UFC 3-490-06
8 June 2018

UNIFIED FACILITIES CRITERIA (UFC)

ELEVATORS

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UNIFIED FACILITIES CRITERIA (UFC)

ELEVATORS

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **\1** ... **/1/**)

Change No.	**Date**	**Location**

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
SUMMARY SHEET

Document: UFC 3-490-06: Elevators

Superseding: NAVFAC ITG 2013-01, NAVFAC Elevator Design Criteria

Description: This UFC 3-490-06 incorporates tri-service requirements into one unified document and provides design and construction requirements for elevators in DOD facilities.

Reasons for Document:

- References industry standards to meet DOD requirements.

- Identifies consistent and uniform design and methodology to be used for effective compliance with National Building and Safety Codes that apply to elevator installations.

- Provides direction for the most effective application of standard elevator types to the majority of typical DOD facility sizes and configurations.

Impact: Design requirements presented herein will reduce design costs by providing standard design requirements utilizing industry standards. Requirements for design and construction of elevators support competition and capture energy savings over the lifecycle of the elevator systems.

Unification Issues: None.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

Non-Governmental building and safety codes identify absolute minimum design and operational requirements for elevator systems and for the building systems that interface with the elevator microprocessor controllers. The performance language used in the codes results in a multitude of different, and often conflicting, interpretations. This UFC was developed to provide the authority having jurisdiction (AHJ) with consistent and uniform methods to be used to comply with the performance language used in the building and safety codes.

While safety codes are designed to achieve safe operation and usage, they do not address reliability and sustainability. The NAVFAC ITG 2013-01, Elevator Design Guide, was originally developed to ensure safety, sustainment, and effective elevator performance. This concept was endorsed by USACE and ITG 2013-01 was adopted by USACE in October 2014. This UFC builds on the holistic design criteria approach and establishes uniform quality and performance requirements for specific elevator components and systems, to ensure safety code compliance, effective performance, sustainability, energy efficiency, and optimum life-cycle costs.

1-2 PURPOSE AND SCOPE.

This UFC provides minimum technical requirements and guidance for new construction and modernization of elevator systems, and their supporting structure, building systems, and components.

1-3 APPLICABILITY.

This UFC applies to all planning, design and construction, modernization, repair, maintenance and operation, and equipment installation in new and existing buildings, regardless of funding source. Certain specialized facilities, such as health facilities, may have more stringent requirements. Project conditions and geographic locations may dictate the need for designs that exceed these requirements.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, DoD Building Code (General Building Requirements). UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 CYBER SECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06 and as required by individual Service Implementation Policy.

1-6 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise stated, the latest available issuance of the reference is used. References to other publications, standards, and technical data referenced herein form a part of the UFC requirements to the extent referenced.

1-7 ADDITIONAL REQUIREMENTS.

When performing work within the U.S., verify if there are additional State requirements that apply to elevator design and operation. Confirm with the DOD Service agency as to the applicability of any state requirements.

1-8 GLOSSARY.

Appendix C contains acronyms, abbreviations, and terms.

CHAPTER 2 PLANNING AND DESIGN REQUIREMENTS

2-1 PLANNING AND PRELIMINARY DESIGN.

Coordinate elevator planning and design with facility operational requirements, DOD policy, UFCs and requirements referenced herein. The project planning and preliminary design process must determine the need for elevators based on facility operational requirements as well as DOD Policy and UFC compliance. Requirements and considerations addressing the need for elevators include the following:

- Operational requirements
- ABA Accessibility Standard for Department of Defense Facilities
- DEPSECDEF Memo: Access for People with Disabilities
- UFC or FC addressing facility type design requirements

2-2 CLIENT SURVEY AND TRAFFIC STUDY.

To determine the elevator types, service, size, capacity, speed, quantity, and operational systems necessary for effective elevator service, the preliminary design process must include a client survey and traffic study of the proposed facility design.

2-2.1 Traffic Study Factors.

For facilities not covered by a UFC or FC specific to a facility type where elevator requirements have been predetermined, obtain the services of an elevator consultant to conduct a traffic study. Utilize the following factors in the traffic analysis:

- Type and Use of Building
- Size and Height of Building
- Building Population
- Exterior Personnel Traffic Considerations
- Anticipated Personnel Traffic Flow

2-2.2 Passenger or Freight Classification.

The two categories of service that are recognized by ASME A17.1, Safety Code for Elevators and Escalators, are Passenger and Freight. For each elevator, the designer and client must decide whether the elevator will be designated as a passenger elevator or freight elevator, based on the anticipated usage of the elevator. An elevator that will be used for the movement of personnel must be designed as a passenger elevator, and must comply with DEPSECDEF Memo “Access for People with Disabilities” dated October 31, 2008. An elevator that will be used exclusively for the movement of material may be classified and designed as a freight elevator.

2-2.2.1 Platform Loading.

Passenger elevators may be utilized for movement of furniture, office equipment, and other material. A passenger elevator that will be used to transport material that exceeds 25% of the capacity of the elevator must be designed with a minimum of ASME A17.1 Class C-3 loading.

2-2.3 Emergency Medical Services (EMS) Elevator.

Where elevators are provided in a building, design a minimum of one passenger elevator to accommodate EMS access to all floors of the building. Design elevator to accommodate a 24-inch by 84-inch (610mm by 2134mm) ambulance stretcher in the horizontal, open position. Identify the elevator with the international symbol for emergency medical services (star of life). Design facility to ensure EMS access from EMS response area to the EMS-designated elevator.

2-3 BUILDING SYSTEMS INTERFACE.

Building utility systems that interface with elevator design and control systems include electrical, mechanical, communication, fire protection, and fire alarm. For modernization projects, verify that existing building systems are compliant with current safety code requirements and are compatible with proposed elevator systems.

2-3.1 Firefighters' Emergency Operation (FEO).

All elevators with a travel distance greater than 80” must be designed with Firefighters’ Emergency Operation (FEO). For modernization projects, verify existing building fire alarm system is compatible with elevator operational controller and compliant with current safety and building codes.

2-3.2 Emergency Power.

For new construction and modernization of buildings equipped with an emergency power generator, the emergency power system must provide, at a minimum, the capability for the normal operation of the EMS elevator on emergency power. In addition, the designer must determine if the client requires additional elevators to be powered by the facility emergency power generator.

2-3.2.1 Emergency Power Design Considerations.

The design of elevator emergency power operation must address the following:

- Identify the number of elevators to run simultaneously.
- Identify elevators and elevator groups to be designed with sequential return operation.

2-3.2.2 Auxiliary Power Operation.

Elevators not designed for building emergency power generator operation must be equipped with an auxiliary power operating system that provides the following operation:

- Electric Traction elevators must run to the next available landing, open and close the doors, and be removed from service.
- Hydraulic elevators must lower to the FEO Designated Landing, open and close the doors, and be removed from service. If elevator is below the FEO Designated Landing when normal power fails, elevator must open and close the doors at first available landing and be removed from service.

2-3.3 Energy Efficiency.

Energy-efficient technologies are available for new construction and modernization of elevator installations and can be effective in buildings with 10 stories or greater. “Regenerative Drive” motor control systems have been developed for use with gearless traction elevators. This motor control system uses the energy that is developed when the elevator is running in an overhauling load condition. The drive converts the mechanical energy into electrical energy and feeds it back to the facility power grid. The use of gearless traction machines and regenerative drive motor control should be considered for mid and high rise elevator installations.

2-3.4 Telephone and Communication Systems.

The elevator emergency communication phone line must provide the capability for the elevator cab automated communication system to connect to an emergency response desk that is manned 24 hours a day by authorized personnel. The phone line must support the elevator cab communication system requirement to automatically identify the elevator location and provide the capability for voice communication between the elevator passenger and authorized personnel. The phone line must also support voice communication between the elevator machine room/control room and the elevator cab.

2-3.4.1 Secondary Call Capability.

The emergency communication line must provide the capability for the elevator cab communication device to accomplish the elevator safety code required secondary phone call in the event that the initial call is not answered within 45 seconds.

2-4 ELEVATOR TYPES AND USAGE.

2-4.1 Hydraulic Elevators.

Direct Plunger Hydraulic Elevators may be used for 2 to 4 stories. Roped hydraulic elevators may be used for specific, approved applications, as incorporated into DoD UFC Criteria for approved building types and designs. Telescopic plunger, and inverted cylinder/plunger elevator designs are not permitted in DOD facilities.

2-4.1.1 Speed and Travel Requirements.

- In-ground Direct Plunger: For an elevator travel distance of 15 feet (258 cm) or less, rated speed must be 125 feet per minute (fpm) (38.1 m/min). For a travel distance between 15 feet (4.6 m) and 44 feet (13.4 m), the rated speed must be 150 fpm (45.7 m/min). Do not exceed a travel length of 44 feet (13.4 m) or a maximum of four floors for this type of elevator.
- Hole-less Direct Plunger: Rated speed must be 125 fpm (38.1 m/min) for this type of elevator. Elevator travel distance is limited by the depth of the hoistway pit and the overhead clearance in the top of the hoistway.
- Roped-hydraulic: A roped-hydraulic elevator is allowed for Air Traffic Control Towers (ATCT). When used for ATCT facilities, elevator travel distance must not exceed 48 feet (14.6 m). This is intended to equate to an ATCT tower cab floor elevation of 60 ft (18.3m) or less as the elevator stops at the floor below the tower cab. The elevator car speed must not exceed 150 feet per minute (45.7 m/min). See section 2-5 Exceptions for other uses of roped-hydraulic elevators.

2-4.1.2 Unified Facilities Guide Specifications (UFGS).

Hydraulic elevator equipment requirements are specified in the following UFGS:

- UFGS 14 24 13: Hydraulic Freight Elevators
- UFGS 14 24 23: Hydraulic Passenger Elevators

2-4.2 Electric Traction Elevators.

2-4.2.1 Minimum Travel and Speed Requirements.

- Geared Traction Machine: This type of elevator may be used for 10 floors or less. For a travel distance of less than 15 feet (4.6 m), the rated speed must be 125 fpm (38.1 m/min). For a travel distance of 15 feet (4.6 m) to 40 feet (12.2 m), the rated speed must be 200 fpm (61 m/min). For a travel distance of 40 feet (12.2 m) - 100 feet (30.5 m), the rated speed must be a minimum of 350 fpm (106.7 m/min).
- Gearless Traction Machine: This type of electric traction elevator may be used for all applications and must be used for greater than 10 floors. For a travel distance of less than 15 feet (4.6 m), rated speed must be 125 fpm (38.1 m/min). For a travel distance of 15 feet (4.6 m) to 40 feet (12.2 m), rated speed must be 200 fpm (61 m/min). For a travel distance of 40 feet (12.2 m) - 100 feet (30.5 m), rated speed must be a minimum of 350 fpm (106.7 m/min). For a travel distance of greater than 100 feet (30.5 m), rated speed must be a minimum of 500 fpm (152.4 m/min).

2-4.2.2 Unified Facilities Guide Specifications (UFGS).

Electric Traction elevator equipment requirements are specified in the following UFGS:

- UFGS 14 21 13: Electric Traction Freight Elevators
- UFGS 14 21 23: Electric Traction Passenger Elevators

Table 2-1 Elevator Types and Usage

Elevator Type	Landings	Travel	Minimum Speed
Hydraulic Traction Geared Traction Gearless	2	Up to 15’	125 ft/min
Hydraulic Traction Geared Traction Gearless	2 - 4	16’ - 44’	150 ft/min
Traction Geared Traction Gearless	2 - 5	24’ - 44’	200 ft/min
Traction Geared Traction Gearless	5 - 10	45’ - 100’	350 ft/min
Traction Gearless	> 10	> 100’	500 ft/min

2-5 EXCEPTIONS.

Submit written UFC exception requests to the responsible Service elevator program SME. For an individual project design, the SME is authorized to grant an exception for the following conditions:

- Use of a roped-hydraulic elevator for a new construction or modernization project (except as allowed for ATCT)
- elevator speed and travel requirements for special purpose, special application, and high capacity freight elevator installations

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CHAPTER 3 ARCHITECTURE

3-1 ELEVATOR MACHINE ROOM.

For building design with elevator machine room, provide one elevator machine room (MR) for each elevator or elevator group. Locate the elevator machine and elevator controller in the machine room.

3-1.1 Machine Room Size.

For a single electric traction elevator, provide a minimum machine room (MR) size of 120 sq. ft., with a minimum interior wall length of 10 feet. For a single hydraulic elevator, provide a minimum MR size of 72 sq. ft., with a minimum wall length of 8'-0". For MR with multiple elevators, increase MR size to accommodate elevator and elevator utilization equipment and to comply with all applicable codes and standards.

3-1.2 Machine Room Location.

Locate elevator MR directly adjacent to the elevator hoistway. For electric traction elevator installations, locate MR directly above hoistway or directly beside the elevator hoistway. Locate hydraulic elevator MR on the lowest landing served by the elevator, except as noted in Paragraph "Flood Zone Restrictions".

3-1.2.1 Flood Zone Restrictions.

For all elevators, design elevator system, and all related components, in accordance with the Elevator Section in the current edition of ASCE 24, Flood Resistant Design and Construction.

3-1.3 Machine Room Plans.

Provide the following:

a. Design building and elevator systems so that access panels are not installed in walls or ceiling of the MR.

b. Provide maximum ceiling height of 15 feet (4.6 m).

c. For overhead traction elevator, provide interior width of elevator MR a minimum of 16" wider than the interior width of the elevator hoistway.

d. Provide minimum clearance of 18 inches (450 mm) between any building component and a traction elevator drive machine.

e. Provide minimum clearance of 10 inches (254 mm) between over-speed governor and any building component.

f. Provide minimum clearance of 10 inches (254 mm) between any building component and a hydraulic elevator pump unit.

g. Provide minimum 3 feet wide X 6 feet 8inches high MR entry door.

h. Provide self-closing MR door with lever handle on MR side of door equipped with a self-locking spring-type lock arranged to permit the door to be opened from inside the MR without a key.

3-1.4 Machine Room Sound Transmission Limits.

Provide elevator MR with a sound transmission coefficient design to not exceed 65 decibels of audible elevator machine room equipment noise, measured at any location outside of the elevator MR.

3-1.5 Machine Room Access.

Provide a permanent and unobstructed personnel and material access route from building entrance to the elevator MR door. The access route must have a continuous minimum width of 3 feet (914 mm) and minimum height of 7 feet (2133 mm).

3-1.5.1 Stairway Access.

When the floor level of the access route is greater than 8” above or below the floor of the MR, provide a stairway with a maximum inclination of 45 degrees. Vertical ladders, ships ladders, and alternating step tread designs are not permitted for MR access. Provide maximum riser height of 8 inches (203 mm) and a minimum step tread depth of 8 inches (203 mm), as measured from each adjoining step, nose to nose. Provide maximum height of the access stairs 12 feet (3.6 m) without an intermediate landing.

3-2 ELEVATOR CONTROL ROOM AND ELEVATOR MACHINERY SPACE.

For building design that does not have an elevator machine room, provide an elevator Control Room (CR) for the elevator controller and an elevator machinery space (MS) for the elevator drive machine and speed governor. For building design with elevator CR and MS, provide one CR and one MS for each elevator or elevator group. Design CR and MS for full bodily entry. Locate elevator controller in CR and elevator drive machine in MS.

3-2.1 Control Room Location and Size.

Locate elevator CR directly adjacent to, and outside of, the elevator hoistway. For a single elevator, provide a minimum CR size of 40 sq. ft., with a minimum of one interior wall length of 7 feet. For CR with multiple elevators, increase CR size to accommodate elevator controls, elevator utilization equipment, hydraulic MS access panel, maintenance and service, and all applicable codes and standards.

3-2.2 Machinery Space Location and Size.

For electric traction elevator, locate MS directly above the hoistway, directly adjacent to the side of the hoistway, or in the top of the hoistway. For a single elevator, provide a minimum MS size of 36 sq. ft. For MS with multiple elevators, increase MS size to accommodate elevator equipment, maintenance and service, and all applicable codes and standards. For hydraulic elevator, locate MS in the elevator hoistway pit or directly adjacent to the hoistway on the lowest landing served by the elevator, except as required by ASCE 24, Flood Resistant Design and construction.

3-2.2.1 Flood Zone Restrictions.

For all elevators, design elevator and all related components in accordance with the Elevator Section in the current edition of ASCE 24, Flood Resistant Design and Construction.

3-2.3 Control Room Plans.

Provide the following:

a. Design building and elevator systems so that access panels are not installed in walls or ceiling of the CR. Exception: Hydraulic elevators with MS in the elevator hoistway.

b. For hydraulic elevator with MS in the elevator hoistway, provide access panel in CR that provides all necessary access to the elevator pump unit and drive machine for maintenance, service, inspection, and testing of the elevator. Maximum allowable height of access panel is 6’ above finished CR floor.

c. Provide maximum ceiling height of 12 feet (3.6 m).

d. Provide minimum clearance of 10 inches (254 mm) between over-speed governor and any building component.

e. Provide minimum 3 feet wide X 6 feet 8 inches high CR entry door.

f. Provide self-closing CR door with lever handle on CR side of door equipped with a self-locking spring-type lock arranged to permit the door to be opened from inside the CR without a key.

3-2.4 Machinery Space Plans.

Provide the following:

a. Design building and elevator systems so that access panels are not installed in walls or ceiling of the MS.

b. Provide minimum headroom clearance of 78 inches (1981 mm) in the MS.

c. Provide minimum clearance of 18 inches (450 mm) between any building component and a traction elevator drive machine.

d. Provide minimum clearance of 10 inches (254 mm) between over-speed governor and any building component.

e. Provide minimum clearance of 10 inches (254 mm) between any building component and a hydraulic elevator pump unit located in a MS outside of the elevator hoistway.

f. Provide minimum 3 feet wide X 6 feet high MS entry door.

g. Provide self-closing MS door with lever handle on MS side of door equipped with a self-locking spring-type lock arranged to permit the door to be opened from inside the MS without a key.

h. Where MS is located in the top of the hoistway, provide solid flooring, excluding holes required for hoist and governor ropes.

3-2.5 Machinery Space Sound Transmission Limits.

Provide elevator MS with a sound transmission coefficient design to not exceed 65 decibels of audible elevator machine room equipment noise, measured at any location outside of the elevator MS, including all building interior areas and the interior of the elevator cab.

3-2.6 Control Room and Machinery Space Access.

Provide a permanent and unobstructed personnel and material access route from building entrance to the elevator CR and MS door. The access route must have a continuous minimum width of 3 feet (914 mm) and minimum height of 7 feet (2133 mm).

3-2.6.1 Stairway Access.

When the floor level of the access route is greater than 8 inches above or below the CR or MR floor, provide a stairway with a maximum inclination of 45 degrees. Vertical ladders, ships ladders, and alternating step tread designs are not permitted for CR or MS access. Provide maximum riser height of 8 inches (203 mm) and a minimum step tread depth of 8 inches (203 mm), as measured from each adjoining step, nose to nose. Provide maximum height of the access stairs 12 feet (3.6 m) without an intermediate landing.

3-3 ELEVATOR HOISTWAY.

3-3.1 Hoistway Pit Entrapment Protection.

Provide a minimum horizontal clearance of 20 inches (508 mm) between the side of the elevator platform/cab and any one wall of the elevator hoistway. A horizontal clearance of 20 inches (508 mm) wide X 36 inches long (915 mm) must be maintained for the entire height of the hoistway. Elevator and building components must not encroach on the minimum clearances or block personnel passage from the elevator pit to the vertical personnel egress route.

NOTE: For the restoration or modernization of an elevator with an existing hoistway, comply with this requirement if practicable.

3-3.2 Elevator Hoistway Plans.

Develop detailed plan and section drawings for elevator hoistway. Provide all layout drawing information required by ASME A17.1. Comply with the following:

a. Elevator hoistway layout and dimensions must take into consideration the size and configuration of the elevator landing entrances.

b. Locate only access panels or doors in the walls or ceiling that are necessary for the operation, maintenance, service, inspection, and testing of the elevator.

c. Provide plumb hoistway walls with flush surfaces on the hoistway side.

d. For hoistway pit with a depth exceeding 35 inches (889 mm), provide fixed ladder on the hoistway side closest to the hoistway entrance.

e. Provide only mechanical equipment and systems directly related to the installation, operation and maintenance of the elevator. Pipes, ducts, and conduit not related to the elevator system must not penetrate the hoistway.

3-4 ELEVATOR HOISTWAY PIT.

3-4.1 Hoistway Pit Waterproofing.

Provide water stops in the walls and waterproofing for elevator pit floor and walls.

3-4.2 Sump and Sump Pump.

Provide elevator hoistway with a sump pit, submersible sump pump, and permanent discharge piping to a point outside of the elevator hoistway and MR. Coordinate discharge location with installation environmental department and local laws and statutes. Comply with the following:

a. Provide sump pit with fully supported and removable sump pit grate cover, with top of grate flush with pit floor.

b. Provide sump pit large enough to fully enclose submersible sump pump and control sensors below the bottom of the sump pit grate cover.

NOTE: For existing facilities that are not equipped with a sump pit, the sump pit is not required. All other requirements of 3-3.2 must be met.

3-5 ELEVATOR LANDING.

Fill elevator landing doorway entrance frames with grout to a height of 60 inches (1524 mm). Design interface between elevator landing doorway entrance frame and elevator hoistway wall to facilitate effective installation of grout in the door frame.

3-5.1 Emergency Lock Box.

For each individual elevator or for each elevator group, a keyed lockbox must be provided at the FEO Designated Landing. The lockbox must be flush mounted in the wall, adjacent to and within 20 inches (508 mm) of the hoistway entrance assembly. Locate lockbox recess in the elevator lobby wall, at a height of 60 inches (1524 mm) above the landing sill. The lockbox must have a minimum size of 6 inches (152 mm) W X 8 inches (203 mm) H X 1.25 inches (32 mm) D. The locking mechanism must utilize the ASME A17.1 FEO key.

3-5.2 Exterior Elevator Lobby Enclosure.

For exterior elevator landing entrances, provide elevator lobby enclosure or vestibule to protect elevator entrance, elevator hoistway, and elevator equipment from snow, ice, and wind driven rain.

CHAPTER 4 STRUCTURAL

4-1 ELEVATOR MACHINE ROOM AND ELEVATOR MACHINERY SPACE.

Design elevator machine beams, sheave beams, floor, and supporting structure in accordance with the concentrated load and live load requirements of ASME A17.1. Do not support elevator machine room floors located over elevator hoistway with cast-in-place or post installed anchors loaded in shear. Instead, design said system to be supported by direct bearing on hoistway walls or on structural beams pocketed in hoistway walls.

4-2 ELEVATOR HOISTWAY.

Design elevator hoistway to provide adequate support for the elevator guide rail and rail bracket connection to the building structure. For hydraulic elevators, design hoistway pit floor in accordance with the concentrated load and live load requirements of ASME A17.1.

4-2.1 Hoistway Wall Construction.

Do not use unreinforced concrete masonry hoistway walls (UFC 03-301-01, Section 2.5.1). This applies to both load bearing and non-load bearing conditions. Additionally, elevator guide rails, rail brackets, hoist beams, and load reaction points must be supported and backed with fully grouted and reinforced cells. Do not use clay tile or brick for the construction of elevator hoistway walls.

4-3 MACHINE ROOM, MACHINERY SPACE, AND HOISTWAY PLANS.

Develop detailed plan and section drawings for elevator MR, MS, and hoistway. Show location of all support beams in the MR, MS, and hoistway. For multiple elevators in the same hoistway, provide divider beams for guide rail support brackets. Provide all layout drawing information required by ASME A17.1.

4-3.1 Structural Design Submittal.

Elevator design submittal must include a design analysis with calculations for the total static loads, impact loads, and horizontal and vertical reaction loads that will be transmitted to machine beams, sheave beams, supports, floors, walls, and foundations.

4-3.2 Lifting Beam.

For hydraulic elevator installations, provide a lifting beam at the top of the hoistway for installation of elevator equipment. The bottom of lifting beam must be a minimum of 13’ (3962 mm) above the top landing finished floor elevation.

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CHAPTER 5 MECHANICAL

5-1 ELEVATOR MACHINE ROOM, CONTROL ROOM, AND MACHINERY SPACE.

5-1.1 Elevator MR, CR, AND MS Temperature and Humidity Control.

For each elevator MR, CR, and MS, provide an independent, dedicated HVAC system. Design HVAC system to maintain MR temperature between 70 and 90 degrees F (21 to 32 degrees C) and relative humidity between 35% and 60% at all times and in all weather conditions. Design HVAC system to include the BTU heat load generated by operation of the elevator equipment.

5-1.2 Mechanical Equipment Installation.

Comply with the following:

a. Provide unobstructed vertical clearance (headroom) below all installed mechanical and electrical system components.

b. Do not locate HVAC equipment above elevator equipment.

c. Provide a minimum of 18 inches (450 mm) horizontal clearance between elevator drive machine and any mechanical or electrical equipment in the elevator MR.

d. Drain AC condensate to a location outside of elevator MR and hoistway.

5-1.3 Machine Room and Machinery Space Sound Level.

Limit maximum acoustic output to 85 dBA at any point in the MR and MS.

5-2 ELEVATOR HOISTWAY PIT.

5-2.1 Hoistway Pit Sump and Sump Pump.

Provide sump pump, automatic sump pump controls, and permanent discharge piping that complies with the following:

a. Provide sump pump discharge capacity of 50 gallons per minute (189 lit/min), per elevator. Sump pump and piping must be sized to accomplish this output, regardless of head pressure or piping run.

b. Discharge to an approved location, outside of the elevator hoistway, MR, CR, and MS, that will accommodate full pump output and comply with all applicable discharge permits, regulations, and statutes.

c. Coordinate sump pump size with Architect to ensure that the sump pump and control sensors will fit completely within the sump.

d. Coordinate power requirements with electrical engineer.

5-2.1.1 Hydraulic Elevator Requirement.

For hydraulic elevator, in addition to the requirements of 5-3.1, provide a sump pump oil sensing control system designed to allow water to be pumped out of the sump without pumping oil/hydraulic fluid from the elevator hoistway pit. The sump pump control system must include an audible alarm and visual indicators for water and oil. Install alarm indicators and controls in the elevator MR, CR, or MS.

5-3 HYDRAULIC ELEVATOR CYLINDER PIPING.

5-3.1 In-Ground Cylinder Well Casing.

A dry, plumb, steel well casing must be provided for every in-ground cylinder assembly. The well casing must be located according to the elevator manufacturer's design. The well casing must have a minimum ¼ inch (6 mm) thick wall and a welded 1/2 inch (13 mm) thick steel bottom.

5-3.2 Hydraulic Oil Supply Piping.

Hydraulic oil lines must remain in or under conditioned space from end to end and remain within the building footprint. For all buried hydraulic lines between hoistway and MR or MS, provide straight pipe run in PVC pipe sleeves. Inside diameter of the PVC must be a minimum of 4 inches (102 mm) larger than the outside diameter of the supply line fittings.

CHAPTER 6 ELECTRICAL

6-1 ELEVATOR MACHINE ROOM, CONTROL ROOM, AND MACHINERY SPACE.

6-1.1 Elevator Power Supply.

For each elevator group, provide electrical power service from the main building electrical distribution panel to the elevator machine room. Designer must consider type of elevator drive specified and design accordingly. Coordinate with Designer of Record for elevator power requirements.

6-1.2 Elevator Disconnecting Means.

Provide elevator disconnecting means on the wall inside the MR and CR, on the strike jam side of the entrance door, within sight of the elevator equipment it controls.

6-1.2.1 Shunt Trip Disconnect.

For elevators with fire protection sprinklers in the elevator MR, CR, MS, or top of hoistway, provide a shunt trip circuit breaker in the elevator MR or CR for each individual elevator main power, and emergency power if provided. Shunt trip breaker design must comply with the following:

a. Shunt trip breaker must be designed to be operated by actuation of the sprinkler flow switch(s) designed to automatically open the power supply to the elevator. Power must be restored manually.

b. Breaker enclosure must include a safety-switch type handle for manual operation of the breaker.

c. Breaker handle must be capable of being locked in the open position only.

6-1.2.2 Sprinkler Line Flow Switch.

Provide sprinkler line flow switches as required by Chapter 7, Fire Protection. Provide an electrical circuit for actuation of the elevator main-line shunt trip disconnect. The sprinkler line flow switch control circuit must be monitored for the presence of operation voltage. Loss of voltage must cause actuation of a supervisory signal and alarm at the building fire protection panel.

6-1.2.3 Auxiliary Contact.

Hydraulic elevators that are not designed for building emergency power generator operation must be designed and equipped with auxiliary power lowering operation for the purpose of lowering the car in the case of failure of the main power supply. When an elevator is equipped with auxiliary power lowering operation, the main line disconnect must be designed with an auxiliary contact to prevent automatic lowering operation when the main line disconnect is in the open position.

6-1.3 MR, CR, and MS Lighting and Receptacles.

Provide a separate 120 VAC branch circuit for each elevator MR, CR, and MS lighting and receptacles. Provide a minimum of two 2-light, 4 feet (1.2 m) long fluorescent, LED, or equivalent energy efficient lighting fixtures for illumination. Provide lighting fixture housings that are dust tight and rated for damp locations. Lighting must provide a minimum of 19 fc at floor level, in all areas of the MR, CR, and MS. The lighting must not be equipped with automatic controls or be fed from the load side of a GFCI circuit.

6-1.4 Dedicated Branch Circuits.

For each of the following circuits, provide a separate, dedicated branch circuit with a fused disconnect or breaker in the elevator MR or CR. Disconnects and breakers must be designed to be lockable in the open position only.

a. Elevator 120 VAC circuit for elevator cab lighting and receptacles.

b. Elevator cab HVAC equipment circuit, if provided.

c. Elevator hoistway pit sump pump power and control system.

6-1.5 Emergency Power.

Design power and control circuits to accomplish automatic transfer of power from normal building power to emergency power operation for elevators that will operate on emergency power. Coordinate elevator emergency power design with designer of record and the results of the client survey, as detailed in Par 2-4.2. Design requirements include the following:

a. Design electrical power circuit from emergency buss to elevator mainline disconnect(s) for all elevators that will operate on emergency power.

b. Determine which elevators will operate simultaneously on emergency power. Design emergency power system capacity to operate these elevator(s), simultaneously, at rated speed with rated load.

c. Coordinate design of the Automatic Transfer Switch (ATS) electrical control circuit with the elevator controller manufacturer’s requirements.

d. Verify location of elevator MRs and CRs for potential control wiring interconnections for sequential elevator return operation.

e. Provide manual selector switch in main elevator lobby area(s) to allow emergency personnel to override the automatic emergency power selection.

f. Provide emergency power for MR, CR, and MS lighting and HVAC equipment.

g. Provide emergency power for Cab lighting and Cab HVAC equipment.

h. Provide emergency power for hoistway pit sump pump operation.

6-1.6 Emergency Communication Systems.

For elevator emergency phone in the elevator cab, provide a dedicated elevator communication service line for each elevator. Locate elevator communication line outlet adjacent to each elevator controller. Indicate outlets on telephone riser.

6-1.6.1 Fire Command Center.

For all elevators with a travel of 60 feet (18.3 m) or greater, provide emergency communication between the elevator cab and the building Fire Command Center.

6-1.7 Firefighters' Emergency Operation (FEO).

Design building fire detection and alarm system for an effective interface with the elevator controller for actuation of Fire Fighter's Emergency Operation (FEO). For FEO actuation, detail ceiling mounted fire alarm initiating devices in elevator lobbies, elevator MR or CR, and elevator hoistway where required, in conformance with UFC 3-600-01. Indicate devices on electrical drawings unless there are separate fire protection drawings. Coordinate with Fire Protection Engineer.

6-1.7.1 FEO Relay Modules.

Mount FEO operation modules on the wall inside the elevator MR or CR. Coordinate with Designer of Record for identification of FEO Designated and Alternate Landings.

6-1.8 General Wiring Requirements.

Only electric wiring, raceways, and cables used directly in connection with the elevator are permitted inside the elevator MR, CR, and MS. Allowable wiring includes wiring for elevator signals, lighting, and HVAC. All conductors and optical fibers must be in conduit.

6-2 ELEVATOR HOISTWAY.

Provide only electrical wiring, raceways, and cables used directly in connection with the elevator inside the elevator hoistway. Allowable wiring includes wiring for signals, lighting, and HVAC of the elevator cab, fire protection, pit sump pump, and HVAC of the hoistway. All conductors and optical fibers in the hoistway, except traveling cable, must be in conduit.

6-2.1 Hoistway Lighting and Receptacles.

Design hoistway pit lighting to provide a minimum of 10 fc at the pit floor in all areas of the pit. Hoistway lighting design must include a minimum of two lighting fixtures for lighting of the elevator hoistway pit. The fixtures must have a one piece, molded, high-impact clear acrylic diffuser with a secure seal against dust and moisture. A similar fixture must be provided at a minimum of every 10 feet (3 m) vertically up the hoistway. The fixture at the top of the hoistway must be mounted on the ceiling. For control of the hoistway lighting circuit, provide two 3-way switches inside the elevator hoistway, at a height of 4 feet (1.2 m) above the top and bottom elevator landings. Mount the switches on the hoistway wall, adjacent to the hoistway entrance strike jamb. The lower level lighting switch must be located adjacent to the hoistway pit access ladder.

6-3 ELEVATOR HOISTWAY PIT.

6-3.1 Sump Pump Receptacles.

Provide a separate branch circuit supplying power to the hoistway pit sump pump. Provide a dedicated simplex receptacle, without GFI protection, to supply the permanently installed sump pump. Mount sump pump receptacle 5 feet (1524 mm) above elevator pit floor. Provide LED indicator light to verify circuit is energized. For hydraulic elevators, provide an additional GFCI duplex receptacle in the elevator MR, CR, or MS to supply power to the sump pump control system.

6-3.2 Hoistway Pit GFCI Receptacles.

Provide a separate branch circuit supplying the hoistway pit lighting and a minimum of two duplex GFCI receptacles in the pit. Locate one receptacle on each side wall of the hoistway, at 3 feet (915 mm) above pit floor. For hydraulic elevators, provide one additional receptacle on the rear wall of the hoistway at a height of 3 feet (915 mm) above the pit floor for elevator oil-scavenger-pump power.

6-3.3 NEMA 4 Electrical Enclosures.

Provide NEMA Type 4 electrical enclosures per NEMA ICS6 for all electrical equipment located less than 4 feet (1219 mm) above the pit floor. Electrical enclosures must be water-tight, dust-tight, and identified for use in wet locations in accordance with the requirements in NFPA 70. Hydraulic elevator scavenger pump receptacle must be provided with an in-use cover.

CHAPTER 7 FIRE PROTECTION

7-1 FIRE ALARM SYSTEM.

Design all elevator installations with Firefighters' Emergency Operation (FEO). Provide fire alarm detection and alarm system for actuation of elevator FEO and automatic elevator operational response to fire alarm initiating devices located in the elevator machine room, elevator lobbies, and elevator hoistway, as required by UFC 3-600-01 Fire Protection.

7-1.1 Elevator Controller Interface.

Utilize FEO operation relay modules for the interface between the building fire alarm panel and the elevator controller. Indicate fire alarm initiating devices, FEO relay modules, and connections on fire protection drawings or on electrical drawings if fire protection drawings are not provided. Coordinate with Electrical Engineer.

7-1.2 FEO Designated and Alternate Landings.

Determine FEO designated and alternate landings during the facility design process and identify same in the design submittal package. Coordinate FEO landing designations with the base or local fire department that will respond to a fire alarm at the facility.

7-2 FIRE PROTECTION SYSTEM.

In buildings protected with an automatic sprinkler system, comply with UFC 3-600-01, applicable codes, and the following.

7-2.1 Machine Room and Hoistway Sprinkler Protection.

For elevator MR and hoistway sprinklers located more than 2 feet (610 mm) above the pit floor, design for a supervised shut-off valve, check valve, flow switch, and test valve in the dedicated sprinkler line feeding the elevator MR and/or hoistway. Locate these items outside of and adjacent to the MR and/or hoistway. Actuation of the flow switch must remove power to the elevator by shunt trip breaker operation. Shunt trip actuation must be instantaneous; the flow switch must not have time delay capability.

7-2.2 Hoistway Pit Sprinkler Protection.

In buildings protected with an automatic sprinkler system, provide sprinkler in the pit for hydraulic elevators (except in Italy). Locate sprinkler head no more than 2 feet (609 mm) above the pit floor. Actuation of a pit sprinkler within 24 inches (610mm) of the pit floor must not remove power to the elevator.

7-2.3 Machine Room Fire Extinguisher.

On MR drawings, indicate fire extinguisher on the wall, inside the elevator machine room, on the strike-jam side of the MR door.

APPENDIX A REFERENCES

AMERICAN SOCIETY OF CIVIL ENGINEERS

http://www.asce.org

ASCE/SEI 24-0514, Flood Resistant Design and Construction

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

http://www.asce.org

ASME A17.1, Safety Code for Elevators and Escalators

ASME A17.3, Safety Code for Existing Elevators and Escalators

INTERNATIONAL CODE COUNCIL

http://www.iccsafe.org

International Building Code, 2015

International Plumbing Code, 2015

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org

NFPA 70, National Electric Code, 2017

UNITED STATES DEPARTMENT OF DEFENSE

http://www.dtic.mil/whs/directives/

ABA Accessibility Standard for Department of Defense Facilities

https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

http://www.lrl.usace.army.mil/Portals/64/docs/Engineering/Design_AF/aba.pdf

DEPSECDEF Memorandum, Subject: Access for People with Disabilities, 31 October 2008:

https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/background/dod-memorandum

DODI 8500.01, Cybersecurity, 14 March 2014DODI 8510.01, Risk Management Framework (RMF) For DOD Information Technology (IT), 12 March 2014

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, DOD Building Code (General Building Requirements)

UFC 3-101-01, Architecture

UFC 3-301-01, Structural Engineering

UFC 3-310-04, Seismic Design for Buildings

UFC 3-401-01, Mechanical Engineering

UFC 3-501-01, Electrical Engineering

UFC 3-600-01, Fire Protection Engineering for Facilities

UFC 4-510-01, Design: Medical Military Facilities

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APPENDIX B BEST PRACTICES

This appendix identifies and describes standard elevator systems that are available in the elevator industry and best practices associated with each type of elevator. The best practices represent design concepts adopted by the DOD to address typical facility types, proven facility solutions, lessons learned, facility system safety, and total ownership cost.

B-1 ELEVATOR MACHINE ROOM.

The elevator Machine Room is the most critical building component of an elevator installation. The elevator machine room is the one functional area in the building that is designed and designated for the safe and effective maintenance, service, repair, and safety code mandated inspection and testing of the elevator system. During diagnostic evaluation and testing of the elevator, the certified elevator technician must operate the elevator from the elevator controller and simultaneously observe and evaluate the operation of the elevator drive machine. In addition, the certified elevator inspector is required to observe the operation of the elevator drive machine and overspeed governor during safety code mandated annual performance tests of the elevator car speed, safeties, hoist ropes, drive sheave, and overspeed governor. Performance of service, repair, inspection, and testing is more effective and more efficient when the elevator controller, the elevator drive machine, and the overspeed governor are all located in the same functional area, the elevator MR. For DoD facilities, elevator systems with a machine room for each elevator or elevator group, and the elevator controller and drive machine in the MR, are the preferred design approach.

B-1.1 Safety.

Elevator systems are comprised of complex and sophisticated mechanical, electrical, hydraulic, and electronic systems that require diagnostic evaluation, maintenance, service, repair, inspection, and testing. Elevator service personnel utilize mechanical tools and electronic equipment to perform the repair, and replacement of elevator components, including the microprocessor controller, drive machine, drive motor, over-speed governor, safeties, rope-gripper, hoist ropes, traction drive sheave, machine brake, and hydraulic elevator control valve. In addition, elevator safety code officials conduct periodic inspection and testing of the elevator system. The elevator machine room is the one functional area in the building that provides a suitable area for the staging of personnel, components, service manuals, tools, and equipment and for the safe and effective performance of these critical functions.

The elevator controller, electric motor, and motor drive, are powered by electrical power circuits that range from 30 VAC to 480 VAC. During elevator service, repair, and testing, elevator personnel are exposed to electrical safety hazards that include both electric shock and arc flash. Safety hazard exposure to any other occupants of the building is minimized by locating the elevator controller, electric motor, and motor drive in the machine room vice public space areas of the facility.

B-1.2 Clearances.

Elevator machine room minimum clearances, between elevator equipment and the MR building components, are provided to facilitate maintenance, replacement, inspection, and testing of elevator components within the machine room. While these clearances may slightly exceed the ASME A17.1 code requirements, they are designed to maximize effective lifecycle sustainment of the elevator system by DOD maintenance personnel and/or contracted services.

B-2 MACHINE-ROOM-LESS ELEVATOR DESIGN.

ASME A17.1 requires an elevator drive machine to be located in either an elevator Machine Room (MR) or an elevator Machinery Space (MS). When the elevator drive machine is not located in the machine room, the elevator is referred to as a Machine-Room-Less (MRL) elevator.

B-2.1 Location and Access.

In an MRL elevator design, the elevator drive machine is relocated from the elevator machine room (MR) to the elevator hoistway. For MRL electric traction elevators, the MRL machine is typically located in the top of the hoistway. For hydraulic elevators, the hydraulic pump unit is relocated to a position along the side wall of the hoistway pit. For both types, the elevator operation controller will be located in what is then referred to as the Control Room (CR).

Machine-Room-Less (MRL) elevator design may be utilized in the design and construction of DoD Facilities. ASME A17.1 requires elevators to be designed and constructed with an accessible machinery space whenever the elevator drive machine is located within the elevator hoistway. This UFC provides specific direction for the location and access to the MS and for clearances around mechanical and electrical equipment in the MS. These safety code and criteria design requirements are intended to facilitate the safety code mandated safe and effective maintenance, service, repair, and safety code certification inspection and testing of the elevator system.

B-2.2 Construction Cost and Leasable Space.

The construction cost and leasable space benefit of using an MRL design is that the size of the elevator equipment room can be reduced since it no longer contains the elevator drive machine. Instead of having a 72 sq ft MR, the elevator equipment room can be reduced to a 40 sq ft Control Room.

However, this perceived advantage is offset by the fact that the building must also be designed with an additional mechanical area, the machinery space described in Par B-2 and B-2.1, above. For an electric traction elevator, a typical machinery space will require approximately 36 sq ft. In developing the building design, and determining the associated costs, designers must take into consideration the duplicate electrical, mechanical, and fire protection utility systems that are required for both the CR and the MS. Building and safety codes require both the CR and the MS to be equipped with lighting, electrical disconnects, fire alarm and fire protection systems, and independent HVAC systems for each area. For electric traction elevators, electrical design considerations must also include the additional run of electrical power conductors from the CR to the MS in the top of the elevator hoistway.

B-3 HYDRAULIC ELEVATORS.

The conventional hydraulic elevator consists of an elevator machine room (MR) located adjacent to elevator hoistway, with the elevator operation controller and hydraulic pump unit located in the elevator MR. The hydraulic pump unit consists of a hydraulic fluid reservoir, an electric motor and hydraulic pump, and control valves that regulate the movement of hydraulic fluid in and out of the pump unit. The hydraulic cylinder/plunger assembly is located in the elevator hoistway and is fully supported by the pit floor. Hydraulic fluid supply piping is installed from the pump unit to the hydraulic cylinder/plunger assembly in the elevator hoistway. When the pump unit supplies hydraulic fluid to the cylinder, the hydraulic plunger is forced up and out of the cylinder, driving the elevator up the hoistway. Downward movement of the elevator is powered by gravity and controlled by the elevator control valve in the pump unit. Current hydraulic elevator control valve technology that controls elevator acceleration, deceleration, and leveling, limits effective hydraulic elevator speed to a maximum of 150 fpm. At higher speeds, excessive slowdown and leveling time and travel distances are required for acceleration and deceleration.

B-3.1 Restricted Designs and Technology.

Roped hydraulic elevators and hydraulic elevators with a telescopic cylinder/plunger assembly (jack) are available in the elevator industry to allow the use of hydraulic elevator systems for higher rise applications. However, the acquisition and sustainment cost of these systems, including cost of equipment, installation, maintenance, and service, is comparable to electric traction elevators without the benefits of greater speed, efficiency, and performance offered by electric traction elevators. There are some, limited, applications where a roped hydraulic elevator can be the best choice, including Air Traffic Control Tower (ATCT) installations and modernizations of existing buildings that cannot support an electric traction elevator.

A non-standard, inverted hydraulic cylinder/plunger design is also available from a limited number of hydraulic cylinder manufacturers. In this design, the hydraulic cylinder is attached to the elevator cab in an upside-down configuration. The plunger protrudes from the bottom of the cylinder and presses against the pit floor. There is no inherent cost or performance benefit to this design and the sustainment cost is much greater than for a standard hydraulic cylinder design.

B-4 ELECTRIC TRACTION ELEVATORS.

Electric traction elevators may be used for all buildings. The traditional overhead-traction elevator consists of an elevator machine room (MR) located above the elevator hoistway. The elevator operation controller and drive machine are located in the elevator MR. Steel hoist ropes (cables) are suspended on the elevator machine drive sheave and the ends of the hoist ropes hang down into the elevator hoistway. In the hoistway, the elevator cab is fastened to one end of the hoist ropes and the elevator counterweight is fastened to the other end of the hoist ropes. The counterweight is used to counterbalance the weight of the elevator cab and the load in the cab, thereby reducing required motor torque and increasing energy efficiency. Alternative roping configurations are also used (e.g. 2:1) for greater energy efficiency and to allow a smaller drive machine to support a higher capacity load than it could otherwise. As identified in Section 2-4, speed limitations are directly related to the height of the building and the number of landings served by the elevator.

B-4.1 Drive Machines.

There are two types of electric traction hoist machines, geared and gearless. Elevator travel and car speed typically determine the most effective application of each type.

- Geared Traction Machine: The elevator drive motor drives a worm and ring gear assembly in the elevator drive machine. The ring gear turns the drive sheave, which moves the hoist ropes that raise and lower the elevator cab in the hoistway.
- Gearless Traction Machine: The gearless drive machine consists of an electric motor that connects directly to the elevator drive sheave; there is no gear reduction unit. Gearless machines are available with a conventional asynchronous induction AC motor with electrically excited fields or with the more energy efficient AC Permanent Magnet (PM) motor. Rapid advances in AC PM motor and machine technology have made this a standard option for electric traction elevator drive machines. The PMAC motor, drive, and machine technology provides the same energy efficiency whether it is located in the elevator machine room or in a machinery space in the top of the elevator hoistway.

B-4.2 Energy Efficiency.

Electric motor and motor-drive energy-efficient technologies are available in the elevator industry for electric traction elevators. High-efficiency alternating current (AC) permanent magnet (PM) gearless machines have been incorporated into elevator design in the elevator industry and can provide up to 30 - 40% efficiency gains over standard geared traction drive machines. The machine utilizes an electric motor design with permanent magnets, in lieu of electrically energized field coils, to increase energy efficiency of the drive machine. In addition, “Regenerative Drive” motor control systems have been developed for use with the AC PM motor drives. This motor control system uses the energy that is developed when the elevator is running in an overhauling load condition and converts the mechanical energy into electrical energy which is fed back to the building power grid.

Electric motor and motor-drive energy-efficient technologies should be considered for all buildings. However, the current AC PM motor and drive technology provides a service life of only 35% - 60% of the standard geared traction machine. Prior to providing direction for use of regenerative elevator motor drives, additional research and cost analysis is required, with regard to a comparison of motor drive energy savings versus excessive cost of replacement of elevator motor and motor drive systems.

B-4.3 Suspension Means.

Elevator traction-steel wire rope is the industry standard for elevator suspension means (hoist ropes). Non-coated steel hoist ropes are specified for use in UFGS 14 21 13: Electric Traction Freight Elevators and UFGS 14 21 23: Electric Traction Passenger Elevators. Elevator certifying officials are required to verify safety code compliance with minimum hoist rope diameters and maximum allowable number of broken wires in the strands of the rope. The use of non-coated steel hoist ropes provides for the effective application of elevator safety code inspection and certification requirements related to hoist rope wear and fatigue. In addition, in the event that the elevator runs past a terminal landing and bottoms out on the car or counterweight buffer, non-coated steel wire rope can slip traction with the drive sheave without damaging the wire rope.

B-4.4 Cost, Performance, and Safety.

Electric Traction vs Hydraulic

Section 2-4 of this UFC provides direction for the application of elevator types to building design, based on the length of travel and number of landings served by the elevator. These limitations are driven by several factors, including effective elevator performance, cost of the elevator system, and safety of the elevator occupants.

When an electric traction elevator is included in the design of a building, building design and construction is more expensive than for buildings with hydraulic elevators. The primary reason is that, for electric traction elevators, the building structure must be designed and constructed to support the weight of the elevator equipment, the elevator capacity, and the vertical and lateral reaction loads associated with elevator operation. In addition, the costs for the electric traction elevator equipment, installation, and sustainment are greater than the associated costs for hydraulic elevators.

B-4.4.1 Application.

For lower rise buildings, hydraulic elevators were developed as an economic alternative to electric traction elevators. By using a hydraulic elevator, cost savings are realized in the design and construction of the building since the building structure does not have to support the weight of the elevator equipment, the elevator capacity, and vertical reaction loads associated with elevator operation. The elevator is supported by the hydraulic cylinder/plunger (jack) which is supported by the elevator hoistway pit floor. All vertical loading is transferred directly to the pit floor. For low rise applications, the costs for the elevator equipment, installation, and sustainment are all lower for hydraulic elevators than the cost of these items for a comparable electric traction elevator.

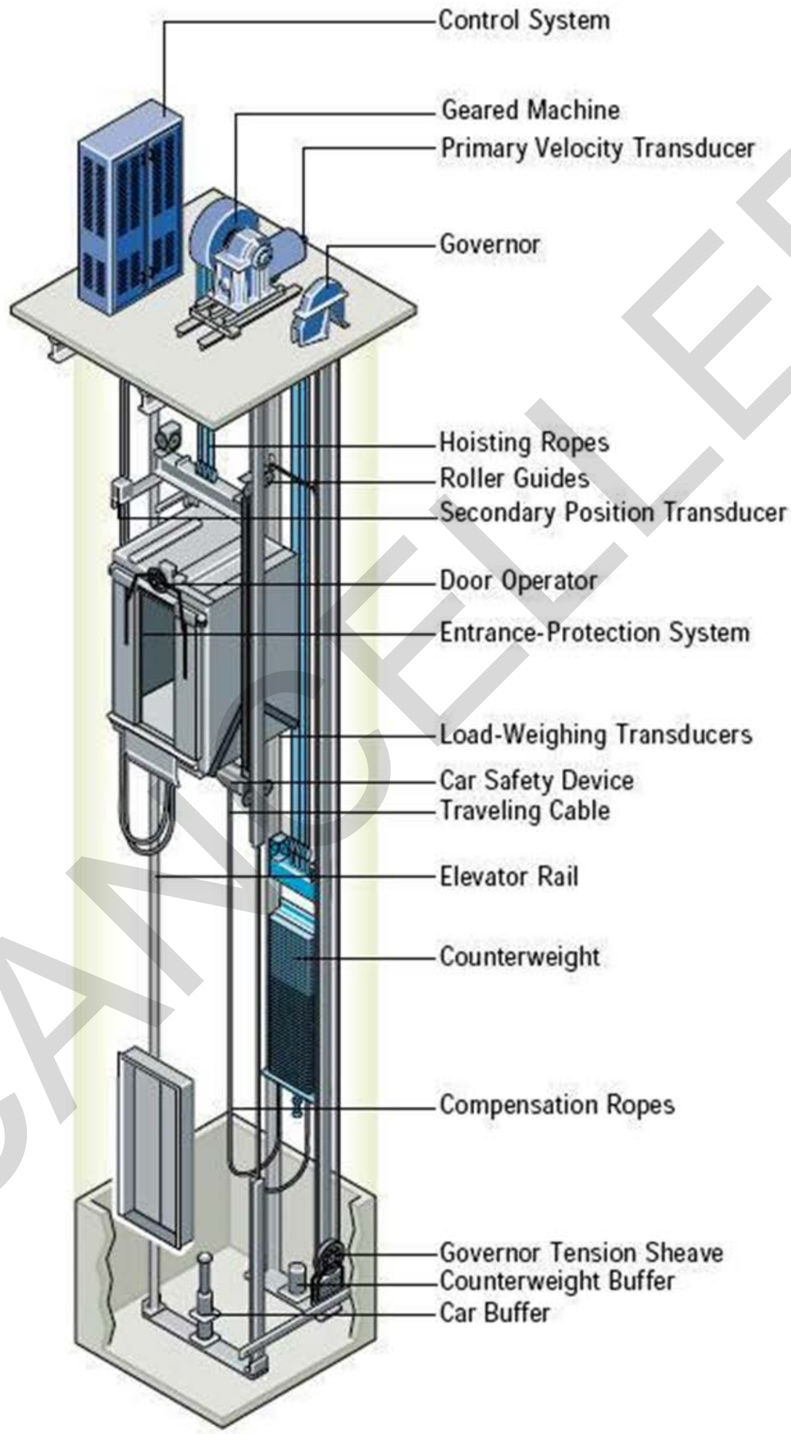
The selection of a hydraulic elevator is effective for buildings of 2 to 4 stories. For buildings of 5 stories and greater, however, the cost of the elevator equipment, the installation cost, and the cost of sustainment begin to rise substantially for hydraulic elevator systems. In addition, the speed limitations associated with hydraulic elevators has a detrimental impact on traffic flow within the building and results in excessive wait times for elevator response to hall calls and car calls. For these reasons, an electric traction elevator is the more appropriate choice for higher rise applications.

B-4.4.2 Safety.

One other critical consideration, for hydraulic elevators, has to do with safety of personnel who will be using the elevator for the life of the building. The ASME A17.1, Safety Code for Elevators & Escalators, requires all elevators suspended by wire rope to be equipped with a speed governor and elevator car safeties. The speed governor monitors the speed of the elevator and actuates elevator car safeties in the event that the elevator accelerates to an over-speed condition. These safety devices are designed to bring the elevator to a sliding stop and are effective for over-speed emergency actuation in both the up and down directions. However, ASME A17.1 does not require direct plunger hydraulic elevators to be equipped with a speed governor or safeties. The travel limitation of 44’ for hydraulic elevators serves to minimize the risk associated with catastrophic failure of the hydraulic cylinder/plunger or the hydraulic oil supply line.

Figure B-1 Electric Traction Elevator with Geared Machine

Elevator Machine Room is located Directly Over the Elevator Hoistway.



B-5 HYDRAULIC ELEVATORS.

The hydraulic drive system consists of a hydraulic fluid reservoir, hydraulic pump, and hydraulic piping from the elevator MR to the cylinder/plunger assembly located in the elevator hoistway. There are two types of cylinder/plunger configurations: direct plunger and indirect plunger.

B-5.1 Direct Plunger Hydraulic Elevator.

There are two types of direct plunger hydraulic elevators: in-ground and hole-less. The use of one or the other is governed the building design characteristics and site conditions.

B-5.1.1 In-ground Direct Plunger.

An elevator cylinder and plunger assembly is installed in the ground, below the elevator cab. The elevator cab frame is connected to the top of the plunger and moves up as hydraulic fluid is pumped into the cylinder from the hydraulic elevator pump-unit reservoir.

B-5.1.2 Hole-less Direct Plunger.

Either one or two hydraulic cylinder/plunger assemblies are installed vertically, in the elevator hoistway, with the bottom of the cylinder supported by the hoistway pit floor. The cab frame is attached to the top of the plunger and moves up as hydraulic fluid is pumped into the cylinder from a reservoir.

B-5.2 Indirect Plunger Hydraulic Elevator.

B-5.2.1 Roped Hydraulic Elevator.

The roped design is similar to the standard hole-less elevator design. The difference is that a wire rope sheave is mounted to the top of the hydraulic plunger and steel hoist ropes are attached to the cylinder base, run over the sheave, and down to the cab frame. As the cylinder runs up, the 1:2 roping moves the elevator cab twice the distance of the plunger travel. The cost of acquisition, maintenance, and service for a roped-hydraulic elevator is substantially greater than for the direct plunger types and is not permitted in DOD facilities except in the event of compelling design conditions.

Figure B-2 In-ground Direct Plunger Hydraulic Elevator

Elevator Machine Room is located Directly Adjacent to the Elevator Hoistway

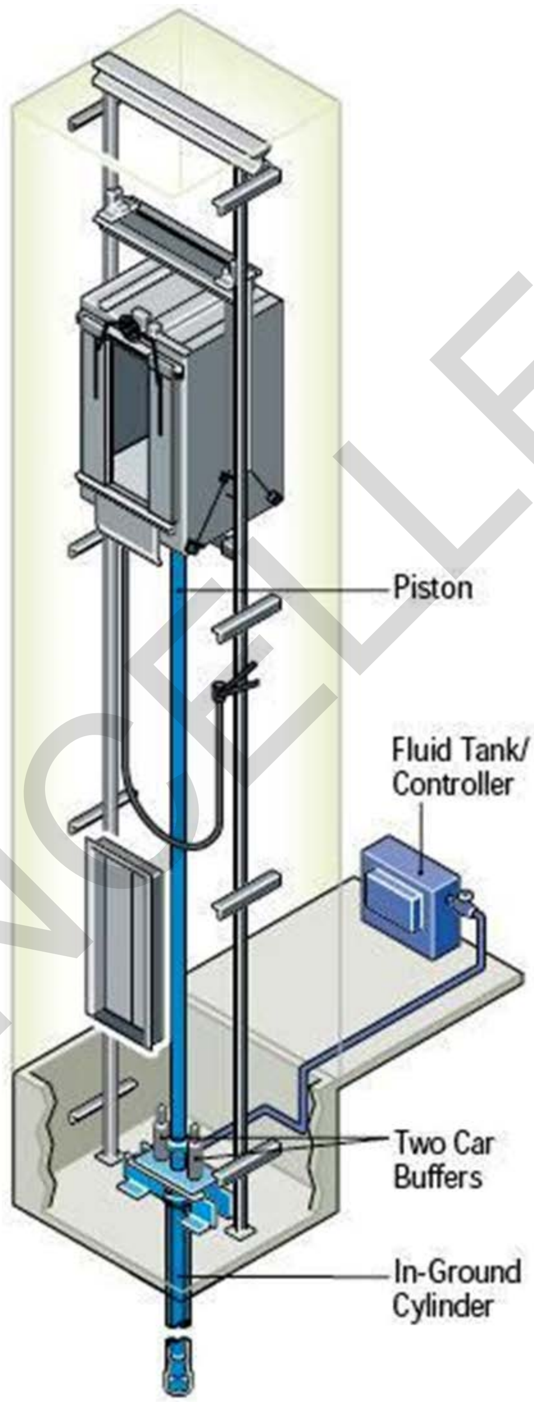
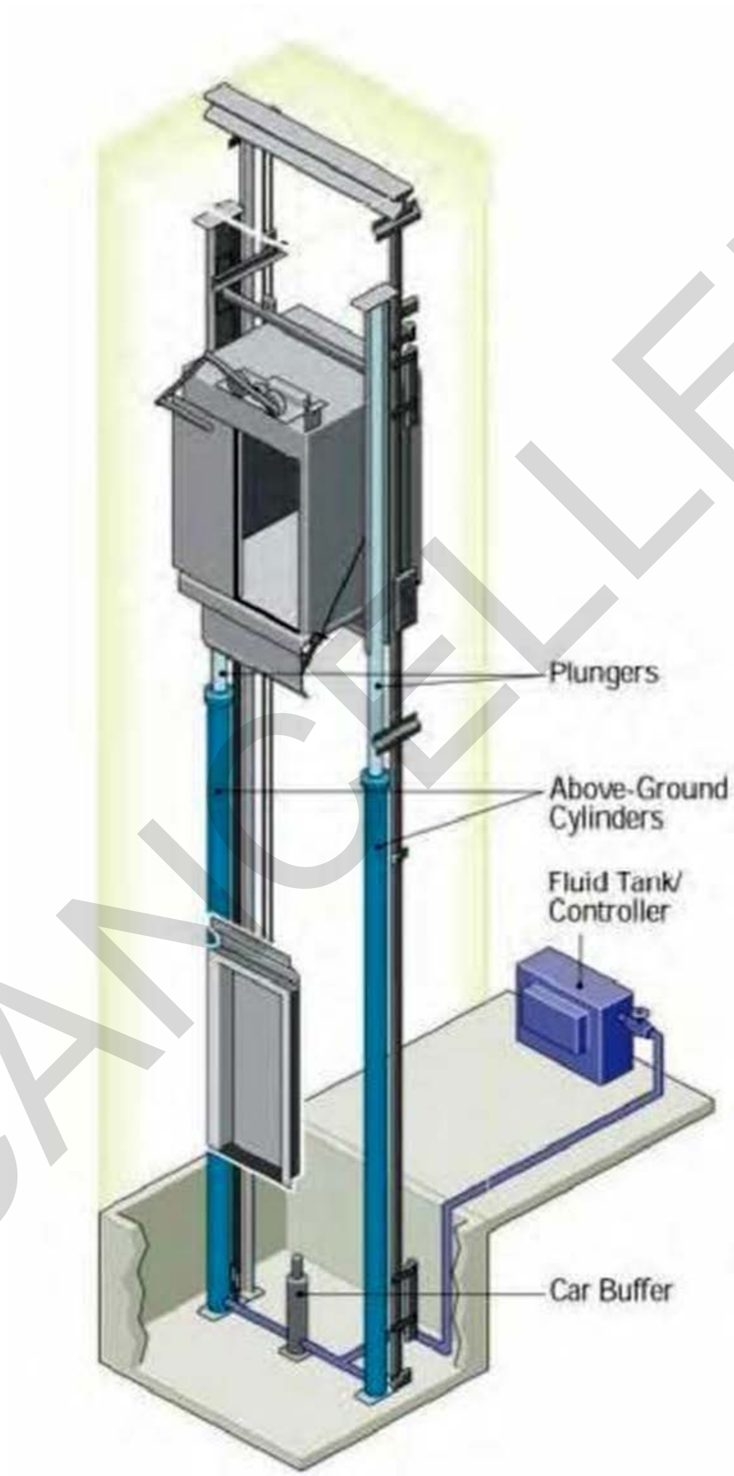


Figure B-3 Hole-less, Dual Post, Direct Plunger Hydraulic Elevator

Elevator Machine Room is located Directly Adjacent to the Elevator Hoistway.



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APPENDIX C GLOSSARY

C-1 ACRONYMS

AFCEC	Air Force Civil Engineer Center
ATCT	Air Traffic Control Tower
ATS	Automatic Transfer Switch
BIA	Bilateral Infrastructure Agreement
DOD	Department of Defense
EMS	Emergency Medical Services
FEO	Firefighters' Emergency Operation
HQ USACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
MR	Machine Room
NAVFAC	Naval Facilities Engineering Command
NEI	National Elevator Industry
SME	Subject Matter Expert
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
U.S.	United States
VTE	Vertical Transportation Equipment