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On-Line Emergency Power and the 2006 International Building Code—How Far Have We Come?

By Richard C. Berger

It seems almost odd that Mother Nature—the essence of peace, tranquility and warmth—has a darker side that literally defines the fundamental nature of what our industry is all about—surviving an emergency. In the November/December 2005 issue of *Powerline*, I discussed one aspect of that "darker side:" earthquakes. The passage and implementation of the IBC-2006 adds three others: **wind, flood and snow**. We also now add a related document, ASCE 7-05, volume 7, published by The American Society of Civil Engineers in 2005. If we thought our lives, responsibilities, duties and liabilities impossible before, read on!

IBC-2006 primarily affects the **"essential facility."** A classification of structure based on its building function, this group (known as Occupancy Category IV) is intended **to remain "operational" in the event of extreme environmental loading from wind, flood, snow or earthquakes.[1]** A host of health-related facilities is included in this category—from hospitals to possibly nursing homes and adult care, to schools and sports arenas serving as emergency preparedness centers, communication and some data processing centers, utilities, certain airport structures and municipal complexes to name but a few. *(Editor's note: see IBC 2006 Section 1604.5 noted as Table 1604.5 below.)*

Section 13.1.3 of the ASCE and IBC Section 1602

To the world at large **"operational"** is defined as "serviced or declared fit for proper functioning"[2]. To those of us within the power generation industry, operational means that wind, snow, floods or earthquakes shall not prevent an emergency-power installation from starting—and running—in the event of an emergency. In the paragraphs that follow, we will examine what that means and the tasks that must be accomplished to achieve that for which the codes, specifications and insurance companies are now holding us responsible!

Two last notes before we begin. The International Building Code, years 2000, 2003 or 2006, is the structural handbook for the building. As of this date, it has been adopted in all 50 states of the United States of America. The 2006 edition is the state building code in 23 of those states. This article touches on the information within Chapter 16, Structural Loads and sections 1608, 1609, 1612 and 1613—snow, wind, flood and earthquake loads, respectively.

This discussion, although focused on the "essential facility," is also partially applicable to many construction projects, Occupancy Category II-III, office buildings to institutions for seismic events, and all construction projects (same categories) from hospitals to restaurants where the forces incurred are from wind, floods or snow.

Protecting the Essential Facility (The Plan)

Any project begins with a concept, an understanding of what we're going to do and how we're going to do it. Let's begin with **floods and Flood Loads, Section 1612.**

The much debated, argued, referenced, talked about Hurricane Katrina and the City of New Orleans is pertinent once more. Even though it was a hurricane, wind took a back seat to flood conditions. The insurance industry is still sorting matters out and may not recover from that event for quite some time.

The target of this discussion focuses on the "essential facility"—hospitals and emergency preparedness centers to name a

Table 1604.5 Occupancy Category IV of Buildings and Other Structures

Buildings and other structures designated as essential facilities, including but not limited to:

- Hospitals and other health care facilities having surgery or emergency treatment facilities.
- Fire, rescue and police stations and emergency vehicle garages.
- Designated earthquake, hurricane or other emergency shelters.
- Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.
- Power-generating stations and other public utility facilities required as emergency backup facilities for Occupancy Category IV structures.
- Structures containing highly toxic materials as defined by Section 307 where the quantity of the material exceeds the maximum allowable quantities of Table 307.1.(2).
- Aviation control towers, air traffic control centers and emergency aircraft hangars.
- Buildings and other structures having critical national defense functions.
- Water treatment facilities required to maintain water pressure for fire suppression.

A Flood Insurance Rate Map defines both flood hazard areas and risk premium zones.

few. The New Orleans Superdome comes to mind as the latter. Located in one of the lowest points in the city, basement and grade level flooding of that structure was a virtual certainty when the levies gave way. It may sound cynical but guess where the emergency power systems, their panels, distribution and fuel source were located?

In the 2006 IBC Code, the term **FIRM** is used extensively. Known as the **Flood Insurance Rate Map** defined in section 1612, Flood Loads, this FEMA-developed community map defines both flood hazard areas and risk premium zones. In plain English, it locates within a community flood plain areas subject to a one percent chance of flood within 100 years and a community's own historical flood hazard map and creates the design criteria based on the more stringent of the two. It should also be noted that some insurance companies have extended the 1 percent/100 years to a 500 year period. Design requirements now include elevation of both site and non-structural components to prevent a recurrence of the human and economic disaster that was witnessed in the aftermath of Katrina.

The second term which is new to us is **High Velocity Wave Action.** Let's say that we are constructing a project near a shoreline in a **known flood hazard area** as illustrated on a FIRM map. The project has several levels, one of which is subject to a wave many feet high capable of scaling that first level. In so doing, components located at that location are not only subjected to flood load but are also subjected to the weight of that wall of water bearing horizontally, vertically or both on a fixed component. In this instance, unless the affected unit or units are protected, additional anchorage and structural integrity will be needed to help deter this aspect of flood damage.

The real question is: what do these terms mean to us?

As manufacturers or designers, we are not about to make or require our components to be submersible. Since liability is the issue, the discussion is information, education and the ensuing project design. Component specifications and literature need to include proper warnings to the design team that components must be placed in suitable flood-free locations, physically protected and anchored if necessary. Those locations must also be defined. The absence of such information can be construed as an error of omission, courtesy of the new code. As a result, sales teams must now be armed with enough knowledge and understanding to serve as the consulting engineer's consultant on matters of electrical generation power, not just for product performance but for product emergency performance as well!

We need to understand that economics and practicality will dictate the location of our components. Perhaps the roof or an enclosed penthouse might make more sense than a grade or below grade location. Suitable weather and wind protection might be a less expensive alternative to the total elevation of all related emergency components. While this last point might seem the province of the consulting engineer, it is in everyone's best interest that a project's budget is met, especially in this economic environment.

Lastly, the project's drawings and specifications must adequately reflect a flood plan that will result in the insurability of the building, the absence of which would prove disastrous. To paraphrase one of the nation's most prominent insurance company's design manual concerning floods, "**the operation can continue without interruption.**" That sounds strangely familiar to the IBC CODE requirement for flood as it relates to an "essential facility!"

Wind Loads, Section 1609

Typically we think of the wind as a structural issue—one that does not really affect our product or design. Our work concerning roof- and outdoor-mounted components is complete once we have relayed weight information to the project's structural engineer. As with all else in this article, the IBC-2006 not only puts an end to that thinking but also levies an awesome responsibility on us as well. Like floods and snow, but unlike earthquake loads, **wind affects all construction, everywhere in the United States.**

The changes imposed by Section 1609, Wind Loads and ASCE 7-05 can best be categorized as follows:

- Changes to the Codes;
- Changes to the Structure;
- Changes to Anchorage;
- Changes to the Manufactured Component.

In the last several years, the insurance industry has been plagued by commercial claims of roof-mounted equipment landing on doorsteps. State after state has experienced this somewhat universal problem. As a result, both the building codes and building insurers view roof-mounted installations in an entirely new way. IBC-2006 has increased the actual calculated wind load throughout the United States by nearly 20% due to a more realistic view of how the wind blows. Entitled **3-second gust,** this approach is more concerned with wind peaks than with the constant velocity norm. Additionally, most coastal states have earned the title of **Hurricane-Prone Regions.** As such, buildings located within one mile of the mean high watermark where the basic wind speed is 110 mph or greater have also earned the title and design restrictions of **Wind-Borne Debris Region.** This new category bears some similarity with **"high velocity wave action"** in that roof-mounted components require not just an enhanced anchorage but must also be able to withstand the damage created by another dislodged component.

While these changes are significant, **it is the ASCE 7-05 document** that presents the **greatest challenge** to our industry. Entitled **Rooftop Structures, section 6.5.15.1** looks specifically at the **two loads** implied on roof-mounted components where the building height is 60' or less. The **first** is standard, the actual profile of the unit's largest exposed area multiplied by the new 3-second gust load in terms of pounds per square foot. The **second, the new and more critical load,** calculates the velocity of the wind as it moves along the ground, turning vertically up the side of the building and then shearing across the roof level. When both of these loads are combined, the resulting loads, both seen by the structure and the component, rival and in many cases exceed a significant seismic event.

In the example below, a typical 5kW emergency generator weighing approximately 1000 lbs was modeled sitting atop a 30' tall structure. The building, located near a coast line, had to withstand loads imparted by wind velocities approaching 110 mph, typical for coastal communities. As you review the model, you will see that the total wind exerted on the genset was almost 1420 lbs—nearly 1.4 times the unit's weight, more than enough to lift, move or overturn the unit. By comparison, an earthquake would have to log a 6.2 to 6.5 on the Richter scale to rival this load.

At first glance, we might not consider these loads a particular problem as the architect has provided a screen for our use to minimize wind load effects. If only that were true! In the IBC-2006 & ASCE 7-05 it is understood that the use of **screens, tall buildings**

Wind Analysis on Roof top equipment

Below is calculates the wind load on a piece of equipment based on section 6.5.15 in ASCE 7-05 equation (6-28)

Force on roof top unit	**F=qz*G*Cf*Af*area factor**		***(6-28) ASCE 7-05***
Velocity Pressure	**qz=.00256*Kz*Kzt*Kd*V2*I**		***(6-15) ASCE 7-05***
	I	1.15	
	V	110	
	Kz	0.98	***Table 6.3***
	Kd	0.85	***For Components and cladding***
	Kzt	1	
	qz=	**29.6734592**	
Gust Factor	**G=.925(1+1.7gQ*lz*Q/(1+1.7*gv*lz))**		***(6-4) ASCE 7-05***
	Lz=c(33/ž)^(1/6)		
	c=	0.2	***Table 6.2***
	ž=	18	
	gQ	3.4	***per 6.5.8.1 ASCE 7-05***
	gv	3.4	***per 6.5.8.1 ASCE 7-05***
	Q=SQRT(1/(1+.63((B+h)/Lz)^.63		***(6-6) ASCE 7-05***
	Lz= L(ž/33)^Є		***(6-7) ASCE 7-05***
	L	500	***table 6-2***
	Є	0.2	***table 6-2***
	Lz	442.9	
	Q=	0.88	
	G=	**0.814134519**	
Force Coefficient	**Cf=**	**1.367**	***Table 6.21***
	h/d=	5	
Unit Area	**Af=**	**24**	
Area factor	**Area factor=**	**1.792**	
Force on roof top unit in pounds	**F=**	**1419.96**	
Force on roof top unit in G's	**g's=**	**1.420**	

Input Data	
Equipment weight	1000
Roof Height (ft)	30
Bulding Length (ft)	100
Unit area (ft^2)	24
unit length (ft)	6
Basic wind Speed	110
Wind Importance	1.15
Exposure	C
Unit height (ft)	4

or blockage of any type or configuration to minimize these loads is unacceptable. In other words, the loads are imposed on the unit, regardless of any other condition with the exception of complete, three dimensional indoor mounting. The wind load **calculation** for our unit, isolators and height extending accessories such as day tanks and enclosures must therefore **include compression, shear, and moment** as well as the support on which they are installed! Additionally, all subcomponents of our exposed component must also be able to take these loads including lines, conduit, panels, radiators and their mountings.

Before we leave this topic and move on, we need to identify the structure that our component sits on as well. Often, the structural engineer provides us with a steel dunnage system which has been designed to encompass the above loads. On occasion, especially the smaller projects, **equipment supports** are used for the power equipment as well as their electrical switch, transfer or transformer counterparts. Two issues come to mind.

As of the date of code adoption, the roof's **metal deck is no longer considered a structural component of the building and cannot be fastened to.** All connections to the building are **structural** and must occur directly **to the building steel** below the metal deck. **Through-bolting or welding** are the only acceptable methods available to us. Thus in some way this connection when made will imply a point load on our equipment support unless we raise the building steel above the roof—a costly process. **For the most part, the typical equipment support as specified by the project's consulting engineer is not designed to accept point load!**

The second issue concerning this type of support is that of **affixing these products to our component.** Current equipment is supported via **attachment through lag bolts into a wood nailer**, an integral part of the product. The new wind load criteria might create some difficulties. Manufacturers of these systems must verify that they can accept not just compression but shear, tension and moment capability as well. Submittals should be accompanied by stamped PE calculations, testing or both in the state of the project's location if liability issues are to be avoided. In short, the industry needs to revisit what it is doing with outdoor or roof-mounted components, make the changes necessary and carry those changes through to project execution and completion. This is not the time to invite your favorite underwriter over to see the good work that you have done on a project unless this aspect—structural supports and connections—has been properly addressed!

One more brief discussion concerning wind need occur, that of tornadoes. As difficult as it is to believe, the discussion of tornadoes in the code has been left to the discretion of local community officials. Our concern is not with construction within the tornado's eye since little is left standing. Instead, our concern rests with those structures slightly outside of the eye which are called on to withstand sweeping cyclical high velocity wind events that history shows have a reasonable chance of surviving to some degree. Because strict definition of those forces is lacking and variations are polar, they are not code quantified. It is our job therefore to at least offer a level of protection that mirrors the higher wind loads charted by the IBC and design on that basis. In future codes, I believe this issue will be addressed.

Snow Loads, Section 1608

Perhaps of all of the foes represented in nature's darker personality, snow loads is the most difficult of the opponents to define. As you will see below, the unanswered questions define the problem and are likely to remain unanswered for some time to come.

"Snow loads" have been **included in the continued operation discussion** of an **"essential facility."** Here is what we know. Section 1609 of the IBC, "snow loads" defers to ASCE 7-05, chapter 7, "snow loads." Between the two, we can define snow-belt locations, roof building loads and associated weights with that load when we look at the interaction of snow and how it affects the structure. When it comes to snow's additional interaction with our component, the clouds move in rapidly. Here are some of the unanswered questions:

- Does the snow add to the weight of our component or will the wind blow it off?
- If the snow does add to the unit's weight and there is a partial snowmelt and then a refreeze, what percentage of weight is added to our component due to the more compacted frozen section?
- If the snow is frozen atop our unit, what is the calculated height that we should be working with on buildings less than 60' overall? Our component now has an increased height, taller profile and a much increased wind load imposed by ASCE section 6.15.1 all of which is acting on a substantially larger exposed area challenging both anchorage and support.

Within the code, "roof projections," paragraph 7.8[4] appears to be the category that identifies a component exposed to a snow load imposed by drift. If the component is less than 15' long, it is not to be considered. Using that as our guide, we begin with larger components only and their accompanying enclosure(s) if they are so housed. Most transformers or separated transfer switches are considerably smaller in overall size and therefore not of concern. There is however some ambiguity as these components are vital to our generator's operation; therefore, in the writer's opinion, they require at least a rudimentary review.

As this portion of the building code is so new as to how it affects our components, there are few substantial analyses or guidelines to work with—just questions. To that end, our VMC Group, licensed to practice Engineering in the State of New Jersey, has taken on the task of determining some of those effects and within the months to come will have some, if not all, of the answers.

Earthquake Loads, Section 1613

Beginning with the introduction of the International Building Code in 2000, earthquakes and their effects on non-structural building components have led the discussion and debate concerning **continued component operation**. Our industry first met this code with indifference followed by disbelief and finally today, eight years later, with action and a partial plan. We have more to go! With the adoption of one of the three IBC code years by all 50 states and nearly every government agency, the IBC-2006 edition takes on enormous significance and impacts our product lines in ways that few preceding codes have ever done. From construction managers to specification writers to insurance companies and building owners, no code has so dramatically driven our requirements and our design. **No code has also made dependence on one another so clear.** Perhaps we should begin with an explanation of this station and look at some of the changes!

Code Changes

Section 13.2.3 and ASCE 7-05, Consequential Damage: "The functional and physical interrelationship of components, their supports and their effects on each other shall be considered so that the failure of an essential or non essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component."

Originally mixed with other sentences in the 2000 code, the 2006 edition has given this criteria its own identity with a separate paragraph, numbered and spaced to highlight the importance of the statement. Simply put, what we do and provide is only as good as the other components within the chain. Should anything in that chain in an "essential facility" not work, if it is an associated component provided by us and it fails, the liability is ours. To the **manufacturer that means that the total package requires compliance**. It also means that our installation literature needs to be addressed to cover all aspects of that installation including our components, isolators, supports, external attachments or hardware including pipe and conduit, bracing, and anchorage just to name a few. To the designer it means that they need to work with compliant manufacturers, have solid specifications and details as part of the bid package and an accompanying "Statement of Special Inspections," (section 1705) when and where a special inspector is a project requirement.

From construction managers to specification writers to insurance companies and building owners, no code has so dramatically driven our requirements and our design.

IBC-2006 & ASCE 7-05: for our purposes, the 2006 Code is really two documents. Unlike the earlier 2000 edition which was essentially "self contained," the basics pertaining to building types, earthquake design, etc., may be found in section 1600 of the 2006 Code. The nuts and bolts and their application are well defined in the related text (ASCE 7-05). We return to the IBC when we need to understand Structural Tests & Special Inspections, Section 17.

Section 1604.5 Occupancy Category: The term "occupancy category" replaced "seismic use group" to reflect the new requirement for inclusion and applicability of considerations for **snow, wind and flood** as well as **earthquakes** for a building's functional design. This table reorganizes the building classifications into a more sensible, orderly, logical progression from "Category I" (the least important; i.e., a dead storage facility) to the **highest of importance, the "essential facility," Category IV!**

Sections 13.2.1, 13.2.2, 1702.1, 1707.9 and 1708.5,[5] Designated Seismic Systems, (Certification)

One almost needs to be a code nerd to understand this paragraph. The shift between the IBC and ASCE 7-05 shown above leaves many an opening to fall and stumble on. All five referenced sections target a specific group of components necessary to keep the word "essential" lit up and powered continuously without interruption. In essence once the debate is over, the code offers manufacturers three methods of determining "on line capability" for their component. They are:

- **Finite Element Analysis,** also known as FEA;
- **Historical evidence,** also known as experience data;
- **Shake table testing**, also known as "if it works after the test it passes."

The first and the third methods are, in the writer's opinion, legitimate and accurate means of determining performance under duress. As I have already stated in ***The Seismic Guidebook***,[6] the second method leaves much to anyone's imagination. When the paragraph concerning experience or historical data is reviewed (Section 13.2.6[7]), we see words like "based upon nationally recognized procedures acceptable to the authority having jurisdiction." What comes to mind immediately is **"what nationally recognized procedure?"** I have read several position papers on this very issue and have yet to find a single individual or organization who lends credence to this method of testing. That is probably why I have not reviewed any testing program by any manufacturer using experience or historical evidence as their basis of compliance.

Section 13.6, Mechanical & Electrical Components, Table 13.6.1 Seismic Coefficients for Mechanical and Electrical Components

The table referenced in 13.6.1 has tremendous implications for manufacturers and designers alike. Two issues are at hand. First, a_p., known as the amplification factor. Components that are rigidly mounted (no isolation internally or externally) are considered rigid and therefore have an amplification of 1.0 or no effect on the load in terms of pounds that the component will see. Components such as emergency generators are typically factory- or field-isolated. By code, their amplification factor increases by a factor of 2.5, adding significantly to tested loads.

The second issue concerns snubbing or limiting the motion of the isolation system. Should the snubbers or restraining system used in conjunction with the isolators come into contact after traveling in excess of ¼", the resulting force regardless of calculation is two times (2X) the resulting load which could prove catastrophic for the component manufacturer's efforts to obtain and continue compliance. This points to the need to purchase proper isolation components.

Section 13.6.4. Electrical Components

This entire section refers to electrical components having an I_p, "importance factor" greater than 1.0. Since all emergency generation power has an I_p of 1.5, all eight (8) of the paragraph's provisions are applicable. Let's highlight several of the more critical points using the numbering system that appears in this section.

2). Loads imposed on the components by attached utility or service lines that are attached to separate structures shall be evaluated. This is a design issue that must be addressed by the project's electrical and structural engineer to determine if seismic drift between two structures will place an unacceptable load on the component. If it does, proper contract detailing must include limiting of that load either by flexible components, loops or other acceptable practices. The equipment component manufacturer must have clear installation information on both shop drawings and I&O manuals to advise of this requirement or he will share in the liability of failure.

4) Internal coils of dry transformers shall be positively attached to their supporting substructure within the transformer enclosure. Transformers, a critical part of the electrical process, are for the most part presently isolated from their enclosure with minimal isolation systems such as isolation washers or small elastomeric mounts. Unless this design has taken seismic issues into account, the present through-bolting of the coil to the frame is not considered positive attachment. Isolator deflection (even though minimal) requires additional snubbing due to the increase of acceleration loads allowing bolt failure. Manufacturers of these components need to rapidly address this issue.

6) Electrical cabinet design shall comply with the applicable NEMA standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated. This message is very clear. Field alterations must not be permitted to manufacturer's components without written authorization from the manufacturer. I&O manuals as well as shop drawings must reflect this warning.

7) The attachments for additional external items weighing more than 100 lbs (445N) shall be specifically evaluated by the manufacturer. This issue greatly affects component compliance for emergency generator product manufacturers. Often, the component manufacturer produces the raw power plant and the dealer has the option of installing accessory items. These add ons could be minimal and pose a minor impact or they could be major accessories with an enormous impact such as enclosures and day tanks. The problem is extensive as the industry practice of dealer supplied and sometimes installed accessories is the norm rather than the exception. There is probably a series of minimum design and structural standards for these accessories that can be set by the component manufacturer and issued to their sales network to help alleviate this problem. In order to do this, the manufacturer needs to assign the task to someone (more than likely they'll assign the analysis to their compliance agency).

8) Where conduit, cable trays or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacement defined in section 13.3.2. This impacts the electrical and structural engineer, component manufacturer and the installing contractor. Let's see why!

Buildings subject to seismic loads are additionally subject to horizontal movement along their vertical "Y" axis from floor to floor. Known as **displacement**, these offsets from one floor to another can place uncomfortable loads on any vertical component that extends from one floor to another and is attached in any way. Those loads can cause distortion, failure or both for the component that is experiencing those loads and the component to which the vertical link is attached or connected! The responsibilities are as follows:

- The project's structural engineer must define the displacement from floor to floor and give that information to the electrical engineer of record.
- The electrical engineer must issue on plans and specifications details and specs to both show and describe the allowable methods of handling that displacement.
- The component manufacturer must state in his submittal and I&O manual the inability of the component to accept displacement loads. Additionally, the I&O manual should reflect suggested installation practices to help guide the installing contractor with what he must do.
- Finally, the installing contractor must recognize that displacement is the norm rather than the exception. It is his responsibility to look for that installation detail and perform no installation unless he gets one.

How far have we come? I will try to answer that question. ***We have yet to graduate to a yardstick!*** That statement is based on new recent projects both under design and in development. Take data centers for example. The new design standard for this type of project incorporates the term **"mission critical"** and other terms like "**24/7" to denote the "on line" requirement of the facility,** joining hospitals, emergency preparedness centers, 911 call centers and outpatient facilities within the "essential facility category." I have found that the concept of "on line" is not truly understood nor is the owner obtaining what he thinks he wants: "continuous operation, no matter what."

Aside from the normal design issues such as fuel storage and operation duration, the design basics of Section 16 still need to be addressed. These include:

- Proper detailing of entering services to accommodate seismic drift through the foundation wall including fuel for the generator.
- Grade or sub grade locations for emergency power and distribution in known or possible flood locations.
- Improper detailing of sub steel and adequate supports for components mounted at roof or grade level to accommodate wind loading.

Add to this the more difficult code requirements of component testing compliance and labeling as well as code acceptable accessory packages and what we have is a project that will neither work 24/7 nor qualifies as an "essential facility."

On the positive side there is both progress and inertia. Manufacturers are rapidly moving to meet the new criteria, trying to stay ahead of the insurance standards and checklists that are about to come. Unfortunately literature and how to's are still lacking as the information highway and professional organizations are slow to react. There are design standards but few design manuals which translate requirements and solutions into basic English for anyone except a degreed structural engineer. Even our own SGMEC® Newsletter Program, which is a free information source for consulting engineers and manufacturers alike, has not had the acceptance we hoped for.

I believe the biggest problem can be summed up with an old cliché: Too much to do, not enough time in which to do it! We are making progress, but we need to make more!

To conclude, for now, a quote from our "Seismic Guidebook" might be in order. "Change is often not negative. The passage of the International Building Code is one example of a positive change whose time has come. Like anything that is new, there will be problems at first. Patience, common sense and a desire to work as a team have always been a winning combination."

Richard C. Berger is a frequent lecturer on Seismic Building Codes for non-structural building components in many states. He is a certified AIA/CES Registered Provider and his multi-state "Seismic Guidebook" is used by building code officials and industry designers alike. He has also designed and patented a series of products-which are industry standards. Mr. Berger is a partner in VMC East, a sales agency for vibration and seismic control systems and Chairman of the VMC Group, Vibration Mountings & Controls, Inc., Korfund Dynamics and Aeroflex International Isolators, manufacturers of seismic, shock, isolation, noise and bomb-blast protection products.

Footnotes

[1] IBC 2006 Section 1602 Definitions & Notations "Essential facility".
[2] American Dictionary 1984 edition
[3] The SGMEC Newsletter Program, is series of electronic code based Newsletters which are designed and developed to keep the reader up to date on the most recent construction code requirements concerning the International Building Code and its effects on the non-structural building components as they relate to wind, floods, snow and earthquakes.
[4] ASCE 7-05
[5] IBC 2006
[6] "A Seismic Guidebook, A Multi-State Training Manual for Non- Structural Building Components." A distributed training manual which embodies a pragmatic, common sense approach and has emerged as an industry standard text, since its premier publication in 1990.
[7] ASCE 7-05