# Subsidence – Property

Subsidence can affect all properties, particularly those built on clay soil types.

This Loss Prevention Standard discusses the main causes of subsidence, and provides useful guidance on reducing the potential for related losses.

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# Subsidence - Property

## Introduction

Subsidence is a growing concern as global temperatures continue to rise, with certain soil types being more susceptible, particularly during protracted periods of hot and dry weather.

This Loss Prevention Standard discusses the risks associated with subsidence and ways to help avoid damage to property and mitigate the extent of subsidence damage.

**Note:** This document relates to subsidence and is focussed on property loss prevention and related risk management guidance. It is not intended to address liability exposures. The presumption is that all regulatory requirements, such as fire risk assessments and compliance with local building regulations, codes, or standards, have or will be met.

## Understanding the Risks

Subsidence is the downward movement of a building's foundations due to changes in the supporting ground. Where these movements are unequal across a building, it can cause structural damage and instability.

In the United Kingdom, changes to the water content of clay soils is the predominant cause of such events, typically following protracted periods of hot/dry weather which causes the ground to shrink. In some cases, clays can become waterlogged, causing them to expand, or heave, causing upward movements that can cause similar damage.

Other factors that can affect the likelihood of a subsidence incident include:

- **Trees**. The presence of tree roots, which can further impact moisture levels.
- **Drier Winters**. The reduction in rainfall in traditionally wetter periods may prevent the ground from fully recovering following a hot/dry summer.
- **Urbanisation**. Property construction into higher risk areas in recent years has also contributed to subsidence incidents.
- **Foundations**. Inadequate foundations or errors in calculating the necessary foundation depths, can contribute to the risk of developing subsidence, particularly for older properties with shallow foundations.
- **Drainage.** Leaking drainage systems can wash away soil from under the foundations causing voids and instability. This is more common in granular or chalky ground conditions.
- **Construction Work.** Nearby building works, such as a new building, extension, storey extensions, basement excavation, or heavy landscaping, can cause movement of the surrounding soil, including under neighbouring properties.

Other causes of subsidence include new, or changes to, underground structures such as tunnelling or mining; collapse of natural caverns and other voids or other ground movement, such as slippage. These are however unusual and not discussed within this document.

Subsidence is a UK wide issue, with any clay soil areas potentially at risk, although there are a number of areas that are more exposed including London, Oxford, Kent and Essex. Climate change is increasing the risk as prolonged periods of warmer, drier weather cause the clay soils to dry out and shrink.

Commercial properties are as vulnerable as residential homes, and in some cases the increased load attributed to building size can worsen the risk of subsidence occurring.

The damage caused by subsidence is generally structural and includes:

- **Cracks**. Whilst natural shrinkage and settlement can result in slight cracking to wall and ceiling surfaces, subsidence related cracking tends to be wider, typically more than 3mm thick and often reducing in size nearer the ground, and following a diagonal pattern.
- **Separation**. In more severe cases, large gaps can occur between walls, ceilings, extensions, etc. Cracks and gaps can be visible internally and externally.
- **Flooring**. Flooring surfaces can start to sink or slope.
- **Openings**. Door and window openings can move preventing normal operation.
- **Roofing**. Stress to buildings can initially lead to sagging and then damaged roof materials.

Certain building types and construction materials are more susceptible to subsidence damage, these include:

- **Traditional Buildings**. Older buildings often feature shallow foundations, which make them more prone to movement. Traditional building materials such as stone, brick, cob, etc., tend to be less resilient to movement.
- **Lightweight Buildings**. Single skin brick or aerated concrete block buildings, concrete panel buildings, and other lightweight structures can be more vulnerable to ground movements and subsidence damage.

Subsidence damage can normally be repaired, however remediation works can be expensive and protracted. Repair works can be simple, however typically take some time and depending on the most likely cause can include:

- **Investigation and Monitoring.** This can include structural and ground surveys, use of crack monitoring gauges, boreholes, etc. (**Note**: crack monitoring gauges can be left in place for in excess of 12 months in some cases to observe movement).
- **Causation**. The monitoring and investigations should help identify the cause of the damage and help decide the most appropriate remediation.
- **Implementing Repairs**. A variety of remediations are available as discussed below. This may be as simple as pollarding and removing trees from the immediate area, or more extensive underpinning works and structural repairs. **Note**: Professional advice from a qualified arboriculturist is crucial for determining the appropriate tree management strategy.
- **Monitoring**. The repair work will need to be monitored to identify further damage.

## Managing the Risks

### Risk Assessment

A risk assessment should be undertaken to gauge whether the property is at risk of subsidence damage. The risk assessment should include:

- **Risk Register**. A register of the Buildings and/or Assets at risk, including age, predominant construction materials, make up of land, e.g. reclaimed, landfill, etc.
- **Building Condition**. Evidence of any damage, cracking, etc.
- **Foundation Quality.** Are foundations suitable for the property type, height and exerted loads? Have any property extensions had properly calculated foundations installed? A structural assessment may be required to determine the suitability of existing foundations.
- **Subsidence Risk Mapping**. Various free online mapping tools are available to assess whether the property location has an increased subsidence exposure, and can be cross checked. Substantive data is available from the British Geological Society here.
- **Soil Type**. Properties built on clay soils are particularly vulnerable to shrinkage in protracted periods of hot/dry weather. Does the ground dry and crack during hot/dry periods?
- **Trees**. Are any trees in close enough proximity to buildings to potentially cause problems? The Association of British Insurers (ABI) has published a guidance document, available here which includes a list of common trees and recommended 'safe' distances from buildings (**Note**: Whilst the document is aimed at residential properties, the guidance is valid for all properties). Some tree types will also remove more moisture from soil than others and/or have expansive root systems which can damage foundations and drainage systems, these include Oak, Poplar, Willow, Cypress and Eucalyptus. Further guidance on such tree types is available from the Royal Horticultural Society (RHS) here.
- **Water-logging**. Is the local ground susceptible to water logging and are drainage systems adequate? Has the local water table been checked? Further guidance is available from the British Geological Society here, The Environment Agency's Groundwater: Current Status and Flood Risk guidance here, and the UK Water Resources Portal here.
- **Underground Works**. Are there any mines, tunnels, underground lines, chutes or other voids in proximity to the building that could affect drainage or eventually decay/collapse? Further guidance is available from the British Geological Society BritPits guidance here. and the Free of Charge Coal Mining Information published by Gov.uk here.

### Tree Management

Careful management of trees, shrubs and other vegetation is one of the main ways subsidence related damage can be avoided. Any trees and shrubs that have been identified as likely to cause future problems should be removed, where possible, or maintained at an appropriate height.

Guidance should be taken from an experienced and qualified arboriculturist on removing trees and whether there are likely to be any consequences with water logging, which could cause upward movements in the soil, called heave, that can cause damage like subsidence. This is unlikely in most cases.

Where new trees are planned, ensure they are suitable for the location and consider the installation of root barrier systems to prevent roots coming into contact with foundations and underground utilities.

Permission should be sought to remove or maintain trees that are owned by third-parties such as local authorities, landowners, Forestry Commission, etc.

Trees that are subject to a Protection Order, such as a Tree Preservation Order in the United Kingdom, cannot be removed or maintained without consent from the relevant body, e.g., Local Authority, etc. Permission can however be granted when there is clear justification.

### Drainage Systems

- Regularly inspect drainage systems including guttering for evidence of leaks, blockages.
  - ✓ Ensure any repairs are completed promptly.
  - ✓ Any underground interceptors should be subject to a formal maintenance and cleaning programme.
- Ensure surface water drains away from buildings and foundations.
  - ✓ Where soakaways are installed these should be designed to disperse water at least five metres from the building and foundations.

### Foundation Design

New build property foundations should be suitable for the ground type. Trench, piled or raft foundations are generally preferred for new properties in areas with clay soils. A competent structural engineer can provide guidance on the appropriate foundation type.

### Building Materials

Choosing subsidence resilient materials for new build projects or post subsidence repairs can help reduce the potential for damage/further damage, or at least reduce the extent of such damage.

Materials with high tensile strength such as reinforced concrete can resist movement, particularly when coupled with similar foundation types. Timber framed structures have increased flexibility and can move with some ground changes.

### Underpinning

Foundations on existing buildings can be retrospectively upgraded, and this is the most common repair undertaken once a building has suffered with subsidence, and removal of trees has not remedied the issue. Main methods include:

- **Underpinning.** This is the most common method of preventing further subsidence issues. Ground is excavated beneath the existing foundations and concrete is used, which when set effectively increases the size and resilience of the foundations. Beam and base underpinning can also be undertaken which uses concrete beams to spread loads.
- **Mini Piled Underpinning**. A number of piles are drilled through the existing foundations into the ground and backfilled with concrete.
- **Resin Injection**. A liquid resin is injected into the foundations, which hardens to form a foundation support. The material can last for several decades and is less intrusive and disruptive than standard concrete underpinning techniques.

The most appropriate underpinning techniques or range of techniques can be sought from a competent structural engineer. **Note**: When underpinning is proposed to an existing foundation, approval under the building regulations will normally be required.

**Important**: Underpinning works may not be necessary if removal of trees and other vegetation resolves the issue. Ensure your insurer and broker are consulted as soon as possible, especially if the subsidence damage is likely to result in an insurance claim.

### Structural Repairs

Various techniques can be employed to repair the property and help resist further damage.

- **Crack Stitching**. This technique uses stainless steel helical bars embedded into bed joints to tie the damage together, is a permanent, and cost effective, repair for joints, can help avoid recurring cracks in the location.
- **Wall Ties.** Any cavity wall areas may require that wall ties are replaced following subsidence damage.
- **Flexible Mortar.** Flexible mortar can provide some flexibility to damaged walling and some resilience to further damage.

### Construction Works

Any construction work, whether adding an extension or removing ground for a basement, can cause changes to the ground and lead to ground movements. Construction works should be properly planned to limit construction-induced ground movements, including:

- **Condition surveys.** Surveys of all existing neighbouring structures to understand their design, including foundations via trial pits, and their condition to assess the ability to withstand changes to ground conditions.
- **Geotechnical investigations.** Fully understand the risks associated with the ground type so risk mitigations can be designed in. These should take into consideration the seasonal changes and how they impact the ground.
- **Construction methodology.** Methods should be adapted to suit the risks associated with a particular project. This may include programming works to avoid a particular season, changing excavation/support sequencing, undertaking ground improvement to provide more stability, or installing drainage earlier in the project.
- **Ground support.** Selecting appropriate ground support for all excavations and the risks identified in the geotechnical investigations, including top-down construction methods, pre-excavation support, or temporary shoring/propping.
- **Instrumentation and Monitoring.** A monitoring regime should be implemented suitable for the risks identified. These include regular surveys of neighbouring properties to assess their response to movements against expectations, as well as the ground and any excavations.

The works may not be carried out by the property owner and may be undertaken by a third party. The effects of construction by another party may still have an impact on buildings owned by others and specialist advice should be sought to understand the protections and obligations the contractor may owe to third parties to protect existing property.

## Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services at preferential rates via our network of Specialist Partners.

For more information please visit: Aviva Risk Management Solutions – Specialist Partners

## Sources and Useful Links

- British Geological Society Subsidence Mapping
- The Association of British Insurers Subsidence Guidance Document.
- Royal Horticultural Society Tree Guidance.
- British Geological Society Water Table Data.
- The Environment Agency's Groundwater: Current Status and Flood Risk Guidance.
- UK Water Resources Portal.
- British Geological Society BritPits Guidance.
- Gov.uk - Free of Charge Coal Mining Information.

**Note:** Whilst UK standards and legislation are referenced in this document, other international standards and legislation should be referenced where applicable.

## Additional Information

Relevant Aviva Loss Prevention Standards include:

- **Flood Guidance and Mitigation (UK)**
- **Lightning Protection**
- **Weather Related Property Damage**
- **Weight of Snow - Property**
- **Wind and Windstorm - Property**

To find out more, please visit Aviva Risk Management Solutions **or speak to one of our advisors.**

**Email us at riskadvice@aviva.com or call 0345 366 6666.***

*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.



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