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# Making-safe Sydney's sandstone buildings within accepted conservation guidelines

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ABSTRACT: This paper considers the issues that arise from the need to maintain historic sandstone buildings in a condition that ensures public safety, and examines how current methods employed in achieving this in Sydney, Australia appear to be at odds with accepted conservation philosophy. The paper focuses on two major issues: (i) the current approach to making the sandstone elements of a significant building safe, and (ii) the introduction of new stone elements into a building – this often being a consequence of (i) – and the effects of this upon the significance of the building. It is hoped that the paper may encourage debate on this issue and assist in the development of alternative approaches.

## 1 SIGNIFICANCE OF SANDSTONE IN THE SYDNEY CONTEXT

Many of Sydney's early public, private and ecclesiastical buildings were constructed from the abundant local sandstone. The use of the material reached its peak in the late 19th century with the discovery of Pyrmont 'Yellowblock' sandstone. The majority of Sydney's prominent public buildings were constructed from this particular sandstone, characterized by its warm, honey-coloured appearance which has helped to establish the material as a quintessential determinant of the city's historic fabric and architectural character. The use of the material has played a critical phase of the city's architectural and urban development. Many of these buildings have associative significance with prominent architects of the day, but it is just as much their architectural aesthetic that comprises their significance. The appropriate care and conservation of Sydney sandstone in this context is therefore necessary to protect the historic built character of the city.

## 2 'MAKE-SAFE' PROCEDURES – AND THE PRACTICAL CONSEQUENCES

### 2.1 *Current practice and historical context*

In the early 1990s, it was reported that a piece of sandstone had fallen from the cornice of Sydney's Queen Victoria Building, injuring a pedestrian on the footpath below when it struck her on the shoulder. What fell was in fact a mortar repair, not a piece of sandstone, but the incident alerted building owners, local authorities and insurance companies alike to a danger that, until then, had not been foreshadowed.

In recent years, local authorities have required that 'make-safe' inspections be carried out on numerous sandstone buildings in Sydney to ensure adequate public safety, the key concern being protection from the danger of unstable or falling masonry in units that have been deemed to have become structurally unsound. Most recently, in 2007, this procedure has been carried out on the Sydney Town Hall, one of Sydney's most prominent and iconic sandstone buildings. This has been at the request of the City of Sydney Council and upon the recommendation of the New South Wales Department of Commerce Stone Conservation Team.

### 2.2 *Definition of 'make-safe' and how it is achieved*

It is generally accepted that a 'make-safe' inspection involves 'the removal of stone which is loose, easily removed or has the potential to fall', (Lloyd, 2006). The accepted method of 'making-safe' usually involves close inspection from a 'cherry picker' and, where deemed necessary, the removal of such pieces of sandstone that are deemed to present a safety risk. Typically, such loose material is found on the highly exposed and projecting elements such as parapets, cornices and string courses, as well as on more ornate elements, such as pinnacles and crockets. Commonly, and as

expressly determined in the example of the Sydney Town Hall, (Lloyd, 2006), a program of conservation designed to last 50 years provides the framework in which to determine the need for works.

### 2.3 *Conflict of contractual liability and conservation practice*

The burden of responsibility to guarantee public safety invariably falls upon the engaged contractor, who is usually a stonemason, and in this alone, a difficulty arises. Whilst architects, engineers and other professionals within the construction industry have little difficulty in procuring professional indemnity insurance, the stonemason will invariably find a distinct reluctance on the part of insurers to offer the same insurance. As a consequence, the contractor's safest bet in seeking to limit his exposure to potential liability claims is to carry out a heavy-handed removal of loose, or potentially loose, material.

There lies potentially herein an argument for engagement of a structural engineer to oversee the execution of make-safe works, but with the need for the engineer to accompany the mason from beginning to end and direct the works at every point, the exercise becomes one of great expense. On occasion this does occur, but frequently it does not. In addition, few structural engineers exist in Sydney with sufficient understanding of the material or expertise in stonemasonry – and these two coupled with an understanding of conservation practice – to be reasonably charged with the task. So in practice, an engaged engineer's approach is likely to be as heavy-handed as the mason's. The result of such an approach, which is prevalent in Sydney, is not only the loss of original fabric that could have been retained, but, more significantly, the consequential introduction of new stone elements in a greater quantity than may have been necessary.

### 2.4 *Economies of scale – a predictive approach*

The application of an 'economies of scale' philosophy has also meant that the wholesale replacement of cornices, parapets and string courses has become commonplace, on the basis that if certain stones of a given type have failed then others of the same type are also likely to fail and should therefore be replaced whilst accessible, again with an eye on the 50-year program. (Figure 1 shows the complete replacement of the parapet balustrade and cornice on the Australian Museum, Sydney). With access costs typically comprising a significant component of overall project costs, it is not difficult to see why this approach has become widely accepted. What is overlooked, however, is that it is impossible to guarantee the longevity of any one piece of sandstone, and who is to say that

Figure 1. Complete replacement of balustrade to 19th-century wing of Australian Museum, Sydney, (right). Note how the eye reads this building now as lower than the newer wing, (left), due to the change in colour of the sandstone at parapet level. The new wing was designed to appear equal in height to the old, but now appears taller. (Source: Author, 2007).

Figure 2. A portion of coping nosing 'loose and easily removed'. (Source: www.sydneymedia.com.au/html/3246).

a stone quarried, worked and installed in the 1870s might not last another 100 years, whilst its replacement in 2008 on the basis of the above outlined philosophy might fail within a shorter period? The structural qualities of sandstone are broadly determined via a series of recognized testing criteria, but it is not practical to test the qualities of each individual stone, and there will be variations across any bed in any quarry, resulting in some stones failing before others. In short, the economies of scale argument is based upon predictive rather than actual fabric analysis, and would appear to fall outside the guidelines of currently accepted conservation practice.

### 2.5 *Interpretation of procedure and examples of practice*

Stone that is 'loose and easily removed' is not difficult to identify. Figure 2 shows an example where the nosing of a parapet coping has clearly suffered from the effects of weathering. A portion of the stone has become partially separated from its substrate, which itself exhibits the effects of weathering within what had formerly been the crack betraying its separation. This is

Figure 3. Removal of stone having 'potential to fall'. (Source: www.sydneymedia.com.au/html/3246).

readily removed by hand. Stone that has 'the potential to fall', on the other hand, is less easily identified, and it is here that the contractor somewhat predictably deems that removal of more material rather than less will provide him with a greater security of cover against liability in the task for which he is engaged.

Figure 3 shows the effects of a typical heavy-handed removal of material having 'the potential to fall'. The example is taken from the Sydney Town Hall, but could have been taken from many of Sydney's prominent buildings in recent years. A thin discoloured band of perhaps 5–6 mm around the perimeter of the newly exposed and damaged stone indicates the extent of the crack that was visible to the contractor upon first inspection. What is clear from the clean and unweathered nature of the damaged and newly exposed substrate is that the piece of 'loose' stone in question was, in fact, quite well attached, and required the use of a hammer and pitcher to remove it; a force that would not have been ordinarily applied through the action of weathering alone. In this particular instance, accepted conservation measures, such as localized pinning and crack injection, followed by installation of a lead cover-flashing, could have protected the repaired stone from further weathering and stabilized this stone for many years to come. Such an approach would have not only constituted conservation in the true sense, but would also have met the Burra Charter guidelines for the conservation of structures: intervening only as much as necessary and as little as possible, (Article 3.1); and making use of all the knowledge, skills and disciplines which can contribute to the care of a place, (Article 4.1). The Burra Charter, adopted by the Australian National Committee of ICOMOS in 1979 and subsequently revised in 1981, 1988 and 1999, provides guidelines for the conservation and management of places of cultural significance.

In either of the above examples, one of the key questions to ask is, was the stone in question really structurally unsound in terms of the overall structure of the building? If not, then the case for carrying out less intrusive conservation measures to preserve the stone, (and vicariously those adjacent to it that might depend upon its functional capacity), would seem to be strong.

What the heavy-handed make-safe procedure more commonly precipitates is unsightly damage to otherwise structurally sound stones and the introduction of whole new stones in their place. In Sydney in particular, this is an issue that has considerable ramifications for the architectural aesthetic of sandstone buildings, which to a very large extent comprises their significance. In order to understand why this is the case, it is important to understand the properties of Sydney Yellowblock Sandstone.

## 3 SALIENT PROPERTIES OF SYDNEY YELLOWBLOCK SANDSTONE

### 3.1 *Geological and chemical properties*

Sydney Yellowblock is an oxidizing sandstone. When freshly quarried, it has a pale grey-white colour, but as moisture ('quarry-sap') within the stone moves to the surface, trace elements such as iron, silica and calcium are deposited at the surface (1–3 mm depth) in the form of iron hydroxide/oxide, silica and calcite, and their oxidization on reaction with the atmosphere leads to a yellowing of the surface through staining of the intergranular clays within the stone, (Gordon & Gibbons, 1970, Gibbons, 1983). The presence of siderite within the stone and its migration to the surface also contributes to the yellowing on exposure to the atmosphere, (Wallace, 1971). Within a short period after quarrying, (2–8 weeks), the stone has its characteristic colour. If, after a longer period, the surface colouration should be removed, the yellowing will not occur again, (Spry, 2000, and as observed by myself over 15 years of experience). In short, the stone oxidizes but once. The source of such sandstone therefore needs to be active, with stone moving swiftly from the quarry, to the masons' shop, to the work site. This was once well-understood and was the normal practice when Sydney's major public buildings were built. Today, however, this process appears to be less well understood, and there is deemed to be no suitable active source of Sydney Yellowblock, (though some useful and often suitable sources do exist, but are principally overlooked).

### 3.2 *Modern sources of Sydney Yellowblock sandstone*

With Sydney's 19th century quarries long since built over, the availability of suitable restoration stone has been an ongoing problem. In 1999/2000, Pyrmont –

Figure 4. Replacement of cornice and blocking course, Darlinghurst Law Courts, Sydney. Note the visually apparent reduction of building mass in the upper courses and overall interference in visual interpretation of the building's form. (Source: Author, 2007).


Figure 5. Art Gallery of New South Wales, with heavy replacement of stone in parapets. (Source: Author, 2007).

the now inner-city location of prominent 19th century Sydney sandstone quarries – was extensively redeveloped and the opportunity seized to extract large quantities of Pyrmont Yellowblock sandstone. The NSW Department of Commerce quarried and stockpiled 4500 cu m of the stone and immediately began an extensive program of restoration of Sydney's public buildings, fuelled not only by the sudden availability of 'the right stone', but also by the 'make-safe epidemic'. Today, the fact that the stone was stockpiled, (as opposed to being an active source), appears not to be regarded as a significant issue. Whilst the blocks have yellowed beautifully in the stockpile, when eventually sawn and processed by the masons, they retain little or no ability to oxidize. (Exceptions appear to be limited to stones of small dimension recovered from the deepest regions of individual quarry blocks, where small levels of oxidization have been evident).

### 3.3 *The effects of new stone upon the architectural aesthetic*

As a consequence of this limited ability to oxidize, many of Sydney's prominent stone buildings now exhibit large quantities of new elements of a readily distinguishable and much paler colour, greatly compromising the architectural aesthetic that comprises a considerable part of their significance, (Figures 4 and 5).

In Figure 4, the entablature of the Darlinghurst Law Courts is divided into two visually distinctive parts, with the cornice and blocking course having undergone almost wholesale replacement. The effect upon the observer's eye is a considerable reduction of building mass in its upper courses, disrupting the overall appearance of the building.

Figure 5 shows a similar example, at the Art Gallery of New South Wales. In both examples, the newly

Figure 6. New stone replacement in pediment springer and blocking course, Darlinghurst Law Courts, Sydney. (Source: Author, 2006).

replaced stones have had several years' exposure to the elements and it seems reasonable to conclude that they have no potential to oxidize and will ever remain almost white in colour.

Equally, the introduction of 'new' Pyrmont stone in lesser and isolated quantities can have a disfiguring effect upon a building, (Figure 6), and the occurrence of this in Sydney is widespread.

### 3.4 *'Reconstructed elements'*

The Australia ICOMOS Burra Charter defines new stone elements such as those exemplified above as 'reconstructed elements'. Article 20.2 of the Burra Charter requires that reconstructed elements should only be 'identifiable on close inspection'. Unfortunately, this is far from being the case in an increasing number of Sydney's important sandstone buildings. The significance of the Burra Charter as the principal guiding document for conservation works in

Australia cannot be under-estimated, and such an apparent departure from one of its key articles carries a risk of undermining the document's relevance.

## 4 POSSIBLE APPROACHES

In view of the above, it would seem reasonable to determine that alternative approaches need to be explored in order to:

i) identify more accurately the actual risk of injury from falling masonry;
ii) establish an acceptable approach to 'making-safe' that better complies with modern conservation philosophy (of doing as much as necessary and as little as possible);
iii) establish, if possible, an active supply of an appropriate oxidizing 'Yellowblock' sandstone; or alternatively;
iv) utilize proven methods of permanent artificial colouration of stone in order to adequately match the existing fabric, when new stone, for structural reasons, has to be introduced.

### 4.1 *Application of mathematical risk analysis models to quantify actual risk*

There is a danger in even discussing the matter of risk evaluation in this context of appearing to value the condition of a building over and above the safety of the public. It is, however, a fact that there is risk attached to all things, if sometimes infinitesimally small. It is probably not too long a bow to draw to suggest that a pedestrian on the footpath of one of Sydney's main streets is at a greater risk of being injured by a vehicle – thousands of which pass not three feet away from large numbers of pedestrians daily – than by a piece of falling masonry. Yet no one would suggest that crash barriers be installed along the curb-side of all Sydney streets.

Risks such as these are invariably quantified by those who insure against them and there would appear to be no reason why the risk of injury to a person through an act of falling masonry could not be quantified for any given building, particularly following a carefully documented make-safe inspection. Mathematical risk analysis models are used in a broad range of disciplines the world over for insurance and other purposes.

There are a number of variables that can be considered in determining the probability of a person being seriously injured by falling masonry, and investigation of these might yield sufficient pertinent data to be used in a workable mathematical risk analysis model. There would, of course, be costs associated with this, but these may even be found to be economical in the long term if the results were to negate the need for repeated make-safe inspections, which typically, once instigated, occur at 12-monthly intervals.

It would seem likely that the statistical probability of a significant injury to a person occurring in this way is extremely small. To my knowledge, no significant injury or death has ever occurred in Australia as a result of a loose piece of stone falling from a building.

To examine the detail of such models is beyond the scope of this paper, but I am currently in discussion with the School of Mathematics and Statistics at the University of Sydney to investigate how relevant, applicable and conclusive methods might be employed in this case.

### 4.2 *A revised and acceptable approach to make-safe methodology*

Notwithstanding the above speculation as to actual risk, it would seem reasonable to conclude that any stone element that might require the force of a lump hammer to remove it would be in little danger of becoming sufficiently loose – even on exposure to severe weather conditions – (and it should be noted that the City of Sydney never experiences frost) – to fall to the ground of its own accord within the 12-month period following inspection. It might therefore be an appropriate measure to remove only pieces of stone or previous repairs that are actually loose and can be removed with ease by hand as the principal act of a make-safe inspection. In this way, when a commitment to properly conserve the building is made and full access provided, those stones that require work that is not structural in nature can be appropriately conserved and the architectural aesthetic of the building preserved. In short, the introduction of new stone elements could be limited to those of structural significance, greatly reducing the number of replacement stones, (and, indeed, project costs), and thus helping to preserve the historic character of the building. If, in addition, acceptable risk analysis models as outlined above could be used to demonstrate negligible risk, then this low level of intervention could provide a means of satisfying both public safety and heritage significance criteria.

### 4.3 *Active supply of oxidizing sandstone*

Active quarries within the Sydney Basin do exist, and produce high quality oxidizing sandstones that in many cases provide a good match for Sydney's Yellowblock Sandstone. However, the uniformity of oxidization that is a characteristic of many of Sydney's prominent stone buildings is less present, and a reliance upon the application of a weak solution of hydrochloric acid is required to ensure this uniformity of colouration. This was a common practice in

the industry for many years. However, in the 1990s it became widely regarded as unacceptable practice and remains so, despite extensive evidence to suggest that the process is not harmful to the stone, (Spry 2000).

### 4.4 *Artificial colouration of stone*

The artificial colouration of sandstone has long been practiced in Sydney, and has been proven to stand the test of time. A method has been developed, (and patented), in which a ferrous oxide solution is applied by brush to the surface of the stone, followed by a weak application of caustic soda. The latter converts the ferrous oxide to ferric oxide, resulting in a permanent colouration that matches the desired Yellowblock very well. In 2008, there appears to be a need either for collaboration between parties who have patented this system and those who now need it, or for the development of alternative methods to achieve the same end.

## 5 CONCLUSION

Certain current practice in the conservation of Sydney's historic sandstone buildings, much of which stems from the need to address public safety, appears to be at odds with accepted conservation policy. The key criterion in determining how to conserve significant sandstone buildings seems not to be one of maintaining structural integrity whilst otherwise intervening as much as necessary and as little as possible, as the Burra Charter would require. My own considered opinion is that this should be the core objective and the end to which all implemented procedures lead. A significant old building has a place in the collective psyche of the community akin to an elderly statesman – omnipresent, familial, dignified, dependable – and this is how it ought to remain, wrinkles and all. We are all familiar with the effects of a series of facelifts upon a person who might otherwise have grown gracefully old, and it is almost universally discomforting to observe. There is a strong case for applying the same philosophy to avoid effecting the same consequence upon an historic building.

In Sydney, the effects of current make-safe procedures and the reconstructive works that follow them threaten the architectural and aesthetic significance of not only individual buildings themselves, but a determinant sector of the character of the city. There is, in my view, a pressing need for revision of current methodologies and there would appear to be realistic options to explore in pursuit of this.

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