Abstract Title: Method of replacing a roofing panel

The method, particularly for use with rooflights in commercial or industrial buildings, involves removing the bolts and fasteners securing a roofing panel and removing the panel to create an aperture in the roof. The replacement panel 5A is prepared by forming holes for the bolts and fastener and a series of first bolts 40 which incorporate a threaded sleeve 50 are fitted to the bottom edge of the replacement roofing panel and a series of second bolts which incorporate a threaded element are fitted to the bottom edge of the roofing panel above the aperture. The replacement roofing panel is located in the aperture and the first bolts are aligned with the holes in the roofing panel below the aperture and the second bolts are aligned with the holes in the top edge of the replacement roofing panel. A fixing element 54 is located upon each of the threaded sleeves and threaded members, and tightened to secure the replacement panel to the roof. Sealant it preferably located between overlapping edges of adjacent panels and the removed roof panel is preferably used as a template for locating holes in the replacement panel. Also claimed is a set of components for replacing a roof panel.
METHOD OF REPLACING A ROOFING PANEL, AND SET 
OF COMPONENTS THEREFOR

FIELD OF THE INVENTION

This invention relates to a method of replacing a roofing panel and to a set of 
components therefor. The invention is directed in particular at the replacement of 
a rooflight within a commercial or industrial building and the following description 
will therefore refer primarily to such use, but is not thereby limited.

In this specification orientational and directional terms refer to the normal 
orientation and direction of the roof and other components.

BACKGROUND OF THE INVENTION

Commercial and industrial buildings often occupy a large ground area, and the 
roof is therefore of a similarly large area. The roof will typically comprise a 
framework of joists and purlins upon which a series of roofing panels are laid and 
to which the roofing panels are secured. In roofs having roofing panels of 
asbestos or fibre cement the roofing panels are usually of a standard size and so 
the purlins can be a standard distance apart, suitable for the securement of the 
top and bottom edge of each roofing panel. In roofs having roofing panels of metal 
on the other hand, whilst the roofing panels will be standard across the roof, they 
may differ significantly from the roofing panels on other roofs, so that the 
positioning and spacing of the purlins may differ significantly between roofs.

To allow rainwater runoff the roof will typically have an incline of between 5° and 
45°, and the panels are laid so that the bottom edge of a higher panel overlaps 
the top edge of a lower panel.
In addition, the side edges of adjacent panels will also overlap, so that the right-hand side edge of one panel will overlap the left-hand side edge of the neighbouring panel (or vice versa).

Most types of roofing panel are corrugated, and adjacent roofing panels are laid so that their corrugations nest together.

A part of a typical roof 10 is shown in the schematic representation of Fig.1. This view is substantially perpendicular to the roof 10, from above, and since the roof is slightly sloping in typical fashion the direction of view is at a slight angle to the vertical.

Fig.1 shows a part of nine adjacent roof panels 1, 2, 3, 4, 5, 6, 7, 8 and 9. In this view, the panels 1, 4 and 7 lie closer to the ground (not seen) than the panels 2, 5 and 8, which in turn lie closer to the ground than the panels 3, 6 and 9.

During construction of the roof 10 the panel 1 is laid first, followed by the panel 2. The bottom edge 12 of the panel 2 overlies the top edge (not seen) of the panel 1, in known fashion. The panel 3 is then laid, with its bottom edge 14 overlying the top edge (not seen) of the panel 2.

The panel 4 is then laid, with its left-side edge 16 overlying the right-side edge (not seen) of the panel 1. The panels 5 and 6 are then laid similarly to the panels 2 and 3, with their respective left-side edges overlying the right-side edges of the respective panels 2 and 3.

The panel 7 is then laid, with its left-side edge 18 overlying the right-side edge (not seen) of the panel 4. The panels 8 and 9 are then laid similarly to the panels 5 and 6, with their respective left-side edges overlying the right-side edges of the respective panels 5 and 6.

It will be understood that the above represents only one method of laying the roofing panels, and the roofing panels could if desired be laid in the order 1, 4, 7,
2, 5, 8, 3, 6, 9 if desired, or from the right-hand side of the roof towards the left-hand side of the roof.

The roofing panels are supported by purlins 20, which run across the width of the roof, i.e. each purlin 20 is substantially horizontal. The purlins are spaced apart by a predetermined distance so that they lie underneath the overlapping top and bottom edges of each roofing panel 1-9. In known fashion, a series of bolts 22 pass through the overlapping top and bottom edges and secure the roofing panels to the purlins 20.

The roof 10 of which a part is shown in Fig.1 comprises panels which are of fibre cement or asbestos, and it is typical with such panels to locate the bolts 22 at the peaks of the corrugations. Typically also, the bolts used with such panels 22 are hookbolts, with the hook passing underneath the bottom edge of the respective purlin 20.

It will be understood that the above-described sequences of laying the roofing panels 1-9 will also be utilised in roofs having roofing panels of metal, but in such roofs the securing bolts typically pass through the troughs of the overlapping top and bottom edges of the respective panels and through a purlin underlying the panels.

The present invention can be used with roofs of fibre cement or asbestos material, or of metal, and unless otherwise indicated the described apparatus and method steps are common to both types of roof.

The overlapping side edges of adjacent roofing panels are secured together by a series of fasteners 24, which may for example be a nut and bolt arrangement or a more specialised fixing such as a grommet-type stitch fixing.

In typical fashion the roofing panels 1-9 are corrugated, with a number of peaks 30 and troughs 32. The form of the corrugations can vary between manufacturers
and applications, but does not vary across a particular roof, so that the corrugations of each panel can nest with the corrugations of its neighbours.

In a roof having panels of fibre cement or asbestos the fasteners 24 are typically located on the outer downslope of the overlapping panels, whereas in a roof having panels of metal the fasteners 24 are typically located along the peaks of the overlapping panels. In both cases, the fasteners 24 typically only secure the two overlapping panels together, i.e. they do not secure the panels to the underlying framework.

In a roof 10 which has been constructed from roofing panels of fibre cement or asbestos as described above, it will be understood that the bolt 22a passes through the bottom left-hand corner of panel 6, then through the top left-hand corner of panel 5, then through the bottom right-hand corner of the panel 3 and finally through the top right-hand corner of the panel 2. The bolt 22b passes through the bottom left-hand corner of panel 9, then through the top left-hand corner of panel 8, then through the bottom right-hand corner of the panel 6 and finally through the top right-hand corner of the panel 5. The bolt 22c passes through the bottom left-hand corner of panel 8, then through the top left-hand corner of panel 7, then through the bottom right-hand corner of the panel 5 and finally through the top right-hand corner of the panel 4. The bolt 22d passes through the bottom left-hand corner of panel 5, then through the top left-hand corner of panel 4, then through the bottom right-hand corner of the panel 2 and finally through the top right-hand corner of the panel 1.

The remaining bolts 22 pass through only two panels, firstly the bottom edge of the uppermost panel followed by the top edge of the lowermost panel. Similarly, the fasteners 24 pass through only two panels.

In a roof constructed from metal roofing panels on the other hand, because the securing bolts at the top and bottom of each panel are located at the troughs of the overlapping panels, and the side edges of adjacent panels only overlap to just beyond the first peak, all of the securing bolts typically pass through only two
panels, as described in more detail in the following specific description in relation to Figs. 9-17.

The roof 10 will often incorporate one or more rooflights. A rooflight is a transparent or translucent panel which is fitted into the roof in place of an opaque roofing panel, and permits natural light to enter the building. A common rooflight is made from glass reinforced plastic. The rooflight is made to match the dimensions and corrugations of the other roofing panels.

A single rooflight may be fitted into a run of standard opaque roofing panels, and in the example of Fig.1 the panel 5 is a rooflight with the panels 1-4 and 6-9 being of fibre cement. In an alternative example, a series of rooflights may occupy the positions of the panels 2, 5, 8, or 6, 5, 4.

It is often necessary to replace a roofing panel. Thus, a single panel may become damaged and require replacement. In the case of rooflights in particular, it is known that a rooflight will deteriorate over time due to the action of ultraviolet light, a typical rooflight of older manufacture (having no surface protection) needs to be replaced after around 15-20 years in the UK. The opaque panels of asbestos or fibre cement for example will last considerably longer than this, and since it is not necessary or economic to replace all of the roofing panels only some of the panels in the roof are replaced.

The replacement of only some of the panels is problematic because of the overlapping and underlapping arrangement of each roofing panel relative to its neighbours. It is also problematic because the roofing panels are initially fitted from above the roof, so it is easier to replace a roofing panel also from above the roof.

The roof of a commercial or industrial building is typically many metres above the ground, and special equipment is needed to access the roof from above. Also, the roofing panel which is to be replaced will often be some distance from the
edge of the roof, so that it is necessary for the operators to be supported by the roof.

Clearly, the replacement of a roofing panel from above represents a considerable health and safety risk. The health and safety risk can be minimised by using scaffolding or the like to access the roof, and by preparing walkways across the roof, but the cost of doing so is typically several thousands of pounds, which is significantly greater than the cost of the roofing panel(s) which are to be replaced.

To avoid the cost associated with accessing the roof from outside the building, and to avoid the risks thereof which are still present even if minimised, it has been desired for a number of years to find a method which allows a roofing panel to be replaced from inside the building. Thus, whilst it is understood that it will inevitably be necessary for the operator to gain access to the roof at a considerable height above the floor of the building, it is much easier and safer to gain that access from within the building than outside the building. Also, if access is obtained from inside the building there should be no reason for the operator to stand or walk upon the roof, and the requirement for the roofing panels (which may be many decades old) to support the weight of the operator(s) can be avoided.

SUMMARY OF THE INVENTION

The present invention provides a method and set of components which can be used to replace a roofing panel from inside a building.

According to the invention there is provided a method of replacing a roofing panel comprising the following steps:

A. Identify a roofing panel to be replaced;
B. Locate a working platform underneath the roofing panel;
C. Remove all of the bolts and fasteners securing the roofing panel;
D. Remove the roofing panel from the roof to create an aperture in the roof;
E. Prepare a replacement roofing panel, including forming holes for the bolts and fasteners;
F. Fit a series of first bolts to the bottom edge of the replacement roof panel, the first bolts incorporating a threaded sleeve;
G. Fit a series of second bolts to the bottom edge of the roofing panel above the aperture, the second bolts incorporating a threaded element;
H. Locate the replacement panel in the aperture and align the first bolts and the holes therein with the respective holes and second bolts in the roofing panels below and above the aperture;
I. Locate a fixing element upon each of the threaded sleeves and threaded members, and tighten the fixing elements to secure the replacement panel to the roof;
J. Fit side fasteners into the aligned holes along the side edges of the replacement roofing panel and the adjacent roofing panels.

Preferably, a sealant is located between the overlapping edges of the replacement panel and the adjacent panels. The sealant may be applied before or after step H, depending upon the sealant and its method of application.

Desirably, in step E the removed roofing panel is used as a template for the holes in the replacement panel.

In a roof comprising roofing panels of fibre cement or asbestos, the fixing element comprises a hook element adapted to locate around a purlin of the underlying roof structure. Preferably the hook element comprises a length of threaded bar and a hooked sleeve which can locate thereupon.

In a roof comprising roofing panels of metal, the fixing element comprises a cap member adapted to engage a part of the purlin of the underlying roof structure and to accommodate a part of the threaded sleeve or threaded element.

In some applications for roofs comprising panels of fibre cement or asbestos the method includes the additional step of taper cutting one corner, said corner being
the upper corner which would otherwise lie between the corners of adjacent roofing panels. Alternatively (or additionally), a third bolt is fitted to one or both of the opposed corners where the replacement panel will lie between the corners of adjacent roofing panels. The third bolt has means for its temporary location in the corner hole of an adjacent roofing panel.

In applications for roofs comprising panels of fibre cement or asbestos, it will be understood that the bolts of the existing roofing panel are typically hookbolts which are accessible from inside the building, so that step C can be undertaken from underneath the roofing panel. In applications for roofs comprising panels of metal on the other hand, the bolts will usually not be accessible from within the building, and an additional step of cutting a hole in the roofing panel to be replaced is required before step C, whereby the bolts can be accessed from above the roof (with the operator working through the hole in the roofing panel). Ideally, the border of the roofing panel should be left intact and continuous, however, so that the removed roofing panel can still be used as a template for the replacement panel.

Also, the bolt holes through the metal roofing panels which are required to accommodate the bolts and other components of the present invention are usually larger than the existing bolt holes. It may therefore be necessary to drill out the bolt holes of the roofing panels above and below the roofing panel which is being replaced. Unlike roofing panels of asbestos, there are no health and safety restrictions when drilling out the bolt holes in metal roofing panels.

There is also provided a set of components for replacing a roofing panel, the set of components comprising:

a replacement roofing panel;

a number of first bolts, each first bolt comprising a bolt member, a first washer, a second washer, a threaded sleeve, a fixing element and a nut;

a number of second bolts, each second bolt comprising a first nut, a threaded element, a first washer, a second washer, a fixing element and a second nut, the
threaded element having a first end with a male thread and a second end with a female thread.

The set of components may also comprise at least one third bolt, the third bolt(s) comprising a bolt member, a first washer, a threaded sleeve with a collar, a threaded bar, a hook element and a nut. A third bolt has utility when it is desired to replace a roofing panel in a roof comprising panels of fibre cement or asbestos.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which Figs. 1-8 relate to a roof comprising roofing panels of fibre cement or asbestos, and Figs. 9-17 relate to a roof comprising roofing panels made of metal:

Fig.1 shows a schematic representation of a part of a roof having a series of roofing panels;

Fig.2 shows an exploded view of the parts of a first embodiment of a first bolt;

Fig.3 shows a view of the first bolt of Fig.2 in use;

Fig.4 shows an exploded view of the parts of a first embodiment of a second bolt;

Fig.5 shows a view of part of the second bolt of Fig.4 in its assembled condition;

Fig.6 shows a view of the second bolt of Fig.4 in use;

Fig.7 shows an exploded view of the parts of a third bolt;

Fig.8 shows a view of the third bolt in use;
Fig. 9 shows an exploded view of the parts of a second embodiment of a first bolt;

Fig. 10 shows a view of the first bolt of Fig. 9 in use;

Fig. 11 shows a part of Fig. 10 in larger scale;

Fig. 12 shows an exploded view of the parts of a second embodiment of a second bolt;

Fig. 13 shows a view of the second bolt of Fig. 12 in use;

Fig. 14 shows a part of Fig. 13 in larger scale;

Fig. 15 shows an exploded view of the parts of a fourth bolt;

Fig. 16 shows a view of the fourth bolt in use; and

Fig. 17 shows a part of Fig. 16 in larger scale.

DETAILED DESCRIPTION

A description of Fig. 1 is provided above and will not be repeated. The method of the invention is described below for the replacement of the rooflight 5, though it will be understood that a similar method could be used for the replacement of any individual roofing panel.

It will be understood that the top and bottom edges of the rooflight 5 are secured to the purlins 20 by respective lines of hookbolts 22, and the side edges are secured to the adjacent roofing panels 2 and 8 by respective lines of side fasteners which can for example be grommet-type stitch fixings 24.
The hookbolts 22 and side fasteners 24 are accessible from beneath the roof 10, i.e. from the inside of the building. Often the roof will be at least 5 metres above the ground or floor level, and so a suitable platform must be erected in the building in order for the operator to access the rooflight 5. In preferred applications a “scissor-lift” or a “cherry picker” is used as the platform, it being understood that these provide access to high locations without compromising operator safety.

Once the platform (not shown) is in place underneath the rooflight 5, the hookbolts and side fasteners are removed. Since the hookbolts and side fasteners are to be replaced it does not matter if the operator needs to cut or otherwise damage these components in order to remove them, but clearly care should be taken to avoid damage to the roofing panels 1-4 and 6-9, and ideally also to the rooflight 5.

Once all of the hookbolts and side fasteners have been removed, the rooflight 5 can be slid down the roof, i.e. over the top of the lower panel 4. This will release the top edge of the rooflight from underneath the bottom edge of the panels 6 and 9, and will release the side edge of the rooflight 5 from underneath the side edge of the panel 8. The rooflight 5 can then be retracted through the aperture in the roof 10 and into the building.

Ideally, the rooflight 5 which has been removed is used as a template to drill holes in the replacement rooflight 5A (Fig.3). The relative location of the two rooflights is assisted by the corrugations which nest together and act to hold the removed rooflight 5 in position on top of the replacement rooflight 5A whilst the fixing holes are drilled.

Typically, the fixing holes of a roofing panel are around 9.5 mm (3/8 inch) in diameter, and similar-sized holes are drilled through the replacement rooflight 5A.

Excluding the bottom right-hand corner where the bolt 22c was located, a set of first bolts 40 are fitted along the bottom edge of the replacement rooflight 5A.
As shown in Figs. 2 and 3, the first embodiment of the first bolts 40 comprise a threaded bolt member 42, a first washer 44 (which is typically of plastics or rubber in fibre cement or asbestos cement roofs), a second washer 46 (which is typically of metal plate conforming to the curvature of the corrugations), a threaded sleeve 50, a fixing element (comprising a threaded bar 52 and a hooked sleeve 54), and a nut 56. In another embodiment the nut 56 is replaced by a captive nut carried by the hooked sleeve, so that the nut is a part of the fixing element.

As shown in Fig.3, and according to method step F, the threaded bolt member 42 is passed through the first washer 44, then through one of the holes which has been formed along the bottom edge of the replacement rooflight 5A, then through the second washer 46. These components are secured by the threaded sleeve 50 which is screwed onto the bolt member 42, the sleeve 50 being too large to pass through the hole in the second washer 46. The sleeve 50 is tightened sufficiently so that the washers 44 and 46 are secured against the respective sides of the replacement rooflight 5A. It is arranged that the sleeve 50 is at least as long as the exposed threads of the bolt 42, so that when the sleeve 50 is tightened it presents a threaded aperture below the rooflight 5A.

Ideally, the threaded bolt member 42 and the threaded bar 52 are both of 6mm diameter, and it is recognised that the ideal length of threaded connection for such a bolt diameter is 9mm. The components are therefore arranged to ensure that the threaded sleeve 50 can cover at least 9mm of the threads of the bolt member 42 and the threaded bar 52.

It will be understood that at the position of the bolt 22d the corner of the rooflight 5 overlays the three adjacent corners of roofing panels 4, 2 and 1. A first bolt 40 is therefore also used at that corner of the replacement rooflight 5A, and the bolt member 42, washers 44, 46 and threaded sleeve 50 are fitted at that corner as described above.
Excluding the top left-hand corner where the bolt 22a was located, a series of second bolts 60 are inserted into the holes in the adjacent roofing panel 6, the operator working through the aperture in the roof 10 during this step.

As shown in Figs. 4-6, the first embodiment of the second bolts 60 comprise a first nut 62, a threaded element 64, a first washer 44, a second washer 46, a fixing element (comprising a threaded bar 52 and a hooked sleeve 54), and a second nut 56. Once again, in another embodiment the nut 56 is replaced by a captive nut carried by the hooked sleeve, so that the nut is a part of the fixing element.

It will be noted that as much as possible of the componentry of the second bolt 60 corresponds to that of the first bolt 40, and whilst that is not necessary it is preferable to reduce the number of components required.

As shown in Fig.5 the threaded element 64 has a first end with a male thread and a second end with a female thread. The second end of the threaded element 64 is outwardly flared to a dimension greater than the dimension of the hole in the second washer 46, so that whilst the remainder of the threaded element 64 can pass through the second washer 46 the flared end cannot.

As shown in Fig.6, and according to method step G, the threaded element 64 is passed through the second washer 44, and then through one of the holes in the bottom edge of the roofing panel 6. With the operator working through the aperture in the roof the threaded element 64 is held in position whilst the first washer 44 and then the nut 62 are fitted. The nut 62 is tightened sufficiently so that the washers 44 and 46 are secured against the respective sides of the roofing panel 6, and importantly so that only the flared end of the threaded member 64 projects below the roofing panel 6 and the second washer 46.

It will be understood that at the top-right hand corner of the aperture in the roof, at which the bolt 22b was fitted, the corner of the rooflight 5 lay below all three adjacent corners of roofing panels 6, 8 and 9. A second bolt 60 is therefore also used at that corner of the aperture, and the threaded element 64, washers 44, 46
and the nut 62 are fitted at that corner as described above. Accordingly, the threaded element 64 is long enough to accommodate three roofing panels 6, 8 and 9 between the first washer 44 and the second washer 46.

It will be understood from Fig.1 that at the corner of the aperture where the bolt 22a was located the replacement rooflight 5A is required to lie between the corners of the adjacent roofing panels, specifically between the corners of the panels 3 and 6. It may be the case that the replacement rooflight 5A is thicker than the removed rooflight 5, and unless it is possible to deform the adjacent roofing panels sufficiently to permit insertion of the replacement rooflight 5A therebetween it will not be possible to insert the corner of the replacement rooflight. In that case, the operator must remove the corner of the replacement rooflight 5A to beyond the bolt hole.

If the adjacent roofing panels are sufficiently deformable to allow insertion of the corner of the replacement rooflight 5A the removal of the corner of the rooflight is not necessary.

It will also be understood from Fig.1 that at the corner of the aperture where the bolt 22c was located the replacement rooflight 5A is required to lie between the corners of adjacent roofing panels 4 and 7.

If, at the corner of the aperture where the bolt 22a was located, the corner of the replacement rooflight 5A is removed to beyond the bolt hole, then a third bolt 70 (Figs. 7 and 8) may be passed through the holes in the adjacent roofing panels. This third bolt 70 should not be tightened until the replacement rooflight is in place since even if the replacement rooflight is not required to be inserted past the bolt hole it must still be inserted part-way between the corners of the adjacent roofing panels so that the integrity of the roof is maintained, and such insertion will not be possible if the corner bolt is tightened before the replacement rooflight 5A has been fitted.
If, at the corner of the aperture where the bolt 22a was located, the corner of the replacement rooflight 5A is not removed then the operator must fit a third bolt 70 to that corner. The third bolt 70 is shown in Figs. 7 and 8, and again makes use of similar components to the first and second bolts where possible.

The third bolt 70 is therefore very similar to the first bolt 40, and comprises a threaded bolt member 42, a first washer 44, a threaded sleeve 72, a threaded bar 52, a hooked sleeve 54, and a nut 56.

The threaded sleeve 72 differs from the threaded sleeve 50 in that it includes a collar 74. Otherwise the sleeve 72 can be identical to the sleeve 50, and is ideally of the same length as the sleeve 50.

As shown in Fig.8, the threaded bolt member 42 is passed through the first washer 44, and then screwed into the sleeve 72. The sleeve 72 is tightened sufficiently so that the washer 44 is secured. With the operator working through the aperture in the roof the assembly of the bolt 42, washer 44 and sleeve 72 is pressed into the hole in the corners of the adjacent roofing panels 6 and 7 at the fixing positions where the bolts 22a and 22c were located. It is arranged that the collar 74 is a tight sliding fit in the hole in the roofing panels, so that the assembly is retained by the frictional engagement of the sleeve 74 in the hole. Importantly, the sleeve 72 should not project into the (restricted) space between the adjacent corners of the roofing panels into which the replacement rooflight must be inserted.

When all of the fixings have been inserted as stated above, the replacement rooflight 5A is passed through the aperture to lie above the roof. If an appropriate sealant is used this may be applied to the replacement rooflight (or to the roofing panels adjacent to the aperture, as appropriate) before the rooflight has been slid into position. Alternatively, the sealant may be applied after the replacement rooflight has been slid into position.
If necessary, the replacement rooflight is slid down the roof so as to insert its side edge between the side edges (18) of the adjacent roofing panels 8 and 7. It is then slid up the roof so as to pass its top edge over the bottom edge 14 of the roofing panel 3 and underneath the bottom edge (14) of the roofing panels 6 and 9.

During this movement, the threaded sleeves 50 of the first bolts 40 (which are located along the bottom edge of the replacement roofing panel 5A) will slide along the top surface of the roofing panel 4, and the flared ends of the threaded members 64 of the second bolts 60 will slide along the top surface of the replacement rooflight. When the replacement rooflight 5A reaches its correct position the threaded sleeves 50 will enter the holes in the top edge of the panel 4, and the flared ends of the threaded members 64 will be aligned with the holes formed in the top edge of the replacement rooflight 5A. The roofing panel 4 is not shown in Fig.3, and the replacement roofing panel 5A is not shown in Fig.6, but it will be understood that when the replacement rooflight 5A reaches its correct position the roofing panel 4 lies beneath the second washer 46 in Fig.2, and the replacement roofing panel 5A lies beneath the second washer 46 in Fig.6.

In any desired order, the operator can then insert a threaded bar 52 into each of the threaded sleeves 50 of the first bolts, and can insert a threaded bar 52 into each of the threaded elements 64 of the second bolts.

If third bolts 70 have been used the operator inserts a threaded bar 52 into the threaded sleeve 72, taking care not to push the threaded sleeve 72 out of the hole in the roofing panel.

When all of the threaded bars 52 have been fitted the hooked sleeves 54 are placed thereupon, with the hook passing around a respective purlin 20. The nuts 56 are fitted and tightened to secure the bolts, and thereby the replacement rooflight 5A, to the purlins 20.
As described below, the set of components for replacing a roofing panel in a roof comprising panels of metal differs slightly from the set of components described above. The differences between the respective sets of components, and their effect upon the methods steps, are set out below, but the apparatus and method steps which are common to both roof types are not repeated.

Notwithstanding that Fig.1 shows a roof comprising roofing panels of fibre cement or asbestos, the same panel numbering 1-9 will be used in relation to a metal roof, for ease of understanding. Accordingly, in the description of Figs. 9-17 it is considered that the rooflight 5 is to be replaced in a roof comprising metal roofing panels 1-4 and 6-9.

As shown in Figs. 9-11, the second embodiment of the first bolts 140 each comprise a threaded bolt member 142, a first washer 144 (which is typically of plastics or rubber in metal roofs), a second washer 146 (which is typically a flat metal plate corresponding to the flat troughs of the corrugations), a threaded sleeve 150, a fixing element in the form of a (non-threaded) cap member 80, and a nut 156.

As shown in Figs.10 and 11, and according to method step F, the threaded bolt member 142 is passed through the first washer 144, then through one of the holes which have been formed along the bottom edge of the replacement rooflight 5A, then through the second washer 146. These components are secured by the threaded sleeve 150 which is screwed onto the bolt member 142, the sleeve 150 being too large to pass through the hole in the second washer 146. The sleeve 150 is tightened sufficiently so that the washers 144 and 146 are secured against the respective sides of the replacement rooflight 5A, the first washer 146 acting as a sealing washer for the bolt hole in known fashion.

It is arranged that the bolt member 142 is considerably longer than the sleeve 150, so that when the sleeve 150 is tightened the bolt member 142 projects a significant distance beyond the sleeve 150, as shown in Fig.11.
A series of second bolts 160 are inserted into the holes in the adjacent roofing panel 6, the operator working through the aperture in the roof during this step.

As shown in Figs. 12-14, the second embodiment of the second bolts 160 each comprise a first nut 162, a threaded element 164, a first washer 144, a second washer 146, a fixing element in the form of a cap member 80, a second nut 156 and a bolt member 142.

It may be possible to commonise some of the componentry of the first embodiment with the second embodiment, i.e. the bolt member 142 may be identical to the bolt member 42, and the threaded element 164 may be identical to the threaded element 64, for example. However, since the thickness of the metal roofing panels is considerably less than the thickness of fibre cement and asbestos roofing panels, such commonisation is less likely.

As seen more clearly in the enlarged section of Fig.14, the threaded element 164 has a first end with a male thread and a second end with a female thread. The second end of the threaded element 164 is outwardly flared to a dimension greater than the dimension of the hole in the second washer 146, so that whilst the remainder of the threaded element 164 can pass through the second washer 146 the flared end cannot.

As shown in Figs.13 and 14, and according to method step G, the threaded element 164 is passed through the second washer 144, and then through one of the holes in the bottom edge of the roofing panel 6. With the operator working through the aperture in the roof the threaded element 164 is held in position whilst the first washer 144 and then the nut 162 are fitted. The nut 162 is tightened sufficiently so that the washers 144 and 146 are secured against the respective sides of the roofing panel 6, and importantly so that only the flared end of the threaded member 164 projects below the roofing panel 6 and the second washer 146. (It will be understood that Figs.13 and 14 show a considerable gap between the second washer 146 and the panel 6, and a smaller gap between the first washer 144 and the panel 6, but that is for ease of understanding only, and in
practice the nut 162 would be tightened sufficiently to clamp the washers 144 and 146 against the opposed sides of the panel 6 before the replacement panel 5A is brought into position.)

It will be understood that one or more of the side fasteners 24 may be inaccessible from below, for example the fastener may overlie a part of the underlying framework. In that case, the fastener hole in the roofing panel 2 or 8 (as applicable) must be sealed against water ingress. The present invention provides a fourth bolt 82 for that purpose. As shown in Figs. 15-17, the fourth bolt comprises a threaded bolt member 84 with a very shallow bolt head, a first washer 144, a second washer 86 and a nut 162. Prior to location of the replacement roofing panel 5A a fourth bolt 82 is placed into each inaccessible hole in the roofing panels 2 and 8. Another fastener hole which is accessible from underneath the roof is drilled through the panels 2, 5A and 8 as applicable, as close as possible to the inaccessible hole(s).

When all of the first and second (and if necessary fourth) bolts have been inserted as stated above, the replacement rooflight 5A is passed through the aperture to lie above the roof. If an appropriate sealant is used this may be applied to the replacement rooflight (or to the roofing panels adjacent to the aperture, as appropriate) before the rooflight has been slid into position. Alternatively, the sealant may be applied after the replacement rooflight has been slid into position.

If necessary, the replacement rooflight is slid down the roof so as to insert its side edge between the side edges (18) of the adjacent roofing panels 8 and 7. It is then slid up the roof so as to pass its top edge over the bottom edge 14 of the roofing panel 3 and underneath the bottom edge (14) of the roofing panels 6 and 9.

During this movement, the threaded sleeves 150 of the first bolts 140 (which are located along the bottom edge of the replacement roofing panel 5A) will slide along the top surface of the roofing panel 4, and the flared ends of the threaded members 164 of the second bolts 160 will slide along the top surface of the
replacement rooflight. When the replacement rooflight 5A reaches its correct position the threaded sleeves 150 will enter the holes in the top edge of the panel 4, and the flared ends of the threaded members 164 will be aligned with the holes formed in the top edge of the replacement rooflight 5A.

In any desired order, the operator can then locate a cap member 80 over each of the threaded sleeves 150 of the first bolts 140 and over each of the threaded elements 164 of the second bolts 160. It will be noted that the outer dimension (typically the diameter) of the open end of the cap member 80 is larger than the hole formed through the purlin 120, and that the inner dimension of the open end of the cap member is larger than the threaded sleeve 150 and the threaded element 164, so that the cap member 80 can accommodate the threaded sleeve or the threaded element as applicable.

The closed end 90 of the cap member 80 has a (non-threaded) opening 92 there-through to accommodate the bolt member 142.

In the first bolts 140 a cap member 80 is placed over the exposed end of the bolt member 142, and the first bolts are completed by the addition of the nut 156. As the nut 156 is tightened the roofing panels 5A and 4 are pulled against the purlin 120.

In the second bolts the nut 156 is fitted onto the bolt 142 and rotated until it is close to the bolt head 96. The cap member 80 is placed over the exposed end of the threaded element 164. The bolt 142 is then inserted through the hole 92 in the cap member 80 and secured into the threaded element 164. When the bolt 142 is secured, the nut 156 is rotated so as to move it away from the bolt head 94 (it may be necessary to hold the bolt 142 against rotation by way of the bolt head 94 as the nut 156 is rotated), and during movement of the nut 156 the roofing panels 6 and 5A are pulled against the purlin 120.

In another embodiment the nut 156 is replaced by a captive nut carried by the cap member 80.
The side edges of the replacement rooflight 5A are secured to the respective side edges of the adjacent roofing panels 2 and 8 by way of conventional fasteners such as lap-locks. Instead of fitting the lap-locks from above as is normal practice the lap-locks are fitted from below. In place of specialised lap-locks, some users may prefer to use a second embodiment of second bolt 160 to secure the overlapping side edges of the respective panels.

The above description for metal roofing panels assumes that the panels are secured directly to the purlins (or other part of the roof framework) which is the most common assembly method. However, some roofs with metal roofing panels utilise spacers such as timber battens laid upon the purlins, and in such applications the first embodiment of first bolt, and/or the first embodiment of second bolt, may be more suitable. It should therefore not be considered that a particular embodiment of bolt is exclusive to a particular type of roofing panel, and an operator can determine the most suitable type of bolt for each application.
CLAIMS

1. A method of replacing a roofing panel comprising the following steps:
   A. Identify a roofing panel to be replaced;
   B. Locate a working platform underneath the roofing panel;
   C. Remove the bolts and fasteners securing the roofing panel;
   D. Remove the roofing panel from the roof to create an aperture in the roof;
   E. Prepare a replacement roofing panel, including forming holes for the bolts and fasteners;
   F. Fit a series of first bolts to the bottom edge of the replacement roofing panel, the first bolts incorporating a threaded sleeve;
   G. Fit a series of second bolts to the bottom edge of the roofing panel above the aperture, the second bolts incorporating a threaded element;
   H. Locate the replacement roofing panel in the aperture and align the first bolts and holes in the replacement roofing panel with the respective holes and second bolts in the roofing panels below and above the aperture;
   I. Locate a first fixing element upon each of the threaded sleeves and a second fixing element upon each of the threaded members, and tighten the fixing elements to secure the replacement panel to the roof;
   J. Fit side fasteners into the aligned holes along the side edges of the replacement roofing panel and the adjacent roofing panels.

2. The method according to Claim 1 in which the steps A-J are carried out in alphabetic sequence.

3. The method according to Claim 1 or Claim 2 in which a sealant is located between the overlapping edges of the replacement panel and the adjacent panels.
4. The method according to Claim 3 in which the sealant is applied before step H.

5. The method according to any one of Claims 1-4 in which, in step E, the removed roofing panel is used as a template for the holes in the replacement panel.

6. The method according to any one of Claims 1-5 in which the first fixing element and the second fixing element comprise the same components.

7. The method according to any one of Claims 1-6 undertaken upon a roof comprising roofing panels of fibre cement or asbestos, in which the fixing elements comprise a hook element adapted to locate around a part of the roof framework.

8. The method according to Claim 7 including the additional step of taper cutting one corner of the replacement panel.

9. The method according to Claim 7 or Claim 8 including the additional steps of {i} providing a third bolt having temporary location means, and {ii} fitting the third bolt to a corner of a roofing panel adjacent to the aperture, said corner being the corner where the replacement panel will lie between the corners of adjacent roofing panels.

10. The method according to any one of Claims 1-6 undertaken upon a roof comprising roofing panels of metal, in which the fixing element comprises a cap member adapted to engage a part of the roof framework.

11. The method according to Claim 10 including the additional step of cutting a hole in the roofing panel to be replaced before step C, whereby the bolts can be accessed from the working platform by way of the hole in the roofing panel.
12. A set of components for replacing a roofing panel, the set of components comprising:
a replacement roofing panel;
a number of first bolts, each first bolt comprising a bolt member, a first washer, a second washer, a threaded sleeve, a first fixing element and a nut member;
a number of second bolts, each second bolt comprising a first nut member, a threaded element, a first washer, a second washer, a second fixing element and a second nut member, the threaded element having a first end with a male thread and a second end with a female thread.

13. The set of components according to Claim 12 in which the first fixing element and the second fixing element comprise the same components.

14. The set of components according to Claim 12 or Claim 13 in which the fixing elements each comprise a hook element adapted to locate around a part of the roof framework.

15. The set of components according to Claim 14 in which the hook element comprises a length of threaded bar and a hooked sleeve which can locate upon the threaded bar.

16. The set of components according to Claim 12 or Claim 13 in which the fixing element comprises a cap member adapted to engage a part of the roof framework.

18. The set of components according to Claim 16 in which the cap member can accommodate a part of the threaded sleeve and can accommodate a part of the threaded element.

19. The set of components according to any one of Claims 12-18 including a third bolt, the third bolt comprising a bolt member, a first washer, a
threaded sleeve with a collar, a threaded bar, a hook element and a nut member.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Northern Ireland

Worldwide search of patent documents classified in the following areas of the IPC:

E04D

The following online and other databases have been used in the preparation of this search report:

WPI, EPODOC

International Classification:

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