Frequently Asked Questions

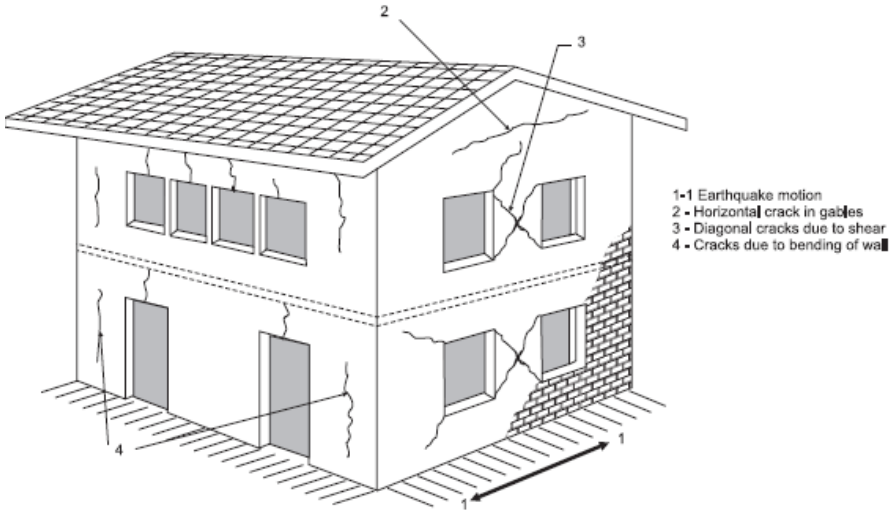
Question 01:

How does a typical non-structural damages in a building? Elaborate.

Answer:

Non Structural Damage:

- The non-structural damage is that due to which the strength and stability of the building is not affected. Such damage occurs very frequently even under moderate intensities of earthquakes
- Cracking and overturning of masonry parapets, roof chimney, large cantilever cornices and balconies.
- Falling of plaster from walls and ceiling particularly where it was loose.
- Cracking and overturning of partition walls, filler walls and cladding walls from inside of frames. (Though not usually accounted for in calculations, this type of damage reduced the lateral strength of the building).
- Cracking and failing of ceilings.
- Cracking of glass panes.
- Failing of loosely placed objects, overturning of cupboards, etc.



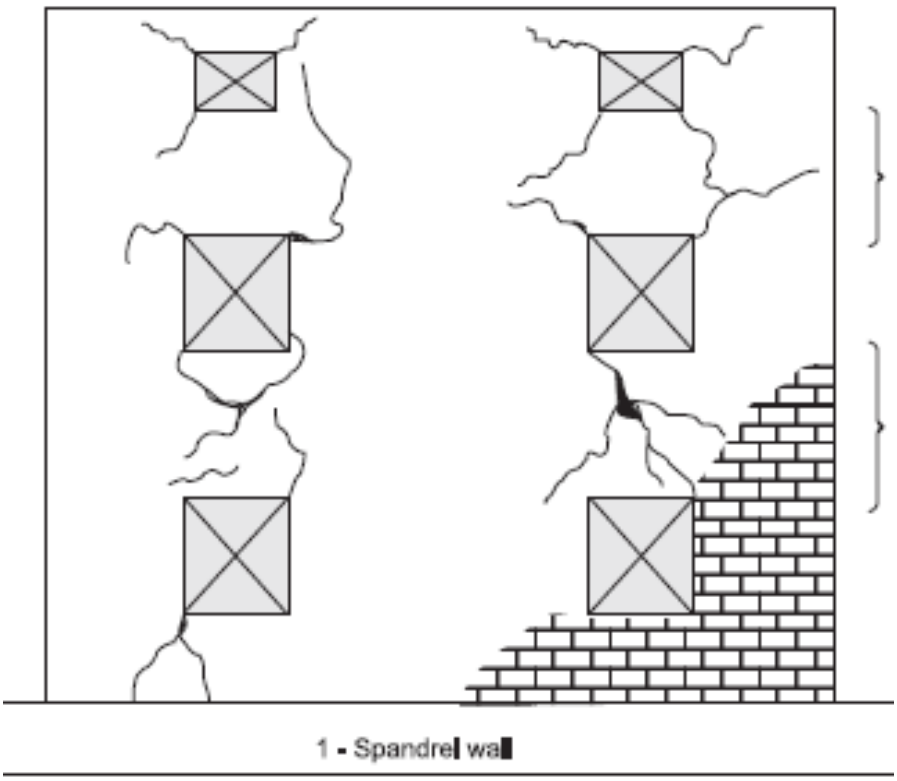
Question 02:

What are typical damage and failure of bearing walls from the seismic point of view?

Answer:

- Failure due to racking shear is characterized by diagonal cracks which could be due to diagonal compression or diagonal tension. Such failure may be either through the pattern of joints or diagonally through masonry units. These cracks usually initiate at the corner of openings and sometimes at centre of wall segment. This kind of failure can cause partial or complete collapse of the structure,
- A wall can fail as a bending member loaded by seismic inertia forces on the mass of the wall itself in a direction, transverse to the plane of the wall. Tension cracks occur vertically at the centre, ends or corners of the walls.
- vLonger the wall and longer the openings, more prominent is the damage. Since earthquake effects occur along both axes of a building simultaneously, bending and shearing effects occur often together and the two modes of failures are often combined. Failure in the piers occur due to combined action of flexure and shear.
- Unreinforced gable end masonry walls are very unstable and the strutting action of purlins imposes additional force to cause their failure. Horizontal bending tension cracks are caused in the gables.

- The deep beam between two openings one above the other is a weak point of the wall under lateral inplane forces. Cracking in this zone occurs before diagonal cracking of piers. In order to prevent it and to enable the full distribution of shear among all piers, either a rigid slab or RC band must exist between them.



ig 4.2 Cracking of spandrel wall between opening

- Walls can be damaged due to the seismic force of the roof, which can cause the formation of tension cracks and separation of supporting walls. This mode of failure is the characteristic of massive flat roofs (or floors) supported by joists, which in turn are supported by bearing walls, but without proper connection with them.

- Also if the connection with foundation is not adequate, walls crack there and slide. This may cause failure of plumbing pipes too.

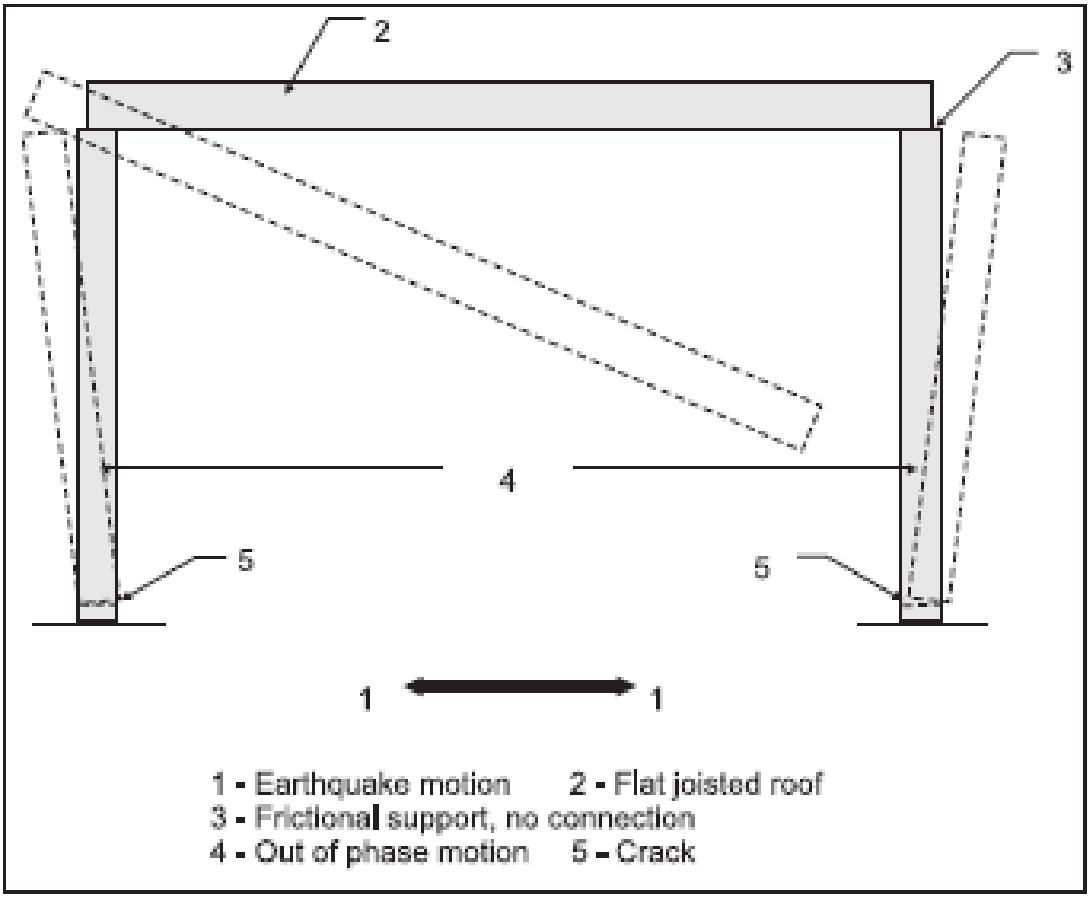


Fig 4.3 Fall of roof because of inadequate connection between roof and wall

Failure due to torsion and warping:

- The damage in unsymmetrical building occurs due to torsion and warping in an earthquake. This mode of failure causes excessive cracking due to shear in all walls. Larger damage occurs near the corner of the building.
- Arches across openings in walls are often badly cracked since the arches tend to lose their end thrust under in-plane shaking of walls.
- Under severe prolonged intense ground motions, the following happens:
    - the cracks become wider and the masonary units become loose
    - partial collapse and gaps in walls occur due to falling of loose masonry units, particularly at location of piers.
    - falling of spandrel masonry due to collapse of piers
    - falling of gable masonry due to out of plane cantilever action
    - walls get separated at corners and intermediate T-junctions and fall outwards.

- roof collapse, either partial or full certain types of roofs may slide off the top of walls and the roof beams fall.
- masonry arches across wall openings as well as those used for roof collapse completely.

Question 03:

What are the typical failures of ground , roof and floor from the seismic perspective?

Answer:

Failure of Ground:

- Inadequate depth of foundation:
    - Shallow foundations deteriorate as a result of weathering and consequently become weak for earthquake resistance.
- Differential settlement of foundation:
    - During severe ground shaking, liquefaction of loose water-saturated sands and differential contraction of weak loose soils occur which lead to excessive cracking and tilting ofbuildings which may even collapse completely.
- Sliding of slopes:
    - Earthquakes cause sliding failures in man-made as well as natural hill slopes and any building resting on such a slope have a danger of complete disastrous disintegration.

Failure of roof and floors:

- Dislodging of roofing material: Improperly tied roofing material is dislodged due to inertia forces acting on the roof. This mode of failure is typical of sloping roofs, particularly when slates, clay, tiles etc. are used as roofing material.
- Brittle material like asbestos cement may be broken if the trusses and sheeting purlins are not properly braced together.
- Weak roof to support connection is the cause of separation of roof truss from supports, although complete roof collapse mostly occurs due to collapse of supporting structure. The rupture of bottom chord of roof truss may cause a complete collapse of truss as well as that of walls.

Question 04:

What are the causes of damage in masonry buildings?

Answer:

The following are the main weaknesses in the materials and unreinforced masonry constructions and other reasons for the extensive damage of such buildings:

- Heavy weight and very stiff buildings, attracting large seismic inertia forces.
- Very low tensile strength, particularly with poor mortars.
- Low shear strength, particularly with poor mortars.
- Brittle behaviour in tension as well as compression.
- Weak connection between wall and wall.
- Stress concentration at corners of windows and doors.
- Overall unsymmetry in plan and elevation of building.
- Unsymmetry due to imbalance in the sizes and positions of openings in the walls.
- Defects in construction such as use of substandard materials, unfilled joints between bricks, not-plumb walls, improper bonding between walls at right angles, etc.