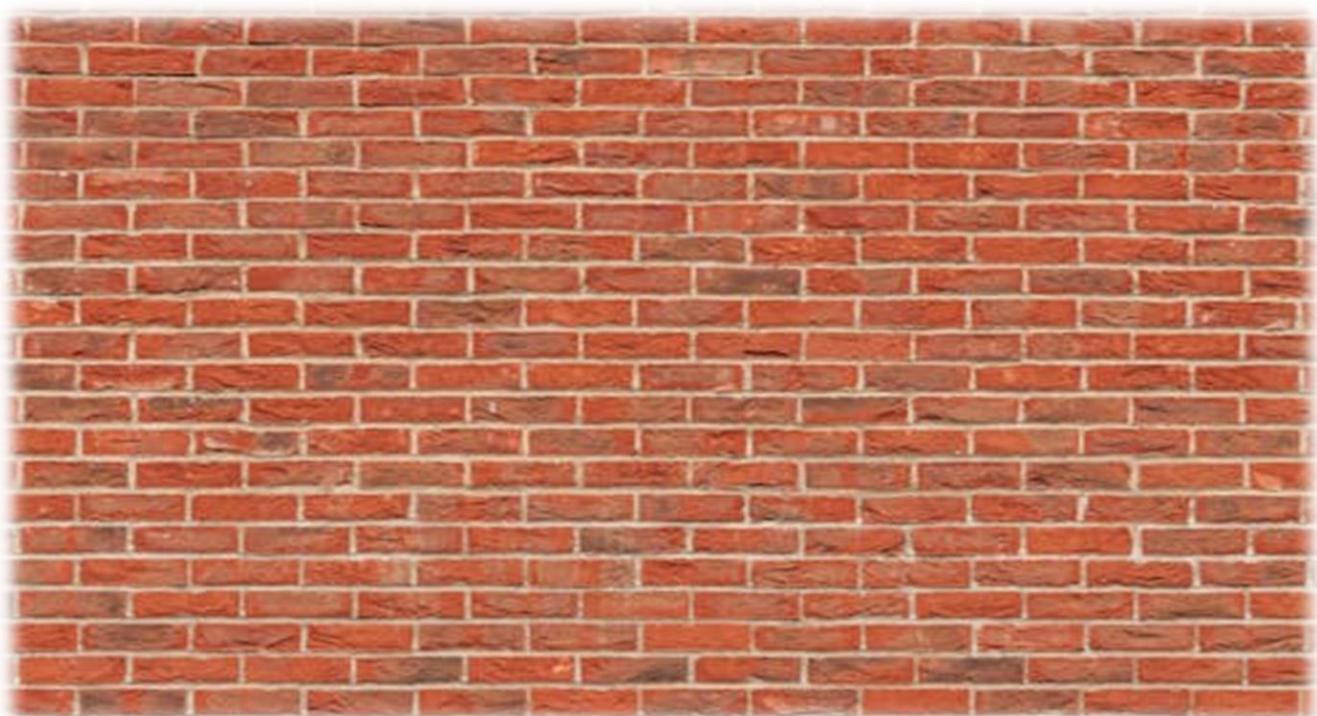




INTERNATIONAL INSTITUTE OF  
INFORMATION TECHNOLOGY

H Y D E R A B A D

**TYPES OF CRACKS  
IN  
BRICK MASONARY**



*Image Source: pixels*

## **BRICK MASONRY:**



Image Source: URSBID

Brick Masonry is a traditional construction technique composed of bricks and mortar.

It is known for its strength, durability, and aesthetic appeal. It possesses good compressive strength, which makes it suitable for use in load-bearing walls as well as partition walls. However, it is inherently weak in tension, which makes it susceptible to **cracking** - one of the most common forms of masonry failure.

Cracks may occur due to several factors such as structural movement, thermal expansion or contraction, moisture variation, or foundation settlement, leading to both aesthetic deterioration and structural distress.

## **FAILURES TYPES IN BRICK MASONRY:**

Brick masonry can fail due to aging, construction errors, or environmental factors such as weathering and foundation settlement. Common signs of failure include **cracking, spalling, and staining**, which are often caused by issues like poor materials, incorrect mortar mixtures, moisture ingress, and inadequate curing.

CRACKING	SPALLING	STAINING
<p>Cracking occurs when bricks break or develop visible lines on the surface without disintegration into separate pieces.</p> <p>It is often caused by differential settlement, thermal expansion, shrinkage of mortar, or structural movement.</p>	<p>The deterioration where the outer layer of a brick breaks off, flaking or crumbling away from the main body.</p> <p>This generally results from freeze-thaw, the use of low-quality bricks, etc.,</p>	<p>Staining denotes any unwanted discoloration or residue on bricks or mortar that does not wash away with normal rainfall.</p> <p>It is considered an aesthetic failure and often serves as an early warning sign of deeper issues, particularly chronic moisture penetration or efflorescence.</p>
 Image Source: amc911	 Image Source: Turnbull Masonry	 Image Source: Infinity Design solutions

## CAUSES OF CRACKS IN BRICK MASONRY:

Cracks in brick masonry walls may develop due to a variety of structural, environmental, or material-related factors. The following are the major causes:

1. **Differential settlement** – All structures experience some degree of settlement after construction. As long as this settlement occurs uniformly, it generally causes no harm. However, when the settlement is uneven, it results in differential settlement, which can lead to serious structural damage and visible cracks.

### Causes of differential settlement include:

- Soil that wasn't adequately compacted before construction
- Variations in soil bearing capacity
- seismic activity
- flooding and
- heavy excavation next to the foundation.
- Expansive soil can also cause differential settlement. Expansive soil expands as it soaks up moisture and shrinks when it dries out.



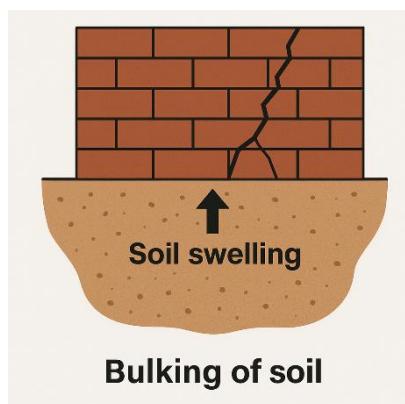
*Image Source: Buildfix*

Over time this swelling-shrinking cycle – which is usually seasonal, but can also be caused by rainfall, leaky plumbing, etc. – creates movement under the foundation that can lead to differential settlement and structural damage, including cracks.

2. **Subsidence** – Changes in soil volume cause subsidence. Subsidence differs from settlement in that settlement is about the building's weight pressing down on the soil. Subsidence can happen even if there isn't a heavy building sitting on top of the soil. often due to:

- Changes in soil volume or water content
- Decomposition of organic materials in the soil
- Mining or tunnelling activities beneath the ground

Subsidence can cause **vertical or diagonal cracks** in walls.



**Bulking of soil**

*Image Source: AI Generated*

3. **Poor design and/or construction** – Faulty design or improper construction methods can significantly weaken masonry structures. Common causes include:

- Incorrect load distribution or inadequate foundations
- Improper bonding of bricks
- Poor-quality mortar mix or insufficient joint thickness
- Inadequate curing after construction

Such defects often lead to early-age cracking or loss of structural integrity.



*Image Source: AI Generated*

4. **Natural disasters** – Natural forces such as earthquakes, floods, or hurricanes can induce sudden movements or stresses in the structure, resulting in diagonal, stepped, or shear cracks in brick masonry.
5. **Interaction with other structural elements** – Brick walls often interact with adjacent structural members such as RCC beams, columns, slabs, or roofs. Differences in thermal expansion, stiffness, or movement between these materials can cause cracks at their junctions or interfaces if proper joints or bonding arrangements are not provided.
6. **Deterioration from poor maintenance** – An example of this would be gutter downspouts that aren't being diverted away from the home.
  - Rainwater pipes or downspouts discharge close to the foundation
  - Leaky roofs or drainage systems cause continuous wetting of masonry
  - Vegetation or tree roots disturb the soil and foundationSuch factors promote dampness, weakening the mortar and eventually leading to cracking and spalling.
7. **Vibration** – Excessive or continuous vibrations due to nearby construction activities, heavy traffic, or machinery can lead to the formation of fine cracks in masonry walls, particularly in aged or poorly bonded structures.

**TYPES OF CRACKS IN BRICK MASONRY:**

Type of Crack	Orientation / Location	Probable Cause
<b>Vertical Cracks</b>	Near corners or mid-wall  Image Source: AI Generated	Foundation settlement or shrinkage
<b>Horizontal Cracks</b>	Along mortar joints  Image Source: AI Generated	Thermal expansion, lateral loads
<b>Diagonal / Stepped Cracks</b>	From corners of openings (doors, windows)  Image Source: AI Generated	Differential settlement or seismic forces
<b>Random / Map Cracks</b>	Irregular pattern over large areas  Image Source: amc911	Shrinkage of mortar, poor workmanship
<b>Cracks at Junction of RCC and Brickwork</b>	At column or beam junctions  Image Source: AI Generated	Differential thermal or elastic movement
<b>Cracks near Arches or Lintels</b>	At ends of openings  Image Source: AI Generated	Stress concentration or inadequate lintel support

**Typical failure modes of masonry walls subjected to in-plane seismic loads:**

**(a) sliding shear failure** - the bricks or mortar joints slide past each other horizontally under shear stress. This kind of failure is typically caused by horizontal forces such as those experienced during earthquakes, vibrations, or other lateral loadings.



Image source: AI Generated

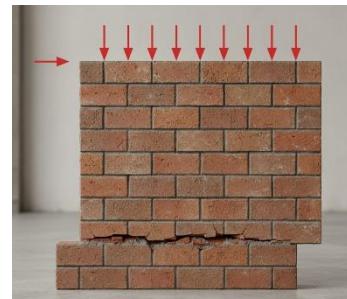


Image source: AI Generated

**(b) diagonal shear** - A diagonal shear crack in brick masonry is a significant form of structural failure, typically appearing as a crack running at an angle, often from the corner of a window, door, or wall, and traversing through both bricks and mortar.

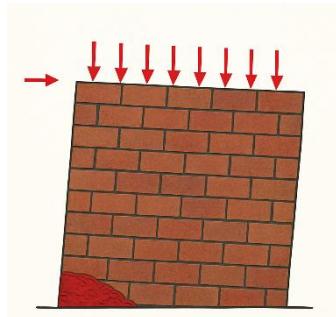


Image source: AI Generated

**(c) rocking** - Rocking failure occurs when a masonry wall or pier rotates as a rigid body about its toe (bottom corner), typically due to lateral forces from earthquakes or wind.

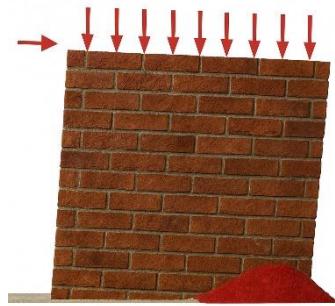


Image source: AI Generated

**(d) toe crushing** - Toe crushing is a compression failure at the pivot (toe) of a rocking wall, arising when the vertical compressive stress at that point surpasses the masonry's strength.

Rocking and toe crushing often occur together. Rocking is the initial motion, and toe crushing occurs if the stresses at the pivot exceed material limits.