

## SCOSS ALERT PV installations: structural aspects

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### WHO SHOULD READ THIS ALERT?

Building control officers/approved inspectors, PV and solar thermal panel providers/installers, structural engineers working for installers and operating in the domestic market, together with all who are engaged in the installation or maintenance of such panels.

### INTRODUCTION

Structural-Safety has concerns about some structural aspects of roof mounted PV and solar thermal panels. Reports have been received of problems with installations including:

- lack of guidance on structural aspects
- excessive load on existing structure
- number and quality of fixings
- quality of workmanship
- damage to roof trusses and timbers
- damage to waterproofing
- wind damage to completed installations

There have also been concerns expressed in the technical press about compliance, or lack of it, with Part A of the Building Regulations (England), the effectiveness of the claimed 25-year life in some cases, the durability of the fixings, the quality of workmanship, and the possibility of leaking roofs and the potential effects of PV installations on fire ignition, growth, development, and firefighting operations.

In 2014/2015, there were 127,000 installations registered with OFGEM in the UK. Predictions in 2011 that reduction in the feed in tariff (FIT) would lead to demand falling have proved inaccurate; the recently published total number is slightly higher than the number registered in the year before FIT reduction. This seems to have occurred because panel costs have been and continue to be significantly reduced. Over the same period there were approximately 5,800 solar thermal panel installations.

### DISCUSSION

Most domestic roofs are pitched and rely on individual tiles or slates fixed onto closely spaced battens which are usually supported on 450/600mm spaced trussed rafters, or loose rafters supported on purlins in older roofs. Combinations of truss and loose rafters are used to form more complex roof shapes. Loading is uniformly distributed and takes advantage of a structural system that shares load through a number of interacting elements.

When PV arrays are added to a roof then, in addition to the dead weight of the panels there is the potential increased load effects of snow and wind uplift. Damage may be caused to the roof structure or finishes during installation and there are future constraints on inspection, maintenance and repair. Solar thermal collectors (either flat panel or evacuated tube collectors) being heavier than PV panels will increase the risk of potential overload. Snow sliding off panels can also be a hazard.

These factors of potential overload and damage must be taken into account when considering any installation on an existing building. For new buildings the panel system will be covered by the building regulations application.

PV panels are typically sized 1.5/1.6m by 1.0/0.9m, with solar thermal panels typically being about 2.0m by 1.0m. Support rails are generally positioned near the ends of the panels, 1.5-2.0m apart introducing concentrated dead and uplift loads on an existing roof whose structural integrity has been configured to support uniformly distributed load. The magnitude of the concentrated load introduced will be further increased wherever rails are not supported on every rafter.

Some engineers recommend that for most roofs PV rails have to be fixed to every rafter, but cost cutting, by reducing the number of fixings on the basis of the structural capacity of the external rail appears to be common. The load-bearing capacity of the supporting structure under the roof finishes is often ignored.

### **BUILDING REGULATIONS 2010**

Approved Document A of the Building Regulations in England, Roof Covering, says:

*4.3 Where the work involves a significant change in the applied loading the structural integrity of the roof structure and the supporting structure should be checked to ensure that upon completion of the work the building is not less compliant with requirement 1A (Loading) than the original building.*

*4.4 A significant change in roof loading is when the loading upon the roof is increased by more than 15%. Consideration might also be given to whether the roof covering being replaced is the original as-built covering.*

This does not refer specifically to PV and solar thermal panels but is frequently interpreted as meaning that if the panels weigh less than 15% of the original roof covering then no other checks are needed. For an existing building the combined dead load of the existing roof and of the panels, along with imposed loads, should be assessed by a competent person to determine whether an existing roof structure will be adequate. If the structure is not sufficient and strengthening is needed, then Building Regulations approval will be required.

In Scotland all photovoltaic systems serving a building must comply with the requirements of the Building (Scotland) Regulations 2004, as amended, and guidance has been published - *Low Carbon Equipment & Building Regulations: Photovoltaics* <sup>[1]</sup>.

### **PV INDUSTRY TECHNICAL GUIDANCE**

A common reference used by installers is the *Guide to the Installation of Photovoltaic Systems* <sup>[2]</sup> published in 2012 by the Microgeneration Certification Scheme ('MCS') and the Electrical Contractors Association ('ECA'). In addition to guidance on electrical design and installation it provides advice on structural considerations, general building workmanship guidance and generic fixings details. Section 4.3.8 notes; *The roof structure shall be checked to ensure it can withstand the imposed loads as calculated. This is to include a site inspection by a suitably competent person, and Structural calculations shall be carried out by a suitably competent person.* The document also warns; if there is any doubt whatsoever then a qualified structural engineer shall be consulted.

*Guidance to Retrofitting Solar Panels* <sup>[3]</sup> published by LABC is intended to provide guidance as to the effect of retro-fit installation of panels on existing domestic-scale roof structures and how this affects compliance with the functional requirement A1 of Schedule 1 to the Building Regulations 2010. It includes descriptions of various types of timber roof structures.

There are other guidance documents available but these usually give little or no advice on structural considerations.

So far as fire safety is concerned a summary of the relevant issues to consider has been produced by Allianz <sup>[4]</sup>.

### **APPROVED PERSONS' SCHEMES**

A number of Approved Persons schemes are listed on the UK Government web site: [Competent person scheme - current schemes and how schemes are authorised](#) including a category for Microgeneration and renewable technologies. The list comprises of organisations that provide or certify persons who are competent to work on the mechanical and electrical aspects of systems but, generally, structural aspects are not covered. Anyone using the services of such schemes should satisfy themselves that adequate structural advice can be provided. It should be recognised that such an installation is a major alteration to the fabric of a building.

### **RECOMMENDATIONS FOR EXISTING ROOFS**

- All roofs must be appraised for suitability on installing a system.
- The installer should provide evidence of structural competence.
- The panels must be capable of being securely and safely fixed to the roof.
- In England part A of the Building Regulations must be complied with either under the 15% additional dead load clause or by a new application.
- Particular care needs to be taken in regions habitually affected by high winds or snow.
- During installation the designed type and number of fixings must be used and securely fastened to the roof trusses or rafters and this would usually require fixings at every trussed rafter position as a minimum.
- After installation a check should be made of the upper surface of the roof and, where possible, of the underside.

### **RECOMMENDATIONS FOR NEW ROOFS**

- The designer of the roof structure must make adequate provision for the installation.
- The presence of PV or solar thermal panels must be shown on the Building Regulations application.
- Installation must comply with good practice in terms of quality and workmanship.

### **REFERENCES**

1. [Low Carbon Equipment & Building Regulations: Photovoltaics, Scottish Government](#), 2012
2. [Guide to the Installation of Photovoltaic Systems](#), the Microgeneration Certification Scheme ('MCS') and the Electrical Contractors Association ('ECA'), 2012, (general building workmanship guidance and generic fixings details in pages 70-75 and 86-89)
3. [Guide to Retrofitting Solar Panels](#), LABC (Local Authority Building Control)
4. [Understanding the Fire Hazards of Photovoltaic Systems](#), Allianz Risk Consulting, 2012

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