

Annex#2: Significance of Non-Structural Damage

The following discussion covers three types of risk associated with earthquake damage to non-structural components: life safety, property loss, and interruption or loss of essential functions. Damage to a particular non-structural item may pose differing degrees of risk in each of these three categories. In addition, damage to the item may result in direct injury or loss, or the injury or loss may be the secondary effect or consequence of the failure of the item.

1. Life safety

The first type of risk is that people could be injured or killed by damaged or falling non-structural components. Even seemingly innocuous items can be lethal if they fall on an unsuspecting victim. Examples of potentially hazardous non-structural damage that has occurred in past earthquakes include broken glass overturned tall and heavy cabinets or shelves, falling ceilings or overhead light fixtures, ruptured gas lines or other piping containing hazardous materials, damaged friable asbestos materials, falling pieces of decorative work such as brick, stone or marble cladding and falling masonry partition walls and fences.

2. Loss of Function

In addition to the life safety there is the risk that non-structural damage will make it difficult or impossible to carry out the normal functions of the facility. After the serious life safety threats have been dealt with, the potential for post earthquake downtime or reduced productivity is often the most important risk.

During the 1994 Northridge earthquake, non-structural damage caused temporary closure, evacuation, or patient transfer at ten essential hospital facilities. These hospitals generally had little or no structural damage but were rendered temporarily inoperable, primarily because of water damage. At over the dozen of these facilities, water leaks occurred when fire sprinkler, chilled-water, or other pipelines broke. Hospital personnel were apparently unavailable or unable to shut off the water, and in some cases water was flowing for many hours. At one facility, water up to 2 feet deep was reported at some locations in the building as a result of damage to the domestic water supply tank on the roof. At another, the emergency generator was disabled when its cooling water line broke where it crossed a separation joint. Other damage at these facilities included broken glass, dangling light fixtures, elevator counter weight damage, and lack of emergency power due to failures in the distribution or control systems.

3. Property Loss

Contents such as movable partitions, furniture, files and office or medical equipment represent a significant cost in case of hospitals. Damage to the non-structural elements and content of a building can be costly since these components account for the vast majority of building costs. Immediate property losses attributable to contents alone are often estimated to be one third of the total earthquake losses. Property losses may be the result of direct damage to a non-structural item or a secondary effect. If water pipes, fire sprinklers or fire sprinkler lines break, the overall property losses will include the cost of repairing the water damage in the facility. If the gas line to a water-heater ruptures and causes a fire, clearly the property loss is much greater than the cost of a new pipefitting. On the other hand, if many file cabinets overturn and all the contents end up on the floor, the direct damage to the cabinets and documents will probably be negligible (unless they are also affected by water), but employees may spend many hours or days sorting out the documents. If a reserve water tank is situated on the roof of a building, the consequences of its damage may be more severe than they would be if it was in the basement or outside the building in the parking lot.