The Building Envelope Authority

WITHSTANDING THE WORST OF THE WEATHER – WIND AND SNOW LOADINGS

Buildings and their cladding are expected to withstand the worst that the weather can throw at them without risk of failure or loss of function. However, such performance is only possible due to the care that goes into their design and the attention to detail during the manufacture and installation of the building envelope. The Metal Cladding and Roofing Manufacturers Association (MCRMA) offers some timely advice for all involved in the specification process as winter approaches, particularly with regard to wind and snow loadings.

Of all the loading that a building is likely to encounter over its life, the wind has the greatest potential to cause damage to the cladding and even to the building structure. News stories about winter storms are often accompanied by pictures of buildings with damaged roofs or walls and it has almost become accepted that some damage will occur during the most extreme weather. However, with the correct design and specification of the roof and wall cladding systems and their fasteners, it should be possible to ensure that no new building built in the UK or elsewhere in Europe suffers this fate.

Furthermore, the force generated by the wind blowing over a building is dependent on the shape of the building and even the location on the building's surface. For example, the edges of a roof are subjected to higher pressures than the centre, so may require additional fasteners or closer purlin centres. The ridges and corners of roofs and the corners of walls are especially vulnerable to high wind loads.

Wind forces on buildings

When the wind blows on a building, the change in wind speed as the air negotiates the obstruction in its path may result in either an increase or a decrease in pressure. When combined with changes to the internal air pressure the result is either a net positive pressure (on windward facing walls and the windward slopes of steep roofs) or a net suction (on leeward facing walls, on walls parallel to the direction of the wind and on roofs generally). Wind pressure and suction will both cause bending effects in the wall and roof cladding and may, in extreme cases, cause structural failure of the cladding profile. Additionally, wind suction may result in failure of the fasteners if not properly specified.

Wind damage: Proper attention to design and detailing will avoid an outcome like this!

Factors affecting wind loading

There is no single value of wind load for design of buildings in the UK. This is due to the variation of wind speed with location and building geometry. The main factors that influence wind speed are:

- Location – some parts of the country are windier than others
- Altitude – the higher the site, the greater the wind speed
- Distance to sea – the closer to the sea, the greater the wind speed
- Town or country – buildings may provide shelter from the wind
- Topography – topographical features can increase wind speed
- Wind direction – the strongest winds generally blow from the south west
- Building height – taller buildings are exposed to stronger winds

Taking account of all these factors, it is clear that wind loading is site and building specific, so should be calculated by a qualified engineer for each and every building project. Failure to do so may result in unsafe buildings in some cases, and uneconomic buildings in others.

The impact of snowfall

Winters in the UK are often relatively mild and severe snowfalls are rare. However, when heavy snowfalls do occur there are often reports of damage to buildings, in particular collapses of roofs and their supporting structures. It is perhaps because of our mild climate that we tend to view the snow that causes these collapses as exceptional. The reality is that most of the recent snowfalls in the UK have been within the design values predicted by the codes and standards, so should not have caused the damage that they did.

Since most of the snow that falls on a building lands on the roof, the correct specification of the roof cladding and its supporting structure are essential to ensuring that buildings survive the winter storms. Key to this is the accurate determination of the likely snow load appropriate for the location and geometry of the building.

When designing a building for snow loading, it is important to distinguish between the two fundamental types of load: uniform snow loading and snow drift. The former assumes an even distribution of snow over the roof and should always be designed for. The latter may need to be considered if there are obstructions against which the snow could accumulate, such as parapets, valleys or walls. While snow drift loading is usually much higher than the uniform snow load, it is limited to a relatively small area.

Snow loading is site and building specific, so it is not possible to calculate a single value of snow load for use across the UK. The main factors that influence snow load are:

- Location – some parts of the country are more susceptible to snowfall than others
- Altitude – the higher the site, the greater the snow load
- Parapets, valleys and obstructions – these cause snow drifts resulting in localised high snow loads
- Neighbouring roofs – there is a risk of snow falling off higher roofs causing local overloading

Both wind and snow loadings on all buildings should be calculated using a recognised code of practice: BS EN 1991-1-4 for wind loading and BS EN 1991-1-3 for snow loading. Both these standards are part of the structural Eurocodes and are applicable across the European Union, although each member state has its own National Annex which must be used when designing for that country.

When designing to the Eurocodes, the snow loading is combined with the dead load for example, self-weight and any positive (downward) wind loading, all multiplied by the appropriate safety factors to give the factored loading for the roof. Access for maintenance (imposed load) is considered as a separate load case and is combined with the dead load only. This means that the snow loading must always be considered, even if it is lower in magnitude than the imposed load.

Snow loading varies from site to site and building to building and the calculation methods for snow and wind loadings can be complicated, requiring the services of a qualified engineer. However, by following the recommended calculation procedures and specifying the cladding and supporting structure accordingly, building designers can ensure that the roofs of their buildings do not collapse even in the harshest of winters.

The only way to be confident that your buildings will survive the worst storms year after year is to ensure that both wind and snow loadings are calculated properly for every building and that the cladding and fasteners are specified accordingly.

The MCRMA website lists organisations that provide online software tools to enable users to calculate wind loads, distance and elevations. There are also links to organisations which provide weather forecasts and data from local weather stations, including near real-time weather maps of wind strength and direction.

MCRMA member companies can advise on the suitability and performance of materials, systems and assemblies. In addition, advice can be obtained from any of the independent roofing and cladding inspectors featured on the MCRMA web site.

Guidance documents Nos 15 and 16 which cover these topics are available to download and as online CPDs at www.mcrma.co.uk

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