Notes on UK Snow & Wind Loading on roof construction.

Part 01: Wind uplift loadings
Part 02: Snow loadings
Part 03: Recommendations
UK wind uplift and snow loading analysis of risks to Onduline roofing coverings

Typical damage to farm buildings caused by gale force wind loading. An example of snow weight loading causing the roofs structural failure.

Introduction:
The scope of this data sheet is to provide simple guidance on the use of Onduline roofing products in exposed ‘high risk’ locations in the UK as defined below, it is not intended as a design guide and professional advice should always be consulted in relation to roof design. Its terms of reference are therefore limited to informing our customers of the additional risks wind uplift and snow loading present to a building and therefore, allow a basic risk assessment to be undertaken on your building and provide an enhanced fixing specification to the Onduline sheet and shingle products if so required.

If erecting a new building in a location likely to be subjected to high wind and snow loadings always seek professional advice from the buildings supplier to investigate if any structural variations or strengthening is required to counter increased roof loadings. On existing buildings the maintenance and structural integrity of the building should be surveyed and upgraded as required and if necessary again seek professional advice (Architects, Surveyors, Civil Engineers and your local Building Control Department.

Identifying risk factors:
The factors that should be considered in the roofs design are as follows:

Building size and configuration: The span of the roof, its design layout, roof slope and height; The ‘dead’ loading applied typically comprising of the weight of individual structural elements, and the ‘live’ loadings applied to the roof such as wind and snow forces acting upon it.

Location: in respect to predicted wind speeds m/s (see chart below)

Exposure: (urban or country)

Altitude of site: The wind speed and snow loadings applied to a roof are likely to be significantly increased the higher the buildings elevation is above sea level.

Distance from sea: Higher wind speed is generally experienced in coastal areas as the force of the wind is not dissipated by the lands topography, trees, buildings etc.

Parapets and roof obstructions: Against which air turbulence can be created; or snow drift against increasing the point weight loadings on a roof structure appreciably.

Note: Buildings in the UK are designed in compliance with the British Standards and Codes of Practice which take into account site location however, your buildings designer or supplier should be consulted should you require confirmation of your buildings design conformity. Building Control Departments can also provide information in this regard.
Part 01: Wind uplift loadings

Introduction:
The Onduline products fixing specification’s in relation to wind loadings have proved themselves more than capable in dealing with even UK extreme gales and weather events being tested to withstand wind speeds of up to 120mph (192kph - 53.6 m/s); therefore the risk as can be seen from the photographs below is more to the integrity of a building and its roof design; in both these cases the Onduline sheets have not parted company from the roof structure; rather it is the buildings structures which have failed resulting in their damage beyond economical repair.

Example of a stable blown off its foundations when subjected to gale force wind loadings, resulting from the failure of the fixings securing its wall structure to the foundation concrete base.

In this case gale force wind loadings have flipped a field shelter over due to an inadequate foundation provision in the form of concrete paving slabs which proved insufficient to counter the force of the wind uplift.

ROOF DESIGN IN EXPOSED UK AREAS OF HIGH WIND AND SNOW LOADINGS

Introduction:
Analysis of Onduline roof coverings weathering and service performance worldwide, from the arctic circle to the tropics confirms Onduline roofing products are both durable and resilient resulting in brand leading weathering performance. However, our experience is that firstly structural faults in the roof and building design are normally associated with roofing failures. Example: A timber frame building which has been designed for use in a typical low elevation sheltered location and which under normal conditions will provide years of trouble free service; However, the same building erected on an exposed elevated coastal site and being subject to much higher wind and snow loadings without upgrading the building’s structural design is likely to be at risk of structural failure; which can be both dangerous and expensive to resolve far exceeding the cost of upgrading the original roof structure.

Next cause of roof failure during gales and snow loading is the failure to fix the product correctly in accordance with our published fixing instructions. We therefore advise that the fixing of your Onduline roofing product is checked to ensure it is in compliance with the relevant fixing instructions. (www.onduline.net)

The Onduline product fixing instructions conform to predicted UK wind uplift loading under normal conditions.
UK Predicted wind speeds and snow loading data (Table 01)
Introduction:
Generally, the dominant load factor requiring design consideration on a roof following a fall of snow is the additional weight it imparts on the roof structure. This load combined with wind loading, ice melt and the increased weight of compacted snow on a roof structure and the effect of prolonged exposure to below freezing temperatures on roof structures must be reflected in the design strength requirement of a building’s roof section.

Fresh ‘dry’ snow fall has nominally 1 : 10 the density of water, and as one litre of water weighs a kilogram accordingly, 1cm of snow covering 1m2 of roof area weighs a kilogram with this the weight of a snow loading can be calculated in consideration of the depth of snow. However, as snow compacts its density also increases to typically a 1:6 ratio increasing its weight, more importantly as snow drifts therefore, the depth of snow can vary greatly across a roof area creating high point loadings which is often the cause structural roof failures.

Other considerations such the design performance of roof windows, ventilation products, soil vent pipes and roof chimneys should be considered with the relevant manufactures.

Note: These considerations are the province of professionals who will assess the buildings location, roof pitch, span and roof configuration; its performance criteria required for roof structures in the UK, considering the predictive wind and snow loading tables to specific geographic location. And using tables can then design the roofing elements its structural design and calculate the pull out resistance of structural fixings in consideration of the buildings location, roof pitch, span and roof configuration.
UK Predicted snow loading area data

Zone numbers:
1. 0.30
2. 0.40
3. 0.50
4. 0.60
5. 0.70
6.5 0.85

Jersey - Zone 3, 0.50 kN/m² at 100m a.m.s.l., Guernsey - Zone 2, 0.40 kN/m² at 100m a.m.s.l.
Part 03: Recommendations

Fixing specification Roof slope recommended minimum 10° degrees:

Sheets must be laid on fully supporting roof deck.

Sheets specification:

- In exposed locations with predicted snow loading of 80 kg/M² or greater; (requiring snow to be cleared from roofs):
- We recommend that Onduline Classic 3mm sheets are used laid on fully supporting roof deck.

Enhanced fixing specification for Bardoline shingles fixed in exposed UK locations subject to high snow & wind loading

Fixing specification Roof slope recommended minimum 15° degrees:

Sheets must be laid on Ondutiss underlay.

Shingle specification:

- In exposed locations with predicted snow loading of 80 kg/M² or greater; (requiring snow to be cleared from roofs):
- We recommend the use of Bardoline Pro 125 shingles.

Notes: Damage to shingle roof coverings due to wind uplift:

There are basically two risks associated with shingle coverings in respect to gale force wind loadings firstly; due to the failure to use sufficient 20 mm large headed galvanised nails to secure a strip - 5 per strip; (or similar pull out resistance rated staples) if insufficient fixings are used the wind can uplift the shingles and peel back areas of shingles strips from the roof.

Next localised damage can be caused to the shingle tile tabs normally due to the failure of the adhesive bonding of the lower course to the tile tab, we recommend that the bonds are periodically checked and reinforced with lap adhesive as required, and In exposed areas of high wind loadings additional lap adhesive should be applied during installation of the shingles.

The vast majority of roofing problems associated with wind or snow loadings; result from poor structural design or building maintenance, allied to the failure to follow product fixing instructions and UK Building Regulations.
### Appendix: Table for the permitted maximum snow load on Onduline sheets.

1. **Onduline Classic.**
   
   Snow load in KN/m²

<table>
<thead>
<tr>
<th>Number of the support in %</th>
<th>Front overlap – 30 cm</th>
<th>Side overlap – 2 corr.</th>
<th>Full deck</th>
<th>Four</th>
<th>Three</th>
<th>Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 – 18</td>
<td>30 cm</td>
<td>2 corr.</td>
<td>NOT RELEVANT</td>
<td>NOT RELEVANT</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
<tr>
<td>19 – 27</td>
<td>20 cm</td>
<td>1 corr.</td>
<td>148 daN/m²</td>
<td>127 daN/m²</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
<tr>
<td>28 -36</td>
<td>17 cm</td>
<td>1 corr.</td>
<td>151 daN/m²</td>
<td>130 daN/m²</td>
<td>104 daN/m²</td>
<td></td>
</tr>
<tr>
<td>36-50</td>
<td>14 cm</td>
<td>1 corr.</td>
<td>152 daN/m²</td>
<td>133 daN/m²</td>
<td>106 daN/m²</td>
<td></td>
</tr>
<tr>
<td>More than 50 %</td>
<td>14 cm</td>
<td>1 corr.</td>
<td>162 daN/m²</td>
<td>140 daN/m²</td>
<td>112 daN/m²</td>
<td></td>
</tr>
</tbody>
</table>

   The load is directly transferred to the deck. Refer to board manufacturer Specifications. In case the values are bigger, apply data from column “Four internal supports”.

2. **Onduline Standard and Onduline base (2.6 mm thickness)**
   
   Snow load in KN/m²

<table>
<thead>
<tr>
<th>Number of the support in %</th>
<th>Front overlap – 30 cm</th>
<th>Side overlap – 2 corr.</th>
<th>Full deck</th>
<th>Four</th>
<th>Three</th>
<th>Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 – 18</td>
<td>30 cm</td>
<td>2 corr.</td>
<td>NOT RELEVANT</td>
<td>NOT RELEVANT</td>
<td>NOT RECOMMENDED</td>
<td></td>
</tr>
<tr>
<td>19 – 27</td>
<td>20 cm</td>
<td>1 corr.</td>
<td>103 daN/m²</td>
<td>89 daN/m²</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
<tr>
<td>28 -36</td>
<td>17 cm</td>
<td>1 corr.</td>
<td>105 daN/m²</td>
<td>91 daN/m²</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
<tr>
<td>36-50</td>
<td>14 cm</td>
<td>1 corr.</td>
<td>108 daN/m²</td>
<td>93 daN/m²</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
<tr>
<td>More than 50 %</td>
<td>14 cm</td>
<td>1 corr.</td>
<td>113 daN/m²</td>
<td>98 daN/m²</td>
<td>NOT RELEVANT</td>
<td></td>
</tr>
</tbody>
</table>

Data compiled by Yordan Nikolov - Oftec legend!
Cleaning snow from roof areas:
Generally in the UK it is not a necessity to remove snow fall from roof areas as required in other geographic areas to avoid the buildup of significant weight loading on a roof structure which can threaten the structural integrity of a building’s roof structure. In these areas other issues such as the formation of ice dams on the roof covering below the snow layer at the eaves must be resolved before melt water backs up behind the ice dam and risk causing leaks through the roof covering.
However, typically in the UK only risks such as the melting snow sliding of a roof damaging gutters and presenting a real danger to pedestrian traffic below need be considered.

By its very nature snow clearance from a roof is a specialist operation and should only be undertaken by professionals using dedicated safety harnesses, access and snow clearing equipment after a full safety risk assessment has been undertaken prior to starting work.

Notes:
Only Onduline roots supported on a fully supporting roof deck should be accessed to remove snow using dedicated safety harnesses, access and snow clearing equipment. Snow should be cleared from the ridge to the eaves in order to protect the sheet and shingle laps. Particular care should be taken to protect both the materials surface and fixings which are vulnerable due to raised position when shovelling without due care.

BIBLIOGRAPHY
UK National Annex to BS EN 1991-1-3:2003

Notes:
Snow load is simply the weight of snow on a roof, as detailed in Eurocode 1 (EC1). Snow load is often just calculated at 0.75kN/m² on plan area of the roof however, given snow can accumulate within the valleys and against parapets and abuting walls this figure does not express true loadings likely to be applied to many roofs.

However many calculations are based on the assumption that a snow load as up to 100m altitude is 0.75kN/m² (75kg/m²) And on roofs over 100m altitude 1.00kN/m² (100kg/m²)wind Load.

This is simply the load that wind will exert on a structure, it used to be determined by CP3 and then BS6399 part 2 but now has been superceded by Eurocode 1 (EC1). Wind load becomes more of an issue the taller a building becomes and in consideration of its shape and the sites topography.
The two more recent references has made wind load calculations very complex without the use of software to determine the worst case scenarios. However, most Authorities accept CP3 calculations for small structures where wind load is not considered the dominant load. Wind loads vary due to many factors but are generally between the values of
0.4kN/m² (40kg/m²) for sheltered low rise buildings
up to
1.5kN/m² (150kg/m²) for low rise factory units with large doors that could remain open in the event of a storm.

Please note:
Onduline Data sheets provide additional general information on our products and related environment issues effecting roof coverings; they are based on the experience and views of our technical Managers. We therefore recommend that whilst you consider the views expressed you should undertake further independant research and seek professional assistance as required on your specific project.

Caution: Working on roofs can be a hazardous operation. All work must be carried out with due regard to health and safety regulations as set out HSG33 working at heights.