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A FIELD REPORT BY SOLAR SURVEYS LTD

The Commercial Solar Structural *Risk Report.*

An analysis of 575 UK commercial rooftops surveyed for solar PV structural feasibility.

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About this report.

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Coverage. Commercial-grade rooftop solar PV in the United Kingdom and Northern Ireland. The dataset is structurally and geographically representative of warehouses, retail estate, manufacturing, public-sector property, and multi-residential portfolios surveyed during the report period. Residential single-dwelling installations are explicitly excluded from the dataset; a small subset of sub-50kWp systems within the broader institutional portfolio is included and noted in the methodology.

Editorial standard. Engineering-grade language only. No marketing claims. No client names. No project names. No vendor or supplier names. Anonymous-authoritative format throughout. Where service-level expectations are described they are framed as targets and benchmarks, not contractual guarantees.

Standards anchor. All findings are read against the standards current at publication date: MIS 3002:2025 V6.0 (issued 18 March 2026, mandatory from 18 June 2026), BS EN 1991-1-3 + UK National Annex (snow), BS EN 1991-1-4 + UK National Annex (wind), BS EN 1990 (basis of structural design), BRE Digest 489 (2014, wind loads on roof-mounted PV), Building Regulations Approved Document A (England and Wales, with the equivalent Section 1 Structure under the Scottish Technical Handbook and Technical Booklet D for Northern Ireland), and the MCS 020 / MCS 032 family for product compliance. BS 6399-2:1997 was withdrawn in 2010 and is referenced only in that context.

NDA disclosure. Client identities and project specifics are withheld under non-disclosure agreement. The dataset has been aggregated, anonymised, and stripped of any commercially identifying detail. No individual project, address, or organisation is identifiable from the published findings. Pseudonymised dataset references (e.g. "Project A37") are not used in this report. Findings are presented in anonymous-authoritative format consistent with the firm's other published material.

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SECTION 01

Executive *Summary.*

SYNOPSIS

An analysis of 575 UK commercial rooftops surveyed for solar PV structural feasibility between Q1 2024 and Q2 2026 finds that 1 in 3 commercial roofs requires engineering intervention before solar PV can be installed. The headline figure (35%) sums conditional design adjustment (15%), physical remediation (15%), and rejected installs (5%); 65% clear first-pass review. Findings anchor to MIS 3002:2025 V6.0 (mandatory 18 June 2026), BS EN 1991-1-4 with UK National Annex (wind), BS EN 1991-1-3 with UK National Annex (snow), BRE Digest 489 (PV-specific wind coefficients), and Building Regulations Approved Document A. BS 6399-2:1997 was withdrawn in 2010 and is no longer a valid reference standard.

The headline finding

35% of UK commercial roofs in the dataset required engineering intervention before solar PV could be installed. The 35% figure is the sum of three sub-categories from the outcome distribution: 15% required conditional design adjustment (array size reduction, fixing density increase, or ballast reconfiguration); 15% required physical remediation of the roof or its supporting structure before installation; 5% were rejected as not viable for PV at the originally proposed scope. The remaining 65% cleared first-pass review and were installed as designed.

Read in commercial terms, that means roughly 1 in 3 commercial PV projects in the UK is presently being scoped, quoted, and contracted on the basis of a structural assumption that does not survive engineering review. The cost consequence falls somewhere between minor design adjustment and full roof replacement; the timeline consequence is invariably measured in weeks added to the procurement cycle. The proximate cause in the dataset is consistently the same: the structural assessment was either not commissioned at all, was commissioned at the end of the design process rather than the beginning, or was commissioned but produced as a software-only output that did not survive a qualified engineer's review.

Four supporting findings

1. **78% of flat-roof ballasted PV installs in the dataset required ballast reconfiguration to meet MIS 3002:2025 V6.0 Clause 5.9.13(h).** Clause 5.9.13(h), mandatory from 18 June 2026, requires a qualified structural engineer to assess the imposed load from the array AND the ballast on the roof structure. There is no array-size discretion. The dataset finds that the original ballast specification did not survive that combined load assessment in 78% of cases.
2. **62% of asbestos-cement roofs in the dataset failed wind uplift adequacy on first review.** Asbestos cement (ACM) accounted for 10% of the dataset and produced a disproportionate share of remediation cost. The combination of fragile substrate, fixing-penetration restrictions under CAR 2012, and the typical age profile of UK ACM commercial roofs means that wind uplift adequacy un-

der BS EN 1991-1-4 with BRE Digest 489 was the single most common rejection reason for this typology.

3. **82% of commercial roofs surveyed showed defects or maintenance issues that could compromise long-term solar PV performance.** Even where the structure cleared first-pass review for the array dead load, the underlying roof condition, drainage adequacy, fixings status, or weatherproofing margin was inadequate for an additional 25 to 30 years of service life of the PV asset on top. Solar PV does not fix a roof. It commits the roof to a longer service life under additional load.
4. **Snow load combined with array dead load was the single most frequent governing load case on rejected projects.** This is a finding specific to Solar Surveys' dataset and to UK commercial geography. The proportion of UK commercial sites at elevations where the BS EN 1991-1-3 snow zone factor adds materially to the design case is higher than industry summaries typically acknowledge. Upland logistics, hilltop public-sector estate, and elevated agricultural commercial roofs feature disproportionately in the rejected sub-set.

Why this matters now

MIS 3002:2025 V6.0 becomes mandatory on 18 June 2026. From that date forward, every MCS-compliant solar PV submission within scope (sub-50kWp DC) must satisfy the V6.0 evidential standard at Clause 5.5.5: documented evidence of the structural assessment, not merely written confirmation. Software-only outputs are not sufficient. Section 5.9.6 enumerates seven roof-type triggers that promote a project from the universal "competent person" baseline to a qualified structural engineer requirement; Section 5.9.13(h) makes that promotion absolute on every flat-roof ballasted system regardless of array size.

The dataset behind this report shows what happens when those requirements meet UK commercial reality. The findings are not surprising to qualified structural engineers active in the sector. They are routinely surprising to the asset managers, EPCs, and PPA providers commissioning the work. This report is published to close that gap.

575	35%	78%	82%
COMMERCIAL UK ROOFTOPS IN DATASET	REQUIRED ENGINEERING INTERVENTION	BALLASTED INSTALLS NEEDED RECONFIG	SHOWED WATERPROOFING CONCERNS

SECTION 02

Methodology.

SYNOPSIS

The dataset comprises 575 UK commercial rooftops independently assessed by qualified structural engineers between Q1 2024 and Q2 2026. Every project was read against the same engineering framework: Eurocode 1 for wind, snow and load combinations; BRE Digest 489 (2014) for PV-specific wind pressure coefficients; Building Regulations Approved Document A for the structural duty; and, for projects within MCS scope, MIS 3002:2025 V6.0 Section 5.9. No individual project, client, partner, or address is identifiable from the published findings.

Dataset population

The dataset comprises **575 UK commercial rooftops** assessed for solar PV structural feasibility during the report period. Of those, 400 are commercial PV projects above the 50kWp DC MCS scope threshold (warehouses, manufacturing plants, retail estate, public-sector buildings, agricultural commercial). 175 are sub-50kWp commercial projects sitting within MCS scope (smaller commercial buildings, multi-residential developments, public-sector estate at the smaller end, agricultural commercial). A further 250 residential and sub-50kWp residential projects assessed during the same period were excluded; this report addresses the commercial segment only.

The dataset is geographically representative of UK commercial property, covering England, Scotland, Wales, and Northern Ireland with no single regional concentration above 35% of the dataset. The earliest project assessed was completed in Q1 2020; the latest within the report period is Q2 2026. The dataset is project-count weighted, not capacity-weighted; capacity-weighted (kWp) findings are noted separately where the two diverge materially.

Assessment standard

Every project was independently assessed by a qualified structural engineer. There are no software-only desktop reviews in this dataset. Every assessment was produced as a signed report referencing its standards basis, calculation inputs, finding, and conditions and limitations.

The standards framework applied to every project comprises: **BS EN 1991-1-3** with UK National Annex (snow); **BS EN 1991-1-4** with UK National Annex (wind); **BS EN 1990** (basis of structural design and load combinations); **BRE Digest 489** (2014, PV-specific wind pressure coefficients); **SPRA S15-19** (pull-out testing for penetrating fixings on metal sheet roofs where applicable); **Building Regulations Approved Document A** (or the equivalent under the Scottish Technical Handbook Section 1 Structure, the Northern Ireland Technical Booklet D, or the Republic of Ireland Technical Guidance Document A); and the **MCS family** (MIS 3002:2025 V6.0, MCS 020, MCS 032) for projects within MCS scope.

BS 6399-2:1997 was not used. It was withdrawn in 2010 when the UK fully transitioned to the Eurocode suite. Where it appeared in inherited specifications or third-party software defaults during the assessment, it was identified explicitly as withdrawn and replaced with citations to the Eurocode 1 framework.

Anonymisation framework

Project records were stripped of any directly identifying metadata before aggregation. No site address, client name, partner name, vendor name, or pseudonymised reference appears in the dataset or in this report. Sector and roof typology coding follow the firm's internal QA framework and are described in Appendix A. No findings in this report can be attributed to any individual project, organisation, or location.

Declared limitations

Three known biases in the dataset are disclosed here so that readers can interpret the findings with the appropriate context.

Altitude bias. Solar Surveys' commercial portfolio includes a higher proportion of upland and elevated UK sites than a randomised national sample would produce. This is the result of the firm's UK-wide coverage including Scotland, Northern Ireland, and the upland regions of Wales and northern England. The practical consequence is that the BS EN 1991-1-3 snow zone factor adds materially to the design case on a higher proportion of the dataset than industry summaries typically assume. Snow load is not the dominant UK PV load case in absolute terms; in this dataset it is the most frequent governing case on rejected projects, which is a function of the altitude profile of the assessed estate rather than a national prevalence claim.

Standards transition during the dataset period. The dataset spans the MIS 3002 V5.0 to V6.0 transition (V6.0 issued 18 March 2026, mandatory 18 June 2026). All findings in this report are read against V6.0 because V6.0 is the standard that will govern the commercial PV market from 18 June 2026 onwards. Some assessments in the earlier portion of the dataset were originally read against V5.0; where V5.0 outcomes differ from V6.0 outcomes, the V6.0 reading is the one reported here. The difference is noted only where it is material.

Mid-process reassessment. A sub-set of projects in the dataset were reassessed mid-process after a client-driven design change (typically a change to PV array location, panel count, or ballast specification). Reassessed projects are tracked once in the dataset, against the final design that was assessed; the earlier reading is retained for the firm's internal records but is not double-counted in the outcome distribution that drives this report.

What this report is not

This report is not a randomised statistical sample of the entire UK commercial roof population. It is a structurally and geographically representative cross-section of commercial PV projects independently assessed by Solar Surveys Ltd during the report period. Findings are reported as findings within that dataset, not as universal claims about the wider UK commercial roof estate.

It is not a forecast. The 35% intervention rate is a finding within the assessed dataset, not a prediction of the rate at which any individual buyer's portfolio will encounter structural issues. That rate depends on the specific roof typology mix, age profile, and geographic distribution of the portfolio.

It is not a substitute for project-specific structural engineering advice. Every commercial solar PV project requires its own structural assessment by a qualified engineer against the specific roof, the specific array specification, and the specific site conditions.

SECTION 03

The Regulatory *Backdrop.*

SYNOPSIS

UK commercial solar PV structural assessment is governed by Eurocode 1 (BS EN 1991), Building Regulations Approved Document A and its devolved equivalents, BRE Digest 489 (2014) for PV-specific wind loads, and, for systems within MCS scope, MIS 3002:2025 V6.0. V6.0 becomes mandatory on 18 June 2026 and substantively raises the evidential standard for structural sign-off. BS 6399-2:1997 was withdrawn in 2010 and is no longer a valid reference standard; appearances of it in current AI-generated summaries and inherited specifications are out-of-date.

The Eurocode framework

UK structural design has operated under the Eurocode suite since the 2010 Eurocode transition. For solar PV projects, three Eurocodes do most of the work: **BS EN 1990** sets the basis of structural design and the load combination rules, **BS EN 1991-1-3** with its UK National Annex sets snow loads, and **BS EN 1991-1-4** with its UK National Annex sets wind loads. The UK National Annexes are not optional; they introduce site-specific exposure factors and reference wind speeds that any compliant calculation must apply.

For roof-mounted PV specifically, **BRE Digest 489 (2014)** is the load-of-the-load reference. It provides PV-specific wind pressure coefficients calibrated for arrays mounted on a range of roof geometries, accounting for the array's own aerodynamic behaviour and its interaction with the roof's pressure field. A wind calculation that applies BS EN 1991-1-4 to the bare roof but ignores BRE Digest 489's PV-specific coefficients understates uplift on the array itself, and is one of the most common defects in software-generated structural summaries reviewed during the dataset period.

BS 6399-2:1997. Withdrawn 2010.

BS 6399-2:1997 was the predecessor wind loading standard. It was withdrawn in 2010 when the UK fully transitioned to the Eurocode suite. Despite that, BS 6399-2:1997 still appears regularly in inherited specifications, in software defaults that have not been updated, and, notably, in some Google AI Overview summaries that quote the obsolete standard as if it were current.

This matters in three ways. First, lenders and Technical Advisors increasingly check the standards cited in a structural report; a report that names BS 6399-2:1997 will be questioned, and at the margin will be rejected. Second, the wind speed conventions in BS 6399 are not directly comparable to the Eurocode conventions, so a report that quotes both in parallel introduces ambiguity into the calculation chain. Third, MIS 3002:2025 V6.0 explicitly anchors its compliance framework to current Eurocode standards, not to BS 6399. Citing the withdrawn standard in a V6.0 context is a procedural defect.

EDITORIAL NOTE

BS 6399-2:1997 should not appear as a reference standard in any current structural report for a UK commercial solar PV project. Where it appears, it should be identified explicitly as withdrawn (in 2010) and replaced with citations to BS EN 1991-1-4 and its UK National Annex. The same applies to inherited specifications, software outputs, and AI-generated content currently in circulation.

Building Regulations Approved Document A

Approved Document A (Structure) of the Building Regulations sets the structural duty in England and Wales. The Scottish Technical Handbook (Domestic and Non-Domestic) sets the equivalent under Section 1 Structure. Northern Ireland uses Technical Booklet D under the Building Regulations (Northern Ireland) 2012. The Republic of Ireland uses Technical Guidance Document A under its own Building Regulations.

Approved Document A does not prescribe specific calculation methods for solar PV; it requires that the structure of the building, with the proposed PV addition, remains adequate under the loads it is reasonably expected to carry, and that the addition does not compromise the durability or safety of the building or its occupants. The detail of how that adequacy is demonstrated is set by Eurocode 1, Eurocode 3 / 5 (steel and timber), and the supporting BRE / SPRA / NHBC guidance.

For PV specifically, the relevant outcomes are: the existing structure must remain adequate under the combined dead load, imposed load, snow load, and wind load with the array installed; the array fixings must achieve adequate pull-out capacity under the design wind uplift; and the array must not impose loads that compromise the roof covering, weatherproofing, or any existing penetrations.

MIS 3002:2025 V6.0

For systems within MCS scope (sub-50kWp DC output), MIS 3002 is the binding compliance standard for MCS-licensed installers. V6.0 was issued on 18 March 2026 and becomes mandatory on 18 June 2026. Three sections of V6.0 do the heavy lifting on structural sign-off: 5.9.4 (the universal SE-check baseline), 5.9.6 (the roof-type triggers), and 5.9.13(h) (the absolute requirement on flat-roof ballasted systems). They are reproduced verbatim below because they are routinely paraphrased in ways that obscure their requirements.

MIS 3002:2025 V6.0: SECTION 5.9.4

"The MCS Contractor SHALL ensure that the roof structure has been checked by a suitably competent person prior to installation."

5.9.4 is the universal baseline. It applies to every domestic and commercial install within MCS scope. The threshold is a check by a suitably competent person; for many residential installs that competent person can be the installer's structural engineer or a desktop assessment. For commercial work the practical reading is consistently a desktop or on-site report from a qualified structural engineer.

MIS 3002:2025 V6.0: SECTION 5.9.6

"A suitably qualified structural engineer is required for: hipped roofs; valley roofs; asymmetric duo-pitched roofs; dormers; parapets; roofs with pitch below 30°; any roof showing signs of structural distress."

5.9.6 is the trigger list. Any one of these features moves the project from "competent person" territory to "qualified structural engineer required". Across the commercial dataset, low-pitch (sub-30°) and parapet conditions are the most frequently triggered criteria; logistics-warehouse roofs frequently combine both. Hipped, valley, asymmetric duo-pitched, and dormer geometries are more common on multi-residential and small public-sector estate within the dataset. "Signs of structural distress" is the elastic clause; in the dataset this routinely covers visible deflection, corrosion of metal sheet roofs, water ingress around penetrations, and previous unauthorised modifications.

MIS 3002:2025 V6.0: SECTION 5.9.13(H)

"A qualified structural engineer SHALL be consulted to assess the imposed load from the array AND the ballast on the roof structure."

5.9.13(h) is the absolute clause. There is no discretion. Every flat-roof ballasted system, regardless of size or specification, requires a qualified structural engineer to assess the combined load case. In the dataset this is the single largest source of structural rework: ballasted systems were specified by EPCs, designed by installers, and only at the structural review stage were the array dead-load assumptions and the ballast distribution found inadequate against the available roof reserve capacity.

Clause 5.5.5. The evidential standard.

The substantive change between V5.0 and V6.0 is not a section number change. It is the evidential standard. V5.0 required *written confirmation* that a structural assessment had been carried out. V6.0 requires *documented evidence*. Confirmation can be a single line on a checklist; documented evidence is the report itself.

REQUIREMENT	V5.0 (SUPERSEDED)	V6.0 (CURRENT)
Structural assessment	Required	Required
Evidence of assessment	Written confirmation	Documented evidence
Calculation references	Implied	Cited explicitly
Engineer signature	Recommended	Practical requirement
Audit retention	Variable	Aligned to MCS audit
Software-only outputs	Often accepted	Insufficient on their own

The practical effect is that a structural sign-off under V6.0 has to look like a report, not a ticked box. It has to cite the standards used. It has to show the calculations or reference them in an accessible engineer's file. It has to be signed and dated by an identifiable engineer. And it has to be retainable for the same audit period as the rest of the MCS submission.

Software-generated outputs alone are not sufficient under V6.0 Clause 5.5.5. Software is a valid input to the engineering process; it is not the output. The output is the engineer's signed reading of what the software produced, contextualised for the specific roof, the specific array, and the specific site. This distinction is one of the most consequential in the V6.0 transition for installers who built their workflow around software-only desktop summaries.

The MCS scope question

MIS 3002:2025 V6.0 caps at **50kWp DC output**. Above 50kWp, MCS does not apply and MIS 3002 is not a binding compliance standard. For UK commercial solar PV at the scale most asset managers, PPA providers, and EPCs operate, the bulk of the project pipeline is therefore *above* MCS scope.

This is widely misunderstood. Several published guides and procurement specifications written before mid-2025 treat MIS 3002 as a universal commercial standard. It is not. For commercial projects above 50kWp the binding framework is the Eurocode suite, Approved Document A, and the lender's Technical Advisor expectations. MIS 3002 V6.0 remains relevant in two ways: as the governing standard for any sub-50kWp segments of a portfolio (multi-residential or small public-sector roofs frequently sit within scope), and as a useful published reference for the structural sign-off methodology itself, which translates cleanly to projects above scope.

For the avoidance of doubt: a structural report on a 1.2MWp logistics warehouse is not "MCS-compliant" or "MIS 3002 aligned" in any binding sense. It is Eurocode-verified, Building Regulations compliant, and acceptable to lenders, DNOs, and Technical Advisors. It may align to MIS 3002 V6.0 Section 5.9 methodology as a matter of engineering practice, but the framework it is bound by is Eurocode 1, not MIS 3002.

What changed at the boundaries

SPRA S15-19 pull-out testing

For penetrating fixings on metal sheet roofs, SPRA S15-19 sets the pull-out test methodology. V6.0 references it more prominently than V5.0 did, and it is increasingly expected as part of the documented evidence package on logistics-tier metal sheet roofs. The dataset contains numerous projects where the pull-out test was the deciding factor between a fixing-anchored design and a ballasted retrofit.

RC62 v2 and PV fire safety

The 2022 RC62 v2 (RISCAuthority) framework on PV fire safety is not a structural standard, but it interacts with the structural decision in two specific ways: it informs minimum array setbacks from roof edges and roof penetrations, which in turn change the effective array footprint and ballast distribution; and it affects fixing material specification on combustible roof build-ups.

MCS 020 / MCS 032

MCS 020 (flat roof PV) and MCS 032 (general PV product compliance) sit alongside MIS 3002 within the MCS family. They do not replace the structural calculations but they constrain the product set that can be specified within MCS scope. Out of scope (above 50kWp), they remain useful as a published reference for product expectations.

The compliance picture for commercial PV in 2026

Pulling the threads together, the binding framework for a UK commercial solar PV project in 2026 reads as follows.

1. **Eurocode 1 (BS EN 1991-1-3 + UK NA, BS EN 1991-1-4 + UK NA, BS EN 1990).** The universal calculation basis for snow, wind, and load combinations. Applies at every system size.
2. **BRE Digest 489 (2014).** The PV-specific wind coefficient framework that sits inside the Eurocode 1 wind calculation.
3. **Building Regulations Approved Document A** (and the devolved equivalents). The structural duty for the overall building.
4. **MIS 3002:2025 V6.0** for the sub-50kWp DC segment of the project pipeline. Mandatory from 18 June 2026.
5. **SPRA S15-19, RC62 v2, MCS 020 / 032** as supporting frameworks where applicable.
6. **BS 6399-2:1997.** Not applicable. Withdrawn 2010. Cited only to be ruled out.

A structural report that demonstrably anchors to that hierarchy will satisfy a lender's Technical Advisor, a DNO connection application, an MCS audit (within scope), and the procurement quality gate of a heavyweight EPC. A report that does not is, in the context of this dataset, the proximate cause of the most common findings in Section 4.

"The substantive change between V5.0 and V6.0 is not a section number change. It is the evidential standard."

SECTION 03 · THE REGULATORY BACKDROP

SECTION 04

Headline *Findings.*

SYNOPSIS

Across 575 UK commercial rooftops assessed during the report period, 65% cleared first-pass structural review and were installed as designed; 15% required conditional design adjustment; 15% required physical remediation; 5% were rejected. Logistics warehouses, manufacturing plants, and retail estate together account for 75% of the dataset. Trapezoidal sheet metal is the single most common roof typology at 45%. The most frequent governing load case on rejected projects is snow load combined with array dead load, followed by existing roof condition, then the Section 5.9.6 trigger criteria.

Outcome distribution across the dataset

The four-way outcome split across 575 rooftops is the most quotable single visual in the report. Read it as a distribution, not a pass-fail rate. The conditional and remediation tiers represent meaningful structural work, but the projects in those tiers were ultimately delivered.

OUTCOME	% OF DATASET	DESCRIPTION
Cleared first-pass	65%	Array installed as proposed. No structural intervention required beyond the assessment itself.
Conditional	15%	Installed after design adjustment: array size reduced, fixing density increased, or ballast reconfigured to meet the available roof reserve capacity.
Required remediation	15%	Physical roof or supporting structure required strengthening, replacement, or modification before install.
Rejected	5%	Not viable for PV at the proposed scope. Either the structure could not be brought to adequacy, or the cost of remediation exceeded the project's commercial threshold.
Total	100%	

The headline takeaway, expressed in commercial terms: 35% of UK commercial PV projects in the dataset required engineering intervention beyond a clean structural sign-off. That is the sum of the conditional, remediation, and rejected tiers. The 65% clear rate is the corresponding good news. Most commercial roofs do clear, when they are assessed correctly at the front end of the project.

"The 35% intervention rate is a finding within the assessed dataset, not a prediction of the rate at which any individual buyer's portfolio will encounter structural issues."

SECTION 02 · METHODOLOGY

Sector breakdown

The dataset's sector composition is concentrated in three: logistics, manufacturing, and retail. Together these account for 75% of all assessed projects. The remaining quarter is split across office and commercial estate, public-sector buildings, agricultural commercial, and multi-residential housing developer programmes.

SECTOR	% OF DATASET
Logistics and distribution warehouses	30%
Manufacturing and industrial	25%
Retail (parks, big-box, supermarkets)	20%
Office and commercial estate	10%
Public-sector estate (schools, healthcare, council)	10%
Agricultural and rural commercial	5%
Multi-residential and housing developer	5%

Logistics dominates not only by share but by intervention rate. Logistics-warehouse roofs combine three Section 5.9.6 trigger conditions at high frequency: low pitch (sub-30 degree), parapet edges, and trapezoidal metal sheet substrate. The combination puts a meaningful proportion of logistics PV projects on the qualified SE pathway by default, before any condition issue is even considered.

Manufacturing and industrial sites add a second axis of complexity: multi-bay portal frames with services bridges, ventilation penetrations, and contamination histories on chemical or process plants. Retail estate is mixed by era; modern retail park roofs are typically clean trapezoidal sheet, but older supermarket and high street commercial roofs frequently contain asbestos cement panels in non-public areas of the building envelope.

The smaller sectors are read in detail in Section 6. Public-sector estate concentrates the asbestos cement findings (older school stock); agricultural commercial concentrates the upland and altitude-driven snow load findings; multi-residential concentrates the Section 5.9.6 hipped, valley, and dormer triggers.

Roof type breakdown

Roof typology is the strongest single predictor of structural outcome in the dataset. Metal sheet roofs (trapezoidal corrugated and standing seam combined) account for 60% of all assessed projects. Single-ply, bituminous, and concrete deck flat roofs together account for a further 20%. Asbestos cement accounts for 10% but produces a disproportionate share of rejected outcomes. Slate and tile pitched roofs account for the remaining 10%.

ROOF TYPE	% OF DATASET
Trapezoidal / corrugated metal sheet (steel)	45%
Standing seam metal	15%
Asbestos cement (corrugated and flat)	10%
Single-ply membrane flat	10%
Slate and tile pitched	10%
Bituminous and built-up flat	5%
Concrete deck (flat or low-pitch)	5%

Section 5 reads each roof typology in turn. The summary observations here are the high-level pattern: metal sheet roofs concentrate the dataset's wind uplift and fixing pull-out findings (BS EN 1991-1-4 with BRE Digest 489 and SPRA S15-19). Flat ballasted roofs concentrate the Clause 5.9.13(h) findings (combined dead load against available reserve). Asbestos cement concentrates the remediation cost. Slate and tile concentrate the Section 5.9.6 trigger criteria (hipped, valley, dormer geometries).

Top failure modes

Across the rejected and conditional sub-sets of the dataset, five failure modes account for the bulk of structural intervention. They are ranked here by frequency.

1. **Snow load combined with array dead load adds an incompatible governing load case.**
   The most frequent governing load case on rejected projects in this dataset. Driven by the altitude profile of the assessed estate (declared in Section 2). On UK upland and elevated commercial sites, BS EN 1991-1-3 snow zone factors push the combined snow plus array plus dead load case above

the available roof reserve capacity. On lower-altitude sites the same combination clears comfortably. Section 8 reads this in detail.

2. **Existing roof condition (corrosion, perforation, moisture, asbestos) precludes fixings.**
The roof itself is in inadequate condition for an additional 25 to 30 years of service life under PV. Common on logistics roofs at the upper end of the typical roof age band (20 years and over), on agricultural commercial roofs with extended weather exposure, and on asbestos cement substrates where regulatory restrictions under CAR 2012 further limit fixing options.

3. **Section 5.9.6 trigger feature requires qualified SE involvement.**
Hipped, valley, low pitch, dormer, parapet, asymmetric duo-pitched, or visible structural distress. The clause is enumerative rather than discretionary; any one trigger is sufficient. Common on logistics warehouses (low pitch plus parapet), on multi-residential and small public-sector estate (hipped, valley, dormer), and on retail estate (parapet, plant penetrations). Section 5 reads this typology by typology.

4. **Inadequate documented evidence of the original roof structure design.**
No retained calculations, no as-built drawings, no maintenance records. The Clause 5.5.5 evidential standard requires the qualified engineer's assessment to be documented; that documentation has to start somewhere, and where the original design evidence is missing it has to be reconstructed from on-site measurement and engineering judgement. This adds time and cost to the assessment, and on a sub-set of projects it produces a finding of "not adequately determinable" against which a qualified engineer cannot sign off.

5. **Wind uplift exceeds available ballast.**
The Clause 5.9.13(h) absolute case. The originally proposed ballast specification did not survive the combined dead-load assessment of array plus ballast against the roof reserve capacity. Section 9 reads this in detail with the specific kN/m^2 numbers from the dataset.

SECTION 05

Risk by Roof *Typology.*

SYNOPSIS

Seven roof typologies cover the full UK commercial PV market. They are read here in order of dataset prevalence: trapezoidal metal sheet (45%), standing seam metal (15%), asbestos cement (10%), single-ply membrane flat (10%), slate and tile pitched (10%), bituminous flat (5%), concrete deck (5%). Each has its own structural risk profile, its own Eurocode 1 governing load case, and its own typical failure mode. The depth of treatment below scales with prevalence; Sections 9 and 10 read the ballasted and asbestos cases in further detail.

Trapezoidal metal sheet (steel). 45% of dataset.

Trapezoidal corrugated steel sheet is the dominant commercial roof typology in the UK. Logistics warehouses, industrial sheds, agricultural buildings, and modern retail estate all default to it. It is structurally efficient, lightweight, and supports long purlin spans with manageable secondary structure.

For solar PV, the governing load case is wind uplift on the array. The trapezoidal profile gives a varied pressure field across the corrugation peaks and troughs, and the fixing detail (penetrating fasteners through the high points of the profile) introduces pull-out variability that has to be tested project by project. SPRA S15-19 sets the pull-out test methodology; the dataset shows that test results vary widely across the same nominal profile depending on profile depth, fastener length, substrate gauge, and the condition of the fastener seating after 15+ years of weather exposure.

Three failure modes recur on trapezoidal sheet:

- **Fixing pull-out below required uplift capacity.** SPRA S15-19 testing returns a value below the BS EN 1991-1-4 with BRE Digest 489 design uplift. The remedy is either a denser fixing pattern (which raises the array's effective uplift transfer area but adds penetrations) or a transition to a ballasted system (which moves the project under Clause 5.9.13(h)).
- **Section 5.9.6 trigger conditions.** Logistics warehouses combine low pitch (sub-30 degree) and parapet edges as a near-default geometry. Either trigger alone moves the project to the qualified SE pathway. The combination is typical, not exceptional.
- **End-of-design-life condition.** Older trapezoidal sheet (20 years and over) exhibits surface corrosion, weather-side fastener degradation, and seam separation on exposed elevations. The MIS 3002 V6.0 Section 5.9.6 "signs of structural distress" clause activates routinely on aged trapezoidal sheet.

Standing seam metal. 15% of dataset.

Standing seam roofs use a continuous ribbed metal sheet with a raised seam between panels, fastened along the seam rather than through the sheet face. Common on modern industrial estate, university buildings, and prestige commercial property. The continuous-sheet construction means there are no through-fixings on the weather face, which is good for weather tightness and, by extension, longevity.

For solar PV, that same construction means that array fixings cannot penetrate the sheet without compromising the warranty and, in many cases, voiding the manufacturer guarantee. The standard PV solution is a clamp-fix system that grips the standing seam itself, transferring the array load to the clamp and from the clamp to the seam. Where clamp-fix is not viable (insufficient seam height, incompatible seam profile, manufacturer restriction), ballast becomes the only option, which moves the project under Clause 5.9.13(h).

The principal failure mode on standing seam in this dataset is clamp-fix capacity at the design wind uplift. Clamp-fix manufacturers publish per-clamp uplift ratings; the design check verifies the published rating against the calculated uplift force per clamp at the array edge and corner zones. Where the rating is below the calculated force, the remedy is denser clamps (cost), reduced array setbacks at the high-uplift zones (yield reduction), or migration to ballast (5.9.13(h) pathway).

Asbestos cement (ACM). 10% of dataset.

Asbestos cement remains a meaningful share of UK commercial roof estate, predominantly on agricultural buildings, older industrial sheds, and parts of the public-sector estate (school buildings of a certain era). ACM roofs in this dataset accounted for 10% of assessed projects and produced a disproportionate share of remediation cost.

The structural challenge is compounded by the regulatory framework. Under the Control of Asbestos Regulations 2012 (CAR 2012), any work that may disturb asbestos cement requires an HSE-licensed asbestos contractor. Penetrating fixings into ACM sheet count as disturbance. The practical effect is that fixing-anchored PV is rarely a viable option on ACM; ballasted designs are also constrained because the sheet is lower-strength than metal alternatives and the additional dead load can be at or above the available reserve.

Section 10 reads the asbestos case in detail. The headline numbers from the dataset: 70% of ACM roofs were flagged amber or red on first review, and 62% specifically failed wind uplift adequacy. The remediation pathway is most often roof replacement before PV installation, which transforms the project's commercial profile from a simple PV install to a major refurbishment with PV as a supplementary scope.

Single-ply membrane flat roof. 10% of dataset.

Single-ply membrane (PVC, TPO, EPDM) flat roofs are the standard substrate for retail park, supermarket, and modern commercial estate. The roof itself is a sealed waterproof membrane laid over insulation, on a structural deck (typically concrete or profiled metal). PV on single-ply is virtually always ballasted; through-fixing penetrates the membrane and risks the warranty.

Clause 5.9.13(h) applies absolutely. Every flat-roof ballasted system requires a qualified structural engineer to assess the imposed load from the array AND the ballast on the roof structure. The dataset's headline finding of 78% ballast reconfiguration concentrates here.

The specific structural questions on single-ply are: (1) the deck's available reserve capacity above the existing roof loads, against which the array dead load plus ballast plus snow plus wind combination must be evaluated; (2) the membrane manufacturer's approval list for ballast pad systems (using a non-approved pad voids the warranty); (3) the ballast pad point-load behaviour on the membrane, particularly around penetrations and at deck deflection points; and (4) drainage interaction (ballast pads can create local water-pooling zones that accelerate membrane degradation).

Slate and tile pitched. 10% of dataset.

Slate and tile pitched roofs concentrate in the multi-residential, small public-sector, and older office segments of the dataset. The structural concerns are different from the metal sheet and flat-roof typologies: rafter capacity, batten and counter-batten condition, fixing penetration risk into the underlying timber, and Section 5.9.6 geometry triggers.

Section 5.9.6 hits this typology disproportionately. Hipped roofs, valley roofs, asymmetric duo-pitched roofs, and dormers are all common features on traditional UK pitched-roof commercial estate. Any one of them moves the project to the qualified SE pathway. The combination of two or more (a hipped roof with a dormer, an asymmetric pitch with a valley) is routine on pre-1980 commercial property and on multi-residential housing developer estate.

The fixing solution is rail-based, with fixings penetrating the slate or tile to engage the underlying batten and rafter. The rafter capacity assessment looks at the existing dead load plus the array dead load plus snow plus wind, against the rafter's available reserve. Where the rafter is inadequate, the remediation is local strengthening (sister rafter, additional purlin) or, on the smaller projects, repositioning of the array to bays with stronger rafters. Section 9 does not apply (no ballast).

Bituminous and built-up flat. 5% of dataset.

Bituminous and built-up felt flat roofs are common on older commercial estate, schools, and small retail. The structural deck is typically concrete or, on older buildings, timber. The membrane itself is a multi-layer build-up of felt and bitumen, with a typical service life shorter than modern single-ply (15-20 years against single-ply's 25-30).

The principal commercial decision on bituminous flat roofs is whether the existing membrane has sufficient residual life to host PV for a further 20-25 years. Where it does not, the project transforms from "PV install" to "roof replacement plus PV", with cost and timeline consequences.

Where the membrane is in adequate condition, the structural picture is similar to single-ply: ballasted PV, Clause 5.9.13(h) absolute, qualified SE assessment of array plus ballast against the deck reserve. Concrete decks under bituminous typically carry a high reserve and clear comfortably. Older timber decks under bituminous are a more variable picture and frequently require local strengthening.

Concrete deck. 5% of dataset.

Concrete deck flat roofs (or low-pitch) appear primarily on multi-storey commercial estate, brutalist-era public-sector buildings, and some retail. They have the highest structural reserve capacity of any typology in the dataset; concrete dead load is high, but its reserve against additional imposed load is correspondingly high.

For PV on concrete, the structural concern is rarely deck capacity. It is more often parapet drift loading (snow accumulation in the lee of parapets, addressed in Section 8), and the interaction of the array with existing rooftop plant (HVAC, lift overruns, communications equipment) and rooftop access requirements. Section 5.9.6 parapet trigger applies; the qualified SE pathway is routine on concrete deck purely on the parapet criterion.

Concrete deck commercial estate produces some of the cleanest first-pass clearances in the dataset. When concrete deck is identified at site survey stage, the project trajectory is typically smooth, subject to the parapet drift and the plant interaction.

SECTION 06

Risk by Building *Sector.*

SYNOPSIS

The dataset's commercial sector mix is concentrated. Logistics, manufacturing, and retail account for 75% of all assessed projects between them. Office and commercial estate, public-sector buildings, agricultural commercial, and multi-residential housing developer programmes split the remaining 25%. Each sector has a characteristic roof typology profile, a characteristic Section 5.9.6 trigger pattern, and a characteristic procurement context. The depth of treatment below scales with dataset share.

Logistics and distribution warehouses. 30% of dataset.

Logistics is the single largest sector in the dataset and produces the highest absolute volume of structural intervention. The reasons are structural and geographic: logistics roofs are large, predominantly trapezoidal metal sheet, almost universally low pitch (sub-30 degree), and frequently parapeted. The Section 5.9.6 trigger criteria apply on near-default geometries. Combined with the dataset's altitude bias (which puts upland logistics in higher snow zones), logistics produces the highest concentration of conditional and remediation outcomes.

The typical logistics roof in the dataset is between 15 and 25 years old, on a steel portal frame with cold-rolled purlins, trapezoidal sheet with a profile depth in the 35-50mm range, and original through-fixings of varied condition. The PV array specification is usually large (multi-MWp ambition) and the design is most often EPC-led without a structural engineer involved at the early stages.

Three structural decisions recur on logistics:

- **Fixing-anchored versus ballasted.** The default specification is fixing-anchored to keep ballast off the roof. SPRA S15-19 pull-out testing on the existing trapezoidal sheet often returns values below the BS EN 1991-1-4 design uplift, particularly at edge and corner zones. The remedy is denser fixings (which adds penetrations and cost) or migration to ballasted (which moves the project under Clause 5.9.13(h) and adds dead load to a roof that is often at or near its reserve).
- **Snow load on upland logistics.** Where the warehouse sits at elevation (Highlands, Pennines, upland Wales, the Cumbrian fells), the BS EN 1991-1-3 snow zone factor adds materially to the design case. The combined snow plus array plus dead load against the available reserve is the single most frequent governing case on rejected logistics projects in this dataset.
- **Roof condition.** 20+ year-old trapezoidal sheet on weather-exposed elevations exhibits surface corrosion, fastener seating degradation, and seam separation. The MIS 3002 V6.0 Section 5.9.6 "signs of structural distress" clause is frequently triggered. The procurement decision becomes whether to PV the existing roof or to over-roof first and PV second.

Logistics commercial implication: the asset manager or PPA provider commissioning a logistics PV programme should expect a meaningful proportion of the portfolio to require either fixing-density adjustment, ballast migration, or pre-PV roof intervention. The cost premium on logistics PV is structural, not array. Programmes that price the structural pathway at the start clear the procurement gate; programmes that do not are the most likely source of deal stall in the dataset.

Manufacturing and industrial. 25% of dataset.

Manufacturing and industrial sites are structurally more complex than logistics. Multi-bay portal frames with services bridges, ventilation stacks, and process plant penetrations create a fragmented roof envelope where the array footprint has to be planned around existing rooftop infrastructure. The typical roof typology is similar to logistics (trapezoidal sheet predominantly), but with greater roof penetration density, more pre-existing dead load (HVAC, services, plant), and a wider age distribution.

The contamination history of the site can become a factor on chemical, food processing, and pharmaceutical plants. Where the existing roof has had cleaning, repair, or coating applications during its service life, the original specification's structural assumptions may have been altered. Adhered coating systems add dead load; coating failure leaves residual surface degradation; previous repair work introduces non-uniform fastener density. The qualified SE assessment has to read all of these against the proposed array dead load plus wind plus snow plus ballast (where applicable).

Section 5.9.6 trigger patterns on manufacturing concentrate on parapets (process plants typically have parapet edges), low pitch (manufacturing roofs are typically sub-30 degree to maximise enclosed volume), and structural distress (cumulative effect of process atmosphere on weathering). Snow load is less consistent than on logistics; manufacturing sites are more often at lower altitude, but specific industries cluster in upland regions where the snow case becomes governing.

Manufacturing commercial implication: the structural assessment timeline is longer than logistics. A manufacturing PV project should budget for a desktop pre-feasibility, an on-site survey including the rooftop services audit, and a follow-on engineer review against the final array specification. Programmes that compress this into a single-pass site survey routinely surface late-stage findings that delay procurement.

Retail (parks, big-box, supermarkets). 20% of dataset.

Retail estate is mixed by era. Modern retail park roofs (post-2000) are typically clean trapezoidal sheet on steel portal frame, similar in structural profile to logistics but at smaller scale per building. Older supermarket and high street retail roofs include flat single-ply, bituminous flat, and (on older buildings) asbestos cement.

The retail-specific structural concerns are: HVAC and refrigeration plant on the roof (especially supermarkets, where chilled rooms create concentrated dead load and require service access corridors); plant rooms and pump houses creating localised structural penetrations; and public-access zones underneath the array, which raises the consequence of any structural inadequacy and tightens the qualified SE assessment.

Where retail estate includes older asbestos cement panels (most often in non-public service zones of the building, behind public-facing facades), the project either accepts a partial-array footprint that excludes the ACM zones or scopes a roof replacement before PV. The dataset shows both outcomes; the cost differential is significant.

Office and commercial estate. 10% of dataset.

Office and commercial estate is the most varied sector by roof typology. Multi-storey concrete deck, single-ply membrane on lower-storey podiums, and pitched roofs on heritage office buildings all appear in the dataset. The structural picture is dominated by the deck capacity (which is usually adequate) and the parapet drift case under BS EN 1991-1-3.

Section 5.9.6 trigger patterns on office concentrate on parapets and structural distress on heritage buildings. The qualified SE pathway is routine, and most office PV projects clear first-pass review. The cost premium on office PV is more often plant interaction (rooftop chillers, lift overruns, telecoms equipment) than substrate inadequacy.

Public-sector estate (schools, healthcare, council). 10% of dataset.

Public-sector estate is structurally the most heterogeneous sector. School estates in particular span a wide age band: some 1950s and 1960s school buildings have asbestos cement roofs, some 1990s and 2000s buildings are flat single-ply, and modern academy estate is trapezoidal sheet. Healthcare estate adds clinical service requirements (continuous operation, restricted roof access during clinical hours) that constrain the structural assessment timeline.

The asbestos cement findings concentrate in this sector. Of the ACM roofs in the dataset, a meaningful proportion sit on public-sector buildings, and the remediation pathway typically requires public-sector procurement processes (tender, framework agreement) that add 6 to 12 months to the project timeline. The Net Zero public-sector procurement context creates pressure to install PV; the structural reality on the older estate creates pressure not to.

Agricultural and rural commercial. 5% of dataset.

Agricultural commercial is small in dataset share but distinctive in structural profile. Roof typology is dominated by trapezoidal metal sheet on simpler portal frames. Roof age is often advanced (30+ years), exposure conditions are severe (rural exposure category to BS EN 1991-1-4 UK NA), and altitude bias is pronounced (upland farms in the Highlands, Pennines, and Welsh hill country).

The agricultural commercial findings amplify the upland-snow and end-of-life-condition patterns from logistics. The procurement context is also different: agricultural projects are most often single-building, with a tighter commercial threshold, and the cost case for pre-PV roof intervention has a lower ceiling. The dataset includes a higher rejection rate in this sector than in any other, driven by the combination of severe exposure, advanced roof age, and tight commercial threshold.

Multi-residential and housing developer. 5% of dataset.

Multi-residential is the only sector in the dataset with a meaningful share of pitched-roof projects. Housing developer programmes typically install per-plot PV on slate or tile pitched roofs, sub-50kWp per dwelling, within MCS scope. The MIS 3002 V6.0 Section 5.9.6 trigger criteria activate frequently: hipped, valley, dormer, and asymmetric duo-pitched geometries are routine on UK housing stock.

The Clause 5.9.13(h) absolute does not apply (no ballast). The qualified SE pathway is mandated by 5.9.6 rather than by 5.9.13(h). Per-plot residential PV on pitched roofs sits within MCS scope and the documented evidence requirement at Clause 5.5.5 applies in full.

Multi-residential commercial implication: the structural assessment is repeatable at scale across a developer programme, with per-plot variation determined by the specific roof geometry. Programmes that batch the assessment at planning stage clear the procurement gate; programmes that defer the assessment to construction stage are the most common source of late-stage delay in this sector.

SECTION 07

The Wind Uplift *Problem.*

SYNOPSIS

Wind uplift is the most consequential single load case for PV on UK commercial roofs. The calculation basis is BS EN 1991-1-4 with the UK National Annex; the PV-specific overlay is BRE Digest 489 (2014); the fixing capacity test methodology is SPRA S15-19. This section reads the failure modes the dataset surfaced and ties each to its standards-anchored remedy. The headline number from the dataset: an average load deficit of 0.25 kN/m² on rejected projects, against an average available reserve of 0.10 kN/m² on those same roofs.

The Eurocode 1 wind calculation chain

The wind uplift calculation for a UK commercial PV install is a chain of inputs from the BS EN 1991-1-4 framework, applied through the UK National Annex, with the PV-specific overlay from BRE Digest 489. Done correctly, every input is sourced and every assumption is stated.

The chain is, in order: **basic wind speed** from the UK National Annex map (this is a 10-minute mean at 10 metres above ground in open country, varying from approximately 21.5 m/s in the south east to 31.5 m/s in the north west of the UK and Northern Ireland); **directional and seasonal factors** applied where applicable; **terrain category** from BS EN 1991-1-4 (categories 0 through IV, ranging from sea exposure to dense urban) which determines the roughness factor; **orography factor** if the site is significantly elevated; **peak velocity pressure** derived from the above; **external pressure coefficients** for the building; **internal pressure coefficient** from the building's permeability; and finally the **force coefficient on the PV array itself**, which is where BRE Digest 489 enters.

A wind calculation that omits any of these steps, or that applies the bare-roof coefficient without the PV-specific overlay, will understate uplift on the array. The dataset shows that this is the single most common defect in software-generated structural summaries.

BRE Digest 489 PV-specific coefficients

BRE Digest 489 (2014) is the load-bearing UK reference for wind loads on roof-mounted solar PV. It calibrates the bare-roof pressure coefficients of BS EN 1991-1-4 for the specific aerodynamic case of an array mounted above the roof surface. The array changes the local pressure field; the array's own surface presents to the wind; the gap between the array and the roof admits flow; and the array's edge zones experience accelerated flow that increases uplift force at the perimeter modules.

The practical effect is that Digest 489 returns higher net uplift coefficients on the array than the bare-roof calculation would suggest, particularly at the array edge and corner zones. For a typical commercial trapezoidal sheet roof at low pitch, Digest 489 edge-zone uplift can be 1.5 to 2.0 times the central-zone uplift. For a flat ballasted system, the same edge effect drives the ballast distribution: more ballast at the perimeter modules, less in the central array.

A bare-roof BS EN 1991-1-4 calculation applied to a PV array (rather than the BRE Digest 489 overlay) typically understates the array uplift by 30 to 50% in the edge zone and 15 to 25% in the central zone. That understatement compounds through the fixing density calculation; a fixing pattern designed against the bare-roof case will be inadequate on the actual PV-overlaid case.

The fixing pull-out problem

For penetrating fixings on metal sheet roofs, SPRA S15-19 sets the pull-out test methodology. The test is conducted on the actual installed substrate (or on a representative sample of the same construction) and returns a per-fixing pull-out capacity in kN. The PV array design uplift, distributed across the fixing pattern, has to sit below the SPRA-tested capacity with the appropriate safety factor.

The dataset shows that pull-out capacity varies widely on the same nominal substrate. A 30mm trapezoidal profile of 0.7mm gauge steel sheet, fastened with a 32mm self-drilling fastener, can return values from 1.2 kN to 2.4 kN per fixing depending on the seating condition of the fastener after weather exposure. The variability is not predictable from the spec sheet; it has to be tested project by project.

Where the SPRA pull-out result is below the BS EN 1991-1-4 with BRE Digest 489 design uplift per fixing, three options exist: **denser fixings** (which raises the array's effective fastener count but adds penetrations to the existing waterproofing), **migration to a ballasted design** (which moves the project under Clause 5.9.13(h) and adds dead load to the roof reserve), or **array setback at the high-uplift edge zones** (which reduces the array footprint and yield).

The kN/m² numbers from the dataset

Three numbers from the dataset frame the wind uplift problem in commercial terms.

0.75 KN/M² TYPICAL 5.5KWH/KWP COMMERCIAL ARRAY DEAD LOAD (PANEL + FRAME + BALLAST WHERE APPLICABLE)	0.10 KN/M² AVERAGE AVAILABLE RESERVE CAPACITY ON REJECTED ROOFS	0.25 KN/M² AVERAGE LOAD DEFICIT ON REJECTED ROOFS	

The 0.25 kN/m² average deficit number is the engineering-quantified version of the headline finding. On a rejected project, the structural deficit between the proposed array load and the roof's available capacity averages 0.25 kN/m². That deficit cannot be closed by spec-sheet adjustment; it can only be closed by physical structural intervention (member strengthening, additional purlins, replacement of the roof substrate, or migration to a fundamentally different array specification).

Software-only outputs and what they miss

Software-generated wind calculations are widely used in the commercial PV pipeline. They are valid as an input. They are not valid as the output. The Clause 5.5.5 documented-evidence standard requires a qualified engineer's signed reading of the calculation, with the assumptions stated, the standards cited, and the conditions and limitations recorded. A software output PDF, on its own, does not satisfy V6.0.

The dataset surfaced four specific defects in software-only outputs:

- **Default exposure factor.** Software defaults frequently use a generic terrain category that does not match the actual site exposure. Coastal, upland, and city centre sites all need explicit exposure category assignment with reference to BS EN 1991-1-4 UK NA categories.
- **Missing UK National Annex factors.** Some software applies the Eurocode 1 base values without the UK National Annex modifications. The UK NA introduces site-specific corrections (directional factors, seasonal factors, altitude factors) that are not optional.
- **Bare-roof coefficients applied to the PV case.** The software calculates wind on the building, then assumes the array experiences the same pressure field. Without the BRE Digest 489 overlay, the array uplift is understated.
- **No pull-out evidence.** The software output assumes a published per-fixing capacity from the manufacturer; the actual roof's SPRA S15-19 test result is not in the calculation. The Clause 5.5.5 evidential standard requires the pull-out test result to be in the documented evidence pack where penetrating fixings are used.

The remedy in every case is the same: a qualified engineer's review of the software output, with the missing inputs supplied, the stated assumptions corrected, and the result signed off as the documented evidence.

SECTION 08

The Snow Load *Problem.*

SYNOPSIS

Snow load is the most under-appreciated UK commercial PV load case in industry summaries. It is rarely the dominant case on absolute load magnitude, but it is the most frequent governing case on rejected projects in this dataset. The reason is the dataset's altitude profile (declared in Section 2) interacting with BS EN 1991-1-3 with UK National Annex snow zone factors. This section reads why the snow case bites where it bites, and why that matters for any UK commercial PV portfolio with material exposure to upland sites.

BS EN 1991-1-3 with UK National Annex

The snow load calculation framework is BS EN 1991-1-3, applied through its UK National Annex. The annex sets a characteristic ground snow load (s_k) that varies across the UK by location and altitude, and a series of shape coefficients that translate ground snow into roof snow load.

The headline UK NA characteristic ground snow load varies from 0.25 kN/m² in the south west to over 0.80 kN/m² in the Highlands. The altitude correction is non-linear: above 200 metres above sea level, the s_k value increases approximately linearly with altitude, and at the upper end of the UK altitude range (450 metres and above, common in upland logistics estate, hilltop public-sector property, and rural agricultural commercial) the characteristic snow load can be more than double the lowland equivalent.

Once s_k is set, the roof snow load is calculated from the roof geometry through shape coefficients. For low-pitch roofs (sub-30 degree, which describes most UK commercial roof typologies) the basic shape coefficient is 0.8, applied uniformly to the roof. For more complex geometries (parapeted edges, lower-roof abutments, valley roofs) the coefficient varies by zone, with drift accumulation factors that can locally raise the load to several times the basic value.

Drift accumulation. The case industry summaries miss.

The most consequential snow effect in commercial PV is not the basic snow load. It is drift accumulation. UK NA shape coefficients for drift on parapets, against stepped roofs (where a lower roof abuts a higher one), in valleys, and in the lee of obstructions can locally raise the snow load to two or three times the basic value. For commercial roofs with parapets (which is most of them), the parapet zone snow load can exceed 2.0 kN/m² on a roof whose basic snow load is 0.6 kN/m².

Where a PV array is installed in or near the parapet drift zone, the array dead load adds to the drift load. The combined dead plus snow plus wind case in the parapet zone becomes the governing load combination for the immediate sub-array structure. The dataset shows that this combination is the single most frequent governing case on rejected logistics and public-sector estate projects.

A second drift case is specific to PV: snow accumulation behind tilt-frame arrays on low-pitch roofs. On a flat or low-pitch roof, a tilt-frame array creates a step in the roof surface; snow shedding from the upper face of the array accumulates against the next row, and snow blowing across the array drifts in the lee of each module row. The drift accumulation is not captured in a basic shape-coefficient calculation; it requires explicit consideration in the design.

Why altitude matters for the dataset

Solar Surveys' commercial portfolio includes a higher proportion of upland and elevated UK sites than a randomised national sample would produce. The altitude bias is declared in Section 2 as a methodology limitation. It is also the reason snow load is the top failure mode in the dataset.

On a logistics warehouse at sea level in the south east, the basic UK NA s_k is approximately 0.30 kN/m². The basic shape coefficient is 0.8. The roof snow load is approximately 0.24 kN/m². Combined with a typical array dead load (0.20 kN/m² for a fixing-anchored install) and the existing roof dead load, the structure has comfortable reserve.

On the same logistics warehouse at 350 metres in the Pennines, the basic s_k is approximately 0.65 kN/m². The roof snow load on the same shape coefficient is 0.52 kN/m². Combined with the same array dead load and existing roof dead load, the combined imposed load can exceed the available roof reserve. The same array specification, the same building, the same roof construction; one site clears, the other does not. The variable is altitude.

For PV portfolio buyers (asset managers and PPA providers in particular) the practical implication is that the structural assessment cannot be applied as a portfolio-wide rate. It has to be applied site by site, with explicit BS EN 1991-1-3 location and altitude inputs. Programmes that apply a flat assumption (typical of headline-pricing solar PV bids) are the most common source of late-stage structural rejection in this dataset.

Co-dominant load case readings

For most UK commercial PV projects in this dataset, neither wind alone nor snow alone is the governing load case. The governing case is the BS EN 1990 combined load case: dead load plus imposed load plus the appropriate wind plus snow combination, weighted per Annex A1 partial factors.

On lowland sites, the wind component dominates the combination, and the calculation in Section 7 covers the binding case. On upland and elevated sites, the snow component dominates, and the BS EN 1991-1-3 framework above is binding. On mid-altitude exposed sites (typical of mid-Wales, the Pennines, and parts of Scotland), the wind and snow contributions are comparable and the combined case is sensitive to the partial factors. The dataset finds the combined case is most frequently governing in exactly this mid-altitude exposed band.

The remedy in every case is the same: a qualified engineer's reading of the BS EN 1990 load combination, with both the BS EN 1991-1-4 wind and the BS EN 1991-1-3 snow inputs explicitly stated for the specific site location and altitude, and the result signed off as the documented evidence under Clause 5.5.5.

SECTION 09

The Ballast *Reality.*

SYNOPSIS

Clause 5.9.13(h) is the only absolute clause in MIS 3002 V6.0 Section 5.9. Every flat-roof ballasted system requires qualified structural engineer consultation, no discretion, no array-size carve-out. The dataset shows why: 78% of flat-roof ballasted PV installs assessed during the report period required ballast reconfiguration before installation could proceed. This section reads the engineering mechanics behind that finding and the procurement consequence for buyers commissioning ballasted PV under V6.0.

The Clause 5.9.13(h) absolute requirement

The verbatim clause is reproduced in Section 3. The two phrases that carry the full weight of V6.0 in commercial PV are SHALL and AND. SHALL is mandatory language; there is no installer discretion, no in-house engineering carve-out, no small-array exemption. AND is conjunctive; the clause requires assessment of the imposed load from the array AND the ballast on the roof structure, as a combined load case. Either component alone is not sufficient.

The clause applies regardless of array size. A 2kWp ballasted install on a small commercial flat roof requires the same qualified SE assessment as a 49kWp ballasted install on a logistics warehouse. The former is structurally trivial; the latter is structurally consequential. V6.0 makes no distinction. The procedural requirement is the same.

For commercial PV outside MCS scope (above 50kWp), Clause 5.9.13(h) is not binding as an MCS standard. It remains binding as engineering best practice and as the framework against which a lender's Technical Advisor will read the structural report. The dataset finds that buyers and EPCs who treat 5.9.13(h) as the universal flat-roof ballasted standard, not just the MCS sub-50kWp standard, clear procurement and lender review more reliably than those who do not.

Ballast block load distribution

A ballasted PV array transfers wind uplift to the roof through the ballast block dead load. The mechanic is straightforward: the wind uplift force on each module equals the ballast weight required at that module to keep the module on the roof. In practice the ballast is distributed across the array, with denser ballast at the perimeter modules (where uplift is highest per BRE Digest 489 edge-zone coefficients) and lighter ballast at the central modules.

Typical commercial ballasted systems use ballast pads with a per-pad weight in the 8 to 25 kg range, distributed at module corners and intermediate points. The pad system is product-specific: each manufacturer publishes a pad layout for a given wind uplift design value, and the design check verifies that the layout matches the actual site uplift calculation.

MCS 020 sets the product compliance framework for flat-roof PV systems within MCS scope. It does not replace the structural calculation; it constrains the product set that can be specified within MCS scope and provides published wind-tunnel data on the aerodynamic behaviour of approved systems. Out of scope (above 50kWp), MCS 020 product approval is not binding but the published wind-tunnel data remains useful as engineering reference.

Membrane and substrate compatibility

Ballast pads transmit point loads to the roof membrane. PVC, TPO, and EPDM membranes respond differently to concentrated load, and each manufacturer publishes an approved-pad list for their specific membrane. Using a non-approved pad voids the membrane warranty.

The dataset surfaced three recurring membrane and substrate findings on flat-roof ballasted projects:

- **Pad point-load on aged single-ply.** A 25kg ballast pad on a 5mm thick PVC membrane that is at year 18 of a 25 year design life behaves differently from the same pad on the same membrane at year 2. Local plastic deformation under the pad accelerates membrane wear at the pad contact zone.
- **Drainage interaction.** Ballast pads create local water-pooling zones on flat roofs with drainage gradients below 1:80. The ponding accelerates membrane degradation and, on systems with insufficient drainage gradient, can cause water ingress at the pad seating after a few years of service.
- **Condensation around array supports.** Tilt-frame arrays create thermal step changes on the roof surface. Where the array support penetrates the roof insulation, condensation can form within the build-up. Standard remedy is to specify support feet that bridge the insulation rather than penetrate it.

The wind-uplift to ballast trade-off

Ballast quantity scales with design wind uplift. Higher uplift (severe site exposure, high parapets, edge zones) requires more ballast; more ballast adds dead load to the roof structure; and the roof structure has to accept the combined dead load against its existing reserve.

The trade-off has two binding constraints. The lower bound is set by the wind uplift calculation: the ballast cannot be lighter than the per-module weight required to resist the design uplift, with the appropriate factor of safety. The upper bound is set by the roof reserve: the combined array plus ballast plus snow plus dead load cannot exceed the structure's available capacity. The meeting point of those two constraints is what the qualified SE under Clause 5.9.13(h) signs off.

On the dataset's rejected ballasted projects, the most common pattern was that the lower bound (wind uplift) required a ballast specification that exceeded the upper bound (roof reserve). The remedies open to the project at that point are: **reduce the array footprint** to lower the total uplift force (and the total ballast); **strengthen the roof structure** to raise the available reserve; **migrate to a clamp-fix design** if the roof typology supports it (standing seam, otherwise some metal sheet); or **reject the project** as not viable for ballasted PV at the proposed scope.

The 78% reconfiguration finding from the dataset is the proportion of ballasted projects that reached this trade-off and required reconfiguration before installation could proceed. The most common reconfigurations were array footprint reduction (the buyer accepting a smaller installed kWp than originally proposed) and ballast pad layout refinement (denser ballast at edges, sparser ballast at the centre, supplied to the membrane manufacturer's approved-list specification).

SECTION 10

The Asbestos *Question.*

SYNOPSIS

Asbestos cement (ACM) roofs accounted for 10% of the dataset and produced a disproportionate share of rejected and remediation outcomes. 70% were flagged amber or red on first review. 62% specifically failed wind uplift adequacy. The CAR 2012 regulatory framework, the HSE licensing regime, and the structural reality of aged ACM combine to make ACM the single typology where the procurement decision most often becomes "replace the roof first, then install PV". This section reads the structural, regulatory, and commercial picture.

The CAR 2012 framework

The Control of Asbestos Regulations 2012 (CAR 2012) governs any work that may disturb asbestos-containing materials in UK commercial property. For PV on ACM roofs, the operative principle is that any penetration, drilling, cutting, or fixing into ACM sheet counts as disturbance and falls under the regulations. The work has to be carried out by an HSE-licensed asbestos contractor, with the appropriate notification, control measures, and waste disposal procedures.

The qualified structural engineer can perform a non-disturbance inspection of an ACM roof: visual condition assessment, dimensional survey, photographic documentation, and capture of the structural geometry from above using drone survey. The engineer cannot perform invasive testing on ACM sheet, cannot extract material samples (a separate UKAS-accredited refurbishment-and-demolition asbestos survey covers that), and cannot install fixings or fasteners as part of the structural assessment. For Solar Surveys' practice, the inspection is non-disturbance and combined with drone capture for documentation; the structural calculation is performed against the inspection finding without disturbing the ACM substrate.

Where the proposed PV design includes any penetration into ACM (any fixing-anchored array, any tilt-frame support that lands on ACM, any cable management that requires ACM penetration), the project enters CAR 2012 territory and the HSE-licensed contractor pathway becomes mandatory.

Why ACM roofs disproportionately drive cost

Three structural and regulatory factors compound on ACM commercial roofs.

Substrate strength. ACM sheet is structurally weaker than steel sheet of comparable profile. The dead load reserve on an ACM roof is correspondingly lower, and the additional PV array dead load (plus ballast where applicable) more often exceeds the available reserve than on metal sheet.

Age and condition. Most ACM roofs in UK commercial estate are 30 to 50 years old. Surface weathering, fastener seating degradation, and embrittlement of the cement matrix all accumulate over that service life. The MIS 3002 V6.0 Section 5.9.6 "signs of structural distress" trigger activates routinely. Even where the structural calculation finds the substrate adequate in principle, the as-built condition often does not.

Fixing options. Penetrating fixings into ACM are tightly constrained by CAR 2012. The default PV solution on ACM becomes ballasted, which in turn brings Clause 5.9.13(h) into play with the additional dead load on a substrate that is already low in reserve. The ballasted-on-ACM combination is the dataset's hardest commercial case; rejection rates here are the highest of any sub-set.

The 62% wind uplift failure finding from Block 8 of the data concentrates exactly here. ACM roofs combine fragile substrate (low fixing pull-out capacity, low resistance to point loads from ballast pads), aged condition (weathered fastener seatings, embrittled sheet), and CAR 2012 restriction on the remediation options open to the project. The result is that wind uplift adequacy under BS EN 1991-1-4 with BRE Digest 489 fails first review on the majority of ACM projects.

The procurement decision: PV on ACM versus roof-first

Two pathways exist for commercial buyers facing an ACM roof in the PV pipeline.

The first pathway is **PV on the existing ACM**, ballasted only, with a partial-array footprint that respects CAR 2012 restrictions and avoids ACM penetration. The qualified SE assessment under Clause 5.9.13(h) sets the binding ballast and array specification. This pathway preserves the existing ACM roof but accepts a lower kWp installation than a full-roof PV would deliver. Cost is lower than the alternative; yield is also lower.

The second pathway is **roof replacement first, then PV**. The existing ACM is removed under HSE-licensed contractor pathway and replaced with a non-asbestos roof (typically modern profiled steel sheet or single-ply membrane on insulated deck). PV is then installed on the new roof in a normal commercial PV procurement. This pathway transforms the commercial profile of the project: PV cost is added to roof replacement cost, but the resulting installation is a full-roof, full-yield PV system on a new roof with a new design life.

The dataset shows both pathways in roughly equal proportion across the ACM sub-set. The decision is sector-specific: agricultural commercial often takes the partial-array pathway (lower cost threshold, simpler procurement); public-sector estate (especially older school buildings) often takes the roof-first pathway (Net Zero procurement context, longer asset hold, planned roof replacement schedule).

For PV portfolio buyers, the practical implication is that ACM should be identified at the desktop pre-feasibility stage, before site survey and before any quote is issued. Treating ACM as a default substrate (in line with non-asbestos sheet) is the most common source of late-stage commercial revision in the dataset's ACM sub-set.

SECTION 11

What Good Looks *Like.*

SYNOPSIS

The structural report that consistently clears commercial procurement, lender Technical Advisor review, and (for sub-50kWp segments) MCS audit follows a recognisable format. This section sets out that format, anchored to MIS 3002:2025 V6.0 Clause 5.5.5 documented evidence and the Eurocode 1 framework. A buyer reading their next structural report can use this section as a checklist.

The structure of a compliant report

A commercial-grade pre-installation structural report for a UK PV project has six sections at minimum. Reports with all six are routinely accepted; reports missing any one of them are routinely questioned at lender or audit review.

1. **Inputs.** Building location with postcode, altitude, and exposure category. Roof typology, pitch, age, span, and condition. Existing dead load (roof construction, services, plant). Proposed PV array specification including module count, dimensions, mounting system, and ballast specification where applicable.
2. **Calculation basis.** Standards cited explicitly with versions: BS EN 1991-1-4 with UK National Annex (wind), BS EN 1991-1-3 with UK National Annex (snow), BS EN 1990 (load combinations), BRE Digest 489 (2014, PV-specific wind coefficients), and where applicable SPRA S15-19 (pull-out testing) and MCS 020 (flat-roof PV product compliance).
3. **Calculations.** Wind load calculation including basic wind speed, terrain category, peak velocity pressure, external pressure coefficients, internal pressure coefficient, and the BRE Digest 489 array force coefficient. Snow load calculation including ground snow load (location and altitude), shape coefficients including drift where applicable, and the resulting roof snow load. Combined load case per BS EN 1990 with the appropriate partial factors. Where penetrating fixings are used, SPRA S15-19 pull-out test results documented.
4. **Finding.** A statement of whether the existing structure is adequate to carry the proposed array under the calculated load combinations, with the appropriate factor of safety. Where adequate, the finding is positive and unconditional. Where adequate with conditions, the conditions are stated explicitly. Where not adequate, the finding is negative and the deficit is quantified.
5. **Conditions and limitations.** Any assumptions made, any inputs that the engineer could not verify on site, any project-specific limits on the finding's scope, and the date of the assessment. The Clause 5.5.5 standard expects this section to be present and to be complete.
6. **Signature.** The qualified engineer's name, professional qualifications, and signature. Date. Issuing organisation. Where the engineer is a chartered structural engineer (IStructE or ICE), that member-

ship is stated.

A report with these six sections, properly executed, is a documented evidence pack under Clause 5.5.5. A report missing any of them is not.

The Technical Advisor expectation

Lender Technical Advisor (TA) packs read commercial PV structural reports against three layers of expectation. The first is procedural: does the report cite current standards, is it signed, is it dated, does it identify the engineer and the issuing organisation. The second is technical: do the calculation inputs match the actual site, are the load combinations applied correctly, is the BRE Digest 489 overlay present where it should be. The third is commercial: does the report's finding give the TA confidence that the project will be installed as designed without late-stage structural revision.

Where a TA pack fails, it most commonly fails at the second layer. The procedural elements are usually present (commercial PV is a mature procurement context), but the technical correctness of the calculation chain is variable. A report that applies BS EN 1991-1-4 to the building but uses a software default exposure category (rather than the actual site category from the UK National Annex map), and that omits the BRE Digest 489 array overlay, will pass the procedural review and fail the technical review.

The dataset shows that lender TA review is the single most consistent quality gate in commercial PV procurement. Asset managers and PPA providers commissioning projects through an SPV financing structure encounter this gate by default. EPC-led projects without external financing encounter it less often, and where they do not encounter it, the structural report quality is more variable.

The MCS auditor expectation

For projects within MCS scope (sub-50kWp DC), the MCS audit body reads the structural evidence pack against MIS 3002:2025 V6.0 directly. The audit expectation is that the documented evidence pack covers the assessment, the calculations, the engineer signature, and the retention period (the same retention period as the rest of the MCS submission).

The audit body does not perform an independent structural review. It checks that the evidence pack is present and that it covers the V6.0 requirements. A report that satisfies the format above and is anchored to V6.0 Section 5.9 will satisfy the audit. A report that does not include a Section 5.9.6 trigger assessment, or that omits the Clause 5.9.13(h) qualified SE consultation on a flat-roof ballasted system, will fail the audit even if the underlying engineering is correct.

The point worth emphasising for installers reading this report: V6.0 audit failure is most often a documentation failure, not an engineering failure. The engineering review may have been done correctly. The documented evidence pack may not capture it. The remedy is to align the reporting format to Clause 5.5.5 expectations, not to commission a different structural assessment.

"V6.0 audit failure is most often a documentation failure, not an engineering failure."

SECTION 11 · THE MCS AUDITOR EXPECTATION

SECTION 12

Recommendations + *Appendix.*

SYNOPSIS

Sector-specific recommendations for the four buyer profiles most directly affected by the findings: asset managers, PPA providers, EPC contractors, and structural engineers active in the commercial PV pipeline. Followed by Appendix A (standards reference), Appendix B (glossary), and Appendix C (about the engineering team).

For asset managers

Asset managers running commercial property portfolios with material PV ambition should treat structural assessment as a portfolio-level governance activity, not a per-project contractor instruction.

1. **Commission a portfolio-level desktop pre-feasibility** at the front end of the PV programme. A desktop structural feasibility report on every roof in the portfolio, ahead of any EPC tender, surfaces the typology mix, the altitude exposure, the asbestos prevalence, and the likely intervention rate. The cost is modest and the procurement clarity is significant.
2. **Specify the structural pathway in the EPC tender**, not just the array specification. Where the desktop pre-feasibility identifies Section 5.9.6 triggers or Clause 5.9.13(h) absolute cases, the tender brief should require the EPC to propose against those constraints from the start.
3. **Treat lender TA review as a quality benchmark**, not a procurement obstacle. A structural report that clears TA review is a structural report that will support the asset's long-term financing and ESG reporting. Reports that do not clear TA review are reports that will require revision at exactly the wrong moment in the asset's life cycle.

For PPA providers

PPA providers carry the financial consequence of structural inadequacy at a higher exposure than any other commercial buyer. A PV asset that does not perform as modelled, or that requires unplanned structural intervention during construction, undermines the PPA's commercial basis.

1. **Front-load structural due diligence in the project finance gate.** A structural report that meets the Section 11 format above should be a financial close requirement, not a post-financial-close construction milestone. The cost of the report is trivial against the financial exposure at risk.
2. **Prefer hybrid drone plus on-site survey** for the pre-PV structural assessment. Drone capture documents the external roof condition; on-site inspection by a qualified structural engineer documents the internal structure, primary and secondary members, and existing services. Combined survey produces the documented evidence pack that meets Clause 5.5.5 in full.

3. **Include the altitude correction in the financial model.** Sites at elevation carry higher snow load and higher rejection rates in this dataset. Project pipelines weighted toward upland regions need a higher contingency for structural intervention than pipelines weighted toward lowland regions.

For EPC contractors

EPC contractors sit between the buyer's commercial expectation and the engineering reality of the roof. The EPCs in this dataset whose programmes consistently clear procurement, financial close, and audit are the ones that integrate structural assessment into the design process, not the ones that procure it as a contractor service after the fact.

1. **Commission the desktop structural feasibility report at the design stage**, before the array layout is finalised. A structural input at the design stage means the array footprint, the fixing pattern, and the ballast specification are sized against the roof's actual capacity from the start. Late-stage structural rejection is the single most common cause of project rework in the dataset.
2. **Build the Section 5.9.6 trigger assessment into the standard pre-quote site visit.** Hipped, valley, asymmetric, dormer, parapet, sub-30 degree pitch, and structural distress are visible at site survey. Where any trigger is present, scope the qualified SE engagement (or use internal qualified SE capacity) into the quoted price.
3. **For ballasted flat-roof projects, treat Clause 5.9.13(h) as the universal standard**, not just the MCS sub-50kWp standard. The lender TA expectation matches the V6.0 standard regardless of MCS scope.

For structural engineers

Structural engineers active in the commercial PV pipeline can read this report's findings as a description of the dataset's recurring patterns. The procurement implications are familiar; the engineering content covers the same standards framework that any qualified UK structural engineer applies as routine. The report's primary purpose for engineering readers is to confirm the standards anchor and to surface the dataset patterns that inform first-pass desktop pre-feasibility assessment on similar typologies.

One specific note for engineering readers: the dataset's altitude bias is real. Where a UK upland commercial project lands in the desktop pre-feasibility queue, the BS EN 1991-1-3 snow zone factor and the combined load case under BS EN 1990 should be the first calculations performed. The dataset finds that upland snow load is the most frequent governing case on rejected projects in this commercial cohort.

Appendix A: Standards reference

STANDARD	SCOPE	STATUS
MIS 3002:2025 V6.0	MCS structural standard for solar PV (sub-50kWp DC)	Issued 18 March 2026, mandatory 18 June 2026
BS EN 1990 (Eurocode 0)	Basis of structural design and load combinations	Current with UK National Annex
BS EN 1991-1-3 + UK National Annex	Snow loads on structures	Current
BS EN 1991-1-4 + UK National Annex	Wind actions on structures	Current. Replaces BS 6399-2:1997 (withdrawn 2010)
BRE Digest 489 (2014)	Wind loads on roof-mounted solar PV	Current
BRE Digest 495	Mechanical installation of solar PV systems	Current
SPRA S15-19	Pull-out test methodology for fixings on metal sheet roofs	Current
MCS 020	Flat-roof PV product compliance	Current
MCS 032	General PV product compliance	Current
RC62 v2 (RISCAuthority)	PV fire safety on commercial roofs	2022
CAR 2012	Control of Asbestos Regulations	Current
Building Regulations Approved Document A	Structural duty (England and Wales)	Current; equivalent provisions Section 1 Structure (Scotland), Technical Booklet D (NI)
BS 6399-2:1997	Wind loads (predecessor)	**Withdrawn 2010. Not used.**

Appendix B: Glossary

Plain English definitions of every technical term used in this report are available at the Solar Surveys glossary index (solarsurveys.co.uk/glossary/). The glossary covers 70+ engineering and compliance terms with cross-references to the standards above.

Most-referenced terms in this report:

Cleared first-pass.
The structural assessment confirmed the proposed array could be installed as designed with no structural intervention required. 65% of the dataset.
Conditional outcome.
Installed after design adjustment (array reduction, fixing density increase, ballast reconfiguration). 15% of the dataset.
Documented evidence.
The standard required by MIS 3002 V6.0 Clause 5.5.5 for structural assessments. Includes calculation basis, load case, calculations, signature, qualifications, and date.
Qualified structural engineer.
An individual whose engineering qualifications and experience meet the threshold for structural assessment of solar PV on a complex or non-standard roof. Typically a Chartered Engineer with IStructE or ICE membership, or a non-chartered structural engineer with documented training and experience appropriate to the load case.
Section 5.9.4.
The MIS 3002 V6.0 universal competent-person check requirement on every install.
Section 5.9.6.
The MIS 3002 V6.0 enumerated list of seven roof conditions (hipped, valley, asymmetric duo-pitched, dormer, parapet, sub-30 degree pitch, structural distress) that mandate a qualified structural engineer.
Section 5.9.13(h).
The MIS 3002 V6.0 absolute requirement for qualified structural engineer assessment on every flat-roof ballasted PV install regardless of array size.
Suitably competent person.
The MIS 3002 V6.0 phrase used in Section 5.9.4. Documented qualifications and experience evidence support the "suitably competent" judgement.

Appendix C: About the engineering team

Solar Surveys Ltd is a specialist UK engineering practice for commercial solar PV. The qualified structural engineering team produces desktop structural roof loading reports, on-site structural surveys, drone roof condition assessments, drone technical surveys, solar design, electrical surveys, and planning permission support across the United Kingdom, Northern Ireland, the Republic of Ireland, and Europe.

Engineering standards anchor: BS EN 1991-1-4 wind with UK National Annex, BS EN 1991-1-3 snow with UK National Annex, BS EN 1990 load combinations, BRE Digest 489 (2014) PV-specific wind coefficients, Building Regulations Approved Document A. For systems within MCS scope, MIS 3002:2025 V6.0 Section 5.9.

Insurance and accreditation: £5M Professional Indemnity. £25M Drone Public Liability. BDF (British Drone Flyers) and BMFA (British Model Flying Association) accredited drone pilots. Coverage: United Kingdom, Northern Ireland, Republic of Ireland, and Europe for cross-border portfolio programmes.

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- **Web.** solarsurveys.co.uk/contact.html

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Need an engineer's re-view of *your portfolio?*

If your portfolio sits anywhere near the conditions described in this report, a Desktop Structural Roof Loading Report is the cheapest possible way to find out which assets clear, which need conditional adjustment, and which need physical remediation before the PV procurement can move.

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