VMC GROUP

CONTROLLED ENVIRONMENT SOLUTIONS™

AIR | NOISE | SEISMIC
VIBRATION | SHOCK

OPERATIONAL RESILIENCE IN HOSPITALS:

Meeting the IBC Standards for MEP Systems

INTRODUCTION

A storm surges inland. The power grid fails. Roads flood. And inside the hospital, critical systems face their own test: Will emergency power kick on? Will air handlers hold? Will patient monitoring, medical gas and IT infrastructure stay online?

These questions aren't hypothetical — they define the difference between a facility that continues to function during an emergency and one that fails when lives are on the line.

Hospitals are more than buildings. In times of crisis, they are lifelines. That's why today's building codes — particularly the International Building Code (IBC) — go beyond structural safety. They require operational resilience. Learn about the essential code updates, certification pathways and integrated design strategies that ensure hospital systems perform when natural disasters threaten to shut everything else down.

© 2025 VMC Group. All rights reserved. 8067 07/2025

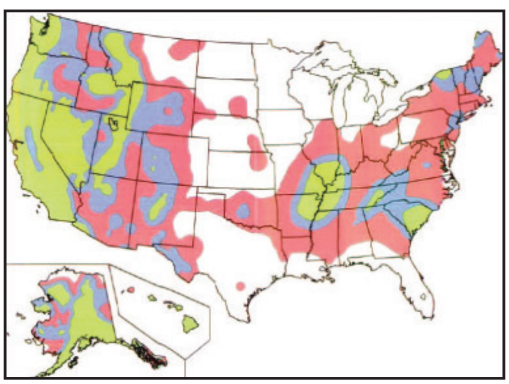
BACKGROUND

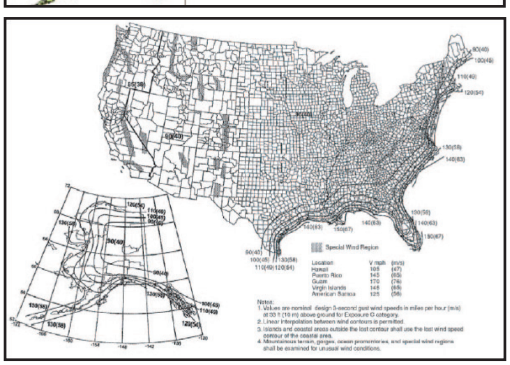
The need for a nationally recognized model building code became urgent after the 1994 Northridge Earthquake, which led to the closure of nine hospitals and the loss of over 2,500 inpatient beds in Southern California. This event exposed the vulnerability of critical nonstructural systems — electrical, mechanical and plumbing — and sparked efforts to standardize and strengthen hospital resilience through updated building codes.

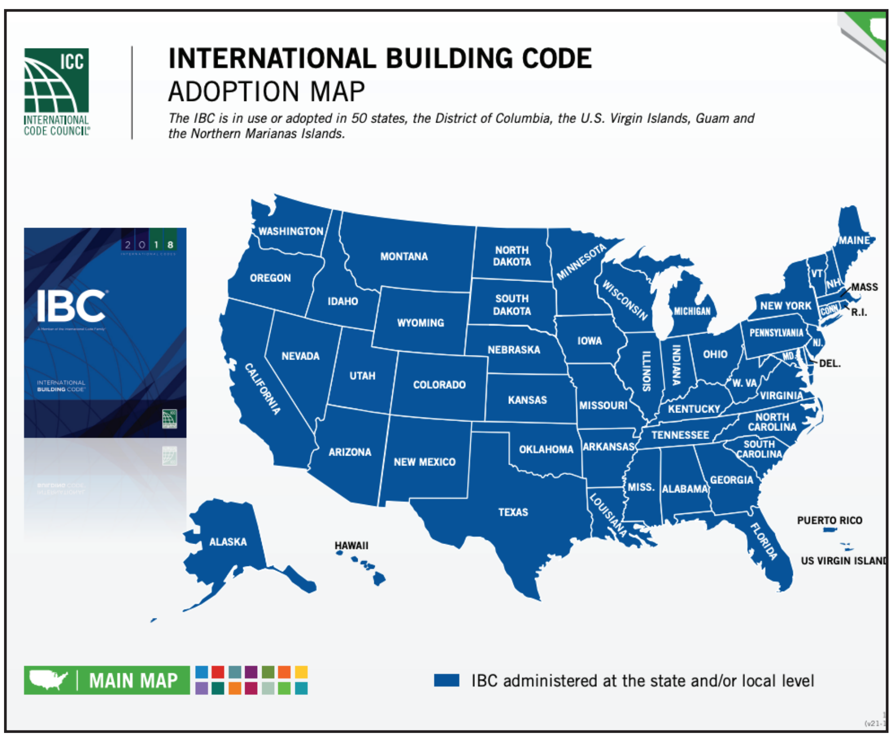
In the years since, additional large-scale disasters have reinforced that lesson. Hurricane Harvey (2017) brought catastrophic flooding to Houston, impacting several major hospitals, overwhelming emergency power systems, and underscoring the importance of flood protection and utility continuity. More recently, the 2019 Ridgecrest Earthquakes caused structural and nonstructural damage to Ridgecrest Regional Hospital, forcing patient evacuations and ambulance rerouting. While the facility remained structurally sound, temporary loss of services highlighted the ongoing need for functional continuity of MEP systems after seismic events.

To address these challenges, three leading code organizations united to form the International Code Council (ICC) and — working in collaboration with NEHRP agencies — developed the International Building Code (IBC). First issued in 2000 and updated regularly, the IBC now serves as the structural and nonstructural design standard for most U.S. jurisdictions.

Today, nearly all states have adopted a version of the IBC, either at the state or local level. The vast majority require seismic compliance for health care facilities, and all include specific wind-load requirements. Coastal regions and inland floodplains — from New England to the Gulf Coast — also require careful attention to flood resilience. Unlike legacy building codes, the IBC requires Essential Facilities such as hospitals to demonstrate not just structural integrity but continued operational performance following a design-level event. Critical systems must be anchored, restrained and certified to remain online — ensuring that health care delivery is not interrupted when it is needed most.







Operational Resilience in Hospitals: Meeting the IBC Standards for MEP Systems

© 2025 VMC Group. All rights reserved. 8067 07/2025

LIABILITY CONCERNS AND CERTIFICATION REQUIREMENTS

The International Building Code imposes specific responsibilities on architects, engineers, contractors and equipment manufacturers involved in the design and construction of hospital facilities. Under both IBC 2018 and IBC 2021, MEP systems that are designated as critical to the continued operation of an Essential Facility must be evaluated not only for structural anchorage, but for verified post-event functionality.

This requirement is codified in IBC Section 1708.4 (2018) and 1708.5 (2021), which state that designated seismic systems — those with a component importance factor (Ip) = 1.5 — must be tested or analytically qualified to remain operational after a seismic event. These components include electrical switchgear, emergency power systems, chillers, pumps, air handlers and similar MEP equipment that, if compromised, would impair the facility's ability to function.

The responsibility begins with the design or specifying engineer, who must clearly identify designated seismic systems in the project specifications and assign the appropriate importance factor per ASCE 7-16 Section 13.1.3 or ASCE 7-22. Once designated, the equipment manufacturer must provide a Certificate of Compliance demonstrating that the system and its anchorage meet the required performance criteria through one or more of the following methods:

- Shake table testing in accordance with **ICC-ES AC156**
- 3D shock or vibration testing
- Nonlinear dynamic analysis using seismic input
- Experience data from previous seismic events
- Finite element modeling (FEA) that accounts for internal and external component response

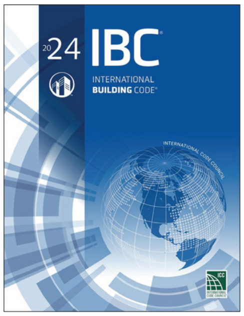
While experience data and analytical methods may be referenced in select cases, reliance on these approaches alone for seismic certification of active or energized equipment is strongly discouraged. Analytical models often lack sufficient experimental validation, reducing their reliability. Similarly, historical experience data sources, such as SQUUG, frequently reference outdated equipment designs that do not reflect modern construction practices.

A Certificate of Compliance must be reviewed and accepted by the registered design professional in responsible charge and approved by the Authority Having Jurisdiction (AHJ). Compliant systems must also be labeled at the factory by the equipment manufacturer. These labels provide traceability for inspectors to confirm that the installed product matches the certified configuration approved during the design phase. A special inspector must verify both the labeling and the anchorage of the equipment as part of the final inspection process.

Contractors also bear responsibility under the IBC. Before installation begins, they must submit a Statement of Responsibility (per IBC Section 1704.4 or 1705.12) confirming their intent to install designated seismic systems in accordance with approved plans and specifications. This documentation protects the building owner and design team from downstream liability.

All parties must also exercise caution when reviewing value engineering proposals or substitutions. Any deviation from the original design must be thoroughly evaluated to ensure it does not compromise seismic, wind, or flood performance. The IBC's provisions for consequential damage extend liability beyond the immediate party responsible for failure, underscoring the importance of compliance at every stage.

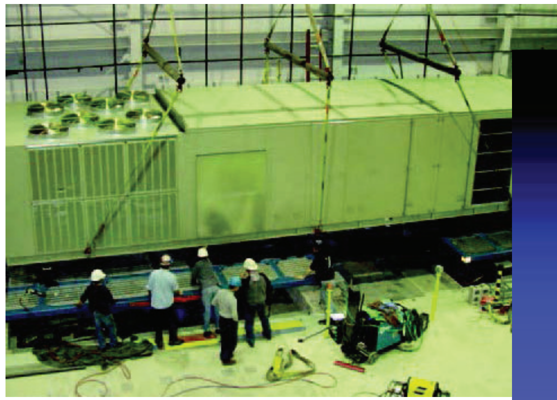
The increased emphasis on operational continuity has led major insurers — such as FM Global — to publish seismic design and installation guidelines aligned with the IBC. Likewise, MasterSpec® now explicitly requires that equipment must "withstand" seismic events, meaning that it must not only remain in place, but also remain fully functional following a design-level event.

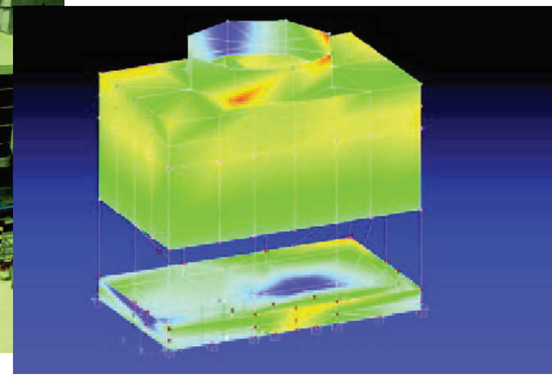


© 2025 VMC Group. All rights reserved. 8067 07/2025

EQUIPMENT CERTIFICATION METHODS AND IMPORTANCE FACTOR REQUIREMENTS

Under the International Building Code and its companion standard, ASCE 7, the operational certification of MEP components in hospitals is no longer optional. Designated seismic systems — those required to function after a seismic event — must be assigned a Component Importance Factor (Ip) of 1.5 and must be certified for performance using recognized methods.





COMPONENT IMPORTANCE FACTOR (IP)

As defined in ASCE 7-16 Section 13.1.3 and continued in ASCE 7-22, the Importance Factor for a nonstructural component is determined by its role in life safety and facility operation.
An Ip of 1.5 is required if:

1. The component is essential to life safety after an earthquake (e.g., emergency lighting, fire suppression).
2. The component contains hazardous materials.
3. The component is located in or supports the continued function of a Risk Category IV facility, such as a hospital.

All other components may be assigned an Ip of 1.0. However, in hospital design, most critical MEP systems — generators, transfer switches, chillers, air handlers, pumps, electrical panels — fall under the 1.5 category due to their role in maintaining operational continuity.

CERTIFICATION METHODS

To meet code requirements, manufacturers of Ip = 1.5 components must provide documented proof that their equipment can withstand and remain functional after the seismic forces expected at the site. Acceptable methods include:

- Shake Table Testing (per ICC-ES AC156): Full-scale dynamic testing on a tri-axial platform to simulate seismic motion. The equipment must automatically restart and operate within manufacturer-specified limits after the test.
- Finite Element Analysis (FEA): Nonlinear structural modeling that evaluates how the equipment and its anchorage respond to applied seismic loads.
- Experience Data: Historical performance documentation of identical or substantially similar equipment in past seismic events.
- Analytical Methods: Calculations that incorporate the equipment's dynamic characteristics and seismic demand.
- Combination Approaches: Many manufacturers combine physical testing with modeling and experience data to create a robust compliance package.

However, reliance on experience data or analytical methods alone is strongly discouraged for critical equipment. Historical experience data often reflects outdated designs, and analytical models without physical validation may not provide reliable post-event performance predictions.

It is important to note that while experience data and analytical methods are recognized pathways, they should not be used as standalone justification for seismic certification of critical, energized components. Experience data is often based on legacy equipment that may not reflect current design standards, and analytical models without physical validation may fail to predict real-world performance.

For electrical equipment, certification must also address internal component behavior — batteries, control panels, circuit boards — especially when those components have low natural frequencies or are known to be vibration-sensitive.

© 2025 VMC Group. All rights reserved. 8067 07/2025

FACTORY LABELING AND DOCUMENTATION

Once they establish compliance, the manufacturer must label the certified equipment at the factory. This label is a key requirement under IBC and ASCE 7 and must provide sufficient information to link the installed unit to its certification record. A corresponding Certificate of Compliance must accompany the product, confirming that the exact configuration, anchorage method and performance criteria have been met.

The special inspector verifies labels and certificates to ensure that the as-installed equipment aligns with the reviewed and approved seismic submittals. This process creates traceability and helps streamline approvals with the Authority Having Jurisdiction (AHJ).

OPERATIONAL RESILIENCE AND EMERGENCY POWER REQUIREMENTS

For hospitals and other Risk Category IV facilities, staying operational during and after a disaster is not a preference — it is a requirement. The International Building Code, reinforced by ASCE 7, mandates that nonstructural systems supporting essential functions must not only survive seismic or wind events structurally, but also continue to perform their intended operations.

This operational requirement extends beyond anchorage and bracing. Systems such as emergency generators, transfer switches, HVAC systems, medical gas infrastructure, water heaters, IT servers and electrical distribution panels must be certified to run within specified tolerances after an event. Failure to do so could jeopardize patient care, staff safety and emergency response capabilities.

COORDINATED SYSTEM DESIGN

Operational resilience is most effective when equipment, anchorage and utilities are designed as an integrated system. HVAC units mounted on seismic curbs, for example, must be matched to isolation mounts that can withstand uplift forces. Generator skids and switchboards must be tested as assemblies under dynamic load.

Without this coordination, even certified components may fail due to incompatibility in mounting, bracing, or load transfer. The IBC and ASCE 7 both emphasize the need for a continuous load path from equipment to structure — and from utility source to critical endpoint.

Ultimately, the IBC establishes the minimum design criteria. Many hospital systems, particularly in high seismic or high wind zones, go beyond these minimums by incorporating additional redundancy and using special seismic certification programs (e.g., OSHPD OSP, FM Approval) to validate component performance.

BEYOND INITIAL SURVIVAL: POWER DURATION AND LOAD

Compliance with IBC 2018 and 2021 assumes that essential systems are designed for sustained operation, not just immediate evacuation. Critical systems must remain active for as long as emergency conditions persist — whether for hours or multiple days — until normal utility services are restored.

Beginning in 2024, this requirement is emphasized in standards like NFPA 110 and reinforced by state-level mandates such as California's HCAI PIN 74, which requires skilled nursing facilities to maintain 96 hours of backup power. While not directly part of the IBC, these standards demonstrate the evolving expectations for resilient healthcare infrastructure.

To meet these demands, design professionals must evaluate:

- Full facility load vs. essential systems load
- Fuel storage capacity and resupply logistics
- Power distribution and redundancy
- Component compatibility with seismic-certified electrical systems
- Coordination with HVAC and life-safety branches

© 2025 VMC Group. All rights reserved. 8067 07/2025

REDUCING RISK THROUGH COMPLIANCE

To reduce liability exposure and ensure continuous operation of health care facilities, it is essential that equipment manufacturers, suppliers, design professionals and installing contractors fully understand and execute their responsibilities under IBC 2018 and 2021.

While code compliance begins with engineering, it must extend through product selection, submittal review, installation, inspection and final commissioning. Critical details — such as anchorage design, labeling and subcomponent certification — can determine whether equipment passes final inspection or fails under real-world conditions.

KEY AREAS OF RISK TO ADDRESS

- Emergency power system runtime and load analysis
- Redundancy in utility feeds for new and existing wings
- Accommodating seismic drift in underground utility connections
- Roof structural support for moment and uplift forces at equipment curbs
- Verification of seismic restraint systems for piping and ductwork
- Anchoring details that maintain a continuous load path to structure
- Coordination across trades to avoid equipment misalignment or overloading

Post-event evaluations — following earthquakes, floods, or hurricanes — consistently show that facilities designed to the current code provisions suffer less damage, retain functionality longer and are more likely to be covered under favorable insurance terms. Major insurers like FM Global now incorporate IBC-based design requirements in their policy underwriting. They also pursue subrogation claims where building failures can be linked to code violations or inadequate documentation. This trend reinforces the need for code-aligned design and robust, traceable certification practices.

© 2025 VMC Group. All rights reserved. 8067 07/2025

VMC GROUP'S ROLE IN COMPLIANCE

As a certifying agency and equipment solutions provider, The VMC Group supports hospitals, engineers and contractors in navigating code requirements and reducing compliance risk.

Our services include:

- Seismic certification for equipment and mounting systems, including shake table testing and analysis per ICC-ES AC156
- Factory-applied equipment labeling and documentation packages for inspection readiness
- Design tools and technical resources, such as pre-approved anchorage details, product data sheets and submittal templates
- Specification support for ASCE 7-16 and ASCE 7-22 code language
- Seismic and wind restraint products, including vibration isolators, spring mounts, seismic brackets and bracing assemblies
- Code-based training seminars and continuing education, tailored to AEC professionals working in health care and mission-critical markets.

By providing integrated solutions that address both code requirements and system performance, VMC Group helps ensure that hospitals remain resilient in the face of natural disasters — functioning when they are needed most.

VMC CORPORATE HEADQUARTERS
113 Main Street
Bloomingdale, NJ 07403
Phone: 973.838.1780
Toll Free: 800.569.8423

thevmcgroup.com

VMC GROUP
CONTROLLED ENVIRONMENT SOLUTIONS™
AIR | NOISE | SEISMIC | VIBRATION | SHOCK

© 2025 VMC Group. All rights reserved. 8067 07/2025