A SHOPPING LIST

Half a Dozen Things We Need To Get on With Making Buildings More Resilient
Project Management

Data Acquisition
Risk Assessment
Project Design
Project Management

Fabrication

Installation

Engineering

Restraint Design
Quality Assurance
Documentation

TerraFirm

MCEEP
Economic Losses

Niigata Earthquake – October 23, 2004

Sanyo Electric Niigata Semiconductor Fab Plant

- Plant damage: $177 million USD
- Lost inventory: $44 million
- Restoration: $260 million
- Business interruption: $356 million

Total Losses: $837 million
THE STAKEHOLDERS

1. Building Code Officials
2. Architects
3. Structural Engineers
4. Equipment Manufacturers
5. Building Owners
6. Government Agencies
THE SHOPPING LIST

1. Enforcement of the building codes.
2. Compilation of the seismic checklist.
3. Embedded anchor points in the structure.
4. Design & testing of building equipment.
5. Realistic budgeting for seismic mitigation.
6. Long term funding of basic research.
WHO DOES WHAT?
The Design Team

- Owner
- Architect / Coordinating Professional
  - Structural Engineer
  - Mechanical Engineer
  - Electrical Engineer
WHO DOES WHAT?
The Construction Team

Owner

General Contractor

Civil /Structural Sub-contractor

Mechanical Sub-contractors

Electrical Sub-contractor

Plumbing/ Piping

Seismic Mitigation Engineers

Seismic Mitigation Engineer

HVAC

Seismic Mitigation Engineer

Specialty Mechanical Equipment

Seismic Mitigation Engineer
# Operational & Functional Components (OFC) Seismic Restraint Check-List

## Building Services (Operational)

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Plumbing</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Heating, ventilation, air conditioning</td>
<td>- Piping</td>
</tr>
<tr>
<td>- Elevator</td>
<td></td>
</tr>
<tr>
<td>- Chiller, ducts, diffusers</td>
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<tr>
<td>- Tanks, boilers, furnaces</td>
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<tr>
<td>- Fire suppression</td>
<td></td>
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<tr>
<td>- Pressure vessels, pumps</td>
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<tr>
<td>- Fuel piping</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical</th>
<th>Telecommunications</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Electrical panel boards</td>
<td>- Telephone systems</td>
</tr>
<tr>
<td>- Emergency Lighting</td>
<td>- Computer systems</td>
</tr>
<tr>
<td>- Light fixtures</td>
<td>- IT racking and cabinets</td>
</tr>
<tr>
<td>- Electric generators</td>
<td>- Cable trays</td>
</tr>
<tr>
<td>- Transformers</td>
<td></td>
</tr>
<tr>
<td>- Electric bus ducts</td>
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<tr>
<td>- Motors, power control systems</td>
<td></td>
</tr>
<tr>
<td>- Uninterruptible power systems</td>
<td></td>
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<tr>
<td>- Battery racks</td>
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</tr>
</tbody>
</table>
# IBC Installation Requirements for Contractors

## Seismic Design Category A & B
- The IBC does not require special ceiling installation considerations in these categories.

<table>
<thead>
<tr>
<th>IBC Category</th>
<th>CISCA Zone</th>
<th>Installation Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>0-1</td>
<td>Ceiling installation should conform to basic minimums established in ASTM C 636.</td>
</tr>
</tbody>
</table>

## Seismic Design Category C: the "unrestrained ceiling"
- The IBC installation requirements for Seismic Design Category [SDC] C exempts ceilings in most one- and two-story buildings unless they are Seismic Use Group III [essential facilities].
- The notion of a free-floating ceiling is new, and will impact the installed cost.
- Ceilings that cannot touch the walls are more expensive to install because it is harder to keep them straight and square.
- Estimated cost increase per SF is 10%-15%.

<table>
<thead>
<tr>
<th>IBC Category</th>
<th>CISCA Zone</th>
<th>Installation Requirement</th>
</tr>
</thead>
</table>
| C            | 2          | To be installed to CISCA recommendations for areas subject to light-to-moderate seismic activity:  
  - minimum 7/8" wall molding  
  - grid must not be attached to the wall molding |
Our Zone 4 relay rack is our heaviest duty model. Designed for maximum durability and resistance to earthquakes or other vibrations, this rack is BELLCORE GR-63-CORE TESTED AND CERTIFIED COMPLIANT. The rack features extra-heavy duty construction, tapped mounting holes along the front and rear, and a large, floor mounted base.

As a perfect compliment to any Zone 4 rack, we offer a special Zone 4 shelf system. Designed to hold your sensitive equipment securely, this system includes two symmetrical shelves and top retention brackets. The shelves mount on both sides of the rack, providing a very stable and secure platform for your equipment, while top brackets can be bolted above equipment to hold it securely in place.
Budgeting

Allow 1% - 2% of the total construction budget for nonstructural seismic mitigation.
We Have Much To Do!