Developing a Maintenance-focused Conservation Model, an Australian overview

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Abstract
Purpose – This paper presents a conceptual design process for developing a maintenance-focused heritage conservation model. Currently, there are several intervention approaches that can be applied in conservation; from reconstruction, restoration, and repairs to a ‘do-nothing’ approach. This paper examines whether a maintenance solution is more than just an option, but rather a necessity. The aim of the paper is to study the challenges and opportunities when putting more emphasis on the maintenance approach in conservation.

Design/methodology/approach - This research was conducted in an Australian context, where many major buildings were constructed from 19th and 20th century and are now categorized as ‘modern heritage’. Three case studies were undertaken to inform this paper and others, and in addition, seventeen global heritage conservation experts were interviewed and their responses analysed, and also comparative field observations and archival records were examined and used to develop the initial framework model. Finally, using focus group discussions amongst seven experts, the framework was reviewed and formerly validated in order to ensure development of a useful model for use is devising an effective maintenance management plan and for monitoring of condition in heritage buildings.

Findings - This paper supports others in a series that have already accepted by this journal focusing on research into heritage building conservation being conducted in Australia, the homeland of the Burra Charter. The other papers are entitled (1) Model for the maintenance-focused heritage building conservation; and (2) Engineering in heritage conservation.

Originality/value –The paper examines contemporary issues in heritage building maintenance and conservation in Australia, and focuses specifically on the lack of focus on maintenance as a conservation intervention for heritage buildings.

Keywords Heritage Building, Monitoring, Maintenance, Repair, Conservation Plan
Paper Type Exploratory Research Paper

1. Introduction
With the growing interest in, and awareness of, the importance of heritage buildings, there is an increasing demand to search for more innovative ways to retain the heritage fabric of such structures that involve minimal intervention, while maintaining structural integrity. Since this social pressure exists to keep heritage buildings from becoming derelict and being demolished, it is a critical juncture to develop an effective conservation strategy to retain such crucial buildings.

Over the years, the extant literature reveals that maintenance operations have been fairly insignificant in the traditional Conservation Management Plan (CMP) approaches as promoted in the Burra Charter. This appears to be due to the traditional CMP usually being a history-laden document that often does not contain any distinguishable specific Action Plan. Often, the Action Plan (even if included within the CMP), offers conservation options based on undertaking major repairs, restoration and reconstruction. At least in the Australia context, this view was supported from both the conducted in interviews and focus group discussion (Cruz, 2020).

For a substantial period, proper maintenance and monitoring have been known factors affecting service life and longevity for elderly buildings, especially for heritage structures. Maintenance neglect often causes major issues that increase the rate at which a building reaches the
point where it is deemed uninhabitable. This is more serious than the mere natural aging of the building, since abandonment of occupancy speeds up a building’s deterioration. With recently restored heritage structures, applied post-monitoring and maintenance processes help to ensure a longer and more sustained service life. Moreover, the survival of any building is importantly underpinned by regular maintenance (Armitage and Irons, 2013, Forster and Kayan, 2009). Many examples of existing heritage policies and guidelines for heritage conservation do not actually emphasize the critical importance of a maintenance component, which, most often takes the backseat of many conservation plans. In Brisbane, the Myer Centre features extensive façadism of several 19th century buildings. There are also numerous post-2000 CBD apartment/office blocks in Australian cities where a small portion of the façade of the original building has been retained and preserved, while the main structure has been largely demolished to make way for a new high-rise block. Another great example of façadism was the restoration of the State Capitol in California have failed to retain the authentic fabric of the architectural legacies of buildings under restoration because maintenance has been overlooked (Worsley et al., 1988, Cartwright and Belperio, 2012, Cruz, 2013). Often, conservation is only called for when the damage is already existing in the fabric of buildings being repaired and often previous major repairs are patently apparent; further, restoration, or reconstruction, efforts have sometimes resulted in loss of authenticity, and economic unsustainability among other social and environmental impacts (Wood, 2009, Levitt, 2013, Chanter and Swallow, 2007, Atkin and Brooks, 2009).

In Australia, there are many discrepancies in the rapidly evolving local building codes and standards, and these are often at variance with the current policies and guidelines for heritage protection (see Figure 1). In addition, there is the durability issue of modern heritage materials; these collectively and inevitably pose potential challenges for both conservation practitioners and stakeholders. The mismatch between the strict requirements of the current building regulations, the delicateness of building materiality and the rigidity of conservation policies are often causing building operators, engineers and realtors to shy away from involvement in heritage buildings (Normandin and Macdonald, 2013). In a climate of professional accountability, and responsibility for negative outcomes from heritage building repair work, many designers and building operators are not keen to risk their licenses because of risk and uncertainty (Custance-Baker and Macdonald, 2014).
While the most current update of the National Construction Code (NCC) establishes constraints regarding health, safety and sustainability, the Burra Charter promotes ‘minimal intervention’ as the prime consideration for any heritage buildings (Australian Building Codes Board, 2016, ICOMOS Australia, 2013). Normandin and Macdonald (2013) posit that the current building code requirements and the terms in the heritage building conservation charter are very demanding and often incompatible such as the NCC and the Burra Charter related to some of their provisions.

Further, despite the fact that current technologies are now so advanced in terms of their design, at the same time building construction is not flexible enough in relation to repairs and maintenance to cater for the compliance needs of heritage buildings as mentioned earlier. Whilst new digital and graphic design tools such as Building Information Modeling (BIM), Structural Health Monitoring (SHM), Building Codes and Standards are rapidly evolving, they are more often dedicated to use on newer structures rather than on heritage buildings (Forsyth, 2007). Their application to heritage buildings is often cumbersome and, so far, mostly only experimental. It is often more convenient to use traditional methods for heritage and traditional buildings which only a relatively small number of professionals and contractors are accustomed to, or experienced with, and they are decreasing in numbers (Star, 2010).

In Australia, heritage buildings are often outside the scope of most of the current Building Codes of Australia and the Australian/New Zealand Standards (Cartwright, 2011, Cartwright and Belperio, 2012). For example, in the case of the Brisbane City Hall restoration completed in 2013, the compressive strength of the structural concrete was already far below the limits indicated by the standards in the pertinent Building Code for concrete structures at that time (AS 3600). The engineers and architects who were engaged to undertake the design and supervision of the repair and restoration works were obligated by their professional ethical standards to bring the building up to the minimum safety requirements of the current Building Code. They thus had to evolve different operational methods beyond the traditional code of practice of that time. The engineers and architects of the Brisbane City Hall project needed to employ an independent consultant who was conversant with both innovative and traditional methods of repair and restoration, and the calculations and operational methodologies also needed to be checked and verified by an independent Structural Engineer and a specialist in the relevant faculty of the University of Queensland (Cruz, 2013).

Along with satisfying the structural requirements of the NCC, there were several other prerequisites to fulfill in order for the Brisbane City Hall to be brought back to a usable condition. These included essential damp and weatherproofing, minimum fire safety, health and amenity conditions, safety movement and access obligations, and energy efficiency requisites (AS 3826 -
1998, AS 3600, AS 1170.4 - 2007, AS 1170.1 - 2002, AS 1170 - 2002). These individual standards compliance requirements were far more challenging to address because of the restrictions imposed by other policies and guidelines, together with the Burra Charter requirements in Australia.

As time has moved on, more innovative and compatible repairs are being evolved, and there has also been some relaxation of standards, improvements to policies and guidelines that are all more applicable to heritage buildings. While operators and stakeholders involved in modern heritage development and maintenance projects await new policies and guidelines to be developed, it becomes clear that an appropriate and effective model for maintenance-focused Conservation Management Plans (CMPs) and monitoring needs developing to fill this vacuum. Such a model would greatly help to ease the current burden to all stakeholders of conserving modern heritage buildings. Maintenance-focused conservation at this juncture would allow more buildings to be retained and preserved, whilst retaining most of the original features and fabric of such buildings.

2. Developing the conceptual framework

Instead of applying traditional research methodological approaches, often embraced by the engineering disciplines – consisting of a realist, quantitative, deductive approach confined to purely structural exploration and validation – for this research a different approach was adopted to investigate and answer the research questions. This research utilises an interpretivist, qualitative, inductive, emic research paradigm, where the theory was generated after immersion within the collected data. This qualitative approach focused on the goal of seeking better ways to contribute to the conservation of modern heritage buildings. It involved the development of theories through a methodical gathering and analysis of data using an inductive methodology, which is in contrast to the hypothetical and deductive approaches of a purely quantitative methodology.

![Figure 2 Developing the initial concept model that puts Maintenance as a priority in Conservation](image)

In the early stages of this research, a number of interviews, case studies and onsite observations were conducted before to come up with an initial model as shown in the centre of Figure 2. This model, was critically examined by the focus group formed from seven international experts, and was conducted during the meeting of SAHC2016 in Leuven, Belgium. The model was carefully scrutinized and discussed, and subsequent improvements were made based on suggestions and opinions of the focus group, before it was confirmed and endorsed for compatibility in the current climate of conservation. Besides validating the model, the group also discussed other issues related to conservation in general, especially the specific advantages and constraints about maintenance as a priority for conservation.
3. Case Studies

By utilising the case study approach, some of the more dominant problems and issues, such as water ingress, and concrete cancer, in the conservation industry were also identified. The use of a case study approach also provided an overview of the challenges specifically encountered in preserving modern heritage buildings; thus, creating the potential to contribute a solution to these issues. The interviews with the experts provided an abundant source of important information and data. Some of the highlights were creating market for conservation, training development, and innovative tools in heritage conservation. The experts who participated in this data-gathering method providing significant knowledge to be used to bridge the research gap. Last, the focus group discussions served as the integrative process to reinforce this knowledge. The three case study buildings, in Sydney, Brisbane and Melbourne, which are all categorically modern heritage buildings, provided real-time data of the problems and practices on current conservation of some important modern heritage buildings in Australia. These three cases have shown that the difference in materiality – natural (such as stone, timber and slate) and synthetic (such as reinforced concrete and steel) – greatly influences the way that operators, specialists, contractors, architects and engineers, and especially facilities managers, should respond to the maintenance and monitoring of existing modern heritage buildings.

For the research described in this paper, the overall approach adopted a mixture of observations, case studies, interviews and, eventually, a focus group discussion; thus combining several complementary qualitative strategies (Groat and Wang, 2013). The case study phase consisted of open-ended interviews with experts, examination and comparison of archival records, and a focus group to validate and comment on the conceptual framework developed through the research. This strategic approach integrated multiple sources of evidence.

The three case study buildings were properly selected, the circumstances and details of the approaches and processes related to their rehabilitation and conservation analysed, and past repair records, plans and specifications were retrieved in order to provide a basis for comparison with other heritage buildings within Australia. Data gathering from the different case studies used methods such as document analysis of records and field inspections. Documents were selected and retrieved from the site repository and in the library and observations of the conservation operation were taken. On-site interviews with operators of the Brisbane City Hall and the Sydney Opera House were also used to inform the research. While these first two case study buildings, the Brisbane City Hall and the Sydney Opera House, showed that reinforced concrete buildings require more innovative maintenance, more complex repairs and upgrading to bring them up to the current standards, the Royal Exhibition building, which is made of more natural materials, fairs better and more traditional maintenance techniques and processes were able to be used.

The method and type of conservation used on the Royal Exhibition Building is relevant and appropriate for ‘ancient’ heritage buildings and its use could possibly with some adaptation, be extended to include some modern heritage buildings if they were built with from more natural and less synthetic materials. While this traditional approach it is more acceptable in buildings which are constructed of more natural materials, due to its durability, when it comes to reinforced concrete, steel, plywoods and other synthetic materials, the approach in maintenance and inspections needs to be more vigilant, in order to prevent corrosion and concrete cancer, similar to the approaches observed in the cases of the Sydney Opera House and the Brisbane City Hall.

Innovations and technology which are already currently available in the construction industry such as BIM and SHM, although being used in some cases in a somewhat limited way, re-
main to be further tested and refined before they can be applied to modern heritage buildings. Use of these new technologies and more innovative techniques would enhance the inspection and record-keeping capabilities of the that are needed to be applied in the monitoring aspects of conservation. These technologies could also enable a more dedicated and vigilant approach in looking after heritage buildings in future years to avoid their inevitable loss. However, due to current costs, and due to the unfamiliarity of these new approaches to traditional operators, their applications are currently fairly limited in the heritage building conservation arena.

CMPs have become an essential requirement for the robust protection of heritage stock, however, most of those examined in this research do not have any kind of action plan component, or even a detailed maintenance plan in some cases, that heritage building operators on site should easily be able to apply. Most of the conservation projects in Australia are based on the use of the requirements dictated by current general policies and guidelines that are more familiar to many of the repair and maintenance operators in the field; a more specific and detailed approach, and a training regime to expedite greater use of comprehensive Conservation Management Plans that contain full Action Plan and Maintenance is therefore critically needed if the current situation is going to be improved.

In the case of the Brisbane City Hall restoration, the CMP was not available before the commencement of works and as a result, consequentially this may have contributed to the eventual total cost of restoration amounting to AUD215M. As often the costs of restoration and upgrade projects are often relatively high, maintenance can be a better option to make conservation less expensive and more effective, especially in being able to retain the fabric and authenticity of buildings. The results examined from the case studies demonstrated that because maintenance had often been neglected, a more intrusive restoration approach subsequently had to be carried out. Comparatively, the total costs of repairs and upgrades applied to the case study buildings were almost equivalent to building new replacements as in the cases of Brisbane City Hall in 2013 and the State Capitol Building in 1988 restorations...

In the case of the Sydney Opera House, the designer (Jorn Utzon) was still living during the listing process; this provided a unique opportunity for the correction of defective detailing by re-engaging Jorn Utzon and his architect son, Jan, to contribute to the ongoing evolution of the building. (Burke and Macdonald, 2014). This situation has become the precedent for a movement to apply similar improvement drivers such as management of, and sensitivity to, change being applied to several 20th century architectural policies.

The Melbourne Royal Exhibition Building being maintenance oriented in its approach, will be the test case study for the model of a maintenance-focused CMP. Over the years, the building has undergone work to various areas and due to differing circumstances, has evolved from major repairs to a maintenance driven approach. It is anticipated that the future conversations around the work carried out to this building will help to emphasise the benefits of maintenance-based conservation that cannot be realised using the more traditional ways of conservation.

Those directly involved with case study buildings operation were also interviewed, particularly those specifically involved in any of the restoration work being carried out. As discussed previously, when other experts, who were independent of the case study buildings in the field of conservation were interviewed, they confirmed that maintenance should be given a priority in conservation. Their independent contributions, more importantly, also contributed to and informed the results of the case study research. It should be noted that the valuable opinions and comments from experts in heritage conservation, both here and abroad, are a critical aspect to further validate the initial conceptual model developed for use in promoting maintenance as a priority in heritage conservation.
4. Aspects of the Burra Charter as the conceptual basis (initial model)

In the most recent version of The Burra Charter (2013) restoration clauses were expanded offering a more detailed and defined process approach, the new processes were; (1) Understand the Place, (2) Assess Cultural Significance, (3) Identify all Factors and Issues, (4) Develop Policy (5) Prepare a Management Plan, (6) Implement the Management Plan and (7) Monitor the results & Review the Plan (see Figure 3 below). The last stage (Monitor the results) is an important addition to the charter and relates to an important post-operational element of maintenance. Up until this addition to the charter, this aspect of the maintenance plan was generally omitted, and as a result, many practitioners were unaware of the continuing obligations to follow through the conservation after implementing the CMP.

4.1 Understanding the Significance of Place

Kerr (2013) suggested that in order to understand the significance of place, firstly, the value of the structure to society and in history, needs to be identified. It is imperative to understand the concept of cultural significance enables effective decision making about its future. The concept of significance of place is the simple notion of assessing the importance of an architectural landmark and the impact and value that it contributes to the existence of those who live around it or utilise, or just even view it. This understanding is crucial to the planning process because it will enable conservators to make more informed decisions around retaining our structural lega-
cies, especially when making laws and policies that will protect them from being abandoned and demolished.

The interviews with experts revealed that most of the conservation plans documents were normally contracted by architectural historians, but that architects and even archaeologists normally end up preparing the conservation policy sections of the recovery plans. The Action and/ or the Implementation sections of the CMPs are normally prepared by either independent contractors, or internal owner’s personnel, who will normally opt for repairs and major restoration. Most of the times, the contractors do not have any regard for proposing maintenance as a major priority for conservation. Hence, one of the problems with most CMPs is that people tend to spend a lot of money on writing up a plan to comply with the standards and conservation requirements but they do not really implement any maintenance, so buildings continue to suffer due to deteriorating fabric.

One of the interviewees indicated that repair and maintenance operators contemptuously remarked that “...with a lot of buildings, the conservation plan is of more use if you take the documents and nail it over the hole in the roof to stop the water from coming in”. Fundamental things in a maintenance specification are: (a) to keep the water out from above, below and sideways of the buildings; (b) to keep pests out of the structure and preferably have somebody use the building and look after it to help it survive; and (c) secure the building so that the priorities can be worked out for the finer details of the maintenance. Once the building has been secured and made safe then what work is important can be done can then be considered, and a plan developed covering ways of repairing it in order to regain, or retain, its integrity. However, maintenance should not stop after stabilising and securing the building. Monitoring is thus crucial post-repair to alert operators to come back and follow-through with the necessary maintenance work.

The maintenance-focused CMP model developed from this study highlights ‘monitoring the results’, and ‘reviewing the plan’ as important sections of the new guidelines. First and foremost for any conservation, is not only to bring maintenance into the cycle of conservation but to prioritise it because monitoring is the essence of maintenance. Highlighting and introducing maintenance prior to the beginning helps to establish the benchmark of exactly what it is to be monitored, and this undoubtedly can make a lot of difference to prolonging the service life of any structure. Incorporating this important element into the approach means that the building condition reports and recommendations should be produced right at the very start of the cycle. However, there are restorations which start without a proper monitoring and maintenance plan before the major repair is started. In such cases, whilst less efficacious, the maintenance and monitoring can be introduced post restoration, especially on major projects.

This approach of having condition reports and maintenance recommendations for most heritage buildings was raised and evaluated in the focus group discussion. The group supported an approach similar to that of Monumentenwacht in the Netherlands, where a group of specialised heritage building inspectors will do the inspections of the heritage buildings on a regular basis at a subsidised rate. Employing a small number of people, spread over the large number of heritage buildings would make this sort of approach sustainable. The property condition reports and recommendations could be standalone documents, or could become part of the CMP. In some circumstances, where there are no major repairs involved, and a building can be conserved using a ‘maintenance-only’ approach, which then becomes a standalone CMP.

Currently in Australia, traditional conservation plans are not generally maintenance-oriented, even in cases of abandoned heritage buildings. Most dilapidated heritage buildings have been neglected because the operators are reluctant to undertake immediate pre-emptive maintenance. It might be because of limited budget or the operators feel that CMP is so complicated, if not restrictive, that might put them into some bureaucratic dilemma. There should be a fundamental process that when the heritage place has been defined and the policy has been worked out then it should have determination if the building is about to collapse. At a minimum, they should put some props to stop it from falling over or even put a covering over the roof, even if it is just a tarpaulin to keep the water out in order to stabilise and secure the building with the minimal intervention as possible.
Kerr (2013, p 34) suggested that what is at least required is a “maintenance manual specifying the cycles on which the various inspections should be performed and the procedures for necessary repair. It is, however, alert, intelligent and responsive supervision that does most to safeguard fabric. The most vital (and frequently neglected) tasks are those of ensuring that buildings are kept watertight by regular attention to roofs, roof gutters and drains, and that destructive pests are kept under control.”

According to expert interviews, the maintenance schedule usually comes in the last section of the CMP; however, often only a small amount of the detailed suggestions in it are found to be workable. Moreover, currently there are also lots of heritage developments that are being undertaken without a CMP. A good heritage impact statement that considers the significance of the heritage place, and how to protect the fabric of a building was considered a substitute by some local councils, because a CMP is a very research laden document, very expensive to undertake and develop, and is written in a language that not many people are accustomed to or fully understand. A CMP is not considered user-friendly by the builder, or manager of the heritage building.

Earlier CMPs do not necessarily have a full maintenance aspect included, because they focused mainly on assessing the historical significance of the building. Such plans were usually written by architectural historians, and so understandably, focused on providing an awareness on the structure’s historical background. History and significance are of course important, but it is unnecessary for builders, managers and development sponsors to have to read so many details every time there a repair intervention is being considered because that information whilst useful background, has no bearing on planning how to maintain the building or repair its fabric if damaged. Instead, according to Kerr (2013), the document should focus on what information is needed to prepare a schedule of conservation works in which all of the necessary maintenance issues and repairs are identified, and the necessary performance measures are effectively set-out for maintaining and retaining the heritage building over the longer term. This cycle should be reviewed at least every five years.

While a maintenance schedule does not necessarily have to be included in the CMP, there is a need for a separate maintenance plan that contains a good fabric analysis, to be developed and consistently upgraded at intervals that are associated with the CMP. According to the interviewees, some of the conservators are beginning to shy away from producing and using a traditional CMP. One interviewee indicated that:

“I don’t have much confidence in that type of document, I stop using it, when clients ask me to write a conservation management plan, I tend to convince them not to, I say do schedule of conservation works and find out exactly what is happening on all the elements in everything, the floor, the walls, the skirting and the ceilings and the lighting, the door hardware and the windows and doors, let’s find out what is happening, how is it performing, every five years you come back and update that and then you get a track record of how the building is progressing and your maintenance plan is associated with that, somebody go to look at it every five years and you can’t just do it once.”

In the absence of the traditional CMP, as long as there is a detailed schedule of maintenance and repairs works, and the work proposed within will not affect the significance of the building, then could be considered as conservation plan by itself. However it will still not be equivalent to a full maintenance-based CMP. In New South Wales, schedules of works for conservation maintenance and repairs are now being called the Conservation Management Document (CMD), which is a more effective name because this is an actual document detailing how to manage the
buildings under consideration for the next five to ten years, and incorporates a stipulation that such documents be regularly updated every few years.

A schedule of Conservation Works, and a Maintenance Management Plan are the two things that dictate the efficacy of operational conservation management of heritage buildings. One interviewee indicated that CMP is a misnomer:

“I won’t call it a conservation management plan, it’s just names, I don’t like to call it a conservation management plan, and I think that these items (5), (6) & (7) [Author’s note, these numbers refer to (5) Prepare management plan, (6) Implement the management plan and (7) Monitor the results & review the plan] are all that you really need on the ongoing management of that heritage facility. It’s about understanding the fabric, not necessarily the history, you must do the history first but once that is done then it is done and then the only part that is to be updated is (5), (6) & (7).”

Another of the interviewees who is responsible for the conservation management plan for one of the case study buildings, the Royal Exhibition Building, and whose company had commenced an AUD$20M project to refurbish it, stated that he had been undertaking conservation works for 30 years. He also mentioned that he had been involved with both maintenance and repairs many times, depending on the type of heritage building that he is working on. He stated that, “it is interesting. I mean we go back and look at project that I work in the Exhibition for 30 years, we go back and look at the project and what we have done and didn’t work very well, or that was the great approach, I mean it is part of the business.” He stated that his experience had been that when maintenance fails, repairs or restoration are most often blamed for the solution not always working well, similarly to surgeons and nurses observing patients after they have undergone operations, for buildings it takes a while for the operators to find out if it what has been undertaken will work well.

**Developing Policy**

To ensure the compliance of a maintenance-focused CMP, policies need to be in place to dictate what content and data pertinent to an effective restoration effort should be included. Often, a CMP will be created just in order to ‘tick a box’ on conservation requirements. As mentioned previously, the result of this approach is a CMP that is solely concentrated on discussing the history of the structure rather than a document that can be used as a strategic guide to the necessary preservation of the heritage building.

Expert interviews undertaken with heritage practitioners in Australia revealed that it has been a practice that many CMP’s have been prepared only to satisfy statutory requirements, not to save at-risk heritage buildings. Analysis of these interviews also indicated that CMPs have been used less and less in the last few years. There have even according to one interviewee, been instances where such statutory requirements did not even exist and yet still major restoration had taken place. Interviewees generally reported that some operators think it is a hindrance to carry out needed conservation action while others thought that it is actually what the purpose of the CMP is to control unwarranted restoration action. The case study of the Brisbane City Hall restoration was a good example wherein a current CMP was not available before the recent major restoration (Cruz, 2013, Interviews and Focus Group Discussion, 2016).

In cases where there had been no clear policy to cover the inclusion of maintenance in the CMP, then there was no obligation to be compelled to write the plan. Another reason for the non-inclusion of CMPs is the burden of the cost. Most often than not, when a need for funding
is involved, operators and specialists often tend to “overlook” the relevance and advantages of involving maintenance in the restoration plan. This lack of understanding of the crucial need for maintenance, given the resulting expense of ignoring it and opting to major repair and restoration, is one of the major issues that need to be overcome for the success of future heritage building repair and restoration projects. Another problem with CMPs is that even though there is sometimes a large cost in creating the document, there is not always sufficient mention of the extent and timing of the maintenance required to ensure the reconstruction proceeds and does not allow buildings to continue to deteriorate. It is critical for future success that maintenance should be embedded into heritage policies and future CMPs, in order for the heritage buildings to survive and remedial efforts to be managed properly.

Manage in accordance with the policy
Whilst there appears from all of what has been stated, little point in taking the trouble to prepare a CMP if it is not to be used, there is also no practical use of a CMP that cannot translate into an Action Plan for the subsequent heritage building conservation. This view was echoed by one interviewee who is an expert in preparing CMPs, who stated that:

“All I’m doing at work is that two inches of history, description and policy. Most of the conservation management plan which are written by historian, archaeologist who don’t have intrinsic understanding of the architecture or the building technology. They just need a document that says that’s what is important, that is what you should and shouldn’t do, and that’s how you do it.”

Based on the evidence collected from the interviews, most experts felt that whenever there is a restoration project, during and after completion, it should always be followed by monitoring and maintenance in order to lessen if not avoid further major reconstruction. The lack of an action plan will devoid, not just the CMP, but the whole restoration venture of which it is a crucial part. As the saying goes, ‘prevention is better than cure’. In the case of heritage buildings, it is almost obligatory to retain as much as possible of the authentic fabric and historical aesthetic, because the essence of preservation is to provide a link for the future generations to enable them to look back and learn about their history and enjoy their sense of place. Sadly many of the traditional CMPs examined by the author for this research failed in one degree or another to achieve this.

5. Towards a maintenance-focused CMP
The monitoring aspect of restoration and refurbishment work is in the guidelines of the Burra Charter for developing a CMP; however, traditionally such plans were normally a minor requirement when doing major repairs and restoration. Currently in Australia, there is an overlap amongst those professions undertaking heritage conservation works and building inspections. Usually, this is performed by building professionals such as building surveyors, engineers or architects in the absence of a dedicated personnel specifically skilled in such works vested with the full qualifications and with an inherent interest in undertaking heritage conservations. The maintenance-focused model developed in this research advocates that there should be a specialised individual, or a group, trained in heritage building inspections, and developing maintenance and monitoring aspects of a comprehensive CMP.

There are two kinds of maintenance operations that exist in Australia; the first employs a traditional in-house facilities manager. While this is beneficial to achieving familiarisation with, and specialisation in, particular heritage buildings, this is not as effective in the overall scenario since there are a large number of heritage buildings across Australia that cannot afford to hire such a professional. A dedicated facilities manager can undertake the overseeing very high profile, complex, and important iconic buildings such as the Sydney Opera House (Case Study 3, but there are still many other heritage buildings of lower profiles registered in Australia that
cannot afford, or appoint a qualified and knowledgeable facilities manager to oversee all-important maintenance and monitoring.

5.1 Monitoring

To solve this issue, i.e., of growing the necessary expertise and the covering the cost of preventive maintenance and monitoring, another form of maintenance-based operation in Australia is being undertaken through the use of contractual maintenance. Heritage maintenance operators are contracted to be responsible for the sustenance of a large number of buildings and eliminate the need for the more expensive and traditional ‘one building per maintenance’ model. This kind of arrangement will be very similar to the initiative of Monumentenwacht that is operating in Belgium and the Netherlands and will yield comparable benefits to the majority of local heritage caretakers who cannot afford the full-time employment of an exclusive facilities manager. This type of maintenance and monitoring could occur in a cost-effective fashion on a semi-annual or yearly schedule depending on the current status of the targeted heritage building.

This second option appears to be more preferable since it is focused on providing a more economically viable option for a wider range of heritage building owners. For sustainability of the operations, a building inspector, or a small group of building inspectors, would be responsible for a large number of heritage buildings. The operators can charge the building owners for the number of hours of inspections and preparing reports that would be similar to doing a series of comprehensive building inspection reports such as the handover report for new buildings, or pre-purchase inspection reports for existing buildings. Operators can create a yearly membership for the building owners and charge a subsidised rate lower than for buildings which are non-members.

Another variant could be based on a subsidy, or grant, being provided from any government to help owners and/or operators to access the services described above. One form of subsidy that could be considered by governments could operate on a similar basis to the Australian Medicare structure currently used by medical practitioners. Medicare system in Australia has a compulsory levy and individual can dip on those resources when needed. Since heritage buildings and structures are listed on either local, state, federal, or national registers, and are therefore assets of the listing bodies, the heritage operators should pay for using the services of the accredited building maintenance operators and make orders for obtaining a maintenance check-up. The listing bodies will actually pay for the maintenance check-up, which is equivalent to a cyclical maintenance inspection, and for the services of heritage ‘doctors’ or other inspectors if required.

Monumentenwacht, described earlier, is already an effective scheme that is operating in the Dutch system of heritage conservation monitoring, and a similar model be adopted in Australia. Pre-purchase building inspections have been accepted and operated in Australia for years. In some states in Australia this process is part of compulsory conveyancing process when buying an existing house, and lending institutions will not offer mortgages without this being undertaken. However, this kind of practice has never been extended to date as a requirement for the required regular building inspection, or used to order maintenance of heritage buildings before financing. In order to ensure that at least regular building inspections (as a basic input for monitoring) are undertaken, then certainly Australia could consider to utilise the setup and use of a pre-purchase building inspection model in future.

The perceived downside to this suggestion would be the need for financing the regular inspections and maintenance of buildings. Undertaking a pre-purchase inspection, offers a monetary incentive as the owner becomes aware of every fault of the building before committing to purchase. Once the property has been acquired, the regular building inspection is normally not given adequate consideration as to an owner, there is no tangible financial incentive to invest in the ongoing maintenance of the building. Governments (Federal, State or local) need to take part in subsidising the regular inspections required for heritage buildings initially by listing them, it thus becomes an important asset of the government and can be maintained to keep it in the best condition. This initiative can work if the private owners, the market, inspectors, con-
tractors, professionals and government support unite to give priority to maintaining and preserving these important heritage buildings.

5.2 Setting up the Benchmark
Monitoring cannot be undertaken without benchmarking the current state of the building through the preparation of initial property condition report on the structural components and basic fabric. This report will set out the scale and extent of monitoring required for any building. Building status, and any issues, will thus be defined for every item that is going to be subjected to monitoring, along with additional appropriate comments and identification of actions that will need to be undertaken. The inspection schedule and updating of property condition reports will occur on a recurring basis, which could be every six months, for one or two intervals depending on the condition of the items inspected. The assessed condition of the building will set the benchmark and from there regular monitoring can begin. The main idea presented in this paper and the original research problem is to develop a system for how maintenance will be used as the fundamental basis of the creation of a comprehensive CMP, including aspects such as understanding significance, developing policy and preparing an action plan.

To summarise, some issues examined in this paper relate to building upkeep compelled the notion of a maintenance-focused CMP. The major problems of interest are those that emanate from a serious lack of support in the preservation of our heritage buildings. Some of these problems are derived from an explicit disregard of the cultural significance of a certain types of elderly buildings or structures. Still others stem from economic and financial insufficiency and also a shortage of skilled professionals to take over proper monitoring and maintenance processes.

5.3 Lack of maintenance
The primary cause of structural deterioration of the heritage buildings is the lack of maintenance whether due to conscious neglect or a disregard for the serious consequences of not attending to faults and issues in such buildings. From the heritage contractors’ point of view, a lot of their work is generated from the fact that heritage building owners do not generally look after, and/or regularly inspect their buildings. Simple situations such as neglecting and not keeping gutters clean and free from blockages will eventually cause significant damage if unattended for many years. The gutter leaks and moisture will seep throughout the components and fabric of buildings, and eventually will start to destabilize the building resulting in complicated structural issues and major loss of heritage fabric, causing complex and costly deterioration that is difficult and costly to address.

For most building practitioners engaged in heritage conservations, the majority of calls are due to failure of building components resulting directly from a lack of maintenance. At the time the original call is made, the problem already exists and the building is already in need of serious repair and possibly reconstruction. For heritage buildings which have in-house maintenance operations, the different levels of conservation repairs initiate as a result of property condition audits. Different consultants are sent out to inspect different areas of the buildings and requested to prepare a property condition report.

There is no culture of long term costing in maintenance to quantify the life cycle relating to preventative repairs of buildings. Often there is a tendency to wait for the building to sustain damages then repair it, rather than maintaining a building in order to prevent, or avoid, costly repairs. Currently, adaptive re-use is slowly becoming an emerging trend in the conservation arena in Australia. Adaptive re-use basically consists of re-purposing a building to maintain its functionality, sustainability and financial efficacy. A building is ‘re-invented’ to serve an alternate application different from its original purpose. Although adaptive re-use gaining popularity within conservation circles, the risk of losing most of the original fabric of the building still remains a possibility. Over the course of an adaptive re-use approach, the historical aesthetic and as a result, ultimately the significance of a heritage building will gradually decrease, until at worst, they entirely vanish. Potentially, the application of the required levels of maintenance and monitoring applied can help significantly to prevent this.
5.4 Economical value versus cultural significance

Most often than not, owners of heritage buildings tend to favour applying the most practical and beneficial financial imperative, rather than striving to retain the cultural value of the property. Unless there is a benefit such as income from using the property, there is no appears to be little value or justification for spending on a building’s upkeep. Additionally, any investment is more likely to be spent on modifications undertaken to suit greater economic advantage such as re-use or conversion.

As the awareness on the importance of heritage conservation is increasing, it is interesting to now find communities getting involved in supporting the retention of heritage buildings more so than previously. This is especially more obvious currently from young people – who can see themselves connected with these heritage buildings. These observations are drawn from the author’s analysis of the opinions of the expert interviewees, who posited that more than ever now, heritage buildings tell people a story that creates a strong foundation to the sense of self: and place. One expert interviewee said, “…it is important because having a strong sense of themselves is confidence, it is national confidence”. Another view expressed was that the economic impact of conserving heritage buildings goes beyond the actual cost of the site on which they sit. Even one expert whose heritage conservation background was not in Australia stated that, “The conservation of Sydney Opera House is a perfect example that goes beyond the branding of the place. That building projects the culture and civilisation of the people who live there to the rest of the world.”

With this growing concern for the sociological importance of conserving heritage building, it also becomes necessary to adopt a more conservative approach to conservation going beyond the practical, or the financial aspects of construction. One interviewee, whose background was building contractor, mentioned that, “Without the knowledge of conservation, it is quite normal in the repair and maintenance industry to tell clients that it is cheaper to demolish and replace with a new structure than to maintain a heritage building”. The same interviewee remarked that in his experience, many people preferred to live in older buildings that had been in the community area for years and that generations were familiar with, he said, “…it’s good for people to live in an environment where not everything is new, or not everything is up for demolition, and it’s good for the environment to be familiar”. There are also buildings and structures of true historic importance, like the place where James Cook landed in Kurnell in 1770, the convict gaols and convict -constructed buildings all over Australia, that should be maintained. In the words of one interviewee who is an Architect and heritage conservator,”People are cultural creatures, we do inhabit the precincts, but we relate to the past, and we imagine the future, and in that sense out of those long and short concepts of conservations there is culture”. This latter view underpins the importance of preserving these assets for future generations so that they will have an idea of the way things were done in the past, and of their own familial histories.

5.5 Shortage of skilled professionals

Maintenance programmes are technically oriented and may not appeal to traditional designers, CMP writers, and architectural historians in Australia. In the conservation industry the professional and the trade skills required for undertaking maintenance supervision and the preparation of maintenance reports are not easily available. There are no particular experts, certainly in Australia, that are trained to undertake maintenance as a profession.

Heritage owners seem confused as to which professional discipline is the best to engage to oversee maintenance of heritage buildings. Normally, the choice is between architects or engineers, but it is not unusual that an architectural historian will be engaged to do such work. There are also Building Surveyors whom, by comparison with other countries such as the UK, where they are mostly involved in building inspections and maintenance, in Australia, Building Surveyors work as Private Building Certifiers and are not necessarily involved in maintenance, usually undertaking straight compliance checks with codes.

According to the expert interviews “most of the architects believe that maintenance is not within their role and should be done by a Facilities Manager”. However, facility management
has already evolved in many disciplines since its inception in the ‘90s and maintenance took a backseat amongst the operational roles of Facilities Managers professionally (Wood, 2009).

Architectural buildings in Australia are mostly ‘modern heritage’ because the colonization of the country coincides with the post-industrialisation. Structural components of these heritage buildings are mainly synthetic materials such as steel compared to iron or timber, reinforced concrete compared to natural stone and even plywood rather than timber planks and panels. The materiality of modern buildings is often less durable than those of the natural material composition of an ancient heritage counterpart. Therefore, modern heritage buildings are more susceptibility than the ancient heritage ones to deterioration and damage.

Working with newer buildings is often considered easier than with old buildings, from a tradesman’s point of view. Newer buildings are highly mechanised and can be worked on with fewer tools while in old buildings work requires the use of a lot of specialized tools because of its structural composition. Modern power electrical and battery-operated tools such as drills have replaced the old-fashioned lockup tradesman’s metal chest that had only a chisel, saw and other simpler hand tools inside. The craftsmanship during previous times was derived from the raw creativity and conscious of the tradesman whilst today, computer simulations and 3D designed structures make work on any buildings simpler due to the use of ‘smart’ technology. There are little training opportunities for those wishing to learn the traditional methods needed for authentic work needed in many cases to maintain and repair heritage buildings.

A good example to illustrate the susceptibility of the modern heritage building to deterioration and damage to the structure is concrete cancer, built mainly of reinforced concrete, which is one of the most popular structural components of modern heritage buildings. However it is very difficult to repair and maintain without seriously damaging a building’s original fabric. As its name implies, it is composed of concrete and reinforced by a structural steel and both components are thus synthetic. The concrete being the aggregate of gravel, sand and gypsum, upon mixing and adding of water turns into a synthetic limestone. While the steel is basically produced by being heated to a very high temperature to expel its oxides and form very strong structural reinforcement. For the concrete however, the moment these separate materials change into the new synthetic form (reinforced concrete) the material will slowly concede to its original composition of gravel, sand, calcium carbonate, water and rust (iron). Furthermore, the individual deterioration of one component contributes to further corrosion of the others. And this symbiotic weakening of individual components is due to the process of carbonation in the concrete and corrosion in the reinforcement steel characterized often as ‘concrete cancer’. This condition of reinforce concrete mostly for modern heritage building has been a significant problem in restoration, repair and maintenance.

5.6 Lack of government support and legislations
In Australia, five different systems of heritage listing exist namely: National Heritage, Commonwealth Heritage, State Heritage, Local Heritage, and the National Trust (which is a non-legislative listing). Additionally, the governance of each listing tends to be very confusing and misleading since the Federal, the State and the Local systems are not interrelated when it comes to the level and kind of legislation they implement regarding heritage conservation and maintenance. Because of this, it becomes too difficult for heritage practitioners to handle restorations, and thus they avoid such work in favour of less complex more lucrative new-build sector work.

There is a notion, most especially with modern heritage buildings, that it is cheaper to demolish and build a new structure than implement a perpetual maintenance and repair programme, although this probably depends on when the maintenance stops on the building. If nothing is being done by way of temporary or permanent repairs for a considerable time, then this notion is true. However, spending more money on maintenance each year, will in the long run, be most effective and would actually require less and less capital works. For long term owners, maintenance is a cost effective form of conservation but it requires to be done routinely.

However, people involved in raising finance for buildings and developments often find it more appealing to spend on capital works, or repairs, rather than on maintenance. Capital works induce depreciation, which although an expense, will not affect cash flow. Additionally, when
maintenance is not written into the budget, it is normally not retrospectively added back in and maintenance is neglected and the damage to heritage buildings slowly worsens often also remaining unnoticed.

6. Conclusions
The materiality of the modern heritage building is more difficult to conserve and requires vigilant monitoring. Most of the heritage buildings in the Oceania and the Asia-Pacific regions are under the threat of advanced deterioration due to their less durable materiality conditions; for example, heritage reinforced concrete suffers from ‘concrete cancer’, corrosion and wood veneer coming loose, etc. In order to sustain the longevity and preserve most of the authentic details and appearance of modern heritage buildings, a more conservation maintenance-focused and monitoring approach needs to be the primary consideration in the preparation of any CMP.

The current practice involves numerous innovative repairs to restore or reconstruct ageing buildings. Several heritage buildings have been repaired and structurally re-strengthened in line with the current policy and guidelines to prolong their public usage. Many others have required vigilant inspections and monitoring, as most have reached or are nearing the end of their structural endurance. Nevertheless, whether reconstructed, restored, repaired or left untouched (without intervention), any further maintenance neglect can severely aggravate the inherent decay in heritage buildings and augment this structural decay to a state of disrepair.

The current standards, guidelines and laws are difficult to change. In the interim, the heritage community awaits some amendments to come, and proactive action is required to address the issues of those ailing heritage buildings before they are lost forever. This research explores the merits and benefits, as well as the shortfalls, of both the Burra Charter and the Building Codes, and aims to seek evidence for the support for maintenance to become a first priority in conservation. However, the current policies and guidelines for restoring modern heritage buildings are not specific enough to cover particular structural conditions because, at present, they are subject to the same procedures and constraints as those for ancient heritage buildings.

Examples of such policies are: (a) Conserve as found – maintain the size and feature of the building; (b) Minimum intervention – do as little as necessary; (c) Like-for-like repair – maintaining the fabric of the building; and (d) Intervention should be reversible – the repairs should be reversible and can be changed in case a better solution was to be found in the future. These policies are hard to apply; for example, in the case of a reinforced concrete modern heritage structure, specifically the stipulations of minimum intervention, like-for-like repairs, and reversibility.

Following on from the work of James Simple Kerr in his 7th edition of “Conservation Plan - a guide for the preparation of conservation management plans for places of European cultural significance (2013),” the framework developed in this current study is intended to improve maintenance consideration in the conservation arena and make suitable for modern heritage buildings in Australia. Over the years, Kerr’s (2013) generic guidelines have been the template for many heritage practitioners in developing conservation plans for heritage buildings. Traditionally, the heritage CMP is developed by architects and architectural historians who refer to themselves as ‘conservation professionals’. Any actual vestiges of true conservation have been lost in the narratives of history and the minefields of policy development; all without implementing any recognisable or significant action plans or introducing proper monitoring of the structural status of these buildings. Developing the maintenance-focused conservation framework presented in this paper will ensure that the integrity of heritage building will not only be protected but also preserved for the future generations to enjoy.

The Burra Charter advocates the preparation of a Conservation Management Plan (CMP) for any assessable development, or redevelopment, of heritage buildings. Whether it is repair, reconstruction, restoration or adaptive reuse, this CMP should not only lay out historical significance and policies but it should also outline a plan and include processes of effectively conserving the heritage building. Unfortunately, one loophole in the Burra Charter definition of a CMP is that maintenance is not an assessable development therefore it is not required to be included into the conservation management plan. The latest edition of the Burra Charter has included
monitoring, after the Implementation stage, hence this study is about the promotion of a maintenance-focused CMP, because monitoring is the core aspect of maintenance. It is time for maintenance to come out of the background and assume a forefront role, especially in the heritage conservation industry.

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