SPRA
Single Ply Roofing Association

TECHNICAL GUIDANCE

SAFETY
DESIGN CONSIDERATIONS FOR REDUCED RISK

ENSURING THAT CLIENTS OBTAIN HIGH QUALITY POLYMER-BASED SINGLE PLY ROOFING, THROUGH A PARTNERSHIP OF QUALITY ASSURED MANUFACTURERS AND CONTRACTORS

S5/17

GUIDANCE DOCUMENT

SAFETY – DESIGN CONSIDERATIONS FOR REDUCED RISK

FOREWORD

This document takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading. Compliance with this Guide does not of itself confer immunity from legal obligations.

OBJECTIVE

The objective of this document is to provide guidance and suggestions to designers, contractors, building owners and facilities managers on the reduction of risk during the construction, refurbishment and operation of polymeric single ply roof systems.

CONTEXT

This document provides both generic advice (applicable to flat roofing as a whole) and advice specific to polymeric single ply roof systems. It should be read together with the SPRA Design Guide for Single Ply Roofing and should be regarded as complementary to the key generic references below:

- HSG 33: Health and Safety in Roofwork (HSE)
- Approved Code of Practice & Guidance -Construction (Design & Management) Regulation 1994
- ACR (M) 001:2000 Test For Fragility of Ro o f i n g Assemblies (2nd edition)
- HSG150: Health and Safety in Construction

SCOPE

This document covers design for reduced risk. It does not cover the construction process or methods of working that can also reduce risk

NEW CONSTRUCTION

1. ACCESS TO THE ROOF

Access to all areas of the roof should be incorporated into the building design from inception. It is vital for safe, efficient planned and reactive maintenance of the roof and of any mechanical or electrical services placed upon it. Internal access

Internal access

The best option is internal access because it is usually safer, less weather dependent and more reliable than external access. Due consideration should be given to security to prevent unauthorised access both to the roof externally and to the building interior from the roof.

Internal access should be permanent and located off a stairwell, circulation area or store room adjacent. If the last link of the access is to be by removable ladder, then it must be positioned well clear of normal or emergency routes. Due note should be taken of the necessity on occasions for equipment, tools and materials to be taken onto the roof, so access points should be generously sized.

Roof access doors should be:

- Fitted with self-closers or restrictors to stop wind damage
- Capable of being held open to enable access for equipment etc.
- Marked with clear warning signage on the inner face

Roof access hatches should be:

- Located well away from the edges of any roof area
- Located well clear of fixed hazards such as overhead plant
- Purpose-made with a self-supporting hinged cover that can be locked in the open and closed positions

Heavy timber or metal covers that have to be lifted aside should be avoided.

External access

If external access is the only feasible option, then it should be by permanently fixed ladder with appropriate security.

Another option is mobile work platforms, such as scissor lifts or cherry pickers. If mobile work platforms are to be used the operators/users should have had the appropriate training and their use should be included in the method statement for the activity being undertaken. Mobile work platforms invariably cause delays and increase costs to the building owner when access is required. There can also be other associated problems such as finding road space where the plant can be parked. The overall difficulties of this approach are

likely to discourage the building owner from carrying out the necessary regular maintenance inspections.

The least favoured option is a temporary ladder. Whilst this may appear economical, it requires at least two operatives for safe use, is a slow means of access and may be difficult to position due to local obstructions around the building. There are also unlikely to be suitable tying-off positions available at roof level to enable the ladder to be properly secured.

2. ROOF DESIGN

There are many aspects of roof design that can assist in risk reduction.

Consider the risk of dropped tools running off the roof and falling externally, for example on sloping sections with open eaves near to access routes or hatches.

Ensure clearance around access routes, both to the side and overhead, to avoid head injury or damage from portable equipment.

Avoid trip hazards where cable or pipe runs across walkways by providing bridging steps or high visibility signage.

3. INSPECTION AND MAINTENANCE REQUIREMENTS

To minimise risk, single ply roofs should be designed for ease of maintenance. Routine maintenance of the membranes themselves is not normally required but regular inspection of the roof as a whole and clearing of leaves, debris and silt is recommended at least annually and preferably in early Spring and late Autumn. The design should take account of the necessity to carry out the following checks:

a Condition of any fall arrest equipment, annual inspection and certification.

b Security and condition of access equipment such as ladders and ramps.

c Condition of plant noting leakage of refrigerants, oils, coolants, fuels etc.

d Condition of any rooflights, particularly in relation to the fragility of any translucent material in their construction.

e Security of lightning conductor system.

f Damage to the membrane.

g Security and condition of flashings and upstands. To reduce risk of injury during inspection, the lower edge of any cladding should be terminated in a folded flange or separate trim and not a cut edge.

h Penetrations including rainwater outlets, overflow pipes, collars and cravats.

A standard format roof plan, marked with co-ordinates, to record the findings of any inspections can reduce time on the roof and be used to record any particular hazards or access limitations. It can facilitate the handover of a roof to a different inspector or facilities manager and reduce risk where new staff are involved.

4. LOCATION OF ROOF MOUNTED PLANT

Flat roofs provide an ideal opportunity for plant to be positioned where it is accessible without occupying space within the building enclosure.

Generally, such plant does not constitute a fall risk in itself, however when installed at roof level its location requires careful consideration:

1. Plant Rooms

a. The location of a plant room should not impede safe access to the perimeter of the roof.

b. It must be possible to access a plant room via a safe area of the roof i.e. one that is free of fall risk(s).

2. Plant Wells

a. Edge protection is required around a plant well if the fall risk exceeds 2m.

b. Fixed ladders or steps are required for access to/ from the plant well.

3. Plant secured at roof level

a. If possible, locate plant in one zone of the roof, with designated walkways to it from the roof access point.

b. Maintain suitable 2m minimum edge distance to enable installation of collective protection (handrail) or fall restraint system.

5. LOCATION OF ROOFLIGHTS AND VENTS

Where a roof incorporates rooflights, careful consideration is required when selecting their type and location.

1. Rooflights should be non-fragile with a design life to match that of the roof. Where such a design life is not possible, there should be a planned programme ofreplacement.

2. Rooflights and vents should be located in such a way so that they do not restrict or impede access to the perimeter of the roof, gutters, outlets, signage or any other maintenance requirements.

3. The minimum edge distance of 2m should be maintained to enable installation of collective protection (handrail) or a fall restraint system.

6. FRAGILE MATERIALS

The roof designer and/or roofing contractor must ensure that no fragile materials are used on any roof (unless fully supported by a non–fragile material).

This requirement is specifically aimed at rooflights, but also applies to all roofing elements.

Designers should seek confirmation from suppliers that roof constructions satisfy at least Class C non-fragile classification when tested to ACR (M) 001:2000 Test For Fragility of Roofing Assemblies (2nd edition). (See appendix for details)

Any material not fully fixed or unknown should be assumed to be fragile and therefore treated as a fall risk.

7. ACCESS ACROSS THE ROOF

Exposed single ply membranes are not adversely affected by the occasional random foot traffic associated with general maintenance access. Because of their smooth finish designed to shed dirt and fines, these products can become slippery when wet. Therefore it is necessary to ensure that appropriate footwear with well defined and deep tread patterns to the sole is worn to avoid accidents. Special care is required when accessing roofs if frost or ice is present or anticipated. Method statements should make specific reference to appropriate precautions if such conditions are likely.

Exposed membrane roofs are not intended for general access by the public or for use as a wearing surface for patios, balconies, terraces or fire escape routes. These circumstances usually demand a paved finish over the membrane.

DESIGNATED WALKWAYS

There are some circumstances where areas of the roof surface will be repeatedly trafficked such as routes to plant, window cleaning equipment and access to/from doors and hatches. This 'designated walkway' should be considered at an early design stage with the objective of providing routes which people will be encouraged to use. Walkways should be a minimum of 2m from any fall risk such as the roof edge. Exceptionally, when walkways have to be located closer than 2m to a fall risk, edge protection or a fall restraint system must be provided.

In designated walkways it is essential to provide protection for the insulation as necessary and a surfacing material to the membrane itself that provides wear and slip resistance. SPRA membrane manufacturers supply sheets or tiles of material with textured or featured surfaces that can be attached to the membrane surface to provide slip resistance and delineate the walkway route. All designated walkways should be constructed in accordance with the manufacturer's recommendations.

PROTECTION OF INSULATION

Thermal insulation can be protected from the compressive effects of repetitive or point loads by installing a load-spreading sheet (usually galvanised steel) below the single ply membrane. SPRA membrane manufacturers can advise on the gauge, corrosion resistance and installation of these sheets. Such sheets reduce risk by ensuring a smooth walkway surface free of undulations.

Should a walkway be required after the roof is installed in order to protect the membrane or avoid damage to the insulation it is possible to retro-fit walkway surfacing and load-spreading in consultation with the SPRA membrane manufacturer. There are also proprietary after-market walkway systems available. The suitability and compatibility of these should always be checked with the membrane manufacturer before selection.

PAVED FINISHES

Alternatively, durable, load-spreading finishes can be provided on warm deck and inverted warm deck roofs by use of pre-cast paving. This is suitable where a very tough, load-spreading and abrasion-resistant finish is required. Incorrect design and installation of paved walkways can create trip hazards and increase risk of injury. The following should be considered:

For paving laid directly on the roof surface:

Paving should be continuous, not in 'stepping stone' layout.

- Shims of compatible membrane may be required to level up the finished surface.
- The membrane manufacturer should be consulted regarding requirements for a separating layer.
- Avoid cantilevers in the paving, for example at steps in the roof surface.

For paving laid on proprietary supports:

- If paving supports are used to overcome steps or drainage falls, they must not be stacked to excessive height; consult relevant manufacturers.
- Paving must be supported at all corners.
- Lateral restraint must be provided at the edge of the route to prevent paving becoming separated.
- Paving cut to reduced width will have reduced load capacity and will therefore require additional support.

8. PROVISION OF A SAFETY SYSTEM

In addition to safe methods of working with materials there is a requirement to protect workers from falls.

The Construction Safety and Welfare Regulations 1996, statutory no.1592 Regulation 6, states that it is the responsibility of the employer to ensure that any employee required to work at a height of 2 metres of more must be suitably protected from any potential fall hazards.

The Construction Design and Management Regulations 1994 (CDM) extend the responsibility for Health & Safety to the designer. The designer must ensure that the design is such that it minimises risk during construction, maintenance and repair. Failure to comply with these requirements could ultimately lead to criminal as well as civil prosecution.

Working with its Associate members, SPRA has developed a classification system for assessing riskassociated with fall protection.

COLLECTIVE PROTECTION+		INDIVIDUAL PROTECTION+ (OF A SMALL NUMBER OF WORKERS)			
Category A1 or CP1	**Category A2 or CP2**	**Category B1 or PP1**	**Category B2 or PA3**	**Category B3 or PA4**	**Category C or PP4**
Permanent structural barri	Guard rails for occasional access	Fall Restraint. No PPE* adjustment required (perimeter system)	Fall Arrest. No PPE* adjustment required (perimeter system with fall hazards)	Fall Arrest. PPE* adjustment required (ridge system)	Roped access (abseiling) specialist techniques
Risk factor* for a basic trained worker **1**	Risk factor* for a basic trained worker **1**	Risk factor* for a basic trained worker **2**	Risk factor* for a basic trained worker **3**	Risk factor* for a basic trained worker **6**	Risk factor* for a basic trained worker **10**
Worker training to control risk **NONE**	Worker training to control risk **NONE**	Worker training to control risk **BASIC**	Worker training to control risk **BASIC**	Worker training to control risk **ADVANCED**	Worker training to control risk **SPECIALIST**

* **Notes:** PPE - Personal Protective Equipment, Risk Factor – 1 = Low Risk, 10 = High Risk

\+ **Definitions:**

Collective Protection
Systems which protect an area, allowing work to take place safely without the necessity for any direct action by the worker to protect himself.

Individual protection:
Systems, which require direct action by each worker in order to ensure that he is protected. The level of worker competency required to safely use different categories of system will vary.

REFURBISHMENT

1. STRUCTURE – CONDITION OF EXISTING MATERIALS WITH REGARD TO LOADS

Refurbishment of existing roofs is often made more difficult for lack of as-built information or drawings. Interested parties may be uncertain as to the nature of a deck and also its integrity. An existing deck could have become weakened through water penetration or ageing.

Four key factors need to be taken into consideration:

1. Imposed load on existing roofs from foot traffic and construction activity.
   a. Ensure safe access
   b. Beware of the following materials used for flat roof decks:
      - Chipboard
      - Wood wool slab
      - Straw board
      - Asbestos/fibrous cement sheet.
2. Fragility of coverings to openings in the structural deck.
   b. Existing rooflights
   b. Covers to rooflight openings
   c. Glazing in the plane of the roof (e.g. mansards or northlights)

Preliminary investigation should involve inspection from within the building with the aim of confirming the type of deck, the location of any rooflights and whether there has been ingress of moisture.

1. The attachment of the single ply membrane.
   a. Discuss the results of any investigation with the membrane manufacturer.
   b. For mechanical attachment refer to a fastener manufacturer to undertake fastener performance tests. Opening up may be necessary to confirm the attachment of ancillary components such as thermal insulation.
   c. For adhered attachment, confirm the compatibility of the material being bonded to and the resistance of each component to de- lamination.
4. The attachment of fall restraint/fall arrest system.
   a. At the earliest opportunity discuss with the safety system manufacturer the suitability of the existing substrate to support the necessary installation.

2. RISK ASSESSMENT - IDENTIFICATION OF FRAGILE COMPONENTS AND SAFE DISPOSAL OF HAZARDOUS MATERIAL

On refurbishment projects the designer and/or roofing contractor must satisfy themselves that all supporting elements are at least Class C non-fragile classification when tested to ACR (M) 001:2000 Test For Fragility of Roofing Assemblies (2nd edition).

Particular attention should be paid to old rooflights, which are very unlikely to meet the above classification. The condition and fixing of existing structural deck components should also be checked if the decking is to be left in place (fragility is commonly caused by inadequate fixing of structural components).

Any material to be removed from a roof must be identified prior to removal. Where identified as hazardous the correct handling and disposal procedures must be followed.

3. HEALTH AND SAFETY OF OCCUPANTS

a. The public may be at risk from falling materials and tools during roof work, particularly where the building remains occupied. Strict preventative measures should be taken.

b. Birdcage scaffolds or debris netting can be used to retain falling materials. The system should be capable of retaining whatever is likely to fall. The scaffold should not be overloaded.

c. Where roof material is stacked on a scaffold platform above the height of the toe board, proprietary brick guards will be needed to prevent material falling.

d. Where people pass below or near to scaffolding then scaffold fans, tunnels or similar arrangements may be required.

e. Material may also fall through gaps in the working platform or between the working platform and the building. Sheeting, combined with a second layer of scaffold boards or plywood sheets, can be used to prevent this. If there is any risk of drips of a potentially hazardous liquid from the roof edge, then physical protection or barriers at ground level may be necessary.

f. Special security precautions will be necessary where children may be put at risk, e.g. at or near schools or play areas. Where possible roofwork at schools should be carried out in the holidays.

g. Waste materials should never be thrown from the roof or scaffold. They should be lowered in skips or baskets designed for the purpose which will not spill material if snagged. Alternatively, enclosed debris

chutes can be used. Chutes should be closed off to prevent their use when the skip below has been removed. Skips should be covered where necessary to protect building occupiers from dust and flying materials.

h. Materials should not be hoisted over the public. An alternative place for hoisting should be found or alternative means of raising materials used. If these are not possible the area should be cordoned off to prevent public access during hoisting.

4. LOCATION OF EXISTING SERVICE SUPPLIES

Where possible identify the routes of:

a. Electrical circuitry

b. Water/sprinkler systems

c. Computer, telephone or security aerials.

The thickness and nature of a deck in relation to the area below is also relevant. Care should be taken when taking core samples or undertaking drill tests.

Hazards to be considered:

a. Trip hazards caused by attachments and wires

b. The removal of any roof build-up exposing any hidden services

c. Fastener performance tests penetrating hidden services

d. The mechanical attachment of materials to a deck penetrating hidden services.

This situation has greater relevance to some building types, they include:

a. High-rise housing

b. Office buildings

c. Educational establishments

d. Government buildings

On-site investigation and discussion with concerned parties is essential to eliminate potential hazard.

APPENDICES

CLASS C NON-FRAGILE CLASSIFICATION WHEN TESTED TO ACR (M) 001:2000 TEST FOR FRAGILITY OF ROOFING ASSEMBLIES (2ND EDITION).

In the test, sheeting is fixed to a test rig specified in the document and a drop test is conducted, which involves releasing a 45kg sandbag from a height of 1.2m. The sandbag must impact the sample: -

1. Within 150mm of the centre of the test sample.
2. Within 300mm of a support point, at least 150mm away from the support.
3. Within 150mm of the edge of the sheet, adjacent to the underlap with the other sheet, at the weakest position.

Other test conditions specified in the document also have to be met.

SUMMARY OF CLASSIFICATIONS

Fragile	Impactor (sand bag) passes through assembly on first drop.
Class C non-fragile	Impactor is retained on the assembly for 5 minutes after 1st drop.
Class B non-fragile	Impactor is retained on the assembly for 5 minutes after 2nd drop in the same place as the 1st drop.
Class A non-fragile	On conclusion of the 2nd drop there is no significant damage to the assembly.

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