

**J**ames Miller certainly left his mark on Scotland. As an architect for the Caledonian Railway he designed a number of Scottish stations, including those on the West Highland line. After setting up his own practice in 1893, he designed various notable buildings in Glasgow including the Royal Infirmary. Further afield, he devised the palatial interiors of the liner Lusitania, which was sunk by a German submarine, and, in 1910, won the competition for the design of the London headquarters of the Institution of Civil Engineers.

His output was prodigious and included commissions for station designs from his old employer, the Caledonian Railway. These included the elaborate glazed curved canopies of Wemyss Bay station and its walkway to the pier, when the station was rebuilt in 1903 to accommodate increasing numbers of paddle steamer passengers. He also designed the 1906 extension to Glasgow Central and its hotel.

#### Miller's extravaganza

It is therefore not surprising that Miller was chosen to design the new station at Stirling that opened in 1915. While there had been a station

at Stirling since 1848, as more lines opened, operated by different companies, the station proved inadequate. In 1889, the Caledonian Railway and North British Railway agreed to enlarge the station and sought powers for additional land. Yet work on the new station, which is essentially the current station, did not start until 1914.

The new station was described as a "crow-stepped gabled and crenelated façade to the street that hides a low, spacious and beautiful concourse, a miniature repeat of Miller's extravaganza at Wemyss Bay" when it opened on New Year's day in 1915.

In recent times, the station had a profusion of flowers and was judged to be the

best-presented station in Scotland in 1993. This tradition has now been reinstated by the Rotary Club of Scotland which recently adopted the station as part of ScotRail's 'adopt a station' scheme to encourage community involvement. Since then, the Rotary's plants have brightened up the station, although this was not helped by the dirty glass above.

#### Polycarbonate replaces glass

A hundred years ago the only material available to Miller to create his 'extravaganza' was glass. Today, six millimetre thick sheets of Makrolon® lightweight, self-cleaning polycarbonate provide a superior glazing material which, when used with the Twinfix Multi-Link Panel NF glazing system, is a non-fragile panel that can be quickly installed. The need for this was clear as an estimated one in six of the glass roof panels had been cracked as a result of vibration from freight trains and there were concerns that a damaged panel might fall onto one of the platforms below.

# Stirling WORK



DAVID SHIRRES



Although the Makrolon sheets used were a Georgian-wired cast-effect polycarbonate which is virtually unbreakable, Stirling City Council's planners were not convinced. Hence it took two years for Network Rail to obtain planning permission to re-glaze the Category A-listed Stirling station.

One concern was that polycarbonate would discolour over time and so would undermine the "architectural integrity" of the station. This was addressed by tests that demonstrated polycarbonate would not discolour in the short term and an agreement for ten-yearly inspections, following which any discoloured panes would be replaced.

The planners were also not prepared to accept the use of Twinfix standard 70mm glazing bars as the existing station bars were 50mm wide. To address this issue, Twinfix designed a new glazing bar and produced a 'mock up' using a 3D printer. This was shown to the planners, to convince them that this was acceptable, and was also used to confirm the dimensional tolerances of a glazing system incorporating the new 50mm bar.

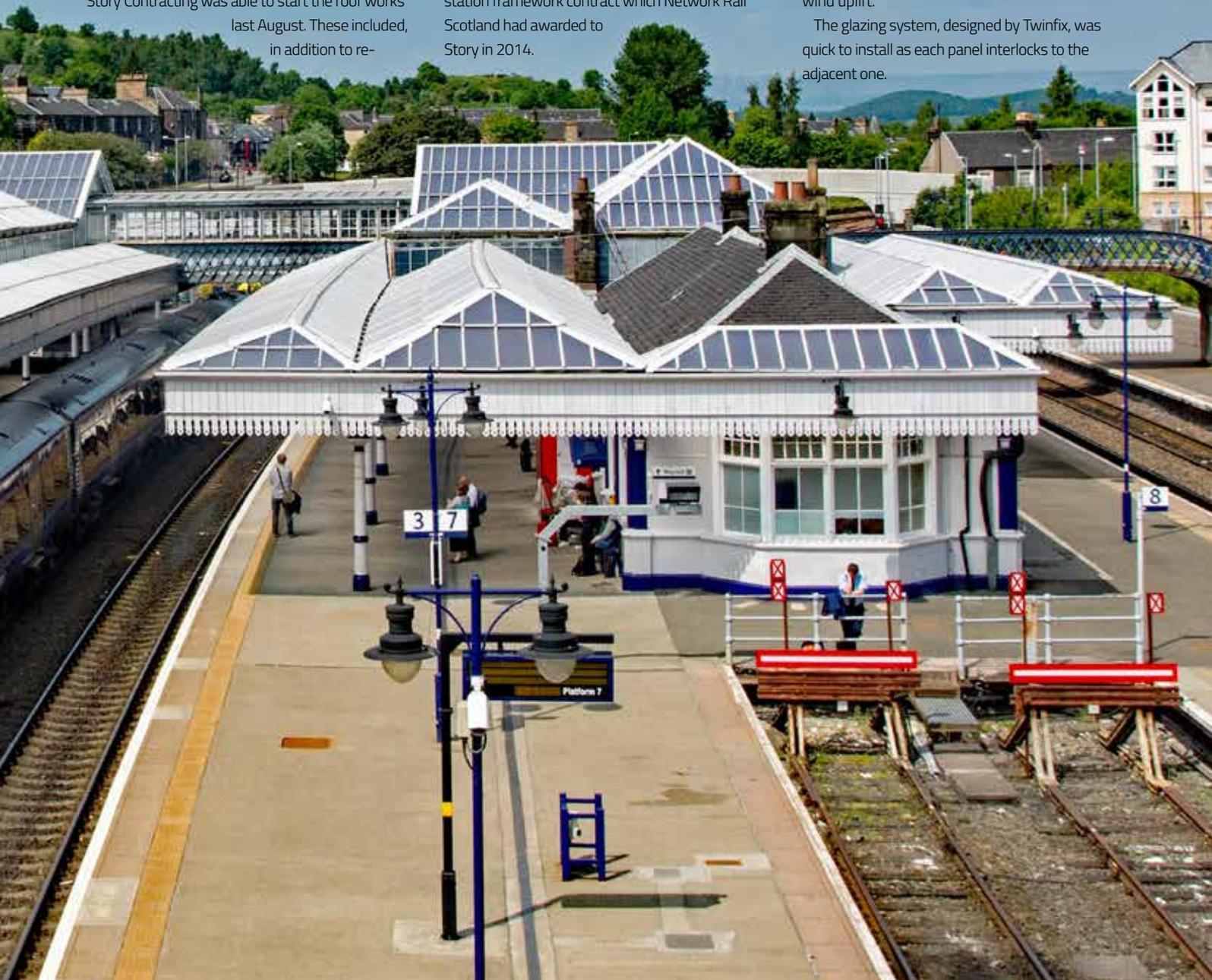
Once planning permission had been received, Story Contracting was able to start the roof works last August. These included, in addition to re-

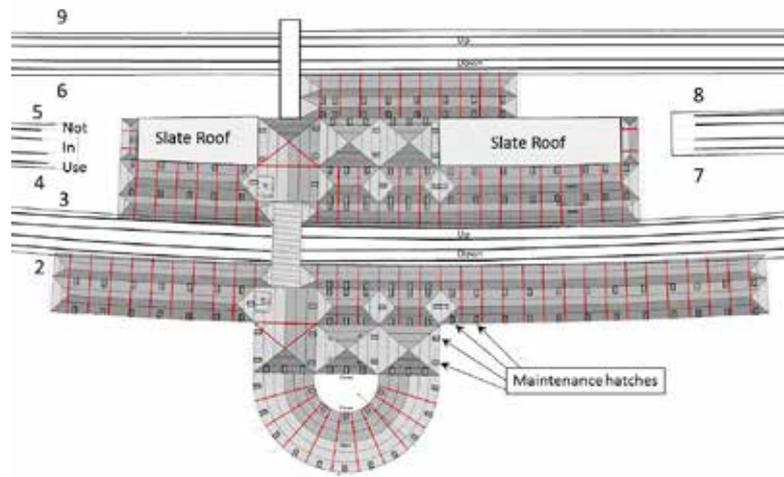
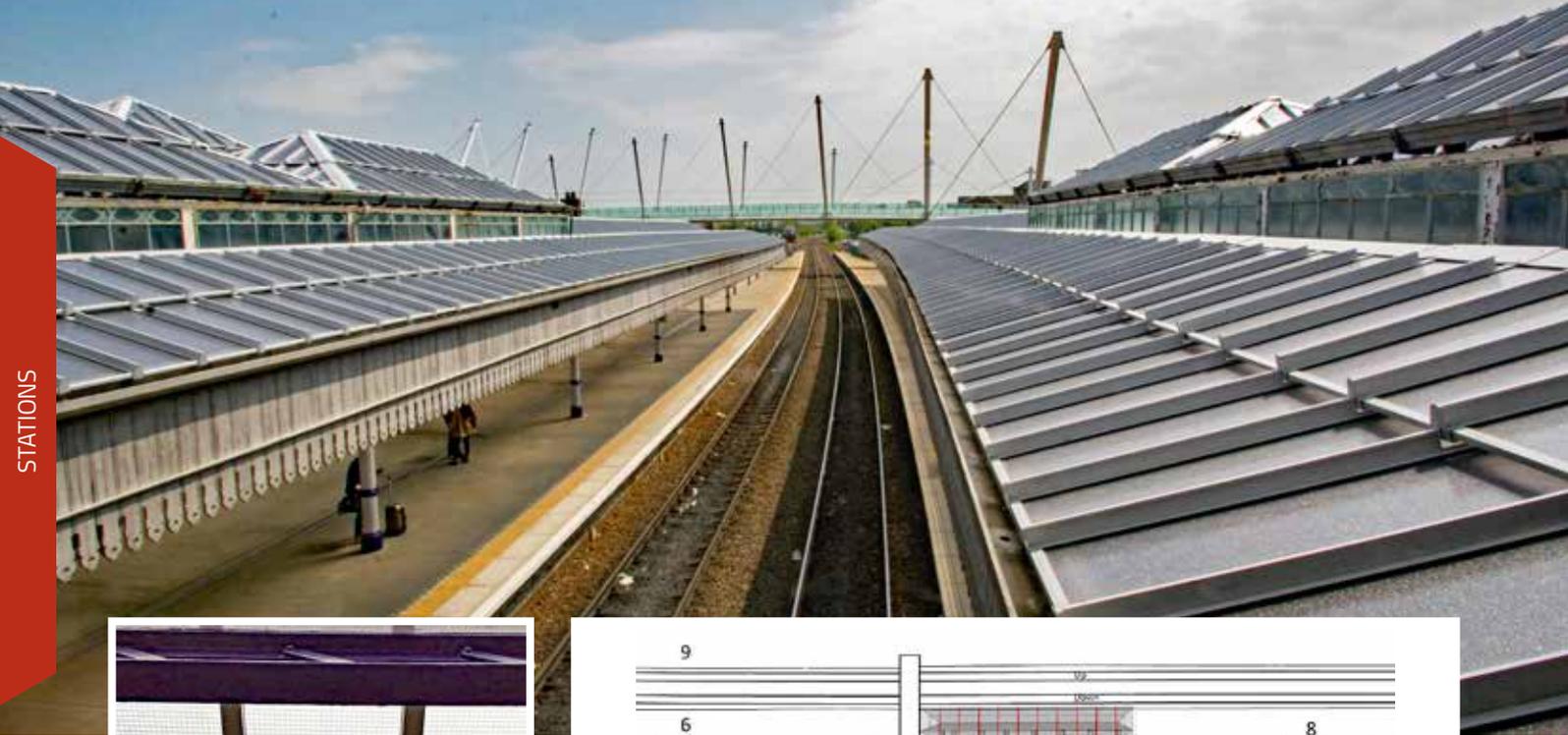


glazing the 2,440 square metre roof, inspection, repairs and painting of the supporting structure as well as relining cast iron gutters and cleaning downpipes, all at a total cost of £2.5 million. The design and execution of this work was part of the station framework contract which Network Rail Scotland had awarded to Story in 2014.

Story's designer was Arup, which was primarily concerned with the connection between the steelwork and the glazing system. As the polycarbonate sheets are much lighter than glass, particular consideration had to be given to wind uplift.

The glazing system, designed by Twinfix, was quick to install as each panel interlocks to the adjacent one.





### Roof access

A recent innovation is the roof access hatches (pictured above). These form an integral part of the glazing system and had been developed by Twinfix in response to a request from Network Rail that maintenance could be undertaken without the need to gain access above the glazing. At Stirling, 174 such hatches were installed at 4.2 metre centres from which gutter cleaning and other work can be carried out using six-foot-long omnipoles.

Story's rail director for Scotland, John MacArthur, considers that Stirling's historic station is not only a high profile project, but also one that presented some interesting challenges. It had originally been thought that the cast iron glazing in the round concourse area would be one of them. However, once the panel sizes were determined, it was found that they were all the same size as the circular glazing was geometrically perfect.

In contrast, there is a significant degree of non-uniformity of the supporting steelwork over the slightly curved platforms. This may have been deformed due to wind loading over the past hundred years but, whatever the reason, the result was that a significant number of glazing panels were of a non-standard size.

Hence Twinfix had a small installation team on site which cut individual panels to the required dimensions. John estimated that this was necessary for 10 per cent of the panels.

The original steelwork was generally in good condition and only required occasional localised repairs before painting. John felt it had been well maintained, perhaps as a result of Stirling being a relatively small and high-profile station. The paint used was a three-coat M24 epoxy protective system applied over the existing lead paint which had previously been prepared using power tools.

The roofing work was undertaken from a fully enclosed crash deck above the platforms. This was erected during a night station closure using rules of route possessions for work close to the platform edge. In this way, the 46,000 passengers who use the station each week were not affected and there were no platform closures.

### Maintaining sightlines

Stirling's slightly curved platforms did, however, present another problem as the crash deck scaffolding hoardings could potentially affect train despatch sightlines. In consultation with ScotRail, this problem was resolved by

closing off the area underneath the crash deck with heavy duty netting through which sight lines could be maintained. It was therefore possible to erect a larger area of crash deck than would otherwise have been possible, greatly improving productivity.

In this way, most of the work took place both during the dayshift and in a high street environment. However, possessions were required for the re-lining of the gutters using mobile elevating work platforms to work over the dagger boards.

Story completed its Stirling station roof work in June, two months ahead of schedule. John MacArthur considers that the key reason for this early finish was the use of a larger crash deck than was originally planned, the result of good collaboration between Story, Twinfix and ScotRail's station management team.

Above the city is Stirling's castle and its medieval town - one of Scotland's great tourist attractions. While it offers much for those with an interest in architecture, they should also venture below the castle to see the architectural gem that is James Miller's Stirling station. With its new roof, and flowers from the Rotary, it is certainly a sight worth seeing. ●



**TWINFIX™**

# Twinfix Georgian Wired Polycarbonate Non-Fragile Rooflights

**Twinfix is a family run business. As experienced innovators they offer a range of well-engineered glazing products, many of which are fitted on the roofs of Rail Stations and Depots.**

The Multi-Link-Panel installed by Story Contracting at Stirling Station in Scotland is an aluminium-framed, modular rooflight system, designed with a unique fixing method that results in incredibly quick installation times.

In order to drive efficiencies within their work in rail Twinfix have utilised up-to-date 3D printing to aid product innovation and development, employing this new technology to view a 3D model of a revised Multi-Link bar design for use in future rail applications.

For ease of specification the Multi-Link-Panel is available as a BIM object for download in IFC and Revit formats from the Twinfix website.

The Twinfix collaboration with Story Contracting on Stirling Station is a great example of Twinfix Georgian wired effect polycarbonate in their Multi-Link Non-Fragile panel. The polycarbonate glazing looks the same as the traditional Georgian wired glass but will not break.

The benefits of this system are:

- Safe in use: All Multi-Link-Panels pass the ACR[M]001:2014 drop test, in accordance with HSE recommendations, with a 'B' designation.
- The Twinfix Georgian wired grade solid polycarbonate is particularly popular as it mimics Georgian wired glass.
- Polycarbonate absorbs vibrations without cracking, crazing or breaking.
- The aluminium framework can be powder coated to a RAL colour to suit your project.
- The light weight of the finished product results in less stress to the fabric of original buildings.
- Sleek in-line access hatches (developed at the request of Network Rail) offer unobtrusive and safe access through the glazing for maintenance purposes.
- Factory manufactured rooflight panels means no costly mistakes on site.

For more information contact us on:

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