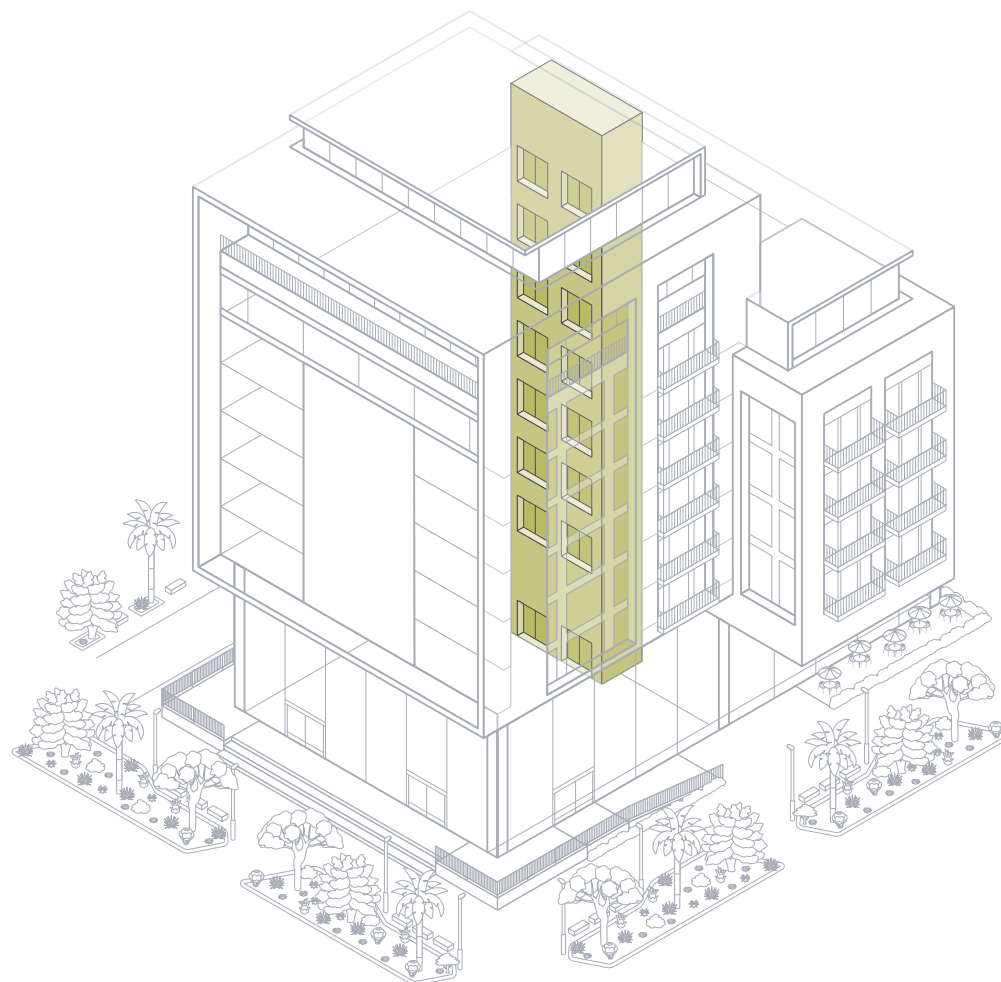




Part D

Vertical transportation

- D.1 Performance statements
- D.2 Definitions
- D.3 References
- D.4 General
- D.5 Safety and reliability
- D.6 Energy conservation
- D.7 Location and arrangement of passenger elevators
- D.8 Design method 1: prescriptive design using predefined numbers of passenger elevators
- D.9 Design method 2: design parameters for use in performance-based vertical transportation design
- D.10 Annex: Vertical transportation design summaries and report template



D.1 Performance statements

Performance statement	The performance statement will be met by following the requirements of:
The building shall provide a safe, sustainable, adequate and effective vertical transportation service.	D.4 to D.9

D.2 Definitions

D.2.1 Terms

Acceleration: Rate of change of speed or velocity of an elevator (m/s^2).

Arrival rate: Rate at which passengers arrive for service by an elevator system, in persons per 5 min or percentage of building population per 5 min.

Average time to destination: Average period of time (s) from when a passenger either registers a landing call or joins a queue until the responding elevator begins to open its doors at the destination floor.

Average waiting time: Average period of time (s) from when a passenger either registers a landing call or joins a queue until the responding elevator begins to open its doors at the boarding floor.

Boarding floor: Floor that provides entry into a building, including ground floors, basements, parking, podium parking, and connections between towers and car parks at high level.

Capacity factor: Filling rate of an elevator during each trip, measured in percentage to rated load.

Door closing time: Period of time (s) measured from the instant the car doors start to close until the doors are locked.

Door dwell time: Period of time (s) the elevator doors are open for a fixed length of time (dwell) after an elevator arrives at a floor. Passengers can then alight or board. These times are different to the landing calls and car calls.

Door opening time: Period of time (s) measured from the instant the car doors start to open until they are 800 mm apart.

Door pre-opening time: Time-saving feature allowing the elevator doors to open in the safe zone while arriving at landing within 200 mm from the landing level.

Flight time: Time between the instant the car doors are locked and the time when the elevator is level at the next adjacent floor.

Grouping: Elevators in a common lobby serving all or part of the floors as one group.

Gross area (GA): Floor area within the inside perimeter of the exterior walls of a building. The measurement excludes shafts and courtyards, but includes corridors, stairways, ramps, closets, base of atria (or similar voids) and the thickness of interior walls, columns or other features.

Handling capacity (HC5): Average number of passengers that an elevator or group of elevators can transport in a period of 5 min.

Handling capacity (HC5%): Percentage of the occupant load that an elevator group can transport in a period of 5 min.

High depth: A building more than 7 m below or more than two basements below the level of exit discharge, measured in accordance with the UAE FLSC [Ref. D.1]. A more detailed definition is given in UAE FLSC.

High-rise building: Building height greater than or equal to 23 m and up to 90 m, measured in accordance with the UAE FLSC [Ref. D.1]. A more detailed definition is given in UAE FLSC.

Jerk: Rate of change of acceleration (m/s^3).

Occupant load: Total number of persons that might occupy a building or portion thereof.

Occupiable floor: Floor designed for human occupancy in which individuals congregate for accommodation, amusement, work, educational or similar purposes.

Rated capacity: Load (kg and number of people) for which an elevator has been built and at which it is designed to operate.

Rated speed (v): Speed (m/s) for which an elevator has been built and at which it is designed to operate.

Super high-rise building: Building height greater than 90 m, measured in accordance with the UAE FLSC [Ref. D.1]. A more detailed definition is given in UAE FLSC.

Swing mode elevator: Elevator that is used for multiple purposes, e.g. passenger/service, passenger/fire/service, or fire/service.

Zoning: Virtual separation of the floors in the buildings based on the elevator groups, such that the elevators serving one zone do not serve the other zone.

D.2.2 Acronyms and abbreviations

AC	alternating current
ASME	American Society of Mechanical Engineers
BS EN	British Standard European Norm
Ch.	chapter
CSA	Canadian Standards Association
d	depth
DBC	Dubai Building Code
DCD	Dubai Civil Defence
DCS	destination control system
DD	destination dispatch
GA	gross area
h	height
HC	handling capacity
HCDC	hall call destination control
RCC	reinforced concrete
s	seconds
UAE FLSC	United Arab Emirates Fire and Life Safety Code of Practice
VT	vertical transportation
VVVF	variable voltage and variable frequency
w	width

D.3 References

ASME A17.1/CSA B44, Safety code for elevators and escalators

ASME A17.2, Guide for inspection of elevators, escalators and moving walks

ASME A17.3, Safety code for existing elevators and escalators

ASME A17.4, Guide for emergency personnel

ASME A17.5/CSA B44.1, Elevator and escalator electrical equipment

ASME A17.6, Standard for elevator suspension, compensation and governor systems

ASME A17.7/B44.7, Performance-based safety code for elevators and escalators

BS EN 81-20, Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 20: Passenger and goods passenger lifts

BS EN 81-21, Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 21: New passenger and goods passenger lifts in existing building

BS EN 81-22, Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 22: Electric lifts with inclined path

BS EN 81-28, Safety rules for the construction and installation of lifts – Part 28: Remote alarm on passenger and goods passenger lifts

BS EN 81-31, Safety rules for the construction and installation of lifts – Lifts for the transport of goods only – Part 31: Accessible goods only lifts

BS EN 81-40, Safety rules for the construction and installation of lifts – Special lifts for the transport of persons and goods – Part 40: Stairlifts and inclined lifting platforms intended for persons with impaired mobility

BS EN 81-41, Safety rules for the construction and installation of lifts – Special lifts for the transport of persons and goods – Part 41: Vertical lifting platforms intended for use by persons with impaired mobility

BS EN 81-50, Safety rules for the construction and installation of lifts – Examinations and tests – Part 50: Design rules, calculations, examinations and tests of lift components

BS EN 81-58, Safety rules for the construction and installation of lifts – Examination and tests – Part 58: Landing doors fire resistance test

BS EN 81-70, Safety rules for the construction and installation of lifts – Particular applications for passenger and goods passenger lifts – Part 70: Accessibility to lifts for persons including persons with disability

BS EN 81-71, Safety rules for the construction and installation of lifts – Particular applications to passenger lifts and goods passenger lifts – Part 71: Vandal resistant lifts

BS EN 81-72, Safety rules for the construction and installation of lifts – Particular applications for passenger and goods passenger lifts – Part 72: Firefighters lifts

BS EN 81-73, Safety rules for the construction and installation of lifts – Particular applications for passenger and goods passenger lifts – Part 73: Behaviour of lifts in the event of fire

BS EN 81-76, Safety rules for the construction and installation of lifts – Particular applications for passengers and goods passenger lifts – Part 76: Evacuation of persons with disabilities using lifts

BS EN 81-77, Safety rules for the construction and installations of lifts – Particular applications for passenger and goods passenger lifts – Part 77: Lifts subject to seismic conditions

BS EN 81-80, Safety rules for the construction and installation of lifts – Existing lifts – Part 80: Rules for the improvement of safety of existing passenger and goods passenger lifts

BS EN 81-82, Safety rules for the construction and installation of lifts – Existing lifts – Part 82: Rules for the improvement of the accessibility of existing lifts for persons including persons with disability

BS EN 115-1, Safety of escalators and moving walks – Part 1: Construction and installation

Ref. D.1 UAE MINISTRY OF INTERIOR GENERAL COMMAND OF CIVIL DEFENCE, 2018. UAE Fire and Life Safety Code of Practice (UAE FLSC). United Arab Emirates: Ministry of Interior General Command of Civil Defence.

D.4 General

Vertical transportation includes elevators, escalators and moving walks. This section prescribes the international standards to be followed for the safety, reliability and energy conservation of vertical transportation (VT) systems.

It also sets out the following acceptable design methods for establishing the minimum number of passenger elevators in different building types:

- a) design method 1 – prescriptive design using predefined numbers of passenger elevators for single occupancy building types (e.g. an apartment building with associated parking and retail at ground floor) (D.8); and
- b) design method 2 – design parameters for use in performance-based vertical transportation design by VT Consultants (D.9).

The accessibility requirements for vertical circulation, including the provision of accessible elevators, are defined in [C.5.9.3](#).

D.5 Safety and reliability

Vertical transportation shall be designed, installed, tested, commissioned and maintained in accordance with one of the following suites of standards:

- a) ASME A17 suite of standards; or
- b) BS EN 81 suite of standards.

One suite of standards shall be selected for a project. The suites of standards shall not be used interchangeably.

Elevators required for firefighting shall conform to Section 2.9, Ch. 2 and Section 3.9, Ch. 3 respectively of UAE FLSC [\[Ref. D.1\]](#), in addition to the chosen suite of standards.

In addition, enhanced handrail protection shall be provided at the entry to escalators and moving walks as shown in Figure D.1.

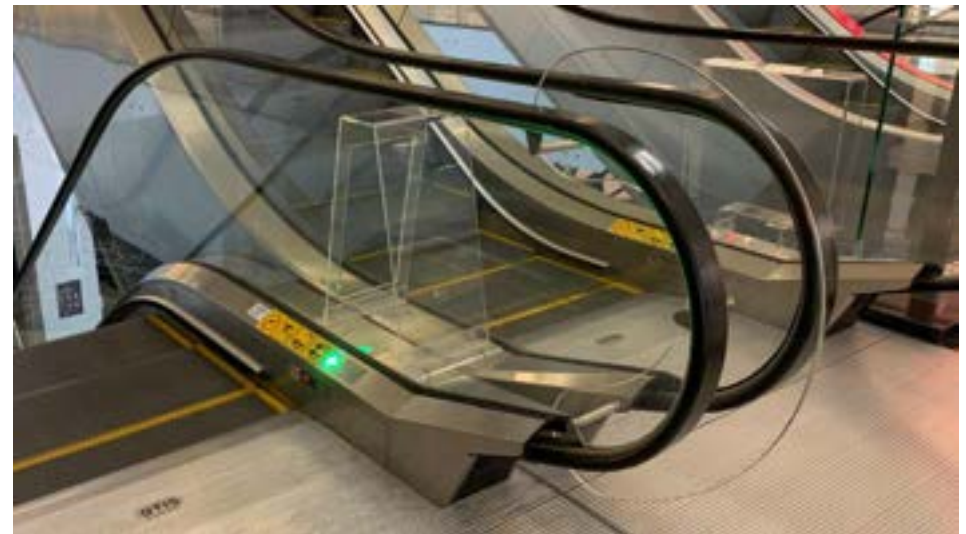


Figure D.1 Escalator with enhanced protection to handrail

D.6 Energy conservation

D.6.1 Elevators

Elevators in new buildings shall include controls to conserve energy. The following features shall be incorporated in traction drive elevators:

- a) AC variable voltage and variable frequency (VVVF) drives on non-hydraulic elevators;
- b) energy-efficient lighting, including controls that turn off lights when the elevator has been inactive for a maximum of 5 min. The energy-efficient lighting shall provide an average luminous efficacy greater than 70 lumens per circuit Watt inside the elevator; and
- c) a standby condition for off-peak periods.

NOTE: Regenerative drives should be used where they are shown to save energy.

D.6.2 Escalators and moving walks

Escalators and moving walks in new buildings shall include the following features to conserve energy.

- a) Reduced speed control. When no activity has been detected for a maximum of 3 min, the escalator or moving walk shall reduce to a slower speed.
- b) Use on demand. When no activity has been detected for a maximum of 15 min, the escalator or moving walk shall shut down. On-demand escalators and moving walks shall feature energy efficient soft-start technology.

For both features, photocell activation detectors shall be placed at the top and bottom landing areas as shown in Figure D.2.



Figure D.2 Escalator with detectors at top and bottom landing areas

D.7 Location and arrangement of passenger elevators

D.7.1 General

The location and arrangement of passenger elevators is common to both design methods (D.8 and D.9) for establishing the minimum number of passenger elevators in different building types.

D.7.2 Location of passenger elevators

D.7.2.1 General

Passenger elevators and multipurpose (e.g. passenger and service) elevators shall be located in the entrance lobby, near to the main entrance(s) of the building.

The noise from elevator hoist-ways shall not be heard in adjacent accommodation, in accordance with **H.10**.

Elevators shall be separated from enclosed parking areas by an air-conditioned lobby. The provision of air conditioning and ventilation shall be in accordance with **H.4**.

Doors from apartments or other residential accommodation (as described in D.8.8 to D.8.13) shall not open directly into an elevator lobby.

D.7.2.2 Horizontal distances

Elevator lobbies shall be located in different building types in accordance with Table D.1.

Building type	Maximum travel distance (m)	Measured between
Accommodation and residential	60 (see Figure D.3)	Elevator lobby and the entrance door of the accommodation unit furthest away from the elevator
Open plan office	60	Elevator lobby and the furthest point on the office floor
Retail (e.g. malls, shopping centres)	150	Elevator lobby and any point on the floor
Assembly (e.g. indoor amusement parks, arenas)	150	Elevator lobby and any point on the floor
Educational	150	Elevator lobby and any point on the floor
Hotel	60	Elevator lobby and the entrance door of the guest bedroom furthest away from the elevator

Table D.1 Maximum horizontal travel distance from elevator lobbies

NOTE: Buildings with a large footprint might require multiple building entrances and elevator lobbies.



Figure D.3 Floor plan with elevator lobby showing maximum travel distance to an elevator

D.7.3 Arrangement of passenger elevators

D.7.3.1 General

A maximum of four elevators shall be accommodated in one elevator core.

A maximum of eight elevators shall share one elevator lobby when used with a conventional control system.

D.7.3.2 Elevators in-line

Elevator grouping in a line shall be arranged as shown in Figure D.4, up to a maximum of four elevators, with the following exception.

With the exception of residential buildings, the distance in front of an elevator in a single sided lobby shall be a minimum of 2.4 m. In the typical floors (e.g. not entrance lobby) of residential buildings, the distance can be reduced to the width of the corridor leading to the elevator lobby or 1.8 m whichever is greater.

NOTE: If an elevator in the group is sized for stretchers then a lobby of 1.8 m width might not be sufficient.

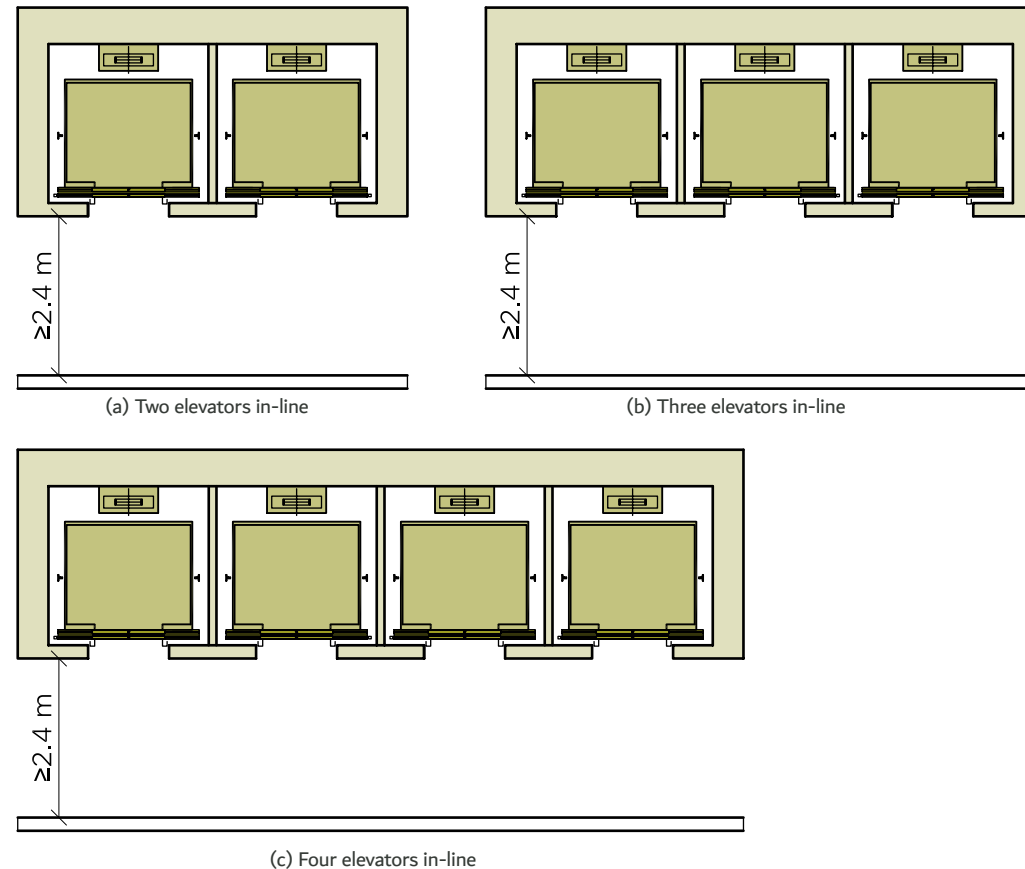


Figure D.4 In-line lobby arrangement (not more than four elevators)

D.7.3.3 Elevators facing each other

Elevator grouping featuring elevators facing each other shall be arranged as shown in Figure D.5, up to a maximum of eight elevators. The distance between the two elevator cores shall be:

- a) whichever is greatest of:
 - 1) a minimum of 2.4 m; or
 - 2) two times the depth of the deepest passenger elevator cabin; or
 - 3) 1.5 times the depth of the firefighting elevator cabin; and
- b) not greater than 4.5 m.

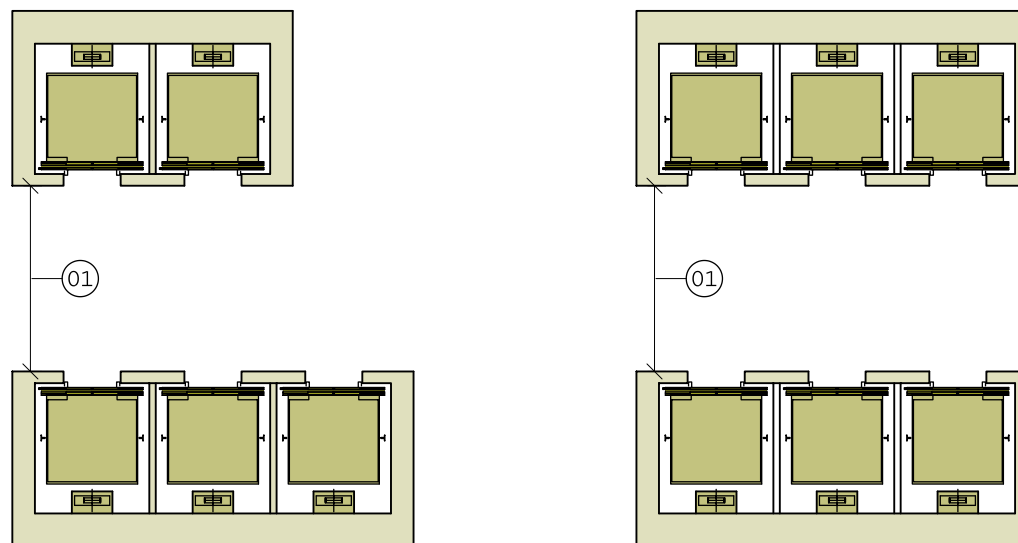


Figure D.5 Permitted distances between elevator cores

Key

01: Maximum 4.5 m and minimum 2.4 m, or a multiplier of the depth of the deepest elevator cabin

D.8 Design method 1: prescriptive design using predefined numbers of passenger elevators

D.8.1 General

Design method 1 allows designers to establish the minimum number of passenger elevators required for different single-occupancy building types, based on the following parameters:

- a) building type;
- b) population;
- c) number of floors occupied by people;
- d) number of boarding floors;
- e) elevator grouping.

NOTE 1: Design method 1 is appropriate for single occupancy buildings with associated facilities such as parking or ground floor retail. Design method 2 is required for mixed use buildings such as a tower comprising 50% hotel and 50% office.

NOTE 2: The minimum number of passenger elevators can be influenced by other parameters. It is the design team's responsibility to include elevators for other services, not limited to firefighting elevators (see Section 2.9, Ch. 2 of UAE FLSC [Ref. D.1]), evacuation elevators (see Section 3.9, Ch. 3 of UAE FLSC [Ref. D.1]), service elevators (D.8.2) and waste elevators, as required by building operators, the DBC and the Authorities.

NOTE 3: Design method 2 is required for buildings whose height or population exceeds those given in the method 1 tables.

NOTE 4: Report templates for design method 1 and design method 2 are given in D.10.1 and D.10.2. A summary of the minimum information required in the design method 2 report is given in D.10.3.

Firefighting and service elevators are permitted to be used as passenger elevators provided that they are located within a group of passenger elevators.

D.8.2 Service elevators

D.8.2.1 Number of service elevators

The minimum number of service elevators serving all floors shall be selected using Table D.2. Any additional elevators to meet the design intent or the requirements of relevant Authorities shall be included as necessary.

Any authority requirement for clean and dirty elevators shall be met accordingly.

Building type	Classifications	Minimum	Remarks
Residential	—	One	The firefighting elevator or one of the passenger elevators could be used as a service elevator. Where a passenger elevator is used as a service elevator, scheduled operation for service mode is required.
Hotel	1- and 2-star	One	For keys more than 250, add one elevator for every 200 keys.
	3-star	Two	—
	4- and 5-star	Two	For keys more than 500, add one elevator for every 200 keys.
Hotel apartment	—	One	—
Office	—	One	The firefighting elevator or one of the passenger elevators could be used as a service elevator. Where a passenger elevator is used as a service elevator, scheduled operation for service mode is required.
Retail/shopping centres/malls	—	One	For buildings with more than 75 outlets, add one elevator for every 100 retail outlets.
NOTE: Minimum and recommended specifications for service elevators in different buildings types are given in D.8.8 to D.8.18.			

Table D.2 Number of service elevators

D.8.2.2 Rated speed

The rated speed of service elevators shall be selected using Figure D.6. Where a service elevator is grouped with passenger elevators, the rated speed shall be selected in accordance with D.8.6.

NOTE: It is recommended that service elevators reach the uppermost floor of a building within 60 s.

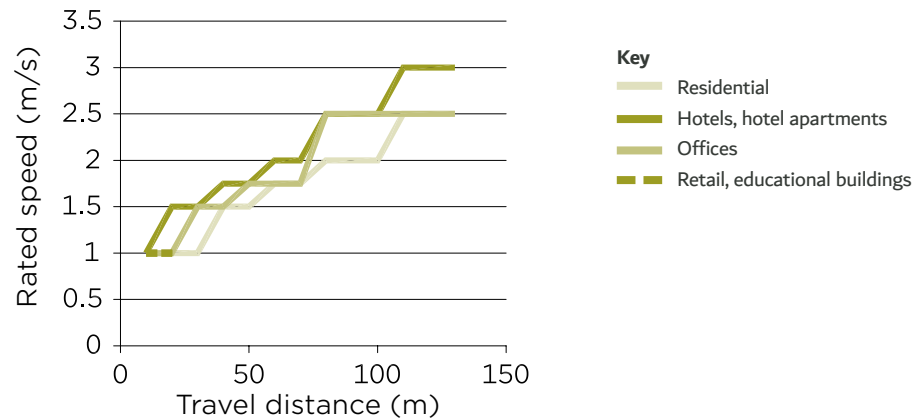


Figure D.6 Rated speed selection for service elevators

D.8.3 Firefighting elevators

D.8.3.1 Firefighting elevators

Section 2.9, Ch. 2 of UAE FLSC requires at least one firefighting elevator in a mall, a multi-storey amusement park and any building which is high-rise, super high-rise or high depth. Firefighting elevators in super high-rise shall comply with D.8.3.3.

Section 2.9, Ch. 2 of UAE FLSC [Ref. D.1] requires each firefighting elevator to have access to every floor of the building.

As specified in Ch. 1 Table 1.9 of UAE FLSC [Ref. D.1], either the firefighting elevator hoistway shall be located within a fire rated shaft constructed of reinforced concrete (RCC) or all elevators in a common RCC shaft shall be designed as firefighting elevators.

Firefighting elevators are permitted to be used as passenger elevators provided that they are located within their own dedicated RCC shaft and are in a group of passenger elevators (see D.8.7).

Section 2.9, Ch. 2 of UAE FLSC [Ref. D.1] permits firefighting elevators to be used as service elevators. Firefighting elevators are not permitted to be used as goods lifts.

D.8.3.2 Rated speed of firefighting elevators

The travel time for firefighting elevators to reach the uppermost floor of a building shall be determined using the suite of standards chosen in D.5.

UAE FLSC [Ref. D.1] requires that firefighting elevators serve all floors of a building.

D.8.3.3 Firefighting elevators in super high-rise buildings

A firefighter's elevator lobby [minimum gross area (GA) of 9 m²] shall be provided to the firefighting elevator in super high-rise buildings (see Section 2.9, Ch. 2 and Table 1.9, Ch. 1 of UAE FLSC [Ref. D.1]). The firefighting elevator lobby shall have direct access to the firefighting elevator and a fire-rated exit stair.

Where a firefighting elevator has two doors, the second entrance is not required to open into the firefighting lobby, but it shall be protected by an alternate 1 h fire-rated lobby.

D.8.4 Minimum number of passenger elevators

The minimum number of passenger elevators shall be established based on estimated population and the number of boarding floors for each building type (see D.8.8 to D.8.18), as shown in Figure D.7.

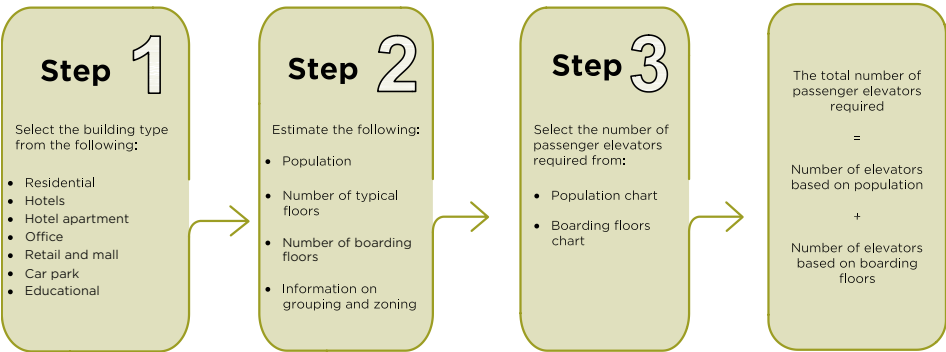


Figure D.7 Illustration for estimation of number of passenger elevators

For values beyond those shown in the charts and tables for each occupancy type, a VT Consultant shall be appointed to design a VT system based on design method 2 (see D.9).

D.8.5 Grouping of passenger elevators and population estimation

D.8.5.1 Single grouping and one floor zone

For buildings with a single elevator grouping and with one zone of floors served as shown in Figure D.8, the population shall be estimated using the occupancy rates in D.8.8 to D.8.18.

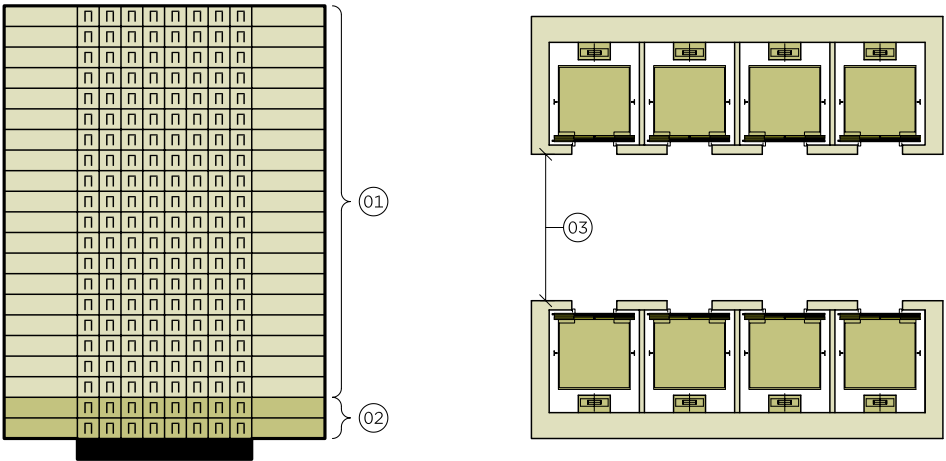


Figure D.8 One grouping-one zone

- Key**
- 01: Occupied floors
 - 02: Boarding floors
 - 03: Permitted distance between elevator cores

D.8.5.2 Multiple lobbies serving one zone

For buildings where two elevator groupings serve the same zone of floors, the groupings shall be located as shown in Figure D.9, based on the proximity of the lobbies to the individual units (as described in D.7.2.2).

When undertaking traffic analysis, the uneven distribution of building occupants between the two groupings shall be allowed for. The overall population used in the analysis shall be 120% of the actual building population.

The population for each elevator grouping shall be distributed based on Figure D9 and the ratios shown in Table D.3.

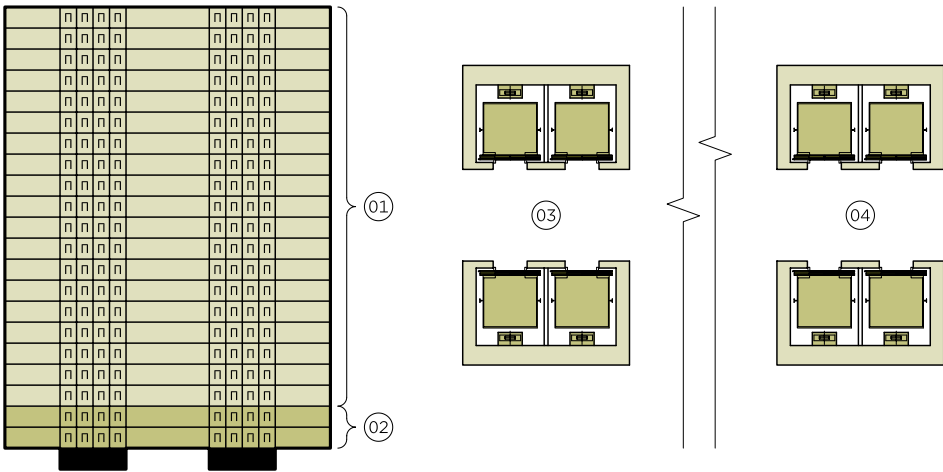


Figure D.9 Two groupings – one zone

- Key**
- 01: Occupied floors
 - 02: Boarding floors
 - 03: Elevator lobby group 1
 - 04: Elevator lobby group 2

Grouping	Ratio 1		Ratio 2		Ratio 3		Ratio 4	
	Actual pop.	Pop. for traffic study	Actual pop.	Pop. for traffic study	Actual pop.	Pop. for traffic study	Actual pop.	Pop. for traffic study
Grouping 1	50%	60%	60%	70%	70%	80%	80%	90%
Grouping 2	50%	60%	40%	50%	30%	40%	20%	30%

Table D.3 Ratio of population for buildings with two elevator groupings

EXAMPLE: The actual population of a residential building is approximately 500 people. Due to its large footprint, the building has two groups of elevators. There is no definite estimation of the population using each entrance. Under these conditions, the population for each group shall be estimated as below.

Actual population = 500 people

Weighted population = $500 \times 120\% = 600$ people

Population for traffic analysis for each group = $600/2$

Population for traffic analysis for each group = 300

The number of passenger elevators for each grouping shall be selected based on the charts in D.8.8 to D.8.18.

Where more than two elevator groupings are required, a VT Consultant shall be appointed.

D.8.5.3 Multiple groupings serving different floor zones

Where multiple elevator groupings serve different floor zones, such as in Figure D.10, the population for each grouping shall be estimated based on the occupancy rates of the floors served.

When reading passenger elevator selection charts for the high zone, the low zone floors (not served) shall be included.

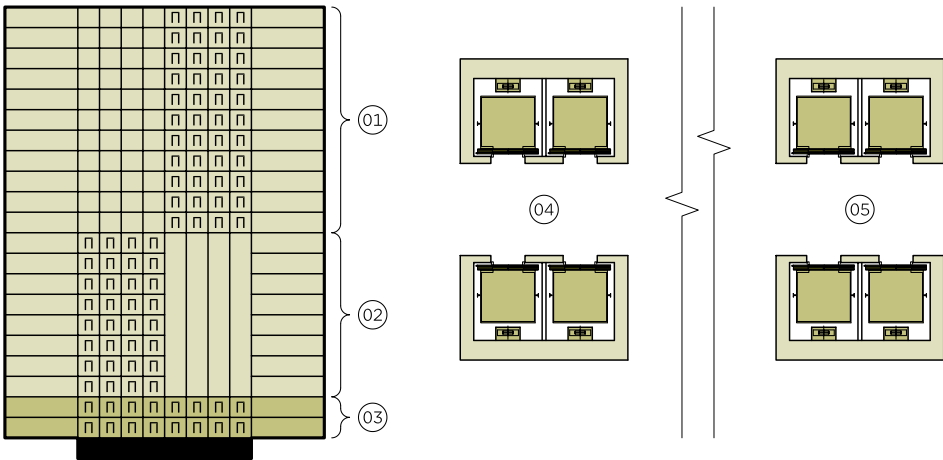


Figure D.10 Two groupings – two zones

- Key**
- 01: High zone occupied floors
 - 02: Low zone occupied floors
 - 03: Boarding floors
 - 04: Elevator lobby group 1
 - 05: Elevator lobby group 2

D.8.6 Rated speed of passenger elevators

The rated speed of passenger elevators (see Figure D.11) shall be calculated as the travel distance between the top most and bottom-most floor divided by the minimum travel time.

The minimum travel time for different building types shall be determined from Table D.4.

Building type	Classification	Travel time (s)
Residential	Apartments	40 to 45
	Accommodation buildings	50 to 60
Hotel	1- and 2-star	35 to 40
	3-star	25 to 30
	4- and 5-star	20 to 25
Hotel apartments	—	25 to 30
Office	Regular	25 to 30
	Concentrated	30 to 35
Healthcare	Clinics and hospitals	25 to 30
Retail	Retail, shopping centres and malls	25 to 30
Educational	Schools and universities	25 to 30

Table D.4 Minimum travel time for different building types

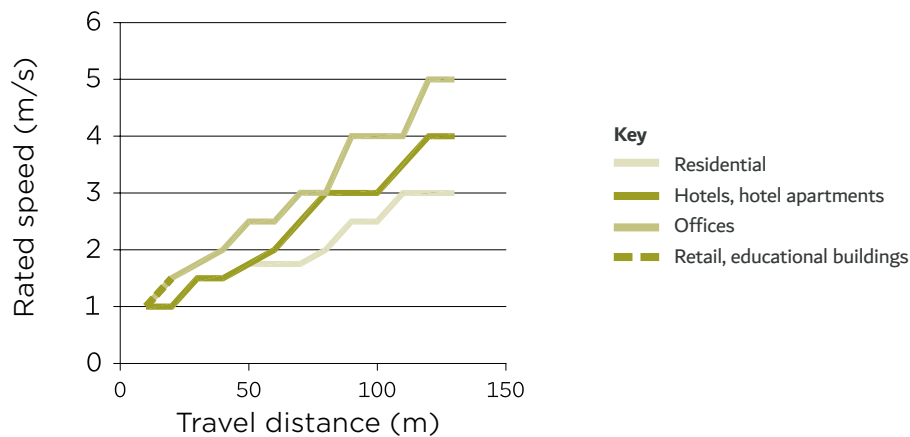


Figure D.11 Rated speed selection for passenger elevators

D.8.7 Passenger elevators serving as multipurpose or swing mode elevators

Some elevators are designed as passenger elevators, while also meeting the requirements for a firefighting elevator or the functional requirements of a service elevator. When these elevators are part of a passenger elevator grouping, they shall be included in calculations for the minimum number of passenger elevators.

Figure D.12 shows a multipurpose elevator in a passenger elevator grouping.

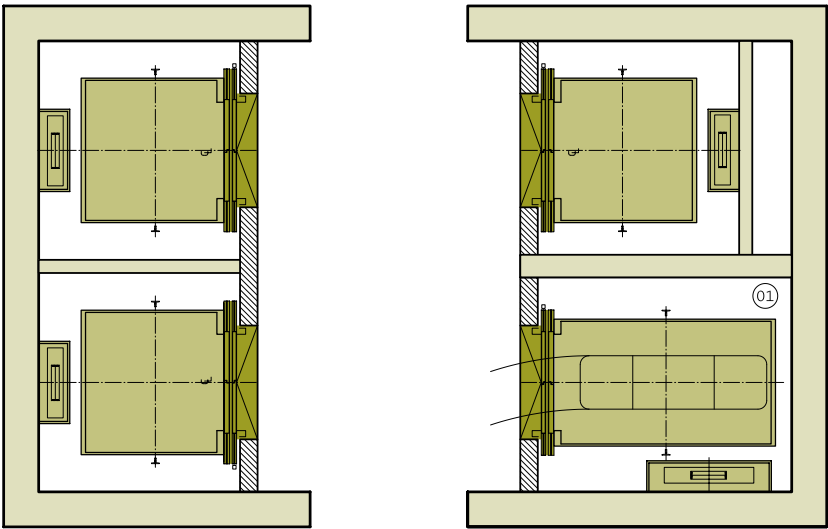


Figure D.12 Passenger, service and fire-fighting elevator in a passenger elevator grouping

Key
01: Firefighting passenger-service elevator

Table 1.9, Ch. 1 of UAE FLSC [Ref. D.1] requires that the firefighting elevator is located within its own fire-rated RCC shaft.

D.8.8 Passenger elevators in residential apartments

D.8.8.1 Population estimation

For buildings with one elevator grouping, the population shall be estimated based on the occupancy rates in Table D.5.

Apartment type	Occupancy rate (persons)
Studio	1.5
1 bedroom	1.8
2 bedrooms	3
3 bedrooms	4
4 bedrooms	5
For each additional bedroom/live-in housekeeper room	1

Table D.5 Occupancy rate for residential apartments

For buildings with more than one elevator grouping, the population shall be estimated in accordance with D.8.5.

D.8.8.2 Passenger elevator selection charts

The minimum number of passenger elevators shall be determined from Figure D.13.

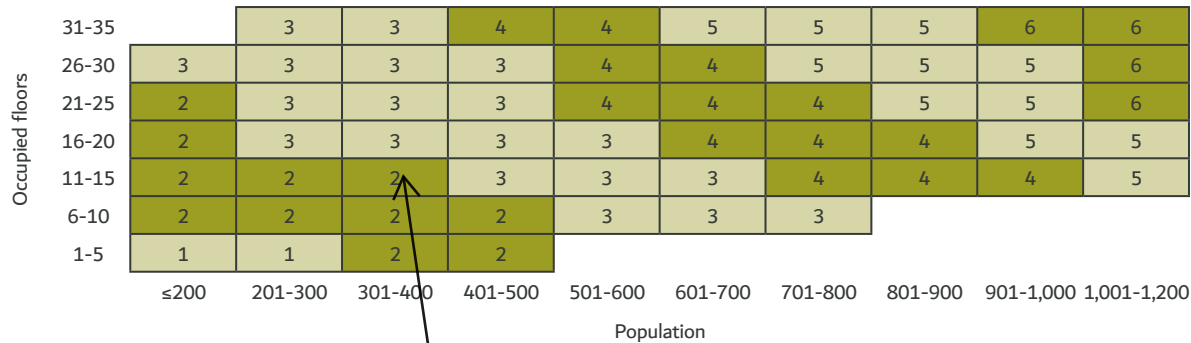


Figure D.13 Elevator chart for population – residential apartments

slhd be 3

The minimum number of passenger elevators shall be taken as the sum of the numbers obtained from Figure D.13 and Figure D.14.

Occupied floors	31-35	0	0	1	1	2	2
	26-30	0	0	1	1	2	2
	21-25	0	0	1	1	1	1
	16-20	0	0	1	1	1	1
	11-15	0	0	0	1	1	1
	6-10	0	0	0	1		
	1-5	0	0	0			
		1	2	3	4	5	6

(a) for population >700

Occupied floors	31-35	0	0	1	1	1	1
	26-30	0	0	1	1	1	1
	21-25	0	0	1	1	1	1
	16-20	0	0	1	1	1	1
	11-15	0	0	0	1	1	1
	6-10	0	0	0	1		
	1-5	0	0	0			
		1	2	3	4	5	6

(b) for population ≤700

Figure D.14 Elevator chart for boarding floors

D.8.8.3 Minimum elevator specifications

Elevators shall meet the minimum specifications given in Table D.6.

Attribute	Passenger elevators			Service elevators	
	Minimum for floors ≤10	Minimum for floors >10	Recommended for floors >10	Minimum	Recommended
Rated capacity (kg)	750	1,050	1,350	1,275	1,600
Rated capacity (persons)	10	14	18	17	21
Number of car doors	One	One	One	One	One
Cabin size, w × d (mm)	1,200 × 1,500	1,600 × 1,500	2,000 × 1,500	1,200 × 2,300	1,400 × 2,400
Cabin height, h (mm)	2,300	2,300	2,300	2,500	2,500
Door size, w × h (mm)	900 × 2,100	1,100 × 2,100	1,100 × 2,100	1,100 × 2,100	1,200 × 2,100
Door type	Two-panel centre opening			Two-panel centre opening	

Table D.6 Minimum specifications for elevators in residential apartment buildings

D.8.9 Passenger elevators in staff accommodation

D.8.9.1 Population estimation

For buildings with one elevator grouping, the population shall be estimated based on the occupancy rates in Table D.7. If the population required by the owner/developer and approved by the Authority is higher, the higher requirement shall be followed.

Apartment type	Occupancy rate (persons)
Studio	2
1 bedroom	2
2 bedrooms	4
3 bedrooms	6
For each additional bedroom	2

Table D.7 Occupancy rate for staff accommodation

For buildings with more than one elevator grouping, the population shall be estimated in accordance with D.8.5.

D.8.9.2 Passenger elevator selection chart

These requirements assume that staff accommodation buildings are a maximum of two storeys. The minimum number of passenger elevators shall be determined from Figure D.15.

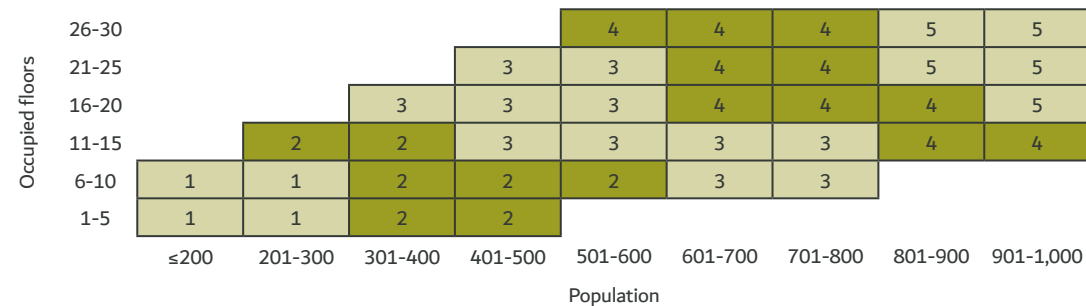


Figure D.15 Elevator chart for population – staff accommodation

D.8.9.3 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.8.

Attribute	Minimum	Recommended
	Passenger	Passenger and service
Rated capacity (kg)	750	1,275
Rated capacity (persons)	10	17
Number of car doors	One	One
Cabin size, w × d (mm)	1,200 × 1,500	1,200 × 2,300
Cabin height, h (mm)	2,300	2,500
Door size, w × h (mm)	900 × 2,100	1,100 × 2,100
Door type	Two-panel centre opening	Two-panel side opening

Table D.8 Minimum specifications for elevators in staff accommodation

D.8.10 Passenger elevators in labour accommodation

D.8.10.1 Population estimation and passenger elevator selection

These requirements assume that labour accommodation buildings have a maximum of six occupiable floors and that stairs are the primary means of circulation.

The population shall be estimated based on a rate of eight persons per room, or the rate required by the owner/developer and permitted by the Authorities.

The provision shall be the higher of either:

- one elevator for every 1,000 labourers; or
- one elevator for every two entrances to the building.

D.8.10.2 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.9.

Attribute	Minimum	Recommended
	Passenger	Passenger and service
Rated capacity (kg)	750	1,275
Rated capacity (persons)	10	17
Number of car doors	One	One
Cabin size, w × d (mm)	1,200 × 1,500	1,200 × 2,300
Cabin height, h (mm)	2,300	2,500
Door size, w × h (mm)	900 × 2,100	1,100 × 2,100
Door type	Two-panel centre opening	Two-panel side opening

Table D.9 Minimum specification for elevators in labour accommodation

D.8.11 Passenger elevators in student accommodation

D.8.11.1 Population estimation

The population shall be estimated based on the occupancy rates in Table D.10. If the population required by the owner/developer and permitted by the Authorities is higher, the higher requirement shall be used.

Apartment type	Occupancy rate (persons)
Studio	2
1 bedroom	2
2 bedrooms	4
3 bedrooms	6
For each additional bedroom	2

Table D.10 Occupancy rate for student accommodation

D.8.11.2 Passenger elevator selection chart

The minimum number of passenger elevators shall be determined from Figure D.16.

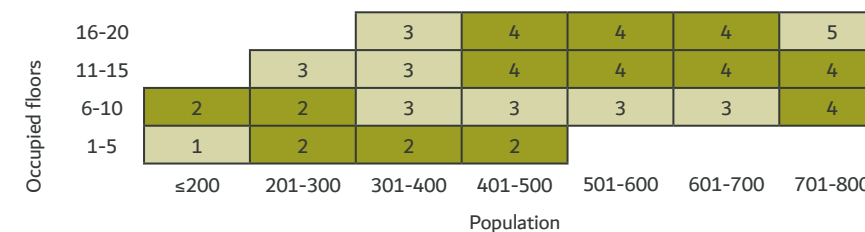


Figure D.16 Elevator chart for population – student accommodation

D.8.11.3 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.11.

Attribute	Minimum	Recommended
	Passenger	Passenger and service
Rated capacity (kg)	750	1,275
Rated capacity (persons)	10	17
Number of car doors	One	One
Cabin size, w × d (mm)	1,200 × 1,500	1,200 × 2,300
Cabin height, h (mm)	2,300	2,500
Door size, w × h (mm)	900 × 2,100	1,100 × 2,100
Door type	Two-panel centre opening	Two-panel side opening

Table D.11 Minimum specifications for elevators in student accommodation

D.8.12 Passenger elevators and escalators in hotels

D.8.12.1 Population estimation

Hotel buildings include guest rooms and common spaces. The guest population shall be estimated based on the occupancy rates in Table D.12.

Building type	Occupancy rate (persons)
4- and 5-star	1.8 per room
3-star	1.5 per room
1- and 2-star	1.5 per room

Table D.12 Guest occupancy rate for hotels

It is highly recommended to provide separate elevators for use by the public. Where there is no provision for public elevators, public populations shall be added to the hotel guest population and access control measures shall be added to elevator controls to ensure authorized access to the guest floors/rooms.

The public population shall be estimated based on the occupancy rates in Table D.13.

Public areas	Occupancy rate (m ² per person)
Meeting rooms	1.2
Ballrooms	1.5
Restaurants	1.5
Food and beverage outlets	1.5

Table D.13 Occupancy rate for public areas

For buildings with more than one elevator grouping, the population shall be estimated in accordance with D.8.5.

D.8.12.2 Passenger elevator selection chart

The minimum number of passenger elevators shall be determined from Figure D.17, Figure D.18 or Figure D.19, depending on the hotel’s star rating.

Occupied floors	Population								
	≤200	201-300	301-400	401-500	501-600	601-700	701-800	801-900	901-1,000
					4	5	6	6	7
			3	4	4	5	5	6	6
			3	4	4	4	5	5	6
		3	3	3	4	4	5	5	
26-30									
21-25									
16-20									
11-15									
6-10	2	2	3	3	3	4	4	4	
1-5	2	2	2						

Figure D.17 Elevator chart for population – 1- and 2-star hotels

Occupied floors	Population								
	≤200	201-300	301-400	401-500	501-600	601-700	701-800	801-900	901-1,000
					4	5	5	7	7
					4	5	5	6	6
			3	4	4	5	5	6	6
		3	3	4	4	4	5		
26-30									
21-25									
16-20									
11-15									
6-10	2	2	3	3	4	4	4		
1-5	2	2	2						

Figure D.18 Elevator chart for population – 3-star hotels

Occupied floors	Population							
	≤200	201-300	301-400	401-500	501-600	601-700	701-800	801-900
					6	6	7	7
				5	5	6	6	7
				4	5	5	6	7
		3	3	4	4	5	5	6
26-30								
21-25								
16-20								
11-15								
6-10	2	3	3	4	4	5	5	5
1-5	2	2	2					

Figure D.19 Elevator chart for population – 4- and 5-star hotels

D.8.12.3 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.14, Table D.15 or Table D.16, depending on the hotel's star rating.

J.5 describes access control requirements between hotel floors.

Attribute	Passenger elevators		Service elevators	
	Minimum	Recommended	Minimum	Recommended
Rated capacity (kg)	1,050	1,350	1,275	1,600
Rated capacity (persons)	14	18	17	21
Number of car doors	One	One	One	One
Cabin size, w × d (mm)	1,600 × 1,500	2,000 × 1,500	1,200 × 2,300	1,400 × 2,400
Cabin height, h (mm)	2,300	2,300	2,500	2,500
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,100	1,100 × 2,100	1,300 × 2,300
Door type	Two-panel centre opening		Two-panel side opening	

Table D.14 Minimum specifications for elevators in 1- and 2-star hotels

Attribute	Passenger elevators		Service elevators	
	Minimum	Recommended	Minimum	Recommended
Rated capacity (kg)	1,350	1,600	1,600	1,600
Rated capacity (persons)	18	21	21	21
Number of car doors	One	One	One	One
Cabin size, w × d (mm)	2,000 × 1,500	2,100 × 1,600	1,400 × 2,400	1,400 × 2,400
Cabin height, h (mm)	2,300	2,500	2,500	2,500
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,300	1,300 × 2,300	1,300 × 2,300
Door type	Two-panel centre opening		Two-panel side opening	

Table D.15 Minimum specifications for elevators in 3-star hotels

Attribute	Passenger elevators		Service elevators	
	Minimum	Recommended	Minimum	Recommended
Rated capacity (kg)	1,350	1,600	1,600	2,000
Rated capacity (persons)	18	21	21	26
Number of car doors	One	One	One	One
Cabin size, w × d (mm)	2,000 × 1,500	2,100 × 1,600	1,400 × 2,400	1,500 × 2,700
Cabin height, h (mm)	2,400	2,600	2,500	2,800
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,100	1,300 × 2,300	1,400 × 2,300
Door type	Two-panel centre opening		Two-panel side opening	

Table D.16 Minimum specifications for elevators in 4- and 5-star hotels

D.8.12.4 Minimum escalator specifications

Escalators providing circulation between public floors shall meet the minimum specifications in Table D.17.

Attribute	Minimum	Recommended
Practical capacity (people per hour)	4,500	4,500
Number of flat steps*	Floor height ≤ 6 m: Two	Three
	Floor height > 6 m: Three	
Step width (mm)	1,000	1,000
Angle of inclination	Floor height ≤ 6 m: 35°	30°
	Floor height > 6 m: 30°	
*Steps refers to the depth of an escalator step or equivalent length of moving walk.		

Table D.17 Minimum specifications for escalators

D.8.13 Passenger elevators in hotel apartments

D.8.13.1 Population estimation

The population shall be estimated based on the occupancy rates in Table D.18.

Apartment type	Occupancy rate (persons)
Studio	1
1 bedroom	1.5
2 bedrooms	2.5
3 bedrooms	3.5
For each additional bedroom	1

Table D.18 Guest occupancy rate for hotel apartments

D.8.13.2 Passenger elevator selection charts

The minimum number of passenger elevators shall be determined from Figure D.20.

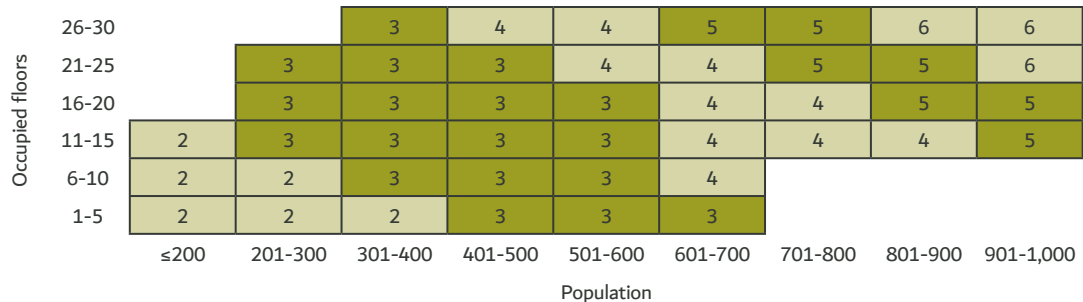


Figure D.20 Elevator chart for population – hotel apartments

The number of additional passenger elevators for the number of boarding floors shall be determined from Figure D.21. The minimum number of passenger elevators shall be taken as the sum of the numbers obtained from Figure D.20 and Figure D.21.

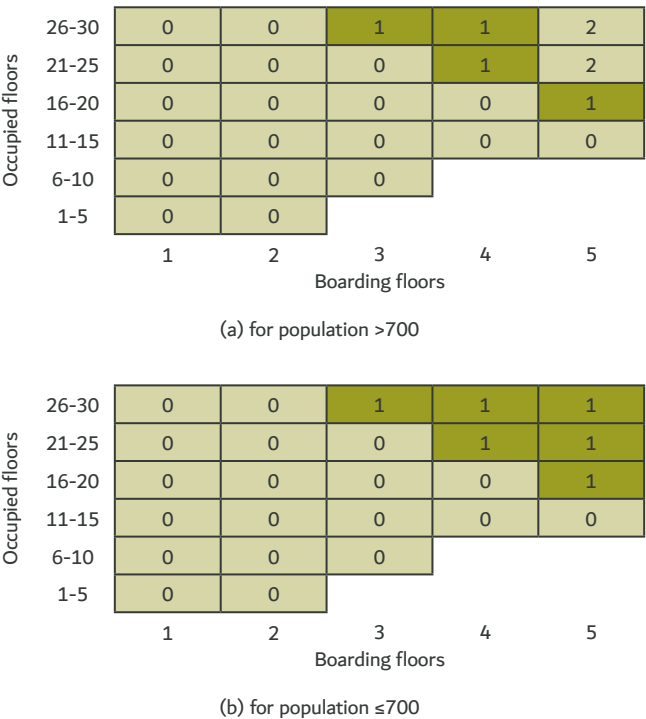


Figure D.21 Elevator chart for boarding floors – hotel apartments

D.8.13.3 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.19. **Part J** describes access control requirements between floors.

Attribute	Passenger elevators		Service elevators	
	Minimum	Recommended	Minimum	Recommended
Rated capacity (kg)	1,050	1,350	1,600	1,600
Rated capacity (persons)	14	18	21	21
Number of car doors	One	One	One	One
Cabin size, w × d (mm)	1,600 × 1,500	2,000 × 1,500	1,400 × 2,400	1,400 × 2,400
Cabin height, h (mm)	2,300	2,300	2,500	2,500
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,100	1,200 × 2,300	1,300 × 2,300
Door type	Two-panel centre opening		Two-panel side opening	

Table D.19 Minimum specifications for elevators in hotel apartments

D.8.14 Passenger elevators and escalators in office buildings

D.8.14.1 Passenger elevator selection

For buildings with one elevator grouping, the number of passenger elevators shall be determined based on the number of boarding floors, the number of occupiable floors and GA, using Figure D.22.

Boarding floors		1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-8	1	2-4	5-									
Occupied floors	19-20										4	6	6	5	7	7	6	8	8	7	9	9	8	10	11	8	11	12	9	12	13									
	17-18										4	6	6	5	7	7	6	7	8	6	8	9	7	10	10	8	11	11	9	12	13									
	15-16										4	5	6	5	6	7	5	7	8	6	8	9	7	9	10	8	10	11	9	12	12									
	13-14										4	5	6	5	6	7	5	7	8	6	7	8	7	8	10	7	9	10	9	10	11									
	11-12													3	5	5	4	5	6	5	6	7	6	7	8	6	7	9	7	9	10	9	10	11						
	9-10													3	4	4	3	5	5	4	5	6	4	5	6	5	6	7	6	7	8	6	7	8	7	9	10	8	10	11
	7-8													2	3	3	3	4	4	3	5	5	4	5	6	5	6	7	5	7	8	5	7	8						
	5-6	2	2	3	2	3	3	2	3	3	3	4	5	4	5	5	4	6	6																					
	3-4	1	2		2	3		2	3		3	4																												
	1-2	1	2		2	2																																		
GA in m²		≤2,500			2,501-5,000			5,001-7,500			7,501-10,000			10,001-12,500			12,501-15,000			15,001-17,500			17,501-20,000			20,001-22,500			22,501-25,000											

Figure D.22 Elevator chart for office building

Figure D.22 assumes an occupancy rate of 10 m² per person on 80% of the GA. For higher occupancy, a VT Consultant shall be appointed.

For buildings with more than one elevator grouping serving all floors or zones, a VT Consultant shall be appointed.

D.8.14.2 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.20.

Attribute	Passenger elevators				Service elevators	
	Minimum		Recommended		Minimum	
	≤5 floors	>5 floors	≤5 floors	>5 floors	≤5 floors	>5 floors
Rated capacity (kg)	1,050	1,275	1,350	1,600	1,275	1,600
Rated capacity (persons)	14	17	18	21	17	21
Number of car doors	One	One	One	One	One	One
Cabin size, w × d (mm)	1,600 × 1,500	1,900 × 1,500	2,000 × 1,500	2,100 × 1,600	1,200 × 2,300	1,400 × 2,400
Cabin height, h (mm)	2,300	2,300	2,300	2,300	2,400	2,600
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,100	1,100 × 2,100	1,100 × 2,100	1,100 × 2,100	1,200 × 2,300
Door type	Two-panel centre opening				Two-panel centre opening	

Table D.20 Minimum specifications for elevators in office buildings

D.8.14.3 Minimum escalator specifications

When escalators are used for occupant circulation between parking floors and office floors, they shall meet the minimum specifications in Table D.21.

Attribute	Minimum	Recommended
Practical capacity (people per hour)	4,500	4,500
Number of flat steps*	Floor height ≤6 m: Two	Three
	Floor height >6 m: Three	
Step width (mm)	1,000	1,000
Angle of inclination	Floor height ≤6 m: 35°	30°
	Floor height >6 m: 30°	
*Steps refers to the depth of an escalator step or equivalent length of moving walk.		

Table D.21 Minimum specifications for escalators

D.8.15 Circulation in retail, shopping centres and malls

D.8.15.1 Primary and secondary modes of circulation

Escalators are used by approximately 80% of people. Where shopping trolleys will be used, inclined moving walks shall be provided instead of escalators. Where moving walks are not feasible, elevators of sufficient capacities to accommodate passengers with trolleys and return of trolleys may be provided.

Elevators are a secondary mode of circulation, used by people with specific requirements. Elevators shall be located next to escalators and moving walks. The maximum distance between sets of elevators/escalators/moving walks shall be 100 m.

Escalators and moving walks shall not replace elevators as the means of circulation for people of determination using wheelchairs.

D.8.15.2 Population estimation

The population shall be estimated based on a rate of one person per 5 m² of gross leasing area and public circulation area.

D.8.15.3 Selection tables

The minimum number of escalators and elevators shall be determined from Table D.22.

Population (persons)	Escalator	Elevator
Less than 600	Optional	One set of two elevators
600 to 4,500	One group	One set of two elevators
4,501 to 8,000	Two groups	Two sets of two elevators
For every additional 4,000	Add one group	Add one set of two elevators

Table D.22 Escalator and elevator selection chart for retail

The minimum number of moving walks and elevators shall be determined from Table D.23.

Population (persons)	Moving walk	Elevator
Less than 600 + trolley movement	Yes	One set of two elevators
600 to 3,600	One group	One set of two elevators
3,601 to 7,200	Two groups	Two sets of two elevators
For every additional 3,000	Add one group	Add one set of two elevators

Table D.23 Moving walks and elevator selection chart for retail

D.8.15.4 Minimum specifications

Escalators shall meet the minimum specifications in Table D.24.

Attribute	Minimum	Recommended
Practical capacity (people per hour)	4,500	4,500
Number of flat steps*	Floor height ≤6 m: Two	Three
	Floor height >6 m: Three	
Step width (mm)	1,000	1,000
Angle of inclination	Floor height ≤6 m: 35°	30°
	Floor height >6 m: 30°	
*Steps refers to the depth of an escalator step or equivalent length of moving walk.		

Table D.24 Minimum specifications for escalators

Moving walks shall meet the minimum specifications in Table D.25.

Attribute	Minimum	Recommended
Practical capacity (people per hour)	3,600 minimum	3,600
Number of flat steps*	Not applicable	Three
Pallet width (mm)	1,000 minimum	1,000
Angle of inclination	12° maximum	10° or 11°
*Steps refers to the depth of an escalator step or equivalent length of moving walk.		

Table D.25 Minimum specification for moving walks in retail buildings

Elevators shall meet the minimum specifications in Table D.26.

Attribute	Passenger elevators		Passenger elevators for trolley circulation		Service elevators		
	Minimum	Recommended	Minimum	Recommended	Minimum	Recommended	
Rated capacity (kg)	1,600	2,000	2,500	3,200	1,600	2,000	2,500
Rated capacity (persons)	21	26	33	43	21	26	33
Number of car doors	One	One	One	One	One	One	One
Cabin size, w × d (mm)	2,100 × 1,600	2,350 × 1,700	2,000 × 2,400	2,200 × 3,000	1,400 × 2,400	1,500 × 2,700	1,800 × 2,700
Cabin height, h (mm)	2,400	2,400	2,400	2,400	2,500	2,500	2,500
Door size, w × h (mm)	1,100 × 2,100	1,200 × 2,100	1,500 × 2,100	1,600 × 2,100	1,200 × 2,100	1,400 × 2,300	1,600 × 2,300
Door type	Two-panel centre opening		Four-panel centre opening		Two-panel centre opening		Four-panel centre opening

Table D.26 Minimum specifications for elevators in retail buildings

D.8.16 Passenger elevators in car parking buildings

D.8.16.1 Population estimation

These requirements assume that car parking buildings have a maximum of five floors above or below ground. The population shall be estimated based on the car occupancy rates in Table D.27.

For car parking connected to retail/shopping centres/malls with multi-level entries, a VT Consultant shall be appointed.

Types of car parking facility	Occupancy rate (persons)
Independent car parking building	1.5 per car
Parking in retail/shopping centre/mall	3.0 per car

Table D.27 Occupancy rate for car parking building

For buildings with more than one elevator grouping, the population shall be estimated in accordance with D.8.5.

D.8.16.2 Passenger elevator selection chart

The minimum number of passenger elevators shall be determined from Figure D.23.

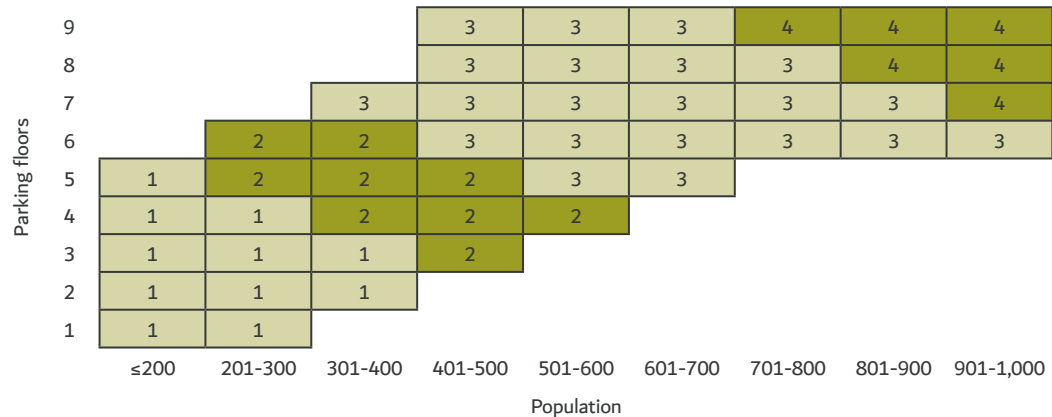


Figure D.23 Elevator chart for car parking building

D.8.16.3 Minimum elevator specifications

Elevators shall meet the minimum specifications in Table D.28.

Attribute	Minimum	Recommended
Rated capacity (kg)	1,275	1,600
Rated capacity (persons)	17	21
Number of car doors	One	One
Cabin size, w × d (mm)	1,200 × 2,300	1,400 × 2,400
Cabin height, h (mm)	2,300	2,500
Door size, w × h (mm)	1,100 × 2,100	1,200 × 2,100
Door type	Two-panel side opening	Two-panel side opening

Table D.28 Minimum specifications for passenger elevators in car parking buildings

D.8.17 Passenger elevators in schools

These requirements assume that the school building is a maximum of five storeys, and elevators are for service applications and people of determination only. Two elevators that meet the minimum specifications in Table D.29 shall be provided.

Attribute	Minimum	Recommended
Rated capacity (kg)	750	1,275
Rated capacity (persons)	10	17
Number of car doors	One	One
Cabin size, w × d (mm)	1,200 × 1,500	1,200 × 2,300
Cabin height, h (mm)	2,300	2,500
Door size, w × h (mm)	900 × 2,100	1,100 × 2,100
Door type	Two-panel centre opening	Two-panel centre opening

Table D.29 Minimum specifications for passenger elevators in schools

D.8.18 Passenger elevators in universities

These requirements relate to multi-storey classroom buildings. For other university building types, the minimum number and specifications for elevators shall be in accordance with D.8.8 to D.8.17 as required.

The minimum number of elevators shall be determined from Table D.30. Where classroom buildings have multiple entrances, a minimum of two elevators shall be provided at each entrance.

Number of people	Number of elevators
For first 400 people	Two elevators
For every additional 300 people	One additional elevator

Table D.30 Number of passenger elevators in classroom buildings of universities

Elevators shall meet the minimum specifications in Table D.31.

Attribute	Passenger elevators		Service elevators	
	Minimum	Recommended	Minimum	Recommended
Rated capacity (kg)	1,350	1,600	1,600	2,000
Rated capacity (persons)	18	21	21	26
Number of car doors	One	One	One	One
Cabin size, w × d (mm)	2,000 × 1,500	2,100 × 1,600	1,400 × 2,400	1,500 × 2,700
Cabin height, h (mm)	2,400	2,400	2,500	2,500
Door size, w × h (mm)	1,100 × 2,100	1,100 × 2,100	1,200 × 2,100	1,400 × 2,300
Door type	Two-panel centre opening		Two-panel side opening	

Table D.31 Minimum specifications for elevators in university classroom buildings

D.9 Design method 2: design parameters for use in performance-based vertical transportation design

D.9.1 General

Design method 2 relies on a series of interrelated parameters, all of which shall be included in the VT design.

It is the design team's responsibility to include elevators for other services, not limited to firefighting and evacuation elevators (D.8.3), service elevators (D.8.2) and waste elevators, as required by building operators, the DBC and the Authorities.

NOTE: A report template for design method 2 is given in D.10.2. A summary of the minimum information required in the report is given in D.10.3.

D.9.2 Population estimation

D.9.2.1 General

The occupancy rate tables referred to in D.8.8 to D.8.18 guide the estimation of population for various building types. The VT Consultant shall use the most appropriate method for estimating population.

If the population required by the owner/developer and permitted by the Authority is higher, the higher requirement shall be followed.

D.9.3 Handling capacity and traffic pattern

D.9.3.1 Handling capacity

The handling capacity of elevators shall not exceed the values given in Table D.32 and Table D.33.

Type	Classification	Handling capacity HC5%
Residential	Apartments	7%
	Student accommodation	8%
	Staff accommodation	6%
Hotel	1- and 2-star	10%
	3-star	11%
	4- and 5-star	12% to 15%
Hotel apartment	Hotel apartment	10%
Car parking	Office/mall	8% to 10%
Office	Regular	12%
	Concentrated	12%
Healthcare	Clinics and hospitals	8% to 10%
Educational	Universities	16% to 20%
Retail	Retail, shopping centres and malls	8% to 10%

Table D.32 Handling capacity (HC5%)

Type	Classification	Handling capacity HC5%
Office	Regular	13%
	Concentrated	13%

Table D.33 Handling capacity (HC5%) during lunch break

D.9.3.2 Traffic pattern

Different building types experience different circulation patterns at different times of day. The traffic pattern adjustments given in Table D.34 shall be used in the design.

Building type	Classification	Traffic pattern
Residential	Morning	35% up/65% down
	Evening	50% up/50% down
Hotel	Morning	50% up/50% down
	Evening	50% up/50% down
Hotel apartment	Evening	50% up/50% down
Car parking	Evening	50% up/50% down
Office	Morning peak – single tenant	85% up/10% down/5% inter-floor
	Morning peak – multi-tenant	85% up/15% down
	Lunch peak – single tenant	45% up/45% down/10% inter-floor
	Lunch peak – multi-tenant	50% up/50% down
Healthcare	Patients	50% up/50% down
	Visitors	50% up/50% down
	Staff	40% up/40% down/20% inter-floor
Educational	Morning	100% up
	Breaks	40% up/40% down/20% inter-floor
Retail	Weekend evening	40% up/40% down/20% inter-floor

Table D.34 Traffic pattern

D.9.4 Average waiting time

The values in Table D.35 shall be used as the basis for elevator specifications.

Building type	Classification	Average waiting time (s)
Residential	Apartment	≤40
	Student accommodation	≤45
	Staff accommodation	≤45
Hotel	1- and 2-star	≤40
	3-star	≤35
	4- and 5-star	≤30
	Hotel apartments	≤35
Car parking	Parking in malls/offices/residences	≤40
Office	Regular	≤35
	Concentrated	≤35
Healthcare	Clinics and hospitals	≤40
Educational	Universities	≤40
Retail	Retail, shopping centres and malls	≤40

Table D.35 Average waiting time

D.9.5 Capacity factor

The capacity factor of elevator cars shall not exceed the values in Table D.36. A maximum capacity factor of 70% shall be used for panoramic elevators.

Figure D.24 illustrates elevator car capacity factors.

Building type	Classification	Recommended
Residential	Apartments	60% to 80%
	Accommodation	80%
Hotel	1- and 2-star	80%
	3-star	60%
	4- and 5-star	50%
	Hotel apartments	60%
Car parking	Parking in malls/offices	80%
Office	Regular	80%
	Concentrated	80%
Healthcare	Clinics	60% to 80%
	In-patient facilities	50%
Educational	Universities	80%
Retail	Retail, shopping centres and mall	50%

Table D.36 Capacity factor

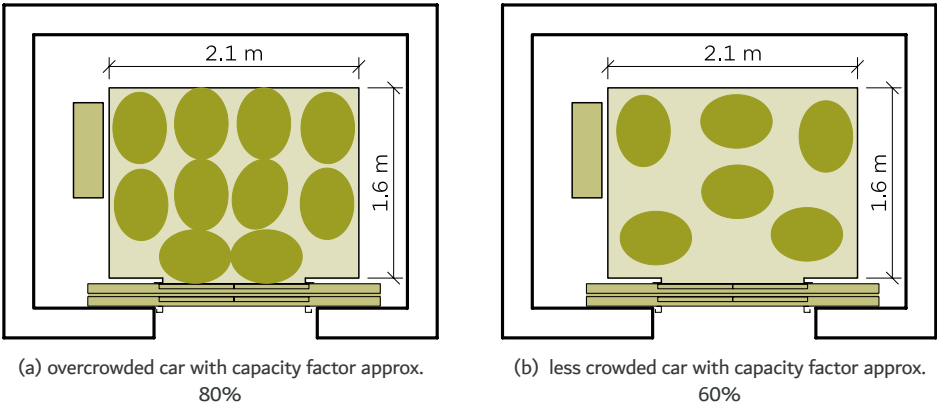


Figure D.24 Occupancy in elevator car

D.9.6 Boarding floors

Car parking floors above or below the main boarding floor become boarding floors for car occupants and distribute the total building population. The population of podium and basement parking floors shall be estimated based on a rate of 1.5 persons per car.

Table D.37 gives an example population distribution for a residential building with a total population of 1,000 people and four parking floors (100 parking spaces each).

Boarding floors	Number of parking spaces	Population	Boarding bias
Podium 2	100	150	15%
Podium 1	100	150	15%
Basement floor B1	100	150	15%
Basement floor B2	100	150	15%
Ground floor	—	1,000 minus the sum of above	40%

Table D.37 Example population distribution at boarding floors

D.9.7 Magnet floors

A magnet floor is a floor likely to attract traffic from multiple other floors. Examples include staff dining rooms, restaurants, gyms and conference suites.

NOTE: Magnet floors should have dedicated elevators. If dedicated elevators are not provided, the population of the magnet floors shall be estimated and added to the building population to help determine the required number of passenger and service elevators.

Access control to residential and office floors in the building shall be provided.

D.9.8 Factors influencing VT system efficiency

D.9.8.1 Door timing

Shorter door timings improve the efficiency of an elevator. The most efficient door parameters shall only be included in the design calculations when they can be fulfilled by the manufacturer.

NOTE: Table D.38 gives door timings for different elevator operations.

Building type	Classification	Door timing (s)			
		Door open	Door close	Dwell time	Pre-opening*
Residential	Apartments <120 m in height	2.2	3.2	3 to 5	0
	Apartments ≥120 m in height	1.9	2.8		
	Student accommodation	2.2	3.2		
	Staff accommodation	2.2	3.2		
Hotel	1- and 2-star	2.2	3.2		0
	3-star	1.9	2.8		
	4- and 5-star	1.9	2.8		
	Hotel apartments <120 m in height	2.2	3.2		
	Hotel apartments ≥120 m in height	1.9	2.8		
Car parking	Mall/residences/offices	2.2	3.2		0.5
Office	Regular	1.9	2.8		
	Concentrated	1.9	2.8		0
Healthcare	Clinics and hospitals	2.2	3.2		
Educational	Schools and universities	2.2	3.2		
Retail	Retail, shopping centres and malls	2.2	3.2		
* This is generally recommended in office buildings. This is not recommended in hotels and residential buildings considering the comfort levels of elders and children.					

Table D.38 Door timing based on two-panel centre opening (900 mm wide to 1,100 mm wide)

D.9.8.2 Acceleration and jerk

Lower acceleration and jerk values provide better perceived comfort for passengers. Table D.39 gives recommended maximum values.

For bed elevators, acceleration shall not exceed 0.6 m/s² and jerk shall not exceed 1.0 m/s³.

Speed (m/s)	Acceleration (m/s ²)	Jerk (m/s ³)
1	0.7	0.8
1.5 to 1.75	0.8	0.9
2.0 to 2.5	0.9	1
3.0 to 4.0	1	1.1
≥5	1.2	1.4

Table D.39 Recommended maximum acceleration and jerk at a given speed

D.9.8.3 Destination control systems

Conventional elevator control systems are the most user-friendly, but they can be less efficient compared to destination dispatch (DD)/hall call destination control (HCDC), or a destination control system (DCS).

Figure D.25 illustrates a conventional control system and Figure D.26 illustrates a DCS. In a DCS, the passenger enters the destination floor before entering the cabin. The terminal shows floor numbers or a telephone keypad.

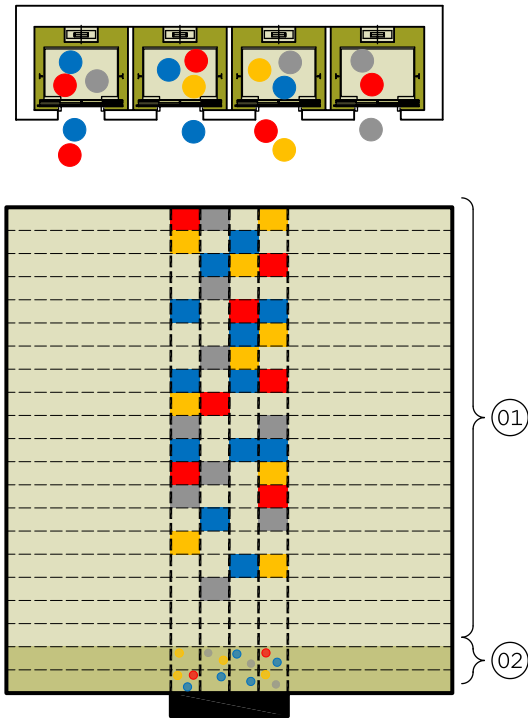


Figure D.25 Conventional control system

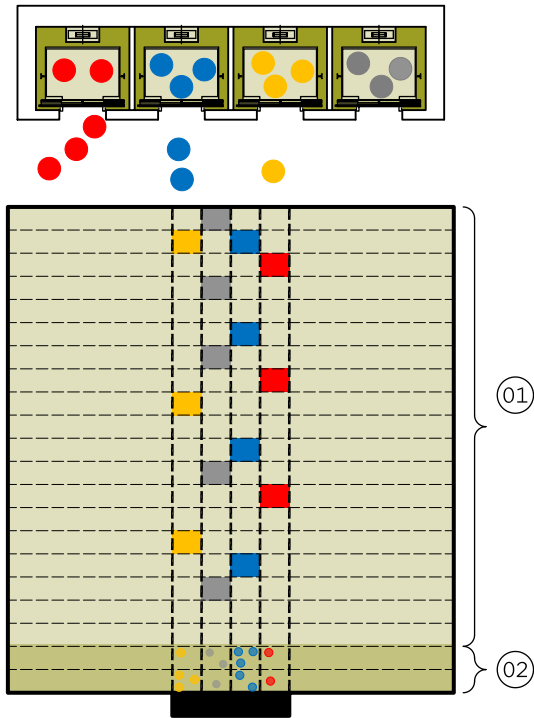


Figure D.26 Destination control system

Key
01: Typical floors
02: Boarding floors

A DCS is preferred under the following conditions.

- The elevators in the group do not serve an equal number of stops/floors.
- The up-peak traffic is demanding.
- There are multiple function areas in floors/mixed use buildings.
- Tenants and visitors enrol to get into the building/office premises.

A DCS offers the following advantages over a conventional control system.

- It improves the time to destination by grouping people travelling to the same floors at learned intervals.
- It results in organized lobby space, allowing more people to wait in the lobby.
- It is able to perform express travel with fewer intervening stops.
- It improves system efficiency and handling capacity, allowing a group of elevators to transport more passengers in a fixed period of time.
- It allows terminals to be mounted away from the elevator lobby, reducing congestion in the elevator lobbies.

A DCS offers the following disadvantages over a conventional control system.

- It has a relatively lower performance during the lunchtime peak.
- For correct and efficient operation of a DCS, each passenger needs to enter their destination and not tail-gate. Groups of people tend to allow one person to enter the destination floor, which means the DCS computes that there is only one person when there could be two, three or more persons.
- It is not user-friendly for people unfamiliar with the system. A passenger getting into the wrong elevator has to exit and take another elevator to reach their destination.

Table D.40 sets out building types that benefit from a DCS compared to a conventional control system.

Building type	Conventional system	Destination control system
Residential apartment – occupants are familiar with the elevator system	✓	✓
Office – occupants are familiar with the elevator system	✓	✓ ✓
Hotel – occupants are unfamiliar with the elevator system	✓	-
Hotel apartment – occupants are unfamiliar with the elevator system	✓	-
Educational building – stairs are relied upon to move between classes	✓	-
Healthcare building (staff area) – occupants are familiar with the elevator system	✓	✓
Healthcare building (all other areas) – mixture of occupants who are familiar and unfamiliar with the elevator system	✓	-

Table D.40 Recommendations for destination control systems in buildings

D.9.8.4 Hybrid systems

A hybrid system (historically called an up-peak booster) combines destination control at the main boarding floor with conventional elevator controls at other floors. A hybrid system should be used where it is necessary to overcome lag in a DCS during peak lunchtime occupant circulation.

D.10 Annex: Vertical transportation design summaries and report template

D.10.1 Vertical transportation selection summary – Design method 1

Vertical transportation selection summary (Design method 1)				
Project name			Form number	
Location			Date	
Plot no.				
Client				
Architect				
Project type				
Project classification				
	Design	Authority		
Estimated population				
Number of groups				
Occupiable floors				
Boarding floors including main lobby				
Number of passenger elevators based on population				
Number of passenger elevators based on boarding floors				
Number of dedicated firefighting elevators				
Number of dedicated service elevators				
Number of other elevators				
Total elevators in the project				
Number of escalators in the project				
Number of moving walks in the project				
Authority section				
Comments				
Reviewed by				

D.10.2 Vertical transportation design summary – Design method 2

Vertical transportation performance approval summary (Design method 2)									
Project name				Plot #			Form #		
Location						Date			
Client									
Architect									
Project type									
Project classification									
Is there a VT Consultant involved?	yes	no		Group 1					
					Morning peak	Lunch peak	Evening peak		
Estimated population				Handling capacity HC5%					
Occupiable floors				Average waiting time (s)					
Boarding floors including main lobby				Average destination time (s)					
	Group 1	Group 2	Group 3		Group 2				
					Morning peak	Lunch peak	Evening peak		
Capacity				Handling capacity HC5%					
Speed				Average waiting time (s)					
Door open time				Average destination time (s)					
Door closing time									
Acceleration									
Jerk									

					Group 3			
Number of passenger elevators						Morning peak	Lunch peak	Evening peak
Number of passenger elevators/ fire/service elevators				Handling capacity HC5%				
Number of dedicated firefighting elevators				Average waiting time (s)				
Number of dedicated service elevators				Average destination time (s)				
Number of other elevators								
Total elevators in the project								
Total number of escalators in the project								
Total number of moving walks in the project								
Declaration: The vertical transportation system in the project is designed within the recommended parameters, and the parameters selected shall be met by suppliers approved in the UAE.								
Remarks by VT Consultant/Lead Consultant								
Authority section								
Comments:								
Reviewed by				Approved by				

D.10.3 Vertical transportation report template for VT Consultants

Table D.41 gives a summary of the minimum information required in the report.

Summary of vertical transportation (VT) design report	
Section A	Main report
A1	Purpose of the report
A2	Project overview
A3	Assumptions
A4	Design of vertical transportation (VT) system
A5	Design elements for residences
A6	Definitions of design parameters
A7	Selection of passenger elevators
A8	Selection of firefighting elevator
A9	Selection of service and other elevators
A10	Conclusions and recommendations
Section B	Annexures
B1	Codes and requirements of Authorities
B2	Traffic analysis
B3	Planning information
B4	Requirements from Authorities

Table D.41 Summary of vertical transportation (VT) design report