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Digest

Wind loads on roof-mounted photovoltaic and solar thermal systems

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Roof-mounted solar systems – solar thermal (ST) and photovoltaic (PV) – have seen a surge in popularity driven by the Feed-in Tariff and Renewable Heat Incentive schemes and the rising cost of energy from other sources. These systems must be designed and installed to withstand the maximum wind loads expected during their lifetime. There are no British or European Standards that give specific guidance on wind loads on these systems and the guidance that is available is limited. The first edition of this Digest[1], published in 2004, presented the best information available at the time for a limited range of integrated and above-roof types of roof-mounted PV systems. However, since then there has been a considerable expansion in solar system installations in the UK and worldwide. This has led to the development of a range of installation configurations that were uncommon or not available in 2004 but are now being used more frequently. This Digest has been revised and expanded to include wind loading guidance for a wider range of roof-mounted solar installations and example calculations, and is now applicable to both PV and ST systems. It includes guidance for installers, designers and manufacturers of such systems, as well as local authorities, architects and specifiers, on the wind loads to be used for the design of roof-mounted solar systems in the UK based on the Eurocode for wind actions (BS EN 1991-1-4:2005[2]) and the UK National Annex[3]. This Digest replaces the guidance published in 2004.

Wind loads

Roof-mounted solar systems must be designed to withstand the worst-case wind loads expected during their lifetime. This applies both to the complete solar system and to each of the component parts including the modules, cover plate, supporting rails, clamps or fixings and the underlying roof structure. This requires understanding of the design wind speeds expected at the site of the installation and the applicable pressure coefficients. The current British Standard for wind actions is BS EN 1991-1-4, plus the UK National Annex to BS EN 1991-1-4. This standard and National Annex give methods for determining the wind actions for the structural design of building and civil engineering works, including the whole structure and parts of the structure or elements attached to the structure, although they do not specifically include wind loads on roof-mounted solar systems.

(Image courtesy of Solar Building Co. Ltd.)

Calculating wind loads is conceptually simple, although quite complex in practice. The first step is to find the fundamental value of the basic wind velocity, $v_{b,o}$, from a map for the UK. The next step is to apply factors to account for site altitude, wind direction, seasonal effects and probability of occurrence, which leads to the basic velocity pressure, q_b. Factors are then applied to account for the building height, terrain type (ie town or country) and orography (referred to as 'topography' in previous UK wind codes) to give the peak velocity pressure, q_p. Finally, the wind pressure is obtained by multiplying the peak velocity pressure by a pressure coefficient, which depends on building geometry. The corresponding wind force is obtained by then multiplying the wind pressure by the area of the module or array of modules.