

VA



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Elevator design manual

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Elevator Design Manual

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1.0 GENERAL REQUIREMENTS

- A. An elevator machine room shall be provided for each individual elevator or group of elevators. The elevator machine and elevator controller shall be located in the same machine room.
- B. The elevator equipment for new facilities shall be included in the general contract with specification sections prepared for each elevator system as required. The overall annual cost of the elevator systems, including amortized costs of the original investment, cost of maintenance, material, and consumed power shall be considered.
- C. Elevators shall be provided in all facilities having two (2) or more floors and shall be designed for the traffic anticipated. Passenger and service elevators shall be sized to accommodate transport equipment used by persons with special needs.
- D. The latest editions of the publications listed constitute the minimum requirements for elevator transportation systems, including design, methods of construction, manner of installation, and testing.

American Society of Mechanical Engineers (ASME) Safety Codes for Elevators - A17.1, A17.3, A17.4, A17.5, A17.6, A18.1

National Fire Protection Association (NFPA) - 13, 70, 72, 101, 252

International Building Code (IBC)

Guide for Inspection of Elevators - A17.2

Standards for the Qualification of Elevator Inspectors - ASME QEI-1

American Society of Safety Engineers (ASSE) – Personnel Hoists and Employee Elevators on Construction and Demolition Operations A10.4

VA Barrier Free Design Standard - PG-18-13

VA Seismic Design Handbook - H-18-8

Vertical Transportation Handbook, 4th Edition

- E. Where conflicts are found between this document and other VA publication this document shall prevail. The conflict shall be brought immediately to the attention of the Project Manager to verify applicability to the project.
- F. Refer to PG-18-3 topic 18 for the qualification requirements for the designers / consultants for this work. All studies and designs are to be provided by independent, experienced and qualified consultant that performs Vertical Transportation studies and design as a standard part of their services.



2.0 ELEVATOR LOCATIONS and TRAFFIC STUDY REQUIREMENTS

- A. The size and number of elevators required for a building depends upon the function of the building size, layout, and the physical location and grouping of elevators.
- B. Locate elevators to serve all floors that require service, including the basement, sub-basement, interstitial spaces, and overhead mechanical spaces. Avoid placing elevators or dumbwaiters over occupied spaces as this will require counterweight safeties and reinforced pits.
- C. Where groups of elevators serving identical floors are required in two or more locations for the purpose of providing reasonable convenience of use, the elevators shall provide a minimum carrying capacity of not less than 120 percent of the maximum traffic peak to allow for migration between the groups.
- D. Where one elevator would meet the service requirements for a healthcare building, provide two (2) elevators to insure continuity of service where patient transportation is essential. If additional patient transport elevators are within approximately 100 feet and serve the same landings a second elevator may not be required.
- E. Elevators shall be grouped in banks of adjacent elevators or banks of elevators facing each other. Do not exceed three (3) service elevators in-line, three (3) passenger elevators in-line, and not more than six (6) cars in a group of three (3) facing three (3). The lobby width between two banks of passenger elevators shall not be less than 3.65 m (12 ft). Service elevator lobbies shall not be less than 4.25 m (14 ft).
- F. The maximum walking distance from patient elevators to the most distant check-in area or rest area with seating should not exceed 45.5 m (150 ft). Elevators for patient transport, hospital services, and staff the maximum walking distance from elevators to the most distant patient room shall not exceed 60.5 m (200 ft). These factors should be weighed along with the advantages of locating elevators near the center of the building and the advantage of elevator clustering. Decentralized elevators should be planned to include at least two (2) elevators and maintain an acceptable average interval approximately <50 seconds.
- G. Estimating the number of elevators required:
 - 1. The criteria recommended for service assumes an understanding of several elevator design terms and concepts. The adequacy of elevator service is related to the length of time passengers wait for service and the ability of the elevator system to handle people and “vehicles” as they require service. Standards for the comparison and evaluation of these two basic measures of elevator service have been developed. They are termed AVERAGE INTERVAL and HANDLING CAPACITY.
 - 2. Average interval is the “quality” measure and is defined as the elapsed time in seconds between elevator departures from a terminal floor, averaged over a specific time period. Average interval is not a direct measure of how long prospective



- passengers wait for service. However, it is a value that can be calculated and verified relatively easily. The accuracy of such calculations has been verified by countless tests. Such tests indicate that average passenger waiting time (APWT) for service at a typical intermediate floor approximates 65% to 80% of the average interval during heavy two-way traffic periods.
3. The “quantity” measure of elevator service is called handling capacity. This is defined as the number of persons and vehicles that can be transported by the elevator system in a given length of time. Average interval and handling capacity must be measured or calculated *for the same designated time period* to be meaningful. Handling capacity measurements shall always be based on the space taken by the various using population such as ambulatory people, wheelchairs, beds, carts, etc.
 4. The building elevator population is the total number of riders / vehicles that will require the use of automated vertical transport (elevators) during their stay in the building. Hence people that come arrive and depart from the main entrance level and that use the stairs would not be included in the elevator population. Traffic studies shall detail the calculations that arrive at the populations used.
 5. The anticipated population figures shall be provided by the Department of Veterans Affairs to assist in the system design. However, in all cases, the vertical transportation requirements shall be planned for the total design occupancy population rather than a forecast of initial occupancy.
 6. Maximum traffic peak, this is the maximum percentage of the total population on the floors served by the elevators that must be handled during the peak five (5) minute period. This maximum traffic peak will vary with the type of functional areas and special conditions applicable to the facility. In general, analysis should consider visitor arrival and departures, staff changes, patient transport/staff/service and material movement. The maximum traffic peak shall be considered as being both 2-way and 1-way peaks based on elevator loading at the lower main terminal, or terminals, local discharge of passengers on the up trip, inter-floor travel and local passenger pickup on the return trip, and discharge at the lower main terminal.
 7. Traffic studies shall be based on the requirements in PG-18-3 topic 18 and shall be accomplished individually for each elevator group except for specialty elevators that have obvious low traffic volumes such as an elevator that may be required in an industrial or storage area of a central utility plant (CUP) used for moving occasional traffic required for servicing equipment or moving bulk storage.



8. Elevator Performance Tables

The criteria for acceptable elevator performance shall be based on the following:

PASSENGER ELEVATORS OVER THE PEAK 5 MINUTES

Building Type	Average Interval Required	Minimum Handling Capacity
Hospital - Medical Center	Under 35 seconds	15% of the calculated building elevator population for the zones serviced (plus 20% migration for multiple elevator groups).
Outpatient Clinic	Under 40 seconds	15% of the calculated building elevator population for the zones serviced (plus 10% migration for multiple elevator groups).
Office Buildings	Under 45 Seconds	12% of the calculated building population.
Parking Garage	Under 45 Seconds	110 % of the calculated elevator population of the zones serviced.

PATIENT / MATERIALS HANDLING SERVICE ELEVATORS
OVER THE PEAK 5 MINUTES

Building Type	Average Interval Required	Handling Capacity
Hospital - Medical Center	Under 40 seconds	15% of the calculated elevator population for the zones serviced (plus migration).
Outpatient Clinic	Under 45 seconds	15% of the calculated elevator population for the zones serviced (plus migration).

PATIENT SERVICE AND PATIENT EQUIPMENT ONLY SERVICE ELEVATORS
OVER THE PEAK 5 MINUTES

Building Type	Average Interval Required	Handling Capacity
Hospital - Medical Center	Under 40 seconds	115% of the calculated traffic.
Outpatient Clinic	Under 45 seconds	110% of the calculated traffic.



3.0 ELEVATOR TYPE, SIZE, and CAPACITY

- A. Passenger elevators are used to transport the public, hospital staff, ambulatory and wheel chair/scooter/walker and otherwise disabled patients.
- B. Hospital service elevators are used to transport patients, staff, carts, and equipment. Patients may be in wheelchairs, beds, and gurneys.
- C. Combination passenger and service elevators may be installed where combined use is possible without interfering with normal activities in the healthcare facility. Avoid mixing patient transport with any other traffic.
- D. Elevators for limited special use are economically undesirable and shall not be specified unless they can be fully justified. The use of slow speed elevators shall be considered and separated from other traffic if required for mortuary use or the transport of animals.
- E. Passenger elevators with center opening doors shall be Class “A” loading as a minimum requirement. Service elevators with center opening doors or side sliding doors shall be Class “C3” loading as a minimum requirement. Freight elevators with vertical by-parting doors shall be Class “C1” loading.
- F. Maximum size and weight of electric powered vehicles, carts, portable medical, and X-ray equipment shall be determined before selecting elevator size and capacity.
- G. Elevator capacity and platform design for healthcare and non-healthcare facilities:
 - 1. Elevator sizes may vary for non-healthcare facilities. Minimum size shall be 1125 kg (2500 lb) capacity to meet the requirements ADA and PG-18-13 with 42 inch wide door openings.
 - 2. Passenger elevators, with single speed center opening doors, shall be a minimum 1818 kg (4,000 lb) capacity with 3.92 sq m (42.2 sq ft) inside net platform area with 48 inch wide door openings. Elevator sizes to be determined by the area required for the Users and not by weight.
 - 3. Passenger/Service elevators, with two speed side opening doors, shall be a minimum 2250 kg (5,000 lb) capacity with 4.65 sq m (50 sq ft) inside net platform area with minimum 48 inch wide door openings.
 - 4. Service elevators, with two speed side opening or center opening doors, shall be a minimum 2273 kg (5,000 lb) capacity with 4.65 sq m (50 sq ft) inside net platform area with minimum 48 inch wide door openings. Consider 6,000 lb. and larger elevators for facilities that require three (3) or more attendants and possibly equipment to accompany patient transports.
 - 5. Bariatric and Trauma elevators, with center opening doors or two speed side opening doors shall be a minimum 2727 kg (6,000 lb) capacity with 5.36 sq m (57.7 sq ft) inside net platform area with minimum 54 inch wide door openings.



6. Freight elevators with vertical by-parting doors shall be sized to handle the intended service; laundry, trash removal, dietary, etc.

H. Traction elevators:

1. Specify overhead geared or gearless hoisting machines for elevators in buildings more than 4 floors or 40 ft of rise. The placing of hoisting machines in basement machine rooms or in machine rooms adjacent to the hoistway shall be limited to conditions that do not accommodate the installation of overhead machines.
2. Utilize minimum .50"x8x19 or .50"x8x25 preformed traction steel hoist ropes.

I. Hydraulic elevator:

1. Oil hydraulic direct plunger elevators will be specified for up to four stops, 12.2 m (40 ft) with a rated speed of 0.63 m/s (125 fpm). Holeless plunger will be considered for difficult site conditions.
2. Electronic Motor Starter shall be used on hydraulic elevators. Do not use Wye-Delta or across the line starters.
3. Locate down overspeed shut-off valve next to the cylinder head.
4. Locate oil line manual shut-off valve in the pit and machine room.
5. Locate oil return scavenger pump in the elevator pit.

4.0 ELEVATOR ENCLOSURE

- A. Elevator Car enclosures shall be front entrance or front and rear entrance and shall be standard design. Cab designs shall be detailed on the architectural drawings.
- B. Enclosure shall have a minimum canopy height inside the cab of 2.4 m (8 ft).
- C. Canopy constructed of not less than 12-gauge steel. Walls shall be not less than 14-gauge steel.
- D. Front return panel(s), entrance columns, entrance transom shall be 14-gauge stainless steel full height of car.
- E. Service elevators: Side and rear walls of service elevators, up to the center line of the top handrail, shall be covered with stainless steel. Side and rear walls to the ceiling may be covered with high pressure plastic laminate, stainless steel applied directly to the cab walls or raised panels.
- F. Passenger elevators: Side and rear wall may use raised panels cover in materials suitable for use in elevators.
- G. Car door(s) shall be reinforced two panels steel construction covered with stainless steel on the inside surface wrapped around the leading edge.



5.0 DOORS AND ENTRANCES

- A. Provide power door operation for all elevators. Non-healthcare facilities may use other industry standard door sizes and entrance frames.
 - 1. Passenger/Service door operator shall be capable of opening doors at the rate of 0.75 m/s (2.5 fps), with actual speed being adjusted to meet requirements of the specific installation. Freight door operator shall open at 0.3 m/s (1 fps).
 - 2. Closing speed shall be 0.3 m/s (1 fps). All power operated doors shall be equipped with an automatic reopening device for passenger protection. In healthcare facilities do not activate door nudging. Use audio voice announcement, “please stand clear of the doors”, and activate the nudging buzzer.
- B. Entrances for Passenger, Service and Freight Elevators:
 - 1. Doors shall be center opening for passenger elevators and center or side opening for service elevators in healthcare facilities. Hoistway doors shall be reinforced two panel construction with stainless steel on the outside surface, wrapped around leading edges. Use only center opening doors for facilities that require three (3) or more attendants and possibly equipment to accompany patient transport.
 - 2. Passenger elevator entrance width: 1.2 m (4 ft) standard.
 - 3. Service elevator entrance width: minimum 1.2 mm (4 ft), larger if required by facilities function.
 - 4. Door minimum opening height: 2.1 m (7 ft).
 - 5. Curved hoistway entrance side jambs shall be 3.5” radius for passenger and service elevators in healthcare facilities.
- C. Freight elevators: Hoistway bi-parting doors and car gate shall have automatic power operation. Opening size determined by facilities function.
- D. Solid grouting of entrance jambs and sills is required.

6.0 OPERATING FIXTURES

- A. All terminology and tactile symbols on the faceplate shall be on square or rectangular plates recessed into the faceplate with its surface flush with the surface of the faceplate. Use 6 mm (.25 in.) letters to identify all devices in the faceplate. The tactile symbols with contrasting background shall be 12.5 mm (0.5 in.) high raised .030 inch on the plate. Surface mounted plates are not acceptable. Each button shall contain an integral registration LED white light which shall illuminate upon registration of a call and shall extinguish when that call is answered.
- B. Round car call and hall call push buttons, minimum diameter of 25 mm (1 in.), and LED white light illuminated. Car call buttons shall be legibly and indelibly identified by a floor number and/or letter not less than 12.5 mm (.50 in.) high in the face of the call button.



The direction of each hall button shall be legibly and indelibly identified by arrows not less than 12 mm (.50 in.) high in the face of each button.

- C. Main Car Operating Panel shall be a one piece front faceplate with edges beveled minimum of 15 degrees, swing return, or tilt panel shall have the firefighter's service panel recessed into the upper section and the service operation panel recessed into the lower section. Doors shall have concealed hinges, be in the same front plane as the faceplate and fitted with cylinder type key operated locks. Secure the faceplate with stainless steel tamperproof screws.
- D. Auxiliary Car Operating Panel in healthcare facilities shall be in the front return panel opposite the main car operating panel, rear return panel (front and rear doors), or side wall of the elevator between the handrails immediately adjacent to the front entrance column strike jamb. The auxiliary car operating panel shall contain only those controls essential to passenger (public) operation. The auxiliary car operating panel faceplate shall match the main car operating panel faceplate in material and general design. Secure the faceplate with stainless steel tamperproof screws.
- E. Communication:
 - 1. Each elevator shall be equipped with a Hands Free Telephone located in the car operating panel that is compatible with the VA facilities telephone system. Conduit and wire shall be provided by the VA from the elevator machine room to a 24 hour monitoring location.
 - 2. Provide digitized audio voice system. Audio voice shall announce floor designations, direction of travel, and other announcements as required. The voice announcement system shall comply with ADA requirements for audible car position indicators. The voice announcer shall have two separate volume controls, one for the floor designations and direction of travel, and another for special announcements. The voice announcer shall have a full range loud speaker, located on top of the cab. The audio voice unit shall contain the number of ports necessary to accommodate the number of floors, direction messages, and special announcements. Install voice announcer per manufacturer's recommendations and instructions. The voice system shall be the product of a manufacturer of established reputation. Provide manufacturer literature and list of voice messages.
- F. Corridor Operating Devices:
 - 1. Fabricate faceplates for elevator operating and signal devices from not less than 3 mm (.125 in.) thick flat stainless steel with all edges beveled minimum of 15 degrees.
 - 2. Corridor push button faceplates shall be sized to accommodate corridor pictograph on faceplate. The centerline of the landing push buttons shall be 1067 mm (42 in.) above the corridor floor. Elevator Corridor Call Station Pictograph shall be engraved in the faceplate.



3. The direction of each button shall be legibly and indelibly identified by arrows not less than 12 mm (.50 in.) high in the face of each button. Provide a corresponding Braille plate on the left side of each button.
 4. Provide emergency power indicator light, medical emergency card reader/key switch and indicator light, fire service recall key switch and indicator light, fire recall instruction, communication failure light and audible annunciator, and communication reset key switch in a fixture at the designated main floor.
- G. Digital Combination Corridor Arrival Lantern/Position Indicator:
1. Provide alpha-numeric digital position indicators between arrival lanterns at all floors in healthcare buildings. Numerals shall be not less than 63 mm (2.5 in.) high with direction arrows. Cover plates shall be removable for re-lamping. The appropriate direction arrow shall be illuminated during entire travel of car in corresponding direction.
 2. Provide alpha-numeric digital position indicators between arrival lanterns only at the main and alternate fire recall floors in non-healthcare buildings.
 3. Provide each terminal landing with "UP" or "DOWN", minimum 63 mm (2.5 in.) high digital arrow lanterns and each intermediate landing with "UP" and "DOWN" digital arrow lanterns. Each lens shall be LED illuminated of proper intensity, so shielded to illuminate individual lens only. The lenses in each lantern shall be illuminated green to indicate "UP" travel and red to indicate "DOWN" travel. Lanterns shall signal in advance of car arrival at the landing indicating the direction of travel. Corridor lanterns shall not be illuminated when a car passes a floor without stopping. Each lantern shall be equipped with an audible electronic chime which shall sound once for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal shall not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal. Car riding lanterns are not acceptable.

7.0 CONTROL SYSTEMS

- A. Provide a microprocessor system with absolute position/speed feedback to control dispatching, signal functions, door operation, and hoist/pump motor control. Complete details of the components and printed circuit boards, together with a complete operational description, shall be submitted for approval. Add Regenerative Drive when determined to be life cycle cost effective for the VA facility.
- B. Controller manufacturer shall provide factory training, engineering and technical support, including all manuals, wiring diagrams, and tools necessary for adjusting, maintaining, repairing, and testing of equipment for use by the VA's designated Elevator Maintenance Service Provider. The materials provided become the property of the VA.
- C. Microprocessor dispatching system shall evaluate building traffic demand including number of elevators in service, hall calls, car calls, elevator position, direction of travel,



load in elevator, door status, and select an elevator to answer hall calls for least possible passenger wait times.

- D. Car lights and fan in the elevator may shut off when elevator is idle. Provide power thru a failsafe relay that is energized to turn off lights and fan. Arrange circuits so that power to the lights and outlets on top and bottom of elevator shall not be interrupted.

8.0 ELEVATOR MACHINE ROOMS

- A. Elevator machine rooms shall be sized to accommodate the elevator machine, controller, and other related equipment. It shall be possible to remove major equipment components of each elevator for repair without dismantling components of an adjacent elevator.

9.0 ELEVATOR HOISTWAYS

- A. The interior face of the hoistway walls shall have a smooth, flush, and non-dust producing surface. Exposed spray-on fire proofing shall not be used in the elevator hoistway.

10.0 ELEVATOR PITS

- A. Provide two stop switches in the pit, 1200 mm (48 in.) above the bottom landing at the top of the pit ladder and 1200 mm (48 in.) above the pit floor adjacent to the pit ladder.

11.0 ELECTRICAL REQUIREMENTS

- A. Each elevator shall be provided with a separate disconnect and surge suppressor in the respective machine room located adjacent to the entry. The supply shall terminate at the respective elevator controller. The elevator power supply shall be a dedicated main feeder utilizing the shortest practical run and continuous ground conductor.
- B. Emergency power supply shall have the capacity to operate a minimum of one elevator per group.
 - 1. If emergency generator is not available, traction elevators shall be provided with an emergency power system that will run the elevator to the nearest floor and open the doors.
 - 2. If emergency generator is not available, hydraulic elevators shall be provided with an emergency lowering system to lower the elevator to the bottom floor, open the doors.
- C. Fire Alarm Initiating Devices shall be installed in elevator lobbies, top of hoistways, and elevator machine rooms as required.
- D. Heat Detectors and Sprinklers shall meet the requirements of IBC, NFPA 13, and ASME A17.1.



- E. Provide a circuit breaker panel or disconnect switches lockable in the off position in each machine room for emergency power circuit for car lights, fan and alarm, circuit for the machine room GFCI receptacles, circuit for the hoistway lights, circuit for hoistway GFCI receptacles, and circuit for the scavenger pump in the pit for hydraulic elevator.
 - 1. Hoistway lights if provided shall be stacked vertically in the rear of the hoistway near the corner for a single elevator or on the back wall between the divider beams of a duplex or triplex installation. The extreme top and bottom fixtures shall be mounted to illuminate the pit area when the car is at the bottom landing and the car top when the car is at the top landing. Provide three way light switches at the top of the pit ladder and five feet above the top terminal landing at the inside front wall near the hall button box.

12.0 DRAWINGS

- A. Separate architectural drawings shall be prepared for the transport systems. Elevator drawings shall show electrical services, materials, sizes, details, space conditions, etc., of hoistway enclosures, pits, cabs, entrances, machine rooms, and other features. The elevator drawings shall be coordinated with the other architectural, structural, mechanical, and electrical drawings to insure that proper space conditions and other requirements have been provided.
- B. The spaces shall be designed to accommodate the elevator equipment specified.
- C. Architectural drawings shall show reactions at point of elevator machine beams and buffer supports. Indicate impact loads.

---- End ----

