

# design for safety

# Non fragile roof sheeting, walk-on

*Many rooflights and metal lining panels are considered to be fragile relative to metal roof sheeting, a fact that building designers and contractors should take into account for safety reasons when designing access routes for ongoing maintenance of a building, planning a building project, selecting rooflighting material and installing rooflighting.*

As with all building, work good safety standards are essential to prevent accidents. In accordance with the Health and Safety Act and South Africa National Standards (SANS) regulations, the building should be designed with safety in mind, not only for the construction period but throughout the normal life of the building. This must include considering the safety of people involved in maintenance, repair and even demolition. It might mean providing permanent access to the roof, walkways and parapets, for example.

## Designing to improve rooflighting safety

Where specifying rooflights, designers should consider the following options:

- Choosing in-plane rooflights that are non-fragile.
- Making sure that all in-plane units (even non-fragile ones) are easily identifiable when installed, for example by the use of bright red fixing heads, to identify the rooflight location.
- Fitting rooflights designed to project above the plane of the roof that cannot be walked on (these reduce risk, but should still be capable of withstanding a person falling onto them).
- Protecting rooflight openings, for example by means of mesh or grids fitted below the rooflight or between the layers of a built-up rooflight. PVC, which is an inherently brittle material, always requires extra safety reinforcement.
- Increasing the safety margin when selecting rooflighting materials and other components (see "Why increase the safety margin?")

The designer and building owner should also design the roof to accommodate ongoing maintenance and roof access during the rooflight's lifespan. As a guide (please see section on non-fragility ratings under the GRP walk on section for more information on Class A, B and C classifications mentioned below):

- **Low-maintenance roofs** require maintenance that is either very infrequent and so requires very infrequent access by experienced roofworkers only, or can be done from ladders. For these roofs the minimum non-fragility classification is Class C.
- **Medium-maintenance roofs** are those that require regular access for maintenance by experienced roof workers only. For these roofs the minimum non-fragility classification is Class A or B.
- **High-maintenance roofs** are those that require frequent access for maintenance by people who may not be experienced roofworkers (eg for plant exhausts). For these roofs the minimum non-fragility classification is Class B, with dedicated walkways to reach the plant to be maintained.

Designers should adopt a principle of matching the non-fragile classification of the roof and rooflight assemblies while following the above guidelines to eliminate areas of unequal performance from the roof covering.

It is the responsibility of the designer to determine the risks, the required period of non-fragility and the safety margins requires, and then to adapt the building design accordingly.

### Why increase the safety margin?

The safety margin of minimum-weight rooflights is sufficient to ensure they will achieve non-fragility classification when new, but will not allow for any deterioration of other aspects of the installation.

MODEK's GRP rooflights have a service life in excess of 25 years. However, their resistance to impact relies on how well they were installed. Even if there is little degradation of the rooflight sheeting itself, long-term non-fragility could be affected by external factors such as:

- Poor design and specification
- Incorrect initial installation
- Corrosion of the fasteners or degradation of supporting material
- Fasteners that have worked loose or seals that have hardened or perished
- Corrosion of surrounding metal sheeting
- Chafing around the fixings (which can be

accelerated by failure to install additional fixings around areas of high wind load)

- Foot traffic

Non-fragility can only be maintained if inspection and maintenance eliminates the effect of these factors. However, MODEK has established that typical maintenance procedures are usually not sufficient to achieve this.

To improve safety in the long term, MODEK recommends selecting rooflight sheeting (and other components, such as fixings) of a higher safety grade in order to increase the safety margin, so reducing dependence on installation and maintenance methods. An incremental increase in the weight of rooflight sheeting (for instance, from 2.4kg/m<sup>2</sup> to 3.0kg/m<sup>2</sup>) will effectively increase the margin of safety and so ensure that long-term non-fragility is preserved with typical maintenance regimes.

### Building to improve rooflighting safety

Construction of the roof is one of the most hazardous operations because of the potential for falls or material dropping onto people below. A roofing contractor should plan and document a safe system of work before starting construction. This plan must take into account the fragility of cladding and rooflighting systems. While fully fixed metal sheeting is generally regarded as non-fragile, many rooflights and metal lining panels must be treated with greater care.

It is important to remember that even non-fragile rooflights are likely to be damaged by impact. They are usually not intended to support heavy foot traffic, and crawling boards should be used when going over them cannot be avoided, either during construction or while undergoing maintenance.

### Improved rooflighting safety after construction

On completion of a building, designers should provide a Health and Safety File to the building owner containing the following information with regard to rooflights:

- The rooflight specification, including the weight (thickness) of the rooflights, the non-fragile test method and classification when new (see Non-

fragility classification of GRP, below), and the expected non-fragile life of the roof and rooflights.

- A schedule for cleaning and maintenance for both performance and longevity of the specific rooflights.

The file should also contain the following warnings:

- Avoid walking on rooflights, irrespective of their non-fragility classification. Even rooflights that are designed to be non-fragile for the life of the roof could be damaged by foot traffic, and this may affect both the non-fragility performance and the light-transmitting quality of the rooflight in the long term.
- No person should have access to the roof, unless under the direct supervision of a competent person who is to assess risks and take action to minimise them.
- Access to the roof should be avoided in wet or in slippery conditions.

### Non-fragility classification of GRP

#### NON-FRAGILITY WHEN NEW

In terms of the guidelines set out by the NARM (British) Red Book (ACR[M]001:2005), non-fragility can be classified into three groups: Group A, Group B or Group C.

Most roof constructions (without rooflights) are Class B or C. Very few achieve Class A. Generally speaking, a rooflight should match the performance of the roof, so if the roof without rooflights achieves Class B, so should the roof assembly including rooflights.

Extensive testing has established the minimum sheet weight necessary to reliably achieve a given non-fragility class (A, B or C). The testing was done on properly installed **MODEK** GRP rooflights at purlin spans of between 1.2m and 2.0m. It cannot be assumed that any other manufacturer's sheeting, even of the same weight, will achieve the same level of performance. Ratings only apply to rooflights with the specified purlin spans.

#### How fragile after 10years/Medium maintenance roof

Applications	Non-fragile classification	Minimum weight for non-fragility when new
Rigid trapezoidal profiles for use with single skin metal sheeting	Class B	3.6 kg/m <sup>2</sup>
Rigid sinusoidal profiles for use with fibre cement sheeting	Class C	3.0 kg/m <sup>2</sup>

The testing further showed that:

- Flexible profiles with few or shallow corrugations perform better than more rigid profiles, as they have greater ability to flex and absorb energy. Increase in rigidity due to changes in profile should not be confused with an increase in rigidity due to sheet weight (thickness). Heavier sheets of a given profile perform significantly better than lighter sheets with the same profile.
- A roof system that incorporates rooflights indicated in the table will achieve the relevant non-fragility classification when new, provided it has been demonstrated that the roof system (without rooflights) has an equal or better non-fragility classification.
- Separate testing should be carried out for exceptional cases (for instance, where there are purlin spans outside the range 1.2m to 2.0m, or rooflights have been fitted to curved roofs). If testing is not possible, a simple and safe alternative would be to incrementally increase the weight of the rooflight sheeting.
- These recommendations only apply to rooflights for use with current reinforced fibre cement sheeting. Obsolete asbestos and fibre cement profiles should always be regarded as fragile.

#### IN THE LONG TERM

The non-fragility ratings in the table above apply to GRP rooflights when new. These ratings can be maintained over the long term, for periods in excess of 25 years, provided that care is given to roof design and assembly, and the manufacturer's advice is followed.

#### How fragile after 25years/High maintenance roof

Applications	Non-fragile classification	Minimum weight for non-fragility when new
Rigid trapezoidal profiles for use with single skin metal sheeting	Class A	4.0 kg/m <sup>2</sup>
Rigid sinusoidal profiles for use with fibre cement sheeting	Class B	3.6 kg/m <sup>2</sup>

The adding of the woven mat shown in this table significantly increase the factor of safety and ensure that typical deterioration to an installation should not affect non-fragility under normal conditions, subject to normal maintenance requirements.

Long-term non-fragility of a rooflight assembly is highly dependent on the long-term durability and performance of all associated components: if these degrade, then the rooflight assembly may become fragile. As such, the specification of all components in the roof assembly should be carefully considered to achieve long-term performance. For example, where it is expected that non-fragility is to be retained for 25 years:

- All fasteners (for both main and side lap fixings) should be guaranteed for 25 years. This will normally require use of stainless-steel fasteners in all locations.
- Single-skin rooflights should overlap metal sheets on both sides.

Incorrect installation, serious deterioration or total failure of associated components, abuse and exceptional circumstances could all jeopardise non-fragility within a 25 year period.

#### While fully fixed metal

sheeting is generally regarded as non-fragile, many rooflights and metal lining panels must be treated with greater care.