Pan American Health Organization
Regional Office of the
World Health Organization

Disaster Mitigation in Health Facilities: Nonstructural Issues
Nonstructural Components

- Lighting System
- Roof
- Electrical and Communications System
- Air Conditioning, Heating and Ventilation
- Pipes, Medical Gases, Industrial Gases, Vacuum, Steam, etc.
- Parapets, Ornaments, Railings and Attachments
- Doors
- Ceilings
- Facades, Windows, Plastering
- Furniture and Equipment
- Divisions / Partitions

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Nonstructural components to consider when assessing vulnerability

<table>
<thead>
<tr>
<th>ARCHITECTURAL</th>
<th>EQUIPMENT</th>
<th>BASIC INSTALLATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interior partitions</td>
<td>• Medical equipment</td>
<td>• Medical gas piping</td>
</tr>
<tr>
<td>• Facades</td>
<td>• Laboratory equipment</td>
<td>• Industrial gas piping</td>
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<tr>
<td>• Suspended Ceilings</td>
<td>• Industrial equipment</td>
<td>• Vacuum devices</td>
</tr>
<tr>
<td>• Roofs or decks</td>
<td>• Furniture</td>
<td>• Steam</td>
</tr>
<tr>
<td>• Parapets</td>
<td>• Supplies</td>
<td>• Air-conditioning systems</td>
</tr>
<tr>
<td>• Chimneys</td>
<td></td>
<td>• Heating</td>
</tr>
<tr>
<td>• Plaster</td>
<td></td>
<td>• Ventilation</td>
</tr>
<tr>
<td>• Glass windows</td>
<td></td>
<td>• Electrical wiring</td>
</tr>
<tr>
<td>• Attachments (signs, antennae,etc)</td>
<td></td>
<td>• Backup power</td>
</tr>
<tr>
<td>• Ornaments</td>
<td></td>
<td>• Communications</td>
</tr>
<tr>
<td>• Canopies</td>
<td></td>
<td>• Drinking water</td>
</tr>
<tr>
<td>• Lighting system</td>
<td></td>
<td>• Industrial water</td>
</tr>
<tr>
<td>• Railings</td>
<td></td>
<td>• Sewerage</td>
</tr>
<tr>
<td>• Doors and exit routes</td>
<td></td>
<td>• Fire sprinklers</td>
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<tr>
<td>• Expansion joints</td>
<td></td>
<td>• Other pipelines</td>
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<td></td>
<td></td>
<td>• Circulation (elevators, stairs)</td>
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</tbody>
</table>
Assessment methods

- Previous experience
- Analysis - mathematical simulation
- Laboratory tests
- Expert opinions
Damage to partition components can also cause damage to the basic components that go within, along, or across them, such as gas pipes, water pipes, electrical wiring, etc.
Damage to the façade of a hospital can affect the image of safety that should be projected by health facilities during an emergency.
The fall of architectural façade components can injure people or damage objects in the vicinity of the hospital.
Special attention must be paid to fragile partition components in critical areas, such as admission units, exit routes, etc.
Considerations regarding partitions, façades, and windows

SEPARATION BETWEEN STRUCTURAL AND ARCHITECTURAL COMPONENT

MATERIAL (STRENGTH, STIFFNESS, DEFORMATION CAPACITY)

PLACEMENT AND CONDITION

STRUCTURAL COMPONENT

FIRE-RESISTANT SEAL

ARCHITECTURAL COMPONENT

TRANSVERSAL STABILITY, LONGITUDINAL DEFORMATION CAPACITY

ANCHORING

STRUCTURAL COMPONENT
The use of inappropriate materials or their incorrect placement can increase the damage caused by an earthquake.
The fall of façade components can hinder the flow of people and vehicles in the event of an emergency.
Cantilevered architectural components must be correctly designed and built
Restraints for parapets, signs and ornaments

SUPPORT LEVEL

BRACING

CONNECTION TO STRUCTURAL COMPONENT
Suspended ceilings are particularly vulnerable in the event of an earthquake.
Placement of restraints for suspended ceilings, lighting fixtures and air-conditioning, ventilation and heating vents.
Architectural components that run across seismic joints must be correctly detailed.
Basic services may be interrupted due to failures associated with the inappropriate crossing of seismic joints
<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indispensable:</strong></td>
<td>Equipment that can not easily be replaced and is essential for the provision of health services</td>
</tr>
<tr>
<td><strong>Essential:</strong></td>
<td>Similar to indispensable equipment, except that it can be replaced promptly</td>
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<tr>
<td><strong>Hazardous:</strong></td>
<td>Equipment that can injure people and damage objects</td>
</tr>
<tr>
<td><strong>Chaotic:</strong></td>
<td>Equipment whose failure may cause disruption to its environs</td>
</tr>
<tr>
<td><strong>Functional:</strong></td>
<td>Equipment that is not used for emergency health care</td>
</tr>
</tbody>
</table>
Components that can tip over in the event of an earthquake should be securely fastened or stored.
Lack of preventive maintenance increases the vulnerability of nonstructural components.
Inappropriate or missing anchoring devices may cause service interruption or failure.
Essential equipment must be correctly placed and anchored to ensure continued operation.
The life of some patients depends on the proper and continued operation of basic equipment and facilities after an earthquake.
Hospital infrastructure must keep abreast of technological advances to reduce vulnerability.
Restraints and fasteners for smaller equipment

- Fastening material
- Fasteners
- Tape
- Chain or strap
- Strapping
- Desk lip
Restraints and fasteners for larger equipment

- Flexible connection
- Proper foundation
- Anchoring bolt to resist motion
- Equipment base
- Flexible material
- Lateral and vertical support
- Space for accommodating vibrations

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Restraints and fasteners for larger equipment
Restraints for slender equipment

ELEVATION

LATERAL SUPPORT COMPONENT

FLEXIBLE JOINT

PLANT

CORRECT SUPPORT STRUCTURE

PLUMBERS TAPE WRAPPED ONE FULL TURN AND PULLED TAUT

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Use of flexible connections in critical areas guarantees continuity of service.
Breakage of containers with chemical or biological supplies can cause fires or pollution.
It is necessary to protect the supplies needed to help the hospital respond to an earthquake.
The loss of clinical information during an emergency forces administrators to assign valuable human resources to deal with the problem, preventing them from attending to other priority tasks.
Restraints must be implemented to prevent the displacement or tilting of key supplies.
Furniture supports

- Shelf lip
- Attachment to wall
- Wire or elastic strap
- Steel angle
- Attachment to wall
- Bracing
- Bolted anchor
- Tying plate
Assessment of basic installations

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The protection of basic service or utility components must start from the point of storage or generation, and include every stage through final use.
To prevent damage to this type of component, attention must be paid to use of restraints at all times (chains provided were not used in this case).
Pipe damaged due to the lack of a flexible joint.
The use of flexible joints in critical areas limits damage and guarantees continuity of the supplies.
Duct support

CROSS SECTION VIEW

CONCRETE

BRACING

DUCT

CLAMP

LONGITUDINAL VIEW

BRACING

DUCT

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