Battle of the Bulge

Earlier this year, at Glaziers Hall, I gave a talk about the East Window at St Paul's Church, Rusthall, by Thomas Ward. The window had remained virtually untouched since its installation, along with storm glazing, in 1855. The stained glass was severely bowed – one of the worst cases I had seen in 30 years, but my talk focused on the early Winston glass rather than on the bowing problem. Following the Conference there was a keen interest in the bowing and I was asked, many times over, to explain how I had dealt with it.

My Rusthall work was completed several years ago, since when some important changes in opinion and methodology have taken place. In September 2004, new Guidelines for the Conservation of Stained Glass were approved by the General Assembly of the International Corpus Vitrearum (see BSMGP *Journal*). Paragraph 4.5.2 of the Guidelines clearly and unambiguously states 'soaking and/or warming of stained glass panels is not acceptable'. I am a little surprised that this seems to be 'writ in stone' as I would have thought a good case could be made for some variation, in exceptional circumstances. The Rusthall window is not in a museum environment. Indeed it had been subjected to extremely high temperatures almost daily for more than a century.

However the directive leaves me somewhat in a quandary as I had, in fact, used warming on the Rusthall glass, and clearly I cannot now promote the use of such a method. I shall therefore touch only briefly on the technique used, and the reasoning behind it. I will also set out some thoughts on the general problem of bowed windows, as very little seems to have been written previously on this subject. Many of us have to restore bowed windows from time to time, and every case is different, needing to be looked at and dealt with individually.

First it is important to ascertain the cause and at Rusthall I identified four main factors, all contributing to the bowing:

1. Inadequate support system: Saddlebars spaced too far apart – especially in the wider centre light. All the tie wires had survived, holding the stained glass firmly, but severe bowing occurred between each pair of bars.

2. Thermal expansion: Daily cycles of wide temperature variations (making glass and lead too hot to touch) due to air trapped by the unventilated storm glazing. Bowed windows are most often found on the sunny side of the church.

3. Tight installation: Border leads had been cut right back to the heart and the panels were 'shoe-horned' tightly into rebates. Copious amounts of the new Portland cement, used in the rebates and covering the fillet borders, made matters worse. The stained glass was held in a tight 'corset'. As temperatures climbed, expansion of the panels forced the medallions to buckle.

In a correctly fitted window the flanges of border leads coupled with weak lime-mortar will afford a little 'give' when the panels expand. Glazing grooves are best not fully packed with mortar. Pointing 10 mm or so deep is usually adequate, leaving a little space at the back of the groove to allow for expansion.

4. Design: Medallions, broadly circular shapes incorporating many small pieces of glass, were located between saddlebars with no support across the middle. Multiple, parallel, lead lines can also be vulnerable to bowing unless they are properly supported.

Other 'causes' to look for include:

5. Gravity: Heavily plated 'slab' windows can succumb to gravity after only a few years if the support system is not up to the job. Weight bearing down from upper panels can cause the lower areas to bulge. In some instances T-bars might be a good option.

6. Delamination/rusting of iron frames, T-bars etc.: This can cause compression – particularly along the bottom edges where dampness persists.

7. Movement of stonework through settlement or subsidence.

8. Bomb-blast dating from WWII: Windows could be 'sucked' out as well as being blown inwards.

9. Wind pressure.

10. Accidental damage or vandalism: e.g. a person falling, or leaning against glazing.

Documentation in the form of a pre-conservation report is essential. This will be needed by the PCC, architect, grant-aid bodies as well as the DAC in support of a faculty application.

A typical report will include:

– Probable/possible causes of the bowing.
– A note of all relevant alternative treatments with pros and cons for each option.
– Condition of leadwork.
– Condition of glass paint, and risks involved if this is unstable.
– Is the glass taut and under pressure, or loose and rattling?
– A record of all pre-existing breakages and cracked glass especially in places where leadwork is distorted.
– Details of support system, and condition of tie-wires.
– Any daylight gaps between lead and glass?
– Any glass protruding from leadwork?
– Condition of glazing cement inside and outside e.g. crumbling/powdery/eroded?
– Evidence of rainwater penetration? Adjacent sills/stonework might show telltale watermarks. Of course these might also be due to condensation or even to overwatering by the flower ladies. I use a roving spotlight to look over the interior surfaces; this often shows up a multitude of problems that cannot be seen in normal lighting
– Recommendations, with reasons.
– Estimated costs.

Flattening, of course, has the major advantage of retaining the original leadwork. This has to be carefully weighed against concerns that some techniques could result in more damage to the glass than full releading. In the majority of cases it is probably best to take no action at all unless the glass is in danger of collapse, or otherwise compromised, in the short term. Few cases of bowing fall into the 'emergency attention' category and it might be appropriate to leave things as they are, but to monitor regularly.

Before recommending intervention, consider the risks and problems involved:

– Is the glass very fragile? With medieval and also thin eighteenth-century glazing, flattening and/or releading might not be an option.
– Medieval lead must be retained and conserved.
– Might partial releading be an option? Perhaps renewing just border/division leads, and of course all wire ties.
– Any special difficulties in removing the glazing from its setting?
– If the bowing is limited to part of the window, could individual panels be removed for attention?
– After removal are the panels likely to flatten readily by simply placing on the bench to allow gravity to work? This can be helped by brushing/raking out the remains of brittle or powdery leaded-light cement. A good dust mask and extraction system will be essential for this (orange flecks in the dust will indicate highly toxic red lead oxide). Flattening by gravity can sometimes be a very slow process. A padded board on the panel, with light pressure over a suitable time, might sometimes be appropriate.

In the case of Rusthall, the leaded-light cement had set solid. Thanks to the storm glazing, the 150-year-old leadwork was in pristine condition and clearly releading was out of the question. However, the panels would not respond to normal flattening techniques and attempts to apply pressure would endanger the glass. The exceptional bowing was serious enough to be causing widespread cracking and clearly a different approach was called for. I carried out tests on a sample of the leaded-light cement taken from between division leads. This was black, brittle and still capable of functioning well. It was rock hard – enough to resist quite strong pressure, but when heated it softened and became malleable.

On the strength of this test I decided to warm one of the panels with an electric heater, blowing warm air across the panel. This softened the 'cement' allowing the panel to 'relax' and slowly flatten, and this process was repeated on the other panels. Progress was slow, taking more than 4 weeks for some of the worst-affected sections. After consultations the positioning of extra saddlebars was agreed, to provide better support. All tie wires were, of course, renewed. Exceptionally wide rebates in the stonework had completely obscured the plain outer fillet borders. By reducing the fillet width and replacing the 'flangeless' border leads, more flexibility was allowed for in the stone rebates. Upon refixing, weak lime-based mortar was used to provide a little 'give' against thermal expansion. Finally provision for good ventilation was made in the new external 'overglazing' to keep temperatures to safe limits.

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