Chapter

2

Reinforced Concrete Building's Seismic Failures

2.1 Introduction

Reinforced concrete (RC) is one of the most common materials used to construct buildings worldwide. In seismic regions, the majority of existing RC buildings have been designed either to old seismic code provisions that are now understood to be inadequate or without any code provisions. As such, many of these buildings are highly vulnerable to earthquakes.[1–3] In this section, the most common failure types affecting RC structures in their entireties will be described, followed by typical failure modes of RC elements.

2.2 Global Vulnerability

2.2.1. Plan and Vertical Irregularities

The response of RC buildings under earthquake loading is highly dependent on the distribution of the mass and the stiffness in both the horizontal and vertical directions. These irregularities in the distribution of mass, strength, and stiffness are broadly classified as plan (horizontal) and vertical irregularities.[4]

During seismic excitation, horizontal inertia forces are generated in buildings, which are considered to act through the centre of the mass of the structure. The vertical elements of the structure resist these actions, which are assumed to act through the centre of rigidity. When the centre of mass does not coincide with the centre of rigidity, there is eccentricity. During an earthquake, torsion results as the centre of mass rotates around the centre of rigidity, which may lead to severe damage (*Fig. 2.1*). Buildings that have an irregular plan shape (such as Π, L, T, and I shapes, see Section 3.2.1.1 for more details) may also suffer from torsion for the same above reasons unless precautions have been taken.

In the building shown in *Fig. 2.1*, shear walls were concentrated mostly at the top and left side (in plan), leading to a significant deviation of the centre of rigidity from the centre of mass. This

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