What MEP Engineers Need to Know

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EGRESS AND FIRE PROTECTION CODES

By Richard Vedvik, senior electrical engineer, IMEG

Egress — the ability to get out of a building safely on a protected pathway — is a critical aspect of building design. But as a building is renovated, exit pathways may change, or be blocked, which can create unsafe conditions.

This whitepaper discusses what mechanical, electrical, and plumbing engineers need to know about the National Fire Protection Association (NFPA) Life Safety Code before making temporary or permanent changes to egress.

Egress Impacts During Construction — Chapter 7 (Means of Egress)

Chapter 7 is predominantly about requirements for egress pathways. This whitepaper will not educate the reader on the entire chapter, but it is important to understand how design and construction phasing affects egress pathways and temporary occupancy challenges.

The distance travel limits, dead-end limits, and common path limits in **Table A.7.6 (Measurement of Travel Distance to Exits)** can be impacted during construction. Designers need to take both temporary and permanent impacts to building egress into consideration during remodels and building addition projects to ensure an unsafe condition is not created while the area is occupied.

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Prep and recovery bays in the cardiac catheterization lab at Advocate Lutheran General Hospital in Park Ridge, IL. The lab is part of the hospital's Heart Institute and is located directly below the emergency department, enabling quick transport in an emergency. The exit pathways lead to adjacent areas in the hospital.

Consider a project where an exhaust duct needs to be added to the space. While most of the project scope may be confined to a small area, the distance to a suitable exhaust system or vertical chase may result in ceiling removal outside of the project limits.

Another example would be the addition of a sanitary drain on an elevated floor, where sloped pipe needs to be routed above the ceiling on the space below, and that route may impact existing systems above those ceilings. It is likely this work will occur in or through existing corridors which will impact egress.

The design team should consider how long the corridor will need to be closed off to execute the work. In some cases, only part of the corridor will be closed at a time, and while this phased installation increases the time and cost of the work, a temporary narrowing of the egress pathway may be tolerable.

For a school or office building this may be done after hours, but for a hospital or other 24-hour occupancy building, the work will trigger a review of alternate egress pathways. If the area in question is in front of an elevator or egress stair, the impacts are more substantial, and the design team should consider if the area served by the egress pathway can remain occupied during construction. It will usually be considered unacceptable to tell a hospital client that the ductwork route will require them to empty a patient wing.

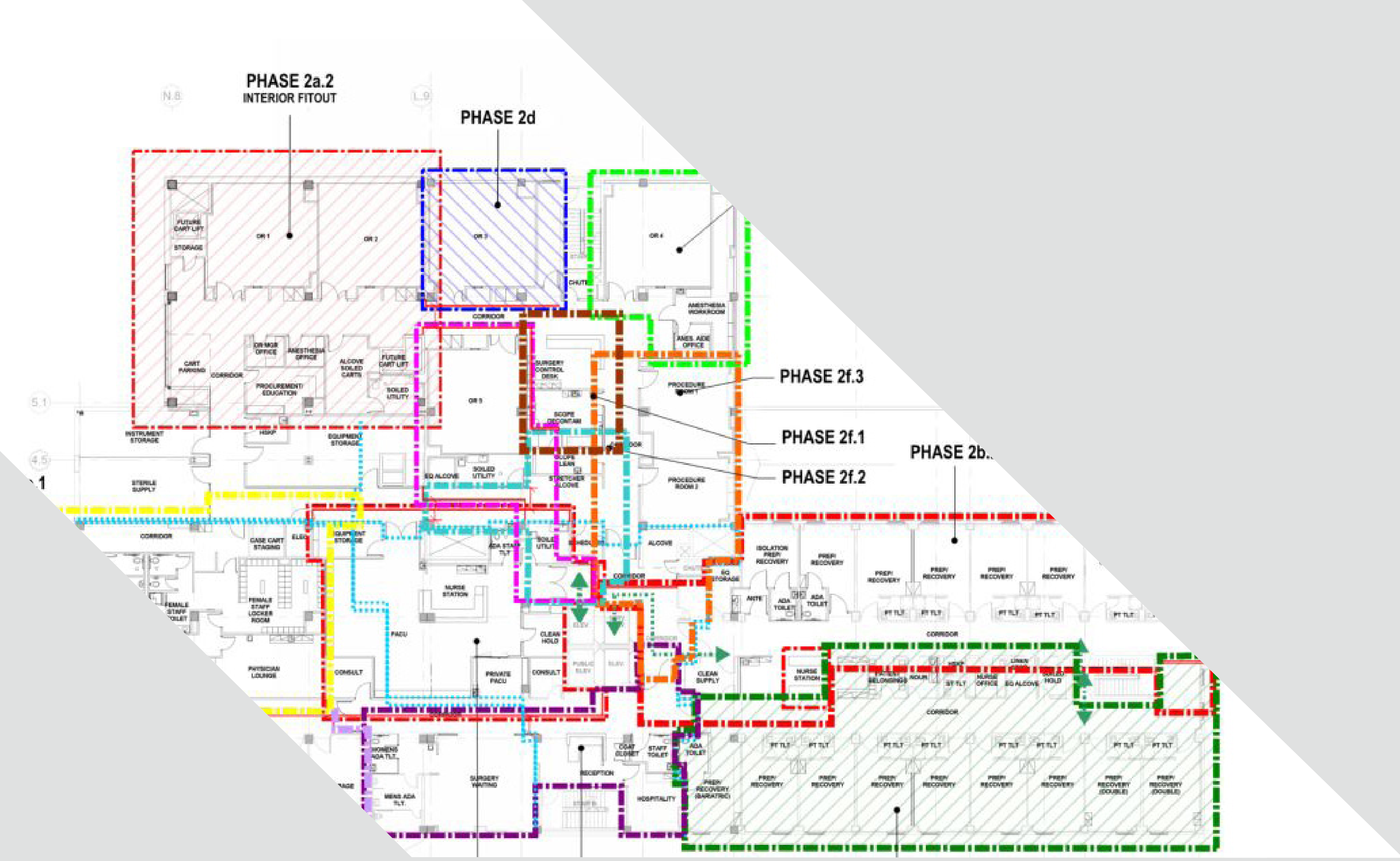
For projects with a larger impact on the building, phasing boundaries should be coordinated with adjacent egress requirements at each stage. Construction barriers that extend into corridors should be evaluated with the adopted code and may require finding alternate options and pathways.

When closing corridors is required, the team must assess the ability to continue to occupy adjacent areas. Depending on the project, the impact may be hours, days, weeks, or months. The facility, the designers of record, and the AHJ (Authority Having Jurisdiction) should discuss the impacts during design and document the agreed approach that will not put occupant lives at further risk.

An example is an addition and remodel of the surgery department at a hospital, where the entire surgical department would be replaced while the department remained active. The purpose of the building addition was to add operating rooms in the initial phase so the number of usable operating rooms could remain constant during construction.

IMEG, the engineering project manager and electrical engineer of record, participated in many meetings and project phasing discussions that included the architect, owner, users, and state health department to evaluate how each area would meet egress requirements during each construction phase.

During a surgical suite renovation, stakeholders hold phasing discussions to determine how each area would meet egress requirements during construction phases, so no occupant lives will be at further risk.



While the engineering team was focused on the impacts that both new and existing electrical, plumbing, and HVAC systems would have on each phase, we also considered the impacts to corridors and adjacent patient care areas. For example, if we phased the project in a way that cut off the main HVAC duct serving areas outside of this phase, a temporary solution would be required, and departments would not be occupied during system outages. Being a surgical department, the cleanliness of the temporary barriers further complicated the effort required, and construction barriers needed to be durable, gasketed, and cleanable. The HVAC air balance of the occupied areas required constant attention during each phase due to the indoor air quality requirements and air pressure relationships.

The state authority required interim life safety drawings be submitted for each phase as part of the project approval process. Our project phases were long enough to require egress solutions suitable for a permanent condition. One challenge was with the creation of dead-end corridors where construction barriers would be needed. Maintaining access to existing stairs became a requirement and the state would not tolerate temporary outages when the department was occupied.

Another IMEG project involved replacing existing ceilings in a surgical department. While the department contained six operating rooms and wasn't physically large, the ceiling replacement required nine separate phases to always maintain OR access and department egress.

Following is an introduction to specific sections of the NFPA Life Safety Code that MEP engineers will need to consider:

Protection of Exits

Section 7.1.3 (Separation of Means of Egress)

Egress exit pathways must be protected by fire resistance-rated assemblies to ensure the pathway is usable and not compromised by the failure of building systems.

The section defines limitations to building systems that can be installed in or routed through exit passages and exit stairways. The restrictions prevent the exit enclosure from being used as a pathway for building systems, such as a vertical or horizontal chase, that do not directly serve the exit enclosure.

The exception to this restriction is listed in **7.1.3.2.1 (10) (Exits)** and includes ventilation, fire protection, heating and cooling systems. Fire alarm and telecommunication systems are also allowed but must be installed in conduit.

Electronic Doors

Section 7.2.1 (Means of Egress Components/ Door openings)

Delayed egress systems described in **7.2.1.6.1 (Delayed-Egress Electrical Locking Systems)** allow for a short-duration impediment to the direction of travel for security reasons, like to deter theft, or discourage the use of the path except in emergencies.

Building additions can affect the path of egress, resulting in the pathway going through a sensitive area. A delayed egress system allows the building to meet the code for egress pathway distance and location while promoting alternate travel paths.

This is not an ideal scenario, and the design team should avoid using delayed egress for this purpose if possible. This door system requires the use of sprinkler and fire alarm systems for deactivation to eliminate impediments during an emergency. Fire alarm relays must then be located at the door controllers and programmed to unlock or bypass locking mechanisms.

Section 7.2.1.6.2 (Sensor-Release of Electrical Locking Systems) defines requirements for locating an electronic door's manual release device — a push button with the words "PUSH TO EXIT" clearly identified. A manual release is more secure than a motion-sensor release system, which can inadvertently provide access to the secure area.

Manual push buttons are required to be within 60 inches of the door opening.

Manual push buttons are required to be within 60 inches of the door opening. This can be challenging with storefront construction and requires careful coordination with the storefront manufacturer to install the pushbutton in the mullion.

The design team should carefully consider the arrangement and labeling of manual release buttons when multiple doors are in one area. A fire alarm interface is required here as well, to unlock the doors when the sprinkler or fire alarm systems are activated. Typical applications for electronic door releases are for areas where public access is restricted or where the facility wants an electronic record of access. These areas can include electrical, technology, and mechanical rooms. If panic hardware is required, the releasing requirements apply.

If the project includes electronic locking of doors to separate an elevator lobby from the exit corridor, **7.2.1.6.3 (Door Hardware Release of Electrically Locked Egress Door Assemblies)** outlines the requirements and interfaces with other building systems. It includes requiring the building to have a sprinkler and a fire alarm system, as well as interface to unlock the doors when those systems are activated. This section also requires a two-way communication system to a continually attended location with trained staff, a requirement not suitable for buildings not staffed 24 hours a day.

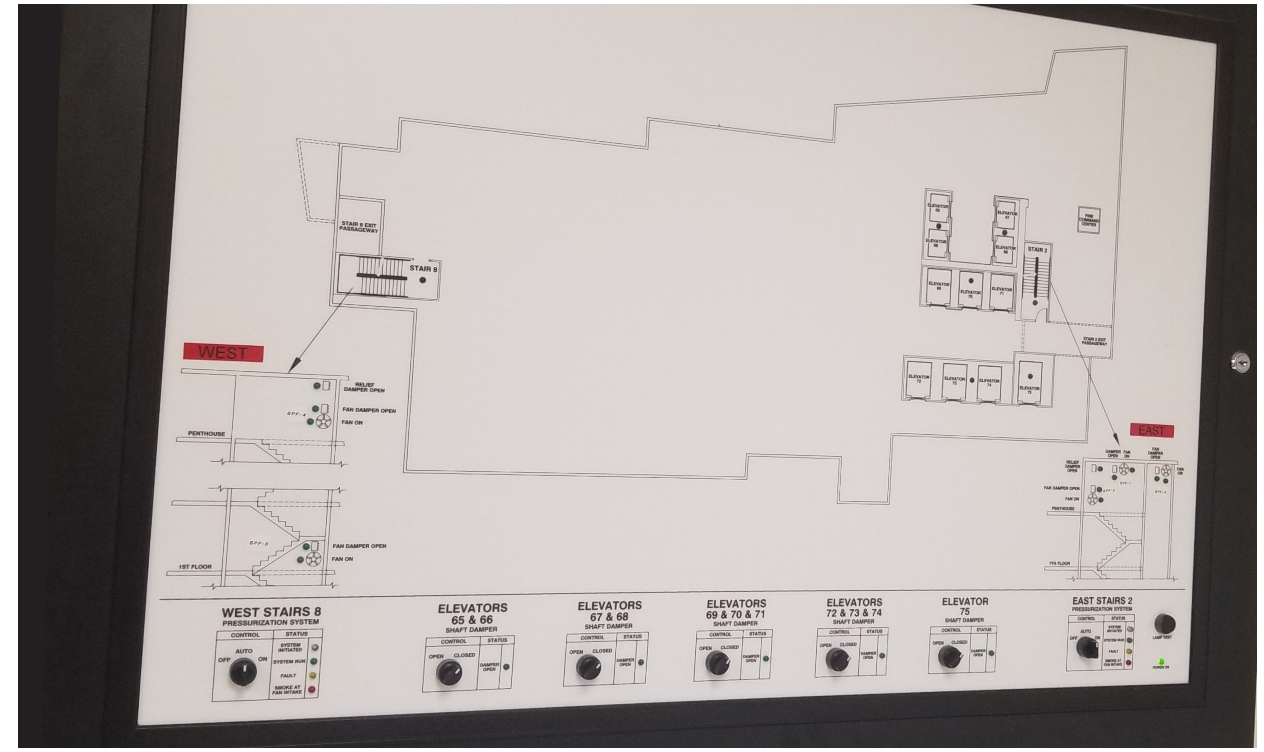
The 2018 version added references to ANSI/BHMI standards, requiring compliance for power-operated and power-assisted doors in **7.2.1.9 (Powered Door Leaf Operation)**. This section also defines the maximum amount of force required to manually open these doors upon loss of power. The maximum forces in section **7.2.1.4.5 (Door Unlatching and Leaf Operating Forces)** will still apply, but a higher initial opening force is allowed for power-operated and power-assisted doors.

It is important to note the HVAC system will affect the force required to open an egress door. Buildings with negative pressure balancing will need additional forces on exterior doors, and designers should carefully consider how building pressure will affect egress requirements. Power-operated doors must be deactivated when a fire alarm is activated in that area.

Stair Enclosures

Section 7.2.2 (Stairs) and 7.2.3 (Smokeproof Enclosures)

NFPA 101 also has requirements for stairs and stair enclosures that engineers need to consider. Minimizing water accumulation is required in **7.2.2.6.5 (Water Accumulation)** and may result in the addition of exterior drains if the landscape cannot allow for natural drainage. Engineers are also impacted by illumination requirements in **7.2.2.5.5.11 (Exit Stair Illumination)** and smoke-proof enclosure requirements in **7.2.3 (Smoke-proof Enclosures)**. Ventilation requirements of smokeproof stair enclosures are defined in **7.2.3.8 (Mechanical Ventilation)** and **7.2.3.9 (Enclosure Pressurization)** and include both air change requirements of at least one air change per minute and an exhaust system that is 150 percent of the supply air.



Stairwells must meet requirements for pressurization.

The physical location requirements of air intake and exhaust grills is also discussed.

The exhaust air discharge is required to be 2500 CFM while maintaining at least 0.10 in. of water column pressure relative to the stair access doors and the occupied space. This pressurization requirement can vary based on the building's sprinkler systems and refers to **7.2.1.4.5 (Door Unlatching and Leaf Operating Forces)** for maximum door opening force. Carefully consider how the system is controlled so the minimum air pressure requirements do not push the door opening force beyond required maximums.

Variable frequency drives could control the pressurization fans to maintain adequate pressure during balancing but not to monitor the actual pressure affected by opening doors. This will cause the system to react in real-time and over-pressurize the enclosure when doors are closed.

New to 2018 is a requirement in **7.2.3.9.1.1 (Enclosure Pressurization)** to comply with NFPA 92 and the addition of survivability requirements for control and power wiring in sections **7.2.3.9.2** through **7.2.3.9.4**. The survivability requirements are like other sections of NFPA where two-hour rated systems are required for power wiring. These power systems must be on an EPSS that complies with the requirements for a Type 60, Class 2, Level 2 EPSS — power shall be provided within 60 seconds of utility failure and shall operate for at least two hours.

Mechanical Room Egress

Section 7.13 (Mechanical Equipment Rooms, Boiler Rooms, and Furnace Rooms)

As mechanical rooms increase in size, the need for egress components should be evaluated. **Section 7.13**

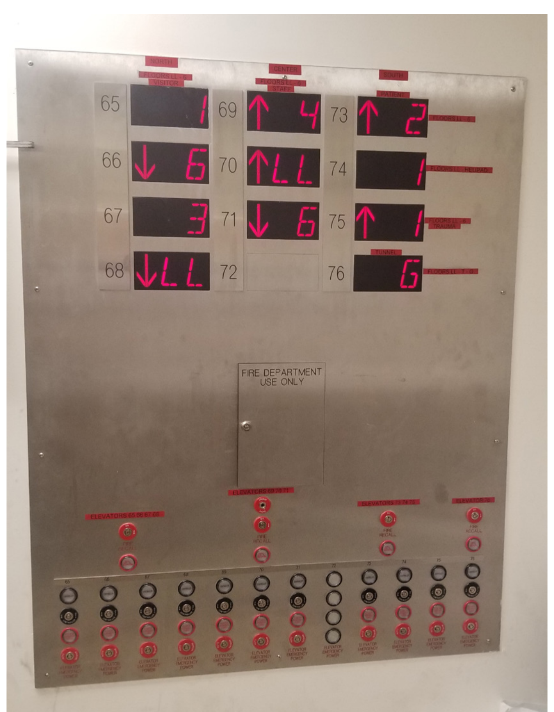
(Mechanical Equipment Rooms, Boiler Rooms, and Furnace Rooms) defines an egress pathway distance limitation of 50 feet with distance extensions for sprinklered buildings, existing buildings, or rooms without fuel-fired equipment.

Egress pathways should be clearly identified, marked, and illuminated in compliance with this and other sections. Mechanical rooms commonly have restrictions to clear height, obstructions on the floor, or obstructions raised off the floor. Designers should carefully consider the location and arrangement of mechanical room exits when the building systems are determined.

Elevators

Section 7.15 (Occupant Evacuation Elevators)

Elevator and escalator code is outlined in ASME A17.1/CSA B44 Safety Code and NFPA 101 **Section 7.15**



(Occupant Evacuation Elevators). Section 7.15 provides requirements for buildings where elevators will be used for egress during an emergency. **Section 7.15.3.3 (Conditions for Safe Continued Operations)** requires a fire command center (FCC) to include a list of elevator information including location, direction of travel, and occupied status. The status of normal and emergency power and fire alarms must be displayed. This information could be integrated into the elevator controller or provided by separate annunciators for transfer switches and the fire alarm (which are already required in IBC Section 911). Elevator override control also is required at the FCC.

A voice-capable fire alarm notification system that allows the FCC to provide verbal instructions on each floor to indicate if and where elevators are available is required. This voice system shall comply with NFPA 72 (Annex D) for speech intelligibility, especially in the elevator lobbies. A two-way communication system is required in the elevator lobbies to allow for communication with the FCC.

Another important requirement is that elevator hoist ways and elevator machine rooms shall not contain sprinklers if the associated elevators are used for occupant evacuation. The reason for eliminating sprinklers in these areas is because of shunt trip requirements, which would conflict with usage, as noted in **7.15.6.2 (Elevator Installation)** and described in the annex section of the code.

The takeaway

MEP designers should carefully evaluate impacts to existing egress when routing, removing, or replacing ductwork, piping, plumbing, lighting, and conduit in occupied areas. While MEP engineers may feel that egress requirements are the responsibility of the architect, the MEP design team must communicate expected impacts and not wait for the discussion to occur during construction.

Contact the author

Richard Vedvik
Senior Electrical Engineer
309.793.3424
Richard.A.Vedvik@imegcorp.com

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