Figure 1. St Mary's Cathedral from Hyde Park.

St Mary's Cathedral – Conserving a Sydney Icon

Stonework Consultant and Client's Project Manager, Jasper Swann, reports on the current program of stonework conservation at St Mary's Cathedral. The works, funded by the Catholic Archdiocese of Sydney, have been documented by TKD Architects and are being undertaken by HBS Group.

Story and photos by Jasper Swann

Brief History

The oldest continuing site of Catholic worship in Australia, Sydney's St Mary's Cathedral towers monumentally over the Harbour City's CBD oasis, Hyde Park. It is a landmark testament not only to the Australian Catholic faith, but also to Sydney's enduring devotion to its definitive building material – sandstone.

Governor Lachlan Macquarie laid the foundation stone of the first Catholic church on the site in 1821. In a somewhat simplistic Gothic style, it was extended in the decades that followed under the design and leadership of the eminent English architect and master of Gothic architectural correctness, AWN Pugin. All of Pugin's work, however, was unceremoniously undone in a great fire of 1865 which destroyed his creation.

The Cathedral that stands in its place today arose from the ashes of its predecessor under the hand of Pugin's understudy, William Wardell. Wardell had been a successful ecclesiastical architect in Britain before making his substantial mark in Australia. The first stones of the new Cathedral were laid in 1868 by Archbishop Bede Polding. Subsequent sections of works saw the main body of the Cathedral completed by 1928, and the twin spires at the southern end – in keeping with Wardell's original design – were added in 2000.

What stands now is the world's longest 19th- and 20th-century cathedral in the Gothic revival style. Influenced in its design by Notre Dame in Paris, it is characterised by rows of flying buttresses along its eastern and western flanks that mirror those that reflect in the waters of the Seine. On the north-eastern side of the Cathedral, these flying buttresses have deteriorated significantly and are the subject of the current scope of conservation works.

The Sacristy, which stands immediately to the northeast of the Cathedral, was one of the first buildings to be re-constructed after the great fire. Today, it, too, is undergoing important conservation works.

The Need for Conservation

No sandstone building of this scale can escape the inevitable need for conservation works as the stone deteriorates in response to a range of environmental influences. Various stages of stonework repairs have been carried out in recent decades, but when engaged to survey the sandstone fabric of the Cathedral in 2013, I found a significant amount of decay on a number of facades, particularly in the stonework in the clerestories and in the bell tower. Carved cornice stones have frequently lost their nosings, allowing accelerated decay of the carvings below, (**Figure 2**); parapet copings have failed, (**Figure 3**); decorative string courses, finials and friezes exhibit advanced disaggregation and exfoliation. Allowing such decay to go unchecked will lead to accelerated decay of the stonework. So it was clear to me, after clambering across every roof top, walking every parapet and ascending every winding staircase to closely inspect the stonework, that a staged program of works was needed to continue to maintain and conserve the sandstone fabric of this iconic building.

Identifying those areas in most pressing need of work led me to two parts of the Cathedral: the flying buttresses over the northern section of the eastern aisle, where levels of deterioration had reached the point of having potential to affect the structural integrity of the clerestory; and the Sacristy, where deterioration of the cornice, due to a flawed integral gutter design, threatened to accelerate decay of the stonework below. There were many other works to

Figure 2. Deterioration of carved cornice cornices in the clerestory.

Figure 3. Failure of parapet copings leading to decay of the stonework below.

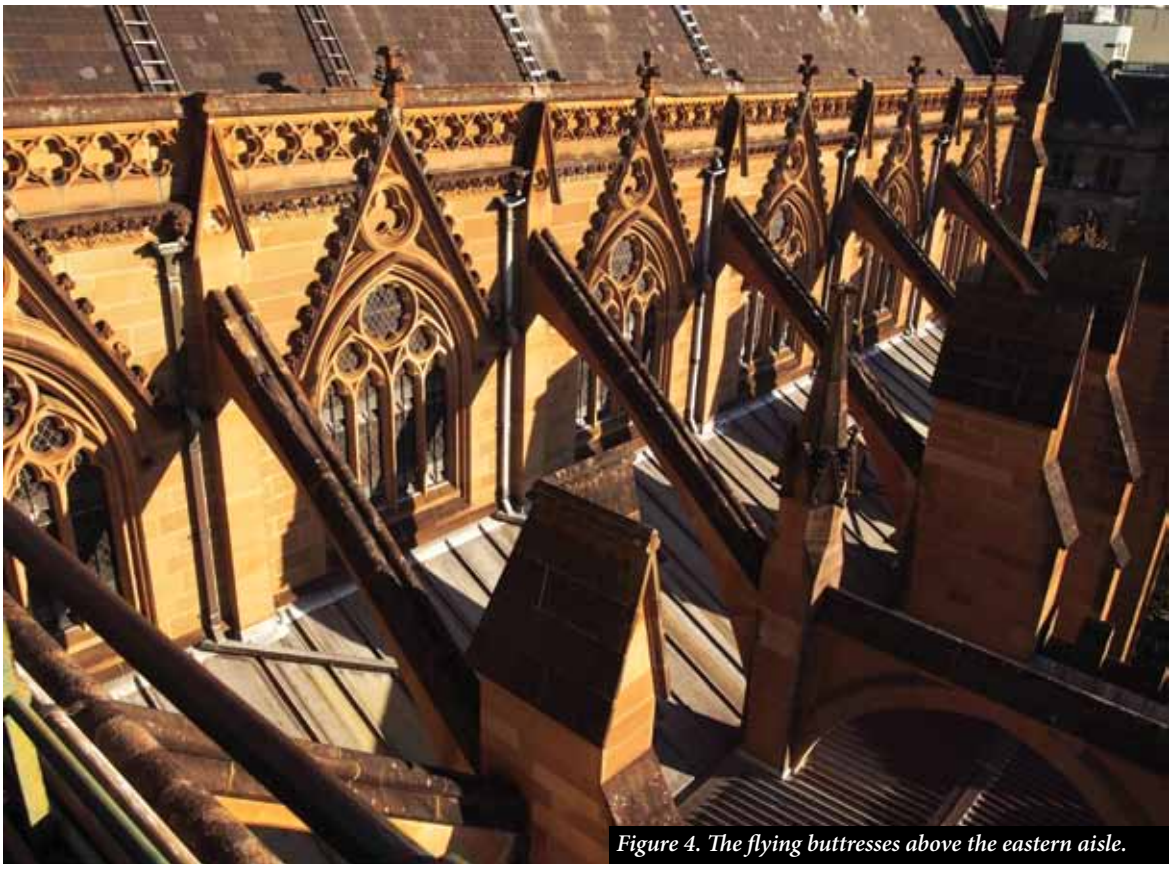

Figure 4. The flying buttresses above the eastern aisle.

be done, too, on other parts of the Cathedral, but with access costs at the forefront of staging considerations, this was where the next program of works would begin. The scaffolding required to access the northern portion of the Sacristy could readily be extended to access the flying buttresses.

Recognising the need for action, the Catholic Archdiocese of Sydney engaged TKD Architects to produce the documentation for the necessary stonework repairs to these areas. Mott Macdonald were engaged to provide structural engineering advice.

The Role of the Flying Buttress

One of the more spectacular elements of any Gothic Cathedral, these great arching stanchions serve to transfer outward thrust from the clerestory walls to a series of piers atop the aisle walls, (**Figure 4**). These piers then rise massively to gablet peaks. Some are topped with soaring pinnacles. Without the flying buttresses, the clerestory walls would collapse, and without the mass of the rising piers and pinnacles bearing downward to counteract these forces, the aisle walls themselves would collapse under the thrust transferred through the flying buttresses. There are, in short, significant forces and huge amounts of potential energy stored in the flying buttresses. A considerable challenge therefore arises when the condition of the stonework within them necessitates dismantling and reconstruction of any one of them.

Figure 5. Advanced deterioration necessitates replacement of this stone in a flying buttress.

Works to the Flying Buttresses

Of the six flying buttresses in the northeastern portion of the Cathedral, one possesses a stone at its centre that has deteriorated to the point of potentially compromising the structural integrity of the buttress in the foreseeable future. (**Figure 5 & 6**). Replacement of this stone is required to ensure its long-term stability. The remaining buttresses all need works – indents, desalination, mortar repairs, repointing – but nothing that requires their deconstruction.

When originally constructed, timber false work would have been supported on a scaffold bearing on the floor of the aisle below. Now, with the copper-clad

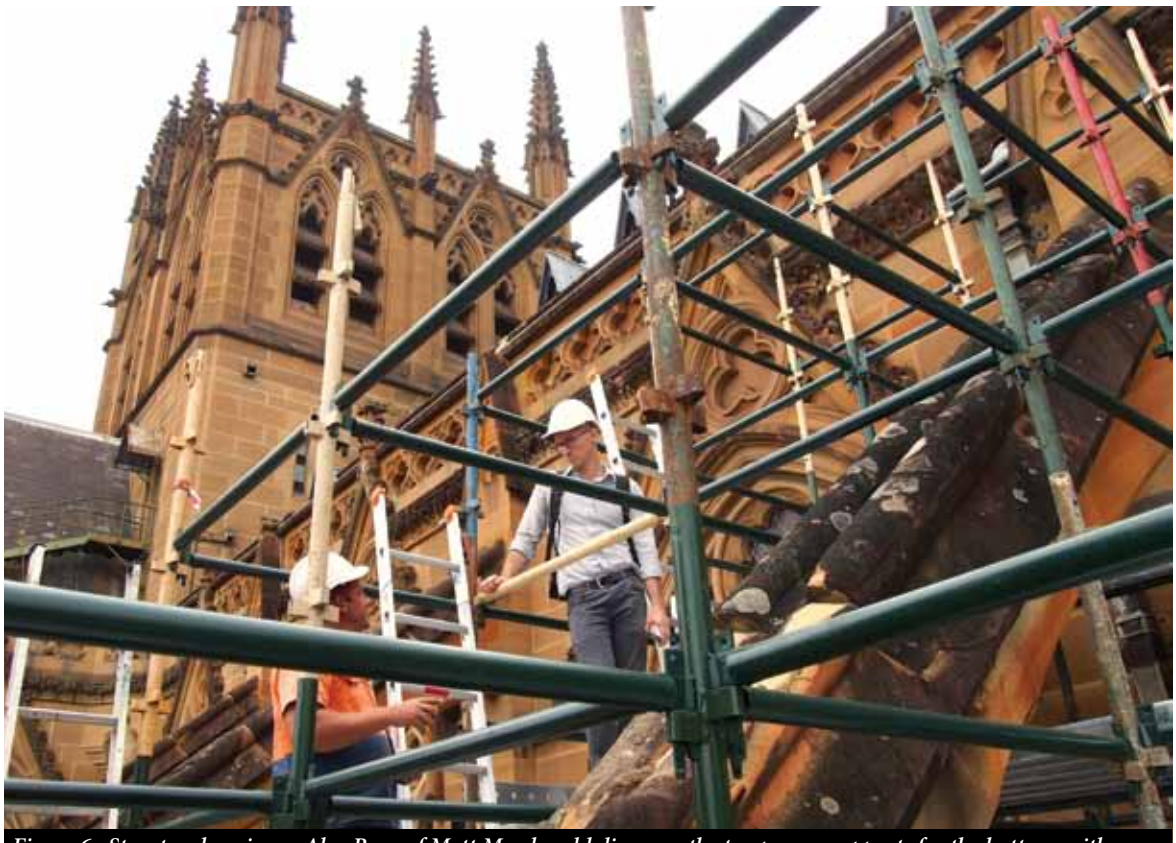

Figure 6. Structural engineer, Alex Been of Mott Macdonald discusses the temporary supports for the buttress with HBS' Tim Havilah.

aisle roof preventing this, an alternative means of supporting the buttress is required. To this end, structural engineer, Alex Been of Mott Macdonald, in discussion with myself and HBS site foreman, Tim Havilah, has devised a method in which the thrust transferred along the buttress to the aisle pier will be taken by temporary steel beams placed immediately either side of the buttress, whilst the live load of the stones within the buttress will be taken by timber false work supported on a steel beam spanning the aisle roof.

At the time of writing, these works are in progress. Deconstruction of the buttress should be straightforward enough. But its reconstruction will require great skill and care, placing stones weighing more than a tonne at a steep angle, with cranked joints, and working within small tolerances – joint widths are around 4mm between each of the stones that comprise the buttress.

Once reconstructed, and on completion of a range of less structurally invasive repairs to the other five flying buttresses, a lead weathering will be applied to all of them to protect the stonework from the weathering agents that have caused them to deteriorate. Whilst this will to some extent alter their visual appearance, it will greatly increase their lifespan and significantly reduce the likelihood of further conservation works being required over the next century.

Works to the Sacristy

The Sacristy lies to the northeast of the Cathedral, somewhat tucked away from the public view. The conservation of its stone facades and chimneys constitutes the greater part of the current stage of works.

Figure 7. Lead lined gutter incorporated into the cornice of the Sacristy.

In addition to the stonework repairs, it will receive a much-needed new slate roof as part of the works.

The cornice to the Sacristy exhibits an integral gutter detail not uncommon in stone buildings of this period. The same detail can be found, for example, in the Wardell-built wings of St John's College at the University of Sydney, and in the Old Melbourne Gaol, now of RMIT University.

Hollowed into the top bed of the cornice, the gutter drains along gentle falls to downpipes that pass through a series of carved bosses engaged in the cornice, (**Figure 7 & 8**). The gutter is lined with lead. On the face of it, it is a neat design that effectively hides the gutter from view when observed from the ground. In practice however, the detail in the Sacristy, (and elsewhere), has failed to consistently and effectively drain rainwater collecting in it. One of its weaknesses is its restricted fall between downpipes. Being worked into

Figure 8. Lead downpipe passing through carved boss in cornice.

the cornice, there is insufficient material to allow the introduction of more than a single step in the gutter in each long run. Overspill occurs during periods of heavy rain and penetration of water through the welted joints in the lead lining has caused deterioration of the carved bosses, the cornice itself and, in places where decay has gone unchecked, the stonework below. In addition, continuous long lengths of lead between downpipes, in the absence of steps, have cracked in response to diurnal forces of expansion and contraction This has allowed further water penetration and deterioration of the cornice and the stonework below.

The replacement of some of the worst-affected cornice stones was considered necessary to preserve the architectural integrity of the building. But to do so without rectifying the cause of their failure would not have been prudent. To that end, two design initiatives have been implemented which it is hoped will prevent recurrence of the historically common failure of this particular gutter detail.

In the first, a profiled hardwood timber batten will be secured to the upper chamfered surface of the cornice, effectively deepening the gutter by 100mm and significantly reducing any potential for overspill, (**Figure 9**). A copper stiffening edging strip will be applied, and a new lead cover and gutter lining installed over the whole.

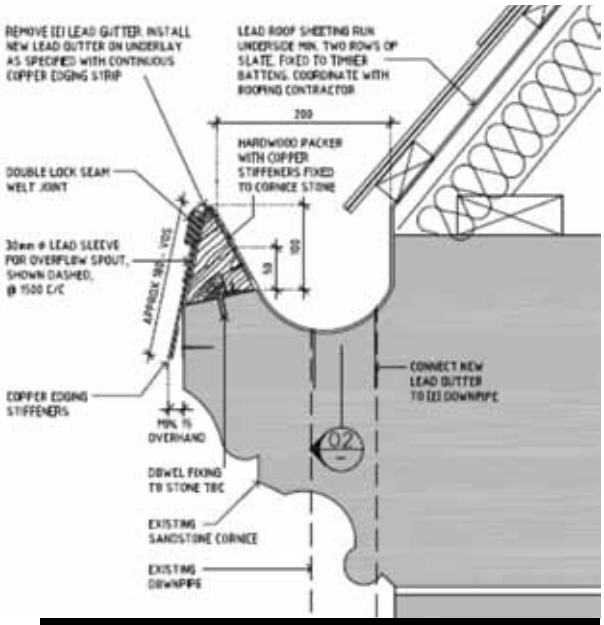

Figure 9. Detail for alteration to cornice gutter. Source: TKD Architects

Figure 10. Lead T-Pren neoprene expansion joint for use in gutter lining. Source: Britishlead.co.uk

In the second, to prevent seepage of water through joints in the lead lining, and to simultaneously overcome the potential for cracking of the lead in response to its expansion and contraction, Lead T-Pren neoprene joints will be installed in place of the traditional welted joints, (**Figure 10**). The neoprene rubber expansion insert is factory-bonded to the lead either side of it by a process of vulcanization. These joints offer a practical solution where restricted falls and existing architectural details prevent the introduction of stepped joints. Designed to perform in temperatures up to 100 degrees Celsius, and resistant to the effects of UV light, they are suitable for use in Australia. Nonetheless, as a 'belt-and-braces' measure, a lead covering will be installed over the neoprene to protect it from the harsh Australian sunlight. Introducing a welded seam at one end only will secure this additional protective cover adequately whilst still allowing it to move freely in tandem with the neoprene.

Both of the above measures provide a useful example of the need, now and then, to change an existing detail in a heritage building in order to improve its performance and longevity.

Use of 200 George St Sandstone

In any stone conservation project, the specification of the best available compatible stone for replacement and indent work is of great importance. Here, sandstone sourced from the development site at 200 George St, Sydney in late 2013 is being supplied by Gosford Quarries for all replacement and indent stones. (Refer 'Discovering Stone – in the Sydney CBD', *Discovering Stone* Vol 13 – Issue 25, March 2014).

This stone has been used in a number of high-profile conservation projects in the past year, and is being widely acclaimed by masons who have had the pleasure of working it as the best stone to come out of the ground in many years. Its excellent durability prospects, demonstrated through a series of extensive engineering tests, and its capacity for self-colouration make it the number one sandstone available at present for use in the conservation of yellowblock buildings. It is hoped that the current stockpile of the George St stone will be sufficient to supply future conservation programs at St Mary's Cathedral.

The Need for Future Works

The current program of works is just the first of a likely five stages of necessary conservation works to St Mary's Cathedral over the coming years. The Catholic Archdiocese of Sydney is committed to conserving its landmark spiritual headquarters, but is reliant upon internal funding and public donations to fund such works.