

Loss prevention standards

Weight of Snow –

Property Precautions

The purpose of this document is to summarise the risks associated with prolonged winter snow combined with sub-zero temperatures, and to provide guidance in relation to precautions that can be taken to reduce exposure to property loss.



Weight of Snow – Property Precautions



Introduction

In general, extreme conditions of prolonged winter snow combined with sub-zero temperatures are fortunately quite rare. However, the potential exists with climate change to experience such conditions more frequently or in areas where they are unexpected. It is therefore important that property owners and occupiers are prepared for such conditions and do not lose sight of the fact that weight loads on buildings, introduced by snow, has the potential to damage the structure. This can result in significant property damage, including damage to the contents and interruption to the business.



The most hazardous conditions are likely to arise when repeated snow falls, that can take place over several days, do not have sufficient time to melt from roofs that can consequently accumulate and exceed the design capability of the roof. Furthermore, conditions can be exacerbated when rain follows heavy snow falls as rainwater will initially be absorbed by the snow layers which will further increase the weight of the snow layer.

Snow and ice on a roof exert vertical loads that can cause a roof to deflect or bow downwards. Also, these extremes in weight load can transfer horizontal forces through the structure that can cause walls to deflect outward, at either the top or the base of the wall. Where snow loads imposed on a roof are within the design limits for the roof then generally any minor sagging or deflection that may occur should be temporary and simply disappear after the load is removed.

Also, in areas of different roof height or where there are **roof mounted units**, snow can accumulate or 'drift'. This causes uneven or spot loading on the building and this can cause problems for a structure.

For example, a 1cm-thick, 10m-square area of freshly fallen snow at 4°C weighs around 100kg – which could potentially cause a lot of damage to your buildings, and as it compresses and freezes, it can weigh even more.

In addition, melting snow combined with rainfall can overwhelm building drainage systems as well as local drainage systems in the area which can result in flooding and damage.

Any work on roofs and gutters will involve work at height and safe methods of working should be used at all times. Any work at height, during adverse weather, will have the added risk of snow, ice and cold weather. It is important that risk assessments are carried out and safe methods of work established. It may be that the work could be more safely carried out by qualified and competent contractors. In whatever capacity, the risk to life is increased when snow accumulates on a roof.

Whilst severe winter weather cannot be avoided, following these simple practical guidelines should help avoid or mitigate damage to property and prevent business interruption.

To protect against the likelihood of snow-related damage to your property, it is important to develop a timely prevention and maintenance program that includes before the winter weather commences, during and after the winter period. These simple practical measures should form part of your building maintenance programme.

LOSS PREVENTION STANDARDS

Buildings at Greater Risk

- Geographical location and exposure to wind.
- The age of the building can be a significant factor in the snow load risk. All properly designed and constructed roofs in many countries are built to withstand a prescribed snow load which is determined by a number of factors including expected frequency and severity based on geographic location. Lack of correct design or design to standards that are lower than current building regulations is not uncommon as newer building regulations provide better guidance for estimating snow loads.
- Roof overhangs that project several feet beyond the horizontal support, particularly if there is a significant build-up of ice.
- Buildings with extensions or modification to roofs without considering the original load design, e.g., installation of a new roof using original structural framework, adding building services such as air conditioning plant to the roof.
- Buildings with lightweight roofs such as profile steel, asbestos or cement sheeting can be vulnerable due to their limited inherent strength. As these are lightweight materials they might not necessarily benefit from substantial purlins, joists, rafters, etc.
- Roofs which have had their insulation properties improved allowing snow to accumulate for longer periods.
- Large span roofs.
- Low pitched roofs.
- Some older structural steel framed roofs can suffer from corrosion.
- Substantial snow drifts can accumulate in valleys, behind parapets and against neighbouring higher structures.
- Roofs with differing levels can result in snow building up on the lower roofs from drifting or sliding snow that is deposited from adjacent roofs of higher levels.
- Poor maintenance of gutters and drainage systems resulting in them becoming blocked, frozen, and melting snow and rain not being able to drain away from the roof.
- Roofs with equipment mounted or plant rooms.
- Roofs with explosion venting or large bore ducting exhausting.
- Roofs constructed in climates not historically known for snow and unusually cold weather conditions which are now occurring or becoming more frequent.

If in doubt, specialist advice from chartered structural engineers or other appropriately qualified persons should be sought about the loads acting on a building, or how these loads can be safely accommodated by the structure to ensure your buildings are best prepared for the anticipated snow loadings they will experience.

How Can Roof Failures Due to Weight of Snow Occur

Roof collapses due to excessive weight of snow can happen for a number of reasons including:

- When the snow load exceeds the design load for the roof.
- Inadequate structural design.
- Imbalance of snow load on a roof.
- Failure of one key member of construction detail, causing others to fail as a result of load transfer.
- Inadequate roof drainage systems.
- Roof drainage systems such as gutters, downspouts and drains that are blocked (by debris) preventing rainwater, water from melting snow and ice from being able to freely drain away from roofs.
- Introducing additional weight to roofs, such as fixed machinery or plant which may reduce the original load tolerances available for weight imposed by snow.
- Poor workmanship and construction detail.
- Critical bracing not installed, poorly installed, or not maintained.
- Trusses, rafters and purlins installed at wider spacing than specified in original approved designs.
- Materials of reduced quality or of smaller dimensions than specified in original approved designs.
- Cycling of melt water during warmer periods/days moving into cracks, joints, etc. and refreezing (expanding) in colder periods/nights. This causes movement, cracks to grow bigger, etc.

Maintenance Before the Winter Weather Begins

Regular and systematic building inspections are a key part of any maintenance programme in order to help identify problems promptly. Early remedial action by a competent person is essential to reduce further, more costly, damage. It may be necessary to engage a competent person with the appropriate skills and equipment to carry out inspections in certain areas.

Intervals between inspections may vary depending on such things as the location, age, construction, usage, etc. of a building. Formal recording of inspections can be indispensable for keeping track of maintenance regimes, identified problems and actions taken.

Rainwater Removal – Gutters, Gulleys, Downspouts and Drains

Blocked or damaged rainwater removal systems will allow damage to the building fabric, water ingress and most importantly may prevent water being drained away from the property. In freezing temperatures this can result in ice dams forming during snow and prolonged cold conditions.

Ice dams can form when snow melts during the day, the water flows away but it cannot sufficiently drain and then refreezes at night. After several melting-freezing cycles combined with any further falls of snow, the weight load on the roof will obviously increase.

There are a number of practical measures that should routinely be undertaken throughout the year as part of your overall building maintenance plan that can help prevent damage caused by heavy snow and ice dam formation which include inspecting:

- All gulleys, gutters, downspouts and drains and repairing any damage.
- And cleaning accumulated debris such as leaves, vegetation and silt from all roofs, roof drains, gutters, valleys and downspouts so that water will flow freely.
- And cleaning accumulated debris such as leaves, vegetation and silt from the underground drainage system around the property to ensure that it will effectively remove water away from the building.

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- The structural elements of the building for accidental damage that may detrimentally affect the structural strength, e.g., damage caused by impact from forklift trucks, high loaders, etc.

Any maintenance regimes, identified problems and actions taken should be formally recorded.

Roofs

Only if safe to do so, roofs generally should be visited as often as you can but formally visually inspected at least twice a year and/or following particularly stormy weather during the non-winter months - debris on the ground from broken slates and tiles or damaging flashing could indicate that there is a problem. This is really important if there are any nearby or over hanging deciduous trees after the autumn leaf fall. If appropriate, roofs could be inspected using drones, binoculars or vantage points from nearby higher buildings.

It is also useful to inspect and observe a roof and its drainage systems during or after heavy rains. This will help paint a picture of how the roofing systems responds to water flow, ponding/static loads, drainage, etc. and will support a view on how melt waters will behave.

Ice can form when heavy snow melts during the day, flows under the roof tiles, and then refreezes at night. After several melting-freezing cycles tiles may be displaced, and water may often enter the roof space and damage insulation, ceilings, walls, contents and even the building itself.

Repair or replace:

- Missing, slipped or broken slates or tiles.
- Damaged or rusty cladding.
- Cracked/alligatored flat roof coverings. A bitumen roofing felt may need to be completely renewed up to every 10 years.
- Corrosion to structural steel framework, bolts, etc.
- Leaking or damaged rooflights.
- Damaged flashing.
- Gaps and missing mortar between ridge tiles.
- Damaged sealed areas at penetrations.
- Missing aggregate coverings.
- Underperforming or damaged guttering systems.
- Areas where roof mounted equipment, plant rooms or solar panels maybe situated and have caused fatigue damage or wear.

In addition, moss, which retains moisture, should be removed since it can cause slate to delaminate and can gradually erode all metals particularly lead work - a seasonal brushing down is often all that is required to prevent excessive build up.

Internal inspection of the roof and framework should also take place.

Steps That Can be Taken During Winter Weather

By taking some simple practical steps during snow conditions it may be possible to reduce the likelihood of damage or collapse to the roof. The following steps should be taken during such weather events:

- Monitor the weather and anticipate the situation you may encounter.
- If safe to do so prior to any snow fall, make regular checks of the roof to ensure all components and arrangements are sound and fit for purpose.
- If safe to do so all roofs, overhangs, porches, etc. should be inspected and cleared of snow on a frequent basis.
 - Note: Snow should NOT be moved into piles on roofs as this could create static loading in balances, drifting, etc.
 - Someone should be made responsible for managing this activity and it should be formally recorded.
 - Consider areas where drifting could be a problem.
 - Consider exhaust areas and air intakes that could also cause melt water issues or ingress.
 - Consider areas that could slide or fall onto the ground below – so exposing life or say equipment.
- Specialist advice should be obtained if considering the removal of snow from roofs and this should only be undertaken if it is safe to do so and by a competent person following appropriate risk assessments.
- Try to keep roofs, gutters, downspouts and drains clear of ice so water can freely drain away – they may be covered in ice and allow water to pond under the snow and ice.
- When clearing snow from yards, driveways and footpaths around the curtilage of your premises you should make sure that snow is not deposited against the foot of any gutter downspouts or over drainage grilles as this may interfere with effective drainage.
- Only where it is safe to do so, chip and channel any ice dams to ensure that water can flow freely.
- Be watchful for signs of stress and deflection of the roof and wall structure such as deflection, cracking, splitting or twisting, particularly in trusses, purlins, joists, beams and girders.
- Roof failures can occur at the exterior wall connections, particularly in buildings with flat roofs so it is important to check the connections for signs of cracking, twisting or deflection.
- Be alert to any unusual sounds emanating from the building such as cracking or creaking from the roof.
- Keep any attic areas or roof voids well ventilated – this can reduce the build-up of snow and formation of ice dams.
- Keep the building heating on.
 - As a last resort, if portable heaters are being considered you should first seek approval from your insurance company and comply with any additional requirements that may be required.
 - Any heaters should be adequately maintained.
 - Employees should be trained to use them safely.
 - Ensure all fire risk assessments are updated to reflect the additional hazard.
 - Any temporary heating should be considered as **'hot work'** and be managed under a formal Hot Work Management system – see Aviva's Hot Work Operations Loss Prevention Standard
- If possible, use drones to get an aerial view of the roof.
- If possible, use thermographic cameras on the roof (externally and internally) to understand if there are any thermal signatures that indicate issues with insulation, melt water (including flow channels), etc.

Note: If there are any safety systems such as emergency venting or explosion relief systems venting through a roof, the impact of snow loading, melt water, re-freezing should also be considered.

Be Alert for the Tell-Tale Signs

Often before a roof collapses due to the excessive weight of snow and ice, the building will generally exhibit some signs that the roof is under excessive load including:

- Visual deformation of the roof steel.
- Cracked or split wooden structural elements of the roof framework.
- Doors and windows that suddenly become misaligned/difficult to open or close.
- Creaking or cracking noises.
- Separation of ceiling joists and beams from wall plates.
- Signs of new movement in flashing around chimneys, door trims, ceilings, staircases and any mastic-type seals which are only designed to withstand very small amounts of movement.
- Deformation to service or conduits to mains services.
- Sprinkler pipework movement, e.g., sprinkler heads pushed down or not visible through any ceiling tiles.
- Ingress of water.

Safety of life is of utmost importance so if there is any doubt about the integrity of a roof, then the building or area should be evacuated until professional advice can be sought.

Note: This understanding should also extend to any trees or raised service pylons in the area, where collapse could impact life safety or the property.

- It is not uncommon for snow laden trees, service pylons, etc. to collapse into buildings, on external equipment or storage, through bridges, etc., so any snow load risk should also extend to nearby exposures.

Health and Safety

It is important that you are aware of the following risks:

- Any work at height should be subject to a risk assessment and development of safe working methods.
 - Consideration should include under foot conditions (water, ice and snow) and such things as wind.
- Safe means of access should be used.
 - Where no formal fixed access is available, cherry pickers may be preferable to ladders, as an example.
- Any person undertaking work at height on roofs, clearing gutters, etc. should be competent and suitably trained. The danger of going onto a roof for whatever reason should not be underestimated.
- Buildings which have been damaged are likely to be unstable and may present a serious health and safety risk. Unless damaged buildings have been verified as being in safe condition by a qualified and competent person it is sensible to keep out of the buildings to avoid the risk of injury through collapse of the structure.
- Seek professional advice to check that any roof is safe and suitable to stand on and has no fragile areas. You should always assume that any roofing surface is fragile until confirmed otherwise by a competent person.
- Seek professional advice to ensure that the roof is capable of supporting additional loads when it is already under load from snow and ice.
- Consider overhangs, drifting, etc. where snow and ice can accumulate and fall onto personnel, equipment, etc. below. This includes accumulation through to the melt stage.

Snow and Ice Roof Melting Systems

There are a range of snow and ice prevention systems available from specialist installers that can reduce the build-up of ice, snow and the dangers posed by heavy snow building up on roofs.

Typically, these are electrically powered trace heating systems comprising of heated mats and cables which are routed and positioned in critical areas of the roof such as eaves, valleys, gutters and downspouts. Such systems are designed to activate automatically by strategically located thermostatic and moisture detection that switches on the heat source whenever the ambient temperatures fall below a set point.

Note: Under no circumstances should direct impingement of hot air guns, naked flames, temporary heaters and other forms of hot work be used to melt ice of any kind.

Other Areas of Concern

- Snow and ice can impair louvered ventilation systems and roof lights.
- Ice can seal shut venting systems, and the weight of snow can stop explosion relief vents from opening.
 - Fluid-filled services or equipment, and sprinkler piping, can freeze if left exposed. - this can then fracture and subsequently leak when thawed.
- Unheated buildings are vulnerable to freezing.
- Melting snow combined with rainfall as stated can easily overwhelm building drainage systems, and with other melt water locally can result in localised flooding.

Business Continuity

Being prepared for such events will increase your businesses resilience and enable your organisation to resume operations in the most effective and shortest possible time should disaster strike.

Although headline disasters capture the attention, businesses need to be aware that other more specific events are just as likely to threaten their organisation. Disasters can and do happen and can cause healthy businesses to fail. Disasters create missed opportunities, cash flow problems and can often result in negative publicity affecting reputation. All this can lead to a loss of client confidence which your competitors may take advantage of.

Planning makes a substantial difference to the possibility of surviving an incident. While it may seem an extra burden to prepare a plan, challenging situations place severe pressure on individuals to make decisions and take action under stressful conditions. Experience proves that it is easier to consider all the issues surrounding a potential crisis objectively beforehand.

Insurance has a vital role to play in supporting your recovery, but it makes sense to have a plan as well. This should give you the opportunity to reduce the risk of some incidents occurring and to know what immediate measures to take to minimise the initial impact. A Business Continuity Plan doesn't need to be complicated and does not need to deal with every scenario. If your plan enables you to cope with the worst-case scenario, it should help you to deal more easily with less serious incidents.

Note: You should also consider weight of snow implications to any services and utilities that you need to operate.

The Business Continuity Planning process is designed to help you reduce the likelihood and impact of risks occurring and becoming a disastrous event, as well as putting in place suitable contingency plans that will enable your business to maintain its revenue and client base, assist with the continuity and recovery of your business and ensure its survival should the worst happen and disaster strike.

LOSS PREVENTION STANDARDS

Key Action Steps

- Do you know and understand the snow load designs for all the roof sections of your building(s)?
- Does your building maintenance program include measures to ensure that your buildings are not compromised by snow events?
- Are you prepared for such events and is your business able to respond effectively to deal with such events?

Effective precautions are required for all work on roofing surfaces, no matter how short the duration, whether the work concerns construction, maintenance, repair, cleaning or demolition.

Checklist

A generic Weight of Snow – Property Precautions Checklist is presented in Appendix 1 which can be tailored to your own organisation.

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

- [The Building Regulations 2010](#)
- [Approved Document A – Structure \(2004 Edition inc. 2004, 2010 & 2013 Amendments\)](#)
- [The Building Standards \(Scotland\) Regulations](#)
- [EN 1990: Basis of structural design \(but also referring to EN 1991 through to EN 1999\)](#)

Additional Information

Relevant Loss Prevention Standards include:

- Business Continuity
- Business Continuity Testing and Maintenance
- Business Impact Analysis
- Emergency Response Teams
- UK Flood – Guidance and Mitigation
- Hot Work Operations
- Photovoltaic Solar Panel Systems
- Trees – Property Damage
- Windstorm – Protection of Buildings

Aviva Seasonal Bulletin:

- Winter Risk Management Bulletin

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.*

*Calls may be recorded and/or monitored for our joint protection.

LOSS PREVENTION STANDARDS

Appendix 1 – Weight of Snow – Property Precautions Checklist



Location	
Date	
Completed by (name and signature)	

	Property Precautions	Y/N	Comments
1.	Is the maximum expected roof loading design of your building known, understood and formally documented?		
2.	Are the buildings and roofs designed for the maximum expected weight loads introduced by snow, based on the geographic area?		
3.	From question (1) and including any existing roof loads, is the maximum safe weight/thickness of snow tolerable for the roof design calculated, understood and formally documented?		
4.	Are the buildings located in an exposed or geographic location which is prone or susceptible to severe winter weather?		
5.	Are weather conditions tracked or documented year on year to understand whether snow deposition is becoming: <ul style="list-style-type: none"> • More frequent? • Greater? 		
6.	Are ongoing inspection, maintenance and repairs made to roofs throughout the year and is this formally recorded?		
7.	Are there at least 2 formal roof inspections each year?		
8.	Ahead of any severe winter weather, for anything other than small repairs, is a roofing specialist contacted to expedite emergency repairs?		

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	Property Precautions Contd.	Y/N	Comments
9.	Is the roof arranged in a way that would lead to drifting, e.g., differing heights, parapet walls, north lights, etc.?		
10.	Is the roof connected to any adjacent buildings, either walls or roofs, that could create drifting or cause large snow deposits to slide onto your roof?		
11.	Does the roof have any unusual construction features that make it prone to uneven or spot snow loading? Is this documented and form part of your emergency response plan?		
12.	Does the roof have any unusual construction features that make snow loading of any kind a severe exposure? Is this documented and form part of your emergency response plan?		
13.	Regardless of the nature of the construction, is the roof deck clear of any debris, moss, etc.?		
14.	If the roof is flat, is there any water pooling? If so, is there a remedial plan in place to address this ahead of winter?		
15.	If the roof is flat, is there any issues with the covering including cracking, alligating, etc.? If so, is there a remedial plan in place to address this ahead of winter?		
16.	Following the autumn leaf fall, are inspections made on the roof and the gutter/drain system to clear away any detritus?		
17.	To help understand the performance of the roof drainage system, has an inspection been completed when it is raining?		

	Property Precautions Contd.	Y/N	Comments
18.	<p>Ahead of any expected severe winter weather/snow are the gulleys, gutters, downspouts and drains around the edge of a building perimeter visually and closely checked?</p> <p>If required, and to facilitate any immediate small level repairs, are a supply of threaded nails with flat washers available?</p>		
19.	<p>If appropriate, are there any missing, loose or damaged roof tiles?</p> <p>If so, are these identified and replaced?</p>		
20.	<p>Are all building joints and roof flashing well maintained and secure?</p>		
21.	<p>Are all roof and wall mounted objects, equipment or plant rooms appropriately secured?</p> <ul style="list-style-type: none"> • Where appropriate, is pointing of an appropriate standard? • Has this been checked and recorded? 		
22.	<p>Have any roof top access hatches or plant room doorways been properly secured?</p>		
23.	<p>Is the maximum weight load design known and recorded for any roof mounted glazed elements (and frame), including skylights?</p> <ul style="list-style-type: none"> • Is the maximum safe weight/thickness of snow tolerable for the glazed element calculated, understood and formally documented? • If not have temporary measures been put in place to protect these elements of construction? <ul style="list-style-type: none"> ○ This may include fixing plywood to protect them. 		

	Property Precautions Contd.	Y/N	Comments
24.	<p>Are there any explosion relief vents or panels that pass through the roof? If so:</p> <ul style="list-style-type: none"> • To prevent damage, is the maximum weight/thickness of snow that can be present on top of the vent panel understood? • To prevent impairing their operation are they maintained clear from snow and ice, including at night? <ul style="list-style-type: none"> ○ If this is not possible, is the associated process ceased to prevent unsafe operation? 		
25.	<p>Are there any heat and smoke vents located in the roof? If so:</p> <ul style="list-style-type: none"> • To prevent damage, is the maximum weight/thickness of snow that can be present on top of the vent panel understood? • To prevent impairing their operation are they maintained clear from snow and ice, including at night? <ul style="list-style-type: none"> ○ If this is not possible, are the operations within the building ceased to prevent any unsafe operation? 		
26.	<p>Are all roofs and gutters maintained, cleared and clean?</p>		
27.	<p>Has the potential impact of snow to any utilities and services been considered?</p> <ul style="list-style-type: none"> • Is this part of your emergency plans? • Has each service been considered and how it could be impacted? • Have all services required to be operational during severe winter weather been identified? • Have any contingencies been identified that need to be put in place, to ensure they remain operational, e.g., uninterruptible power supplies? • Can/should any services be isolated ahead of any severe winter weather? <ul style="list-style-type: none"> ○ Has this been verified by formal documented risk assessment and permit to work? ○ Is this managed with a formal lock out/tag out process? ○ Have service restoration dates been identified? 		
28.	<p>Are there any trees or utility/service structures that could collapse onto your building, external equipment, services/utilities, etc. if loaded with snow?</p>		

	Property Precautions Contd.	Y/N	Comments
29.	<p>Are there formal emergency preparedness and emergency response plans?</p> <ul style="list-style-type: none"> • Does this include named accountable positions for key roles? • Is this up-to-date severe winter weather conditions and for snow deposition on the building? • Have the plans been recently tested? • Do the plans provide accountability for tracking any severe winter weather before, during and post their impact? • During snow fall conditions does the plan include appropriate 'safe' snow clearing from: <ul style="list-style-type: none"> ○ Roofs? ○ Gutters and drains? ○ External equipment? ○ Nearby trees? ○ Services supporting or exposing the building? ○ Roads? • Does the plan include monitoring of drains and gutters and what measures to take if they are not performing as designed and/or expected? 		
30.	<p>Aside from direct impact to a building, have the following been considered:</p> <ul style="list-style-type: none"> • Denial of access to the site? • Impact of the weather on employees, site management and the emergency response team? 		
31.	<p>Additional comments:</p>		

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