Fellowship Report

The Winston Churchill Memorial Trust of Australia

The use of traditional lime products in architectural sandstone conservation, and examination of heritage skills training programs.

Scotland and England

June-July 2009

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2008 Churchill Fellow
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Dated 14th October 2009.
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1. Executive summary

This document reports on the learning experiences, findings, outcomes and recommendations of a Winston Churchill Memorial Trust fellowship, awarded in 2008, and undertaken in the United Kingdom from May 28th to July 10th 2009.

The aim of the fellowship was to examine best-practice in the use of traditional lime (calcium carbonate based) products in the conservation of architectural sandstone, as well as looking at the various ways of delivering heritage skills training. This report details my findings – both on the philosophies and broad practice of lime use in architectural sandstone conservation, as well as examining models for disseminating such information through training and accreditation programs. Several recommendations arise from the learning undertaken in this fellowship, based on the broad categories below:

Lime use and sandstone conservation:

- Australia requires a better understanding of specific properties of materials (lime, stone etc) and how they interact with each other and the environment for successful application in the restoration industry.
- The approach to the conservation of masonry buildings needs to be on a case-by-case basis, not a broad-brush approach based on past practice.
- Understanding and specifying lime based products needs to be founded as much in archaeological and historical analysis of a building, as it is in materials science and technology. Specific environmental conditions must be coupled with this historical and archaeological context, as dictated by the characteristics of the materials.
- The use of traditional lime products should be explored in new-build, in addition to restoration.

Traditional building skills:

- Australia needs a more systematic approach to the perpetuation of heritage building skills.
- Curriculum for heritage skills training needs to be developed in-line with industry expectation and market demand.
Accreditation systems need to be put in place which provides an onus on the industry to become accredited, before such accreditation becomes mandatory.

Accreditation systems must consider the needs of those entering the industry, as well as those who have been in the industry for a longer period, and different and equitable approaches for delivering accreditation must be developed accordingly.

High level government policy needs to address the question of ‘who pays’ for heritage skills training, and provide the conduit for the systematic rollout of accredited curriculum.

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2. Introduction and rationale of fellowship

This document reports on the learning experiences, findings, outcomes and recommendations of a Winston Churchill Memorial Trust fellowship, awarded in 2008, and undertaken in the United Kingdom from May 28th to July 10th 2009.

Sparking an interest

The use of lime as a building material dates back over 3000 years, from Cretan civilisations in the Mediterranean. By Roman times, lime products were widely in use – and well noted by writers such as Vitruvius and Augustus. The use of lime in China is of similar antiquity, with all of those civilisations leaving an enduring legacy of buildings utilising lime. This tradition endured the millennia... The Pantheon in Rome was the largest unreinforced lime concrete dome in the world until 1953. The skills of lime use largely declined after WWII, when rapid rebuilding was desired, and when a relatively new invention rose to prominence – Portland cement. Hard, strong, cheap, quick setting, waterproof – cement rapidly overtook lime as a preferred building material during the post-war building boom.

However, harder, stronger and more durable isn’t always a good thing... as the conservation world is now discovering.

My interest in lime stems from my 2003 Honours thesis in historical archaeology, where I examined the transfer of stonemasonry technology from Britain to colonial Australia. I examined how the stonemasonry and limeburning industries were brought to Australia with early settlers, and how the industry continued, and was adapted to suit local variables. During this research, I became interested in the concept of lime, its processing and products. Take a rock from the earth, burn it, throw it in water, let it fizz, mix it with sand, then apply it to building. This sounds simple – but there are a great number of variables at work during that process which make it far from simple.

There are scores of variables during all parts of the process of using lime, which will impact the success of use, both in its application, and well into the future. A better knowledge of lime and lime products would certainly feed into addressing present day conservation issues, which, working as a heritage consultant for the
last few years, few people have a good grasp of – and when they think they do, there’s always a dozen other ways of doing it. Seemingly good work begins to deteriorate after a few short years – despite the well intentioned actions of those involved in thinking that they have a sufficient grasp of lime use.

In recognition that I had a lot to learn, I applied for a Winston Churchill Memorial Fellowship, to travel to the United Kingdom. To visit the people who I had spoken to during my research years earlier, to visit the places where our colonial masons came from, and to see how those people are reviving the tradition of lime use in architectural stone conservation.

So, off I went to Scotland and England for 6 weeks – with a handful of questions to ask. Not all of that time was intended to be up to my neck in lime, I had allocated two weeks to spend time with heritage skills training agencies throughout the United Kingdom, to gain insight as to how heritage skills are perpetuated into the industry and the community – to begin to break the ‘cement mentality’.

This report details my findings – both on the philosophies and broad practice of lime use in architectural stone conservation, but also towards heritage skills training and accreditation programs.

During a workshop in Fife, a gentleman with a broad Scottish accent, who heard that I was from Australia and researching traditional lime use, came up to me and asked:

‘why canna you just find what you need by Googling it?’

Having been a couple of weeks into my fellowship when facing that question, I was able to confidently tell him that to really learn anything about an art, it is necessary to plunge oneself in the deep end – to work hands on with the people who have dedicated their careers to it, and to see how they approach real life problems. To witness real people broach a conservation issue, to work through various scenarios, and come up with the solution is something one has to experience first-hand. Googling something will only allow us to see the end (and polished) result – to get a blinkered view of what’s going on, bi-passes the trials and errors, and doesn’t allow us to reach the inner passions and personalities of those with a common interest.
Therein lays the key attribute of programs such as the Winston Churchill Memorial Trust – worldwide networking, allowing people to meet those who can share their passions, and to build lasting linkages where learning becomes a symbiotic relationship. I left home with 20 questions…. I had 50 answered….. I came home with 100 more..... But, the people I have met, and the networks I have established, will certainly help me into the future answer those questions, as I digest the phenomenal amount of information that such a fellowship throws one’s way.

**Fellowship timetable**


June 1st–18th: Scottish Lime Centre Trust, Charlestown, Scotland. Including Scottish Stone Liaison Group, Simpson and Brown Architects (Edinburgh) and Penicuik House Trust.


June 30th: West Dean College, Chichester, England.


July 3rd-7th: Scottish Lime Centre Trust, Charlestown, Scotland.


Acknowledgements

My list of acknowledgements is voluminous... but cannot be overlooked, so I would like to thank the following people for helping me make this happen:

- Roz Artis-Young, Gillian Ferguson, Moira McKay - Scottish Lime Centre Trust – in particular Doug Johnston and Tom - Merryhill Workshops.
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- And back home, Tim Kirkwood and Kylie Williams, my part time bosses who were able to assist with study leave.
- Also my family and friends who are always there to support me.
And most of all, the Winston Churchill Memorial Trust, and the Tasmanian Board of the Trust – who made this possible in all aspects.

Also a special thanks to Patricia Corby whose vigilant work keeps the Tasmanian Fellows Society ticking along.
3. Sandstone conservation - The Australian scenario

As a heritage consultant working in Tasmania for the last 6 years, much of my work is with historic buildings. Tasmania has a wealth of sandstone buildings from the nineteenth century, and one of the areas where I am based, Oatlands, reputedly has the largest collection of Georgian Sandstone architecture in any village in the southern hemisphere. I am faced daily with sandstone conservation problems.

For the last two years I have sat on the Tasmanian Heritage Council’s Works Application Assessment Committee, which has confirmed that sandstone conservation problems are widespread across Tasmania – horror stories of neglect and bad practice in the past which has severely compromised much of our historic cultural heritage. An informed eye walking through the streets of Hobart can see hundreds of examples of past poor practice in the application of cement, and misapplication of lime. My discussions with other interstate practitioners have indicated that this problem is not exclusive to Tasmania.

Conservation nightmares - years of bad practice

Sandstone is a dynamic material that needs to breathe. Being a gently formed sedimentary stone, its crystalline structure is very porous and breathable. By nature, sandstone is not waterproof. So it is little surprise that when we encase it with hard waterproof materials it becomes stressed and weakened.

Cement is hard and waterproof. It is strong and durable, easy to acquire, and very cheap and for decades tradespeople, in their approach to sandstone conservation, applied cement to everything, believing that its strength would ensure that the buildings would last for all eternity. The points (and photographs) below will show why this is certainly not the case. The ramification of the ‘cement mentality’ is all too clear - everywhere you go in Tasmania (at least). The photographs below, taken in Hobart’s Salamanca Place (a premier heritage precinct), show the typical damage that cement has caused sandstone buildings –
accentuating moisture problems, accelerating decay, promoting structural failure and probably causing more damage than if someone had never tried to ‘repair’ the building in the first place.

Typical examples of sandstone degradation caused by poorly executed ‘conservation’ work – taken in Salamanca Place, Hobart.
Lime - basic principles

Hundreds of books have been written on the properties of lime, its procurement, uses and conservation. A comprehensive essay on such a subject is beyond the scope of this report, and indeed, beyond the knowledge of any one person – let alone someone who has only had a few weeks of exposure to the principles. Whole lifetimes have been dedicated to this subject. Provided below is a very brief overview of the very basic properties of lime, as a means of contextualising the principles, and introducing the terminology, used in this report.

The lime cycle

At first glance, the concept of the lime cycle couldn’t be simpler: you take a stone, alter its properties so that you can use it in a building, where it turns back into stone. Well, that’s the very basic story. The use of lime in a building can be summarised chemically by way of ‘the lime cycle’.

- Limestone is quarried as a source of Calcium Carbonate - CaCO³.
- The stone is burned in a kiln, emitting Carbon Dioxide (CO²), the remaining stone is then Calcium Oxide - CaO.
- Addition of water forms (in a violent reaction) calcium hydroxide - Ca(OH)². Depending on the type of limestone, particularly any clay based impurities, the calcium hydroxide is either a non-hydraulic putty (a paste), or if the (chemically determined) exact required water is added to a clay-rich limestone, a dry hydrated powder will be formed (hydrated lime). Depending on the type of clay impurities, the hydraulic properties of the lime will range from feebly hydraulic, to eminently hydraulic.¹
- The putty is mixed with an aggregate (sand or stone dust) and the powder mixed with water and an aggregate for use as a lime product (render, plaster, mortar, grout). Other additives can change workability and set properties.
- As the product dries, water (H²O) is lost, whilst Carbon Dioxide (CO²) is absorbed from the atmosphere, to again form Calcium Carbonate - CaCO³.

¹ More modern terminology refers to non hydraulic, feebly hydraulic and eminently hydraulic limes as CL90, NHL2-3.5, and NHL5 respectively.
So you take calcium carbonate, burn it, wet it, add a few things, mould it to the shape you want, and apply it to a building. It’s not as simple as it sounds though, with dozens of variable acting upon all stages of the above process, as well as acting upon the life of the product. The learning from this fellowship, and indeed an escalating worldwide industry based on research, product development and the use of lime in buildings, prove that there are a myriad of complex variables in force which can draw a very fine line between success and failure at any given time.

It seems like lime is being revived.
Properties of lime

As will be detailed later in this report, lime and lime products have certain unique properties and characteristics – differing greatly from cement. Although a very brief overview, below will give some of the properties of lime products when compared to cement based products. Generally, lime is:

- More able to diffuse moisture and vapour.
- Weaker.
- More flexible.
- Less brittle.

Generally, the properties of lime are more desirable than cement, particularly in instances where:

- Compressive strength is not essential (e.g. a small scale building)
  - e.g. A cement mortar can withstand compressive pressure of over 65 Newtons per square metre. An NHL3.5 (moderately hydraulic) lime mortar can withstand compressive pressure of 3.5 Newtons per square metre. The basal courses of a 4 storey sandstone terrace-house are subject to a compressive pressure of less than 0.6 Newtons per square metre, (and less than 0.7 Newtons for a 10 storey building). The NHL 3.5 is more than sufficient to withstand compressive forces, so why do you need cement which might cause problems due to brittleness and impermeability?

- Flexibility is desirable (e.g. a building with some movement)
  - e.g. the weaker the mortar (e.g. less compressive strength), the more flexible, therefore a greater ability to withstand movement in a building. Provided a mortar can withstand compressive forces, then more flexibility is desirable. Lime is, to a degree, self-healing, so that where micro-cracking occurs through minor movement, re-carbonation can in-effect heal these cracks.

- Breathability of a product is required (e.g. a building with some dampness or the potential to be damp).
  - E.g. moisture will always diffuse out of a solid wall via the weakest product. It is best that this happens through mortar, as it is more easily repaired than masonry units. Provided the mortar is strong enough to withstand compressive strengths and environmental conditions, then weaker (and less dense) is better to facilitate diffusion.
The above scenarios describe the vast majority of historic buildings encountered daily in the Australian conservation industry (not to mention the applicability in new-build – as discussed later). However, the use of lime has a number of idiosyncrasies, which make it a more difficult and uncertain product to use than cement:

- The eventual strength, permeability and flexural strength of a lime product is closely related to the mineralogical content of the original limestone, which differs greatly according to geological context.
  - E.g. minerals (clays) present in limestone will result in a stronger lime product (e.g. more cement-like).

- Only 10% of carbonation of any lime product occurs in the first 28 days.
  - Therefore it can take months, even years for optimum properties to be achieved – whereas cement is much more ‘what you see is what you get’ almost immediately. Lime products must be protected and treated accordingly during the carbonation process (e.g. monitoring of curing temperature, moisture content etc), which may cause difficulty in the building process.

- The properties and performance of a lime product can be greatly influenced by the type and ratio of aggregate used.
  - E.g. type of aggregate (e.g. sand) used in a lime product will influence its colour, texture, permeability, strength, flexibility etc. These variations can be extreme, according to the geological context of the aggregate source. It is as important to know the properties of the aggregate as the lime itself. Course aggregate generally requires a higher ratio of binder (lime). The ratio of binder to aggregate will influence strength, shrinkage/cracking resistance etc.

- The properties and performance of a lime product can be greatly influenced by the type of additives included (including water content).
  - E.g. Moisture content of a lime product is critical when avoiding cracking through rapid drying, or shrinkage. Addition of proteins, clays, acids, fats etc can radically impact the properties of a product, both during use, and long-term (e.g. adding clay can make a harder product long-term, adding milk protein can make a product less viscous without adding more water). Knowledge of the ability of these additives can greatly assist lime use, but a misunderstanding can cause disaster.
Australian standards, and lime on the market in Australia

The previous section has outlined the British Standards relevant to the formulation, testing and performance of lime based products\(^2\), which are slowly being aligned to European standards.\(^3\) Similarly, Australian standards exist (AS4489)\(^4\) which set standards for testing and performance of lime based products – a worthwhile exercise would be to assess whether the Australian standards cover the breadth of topic covered by the British/European standards.

With the huge scope of lime products available, I have undertaken some very brief (so far) post-fellowship research on those available commercially in Australia, and the standards which these meet – although more work on understanding the exact availability of products is required. A cursory survey of websites of companies that sell building lime products was undertaken, which reveal that a broad range of information, but nothing too specific, is available in Australia on the formulation, testing and durability of particular lime products. Nonetheless, more data may be available directly from those companies, who are likely to have undertaken research which should be examined when making firm statements about the lime available in Australia, and its alignment with the applicable standards.

In contrast, European lime producers such as St Astier\(^5\) provide a wealth of testing data on their products – whether this data is easily available in Australia has not yet been comprehensively investigated, however it is essential to gain such an understanding as to their suitability for different conservation circumstances. Comparison of the St Astier data to than known (or known in future) in Australia would be worthwhile when drawing comparison between the methodologies and applicability of lime based products between the UK/Europe and Australia.

\(^3\) [http://www.cen.eu/cenorm/homepage.htm](http://www.cen.eu/cenorm/homepage.htm)
\(^5\) [http://stastier.co.uk/test.htm](http://stastier.co.uk/test.htm)
Research and development

Leading from the statements above, the scope and timing of this investigation this far has not allowed, as yet, allowed a comprehensive national survey of research, testing and development of lime products – particularly from an archaeological, historical and environmental context. My pre-fellowship planning was centred on examining the application of lime products in a more broad sense, and it was not until part-way through the fellowship that I realised that more attention needed to be paid to the individual case-by-case analysis of lime use. Australian companies are sure to have undertaken a certain degree of testing of lime products, and that a survey of that work should be done to gauge the extent of such research. Similarly, there are some academic approaches to materials testing pertinent to the conservation industry, as well as many practitioners (and entrepreneurs with a heritage bent) who undertake their own materials development and testing – all of which are difficult to quantify without an in-depth survey. This is a priority for follow-up research, and to assist in (and avoid duplication of) any future research.

Stonemason approaches

It has been my experience that the stonemasonry trade, and those who write specifications for restoration jobs, sometimes have only a cursory knowledge of the properties of lime, and the masses of variables which influence its use and durability. Long-established stonemasons seem to run predominantly on the ‘tried and true’ philosophy – that of developing a ‘mix’ (e.g. a standard ratio of lime and binder for a mortar) which they apply universally to all their jobs. Whilst the quality of work upon completion is generally very good, this misunderstanding of the properties of lime, and the lack of required aftercare in its application, is very likely to result in conservation problems into the future.

A two handed approach is required to understanding the use of lime – that of material interactions in specification and that of workmanship in application.
3. Sandstone conservation methodology - The UK learning experience

The primary aim of the fellowship was for me to gain a better understanding of the use of lime in architectural sandstone conservation. In the initial planning of the fellowship, I had to ask myself ‘where to go?’ Having been working in the conservation of colonial sandstone buildings, my previous learning on the subject had been within the realm of ‘technology transfer’ – how British stonemasonry technology had been employed in the colonies – how this had been adapted to suit local conditions (or local constraints) and how successful our colonial builders had been in maintaining British tradition⁶.

Britain was therefore my first port of call for research, as I thought it important that I step into the shoes of those whose buildings I work with – as there may be links with how nineteenth century British stonemasons operated which filter into modern day conservation issues. In looking at the British options, I considered concentrating my studies at some very reputable commercial lime research, training and product development companies in England. However, England does not have a high percentage of architectural sandstone use, meaning that learning in those instances might not be as relevant to my situation at home. I then considered an area more geologically similar to Tasmania – Scotland, and it happens that in that country the Scottish Lime Centre trust is considered a centre for excellence in the use of lime products in sandstone conservation. Many of Tasmania’s colonial stonemasons came from Edinburgh, and the Scottish Lime Centre is right near that city. So, after a few years of seeking of funding, regular emails to the centre’s Director Roz Artis-Young, who developed a month-long learning program for me, I finally packed my bags and headed off... thanks to the Churchill Trust.

⁶ See Williams, B (2003); *Transfer of Technology from Britain to the Colony – The Oatlands Stonemasonry Industry*. Unpublished BA(Hons) thesis, Australian National University. (Copies held by ANU and Southern Midlands Council).
The Scottish Lime Centre Trust

Background mandate and structure

The Scottish Lime Centre Trust (SLCT) was established in 1994 as a registered charity and company limited by guarantee. The mandate of the trust is to:

“promote for the public benefit the appropriate repair of Scotland’s traditional and historic buildings; provide advice, training and practical experience for the repair and conservation of Scotland’s traditional and historic buildings; promote and further the preservation and development of Scottish building traditions, crafts and skills; promote the use of environmentally appropriate building technology and materials and preserve buildings or other structures of particular historical, architectural or constructional interest”

The trust achieves its aims through a program of activities including delivery of courses in masonry conservation (accredited and non-accredited), work placements and building materials analysis and conservation consultancy. Previous activities have included a commercial masonry training squad (however this has been recently disbanded). The trust’s business units are divided into the Charlestown Workshops (training arm) and Charlestown Consultants (research and consultancy arm).

Since 2005, 700 companies have used SLCT to train 6000 students. Since 1994, advice has been given on the restoration of 2000 buildings. Charlestown Consultants field over 1500 free advice enquiries annually.  

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7 See the SLCT Annual report 2006-7 at http://www.scotlime.org/Annual%20report%202006-07.pdf
Formal course attendance

This report will not attempt to detail the voluminous technical data and practical experience which was gained through study at the SLCT – to do so would exceed the realms of a reader-friendly report on the fellowship, and still would not even cover a minor percentage of the wealth of data available on the subject. Also, the learning from the centre has, in most cases, sparked the need for me to undertake more research and learning, in order to gain a firm grasp on the subject. As this report details, I’ve more so learned the questions to ask, rather than finding all the answers – a month of learning can hardly do justice to this subject.....

This report will concentrate on the broad principles and analytical criteria used when approaching sandstone conservation, as learned on the fellowship, and give an overview of where to find further information on each of these analytical streams where appropriate. It will also concentrate more on the overarching philosophies learned, and how these act to guide the specific technical and practical application of knowledge on the subject.

Whilst at the SLCT, the following courses were attended:

- Making and using traditional mortars.
- Ashlar pointing and grouting.
- Rubble pointing for homeowners.
- Stone scheduling masterclass.
- Surface repair workshop.*
- Structural repair of historic buildings workshop.
- Ruin consolidation workshop.
- Limewashing workshop.*

* Attended as an observer rather than a student.
Whilst these courses were attended primarily as a student – I also opened my mind as to how the information was being conveyed – how the need for the training was identified, how curriculum was developed and delivered and how this might have applicability in assisting me pass on such information back home.

Principles learned

As a precursor to most of the courses, an introduction to the properties of lime products was given. This introduction explained the criteria which are essential in understanding the material properties of lime products when used in masonry conservation. It is a lack of knowledge (or misunderstanding) of these criteria which I believe is a more critical problem in Australia than the actual application and workmanship in the use of lime products.
The basic criteria which must be understood when specifying a particular lime product for conservation use (with examples) are:

1. **Bond strength.** A lime product must have sufficient strength to bond to the host masonry to which it is applied, but (as detailed below) not be so strong that its strength exceeds that of the host masonry.

   A pointing mix must be able to bind to the masonry joints to which it is applied, but not be so strong that it acts to ‘stick’ the masonry together. If there is to be breakage in a wall through movement, it is best that this breakage be along a bond between mortar and masonry unit, where it can easily be repaired – too strong a bond may result in more detrimental breakage elsewhere (e.g. breakage of the masonry unit).

2. **A level of flexibility sufficient order to cope with small movements in the substrate to which it is applied.**

   Mortar must be flexible enough to move with the masonry it binds. A flexible mortar will prevent cracking in a wall to a certain degree. Render/plaster should be flexible enough so that movements in a wall do not result in cracks. With flexibility, however, sufficient tensile strength must be present to resist any shear forces from movement in a building. Because lime is (to a degree) self healing, small cracks in a flexible product may be able to self-heal through absorption of additional carbon dioxide from the air. Flexural strength of a lime product can be tested by measuring the breaking point of a moulded beam of a product. Tensile strength can be measured by measuring a beam sample’s resistance to pulling apart.

3. **Vapour permeability to allow ease of moisture diffusion.**

   A mortar joint must have a level of permeability greater than that of the host masonry, so that trapped moisture vapour can diffuse through the joint, rather than through the masonry. Renders should be permeable to as not to trap moisture vapour in a wall. The more air which is trapped within a lime product, the higher the permeability will be – addition of air entrainers, such as soap or tallow, will increase bubbles in the cured product, hence more permeable (and less dense). Use of ‘hot limes’, where aggregate is added at the time of slaking, will always result in a more permeable product. Water and water vapour that enters a wall will always evaporate through the most permeable (e.g. easiest) route through a wall – where it can cause damage. It is best that the most permeable route be through lime products, which can eventually be replaced, rather than through the host masonry where damage is more difficult to repair. Permeability, particularly release of moisture, is also a critical consideration when requiring durability against freeze-thaw – water trapped within a lime product in freeze-thaw cycles makes it susceptible
to cracking. Permeability may be measured by an air-peel meter which measures the air spaces in a product, hence its ability to diffuse moisture. Rate of diffusion can be measured by simple capillary rise tests. See also (8) below – as these principles are closely linked. Density can also easily be measured by a simple water displacement test of a sample (volume: weight ratio). Evaporation rate can be measured by a simple saturation and drying test of a sample.

4. Sufficient durability to withstand compressive pressure and environmental conditions.

A mortar must be strong enough to withstand the compressive pressure (e.g. weight) of the host masonry. A render should be durable to withstand environmental conditions (e.g. harsh weather). Required durability must be assessed both after initial application (see 6 below), as well as long term – as it may take a year from application for optimum durability to be achieved. The strength of a lime product is dictated by the hydraulic of the lime from which it is made (coupled with other factors such as the proportion of binder/aggregate). For instance, a non-hydraulic mortar made from a lime putty (CL90) will be less durable and have a lower compressive strength (although higher flexural strength) than a mortar made from a hydraulic lime powder (e.g. NHL5). The CL90 mortar will be less strong, but its permeability will be higher, flexibility greater and absorption rate faster than the NHL5 mortar. Also, the content of a mortar should be such that it does not promote adverse reactions with environmental conditions – e.g. sometimes hydraulic lime may react with certain clays in stone, or certain pollutants in the air. Compressive strength of a sample can be tested by measuring the compressive failure point of a cube moulded sample, usually mixed at a 1:1 to 1:3 binder/aggregate ratios.

5. Ability to be finished to desired effect

Coarse aggregate grains in a plaster or render may not allow a smooth and polished finish if desired. If a very fine finish is desired, fine aggregates such as fine sands, stone or marble dust may be used. These however may not be as permeable as products which contain coarser aggregates, or may not have the desired aesthetic qualities.


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8 British Standard – Frost resistance of mortar BS EN 12371
9 British Standard – Compressive strength of stone BS EN 1263
10 A wealth of data on mechanical testing of lime products see the St Astier website [http://www.stastier.co.uk/nhl/testres/physmech.htm](http://www.stastier.co.uk/nhl/testres/physmech.htm)
A product should not set too rapidly (e.g. whilst still working) or slowly (which may result in damage). Rapid setting products may not allow sufficient time for application or to work to the desired finish. Rapid set will also prevent proper curing (e.g. non-hydraulic carbonation) of the lime. Whilst slow setting products might allow a better carbonation (in non-hydraulic limes), a more rapid set may be needed in order to address environmental factors, e.g. harsh weather, high traffic areas or (in the case of hydraulic limes) underwater. Melamine (or more traditionally, casein – a milk protein – a superelasticiser) and bentonite (a fine burnt clay) can be used to alter workability properties without changing the actual composition of the final product. For instance, melamine can make a grout less viscous, but not alter the water content, therefore not adding to the risk of shrinkage/cracking that the addition of water for viscosity might. Bentonite acts as a gelling agent, which slows the flow of a non-viscous grout without adding more binder or removing water – it can also have the effect of making the workability of a non-hydraulic product more hydraulic-like, e.g. allowing use of a non-hydraulic product in damp conditions. Fine, round sand grains used as an aggregate will provide a less viscous mix than crystalline aggregate (e.g. ‘sharp’ sand). Extensibility and viscosity of a product can be tested through a marsh-cone or on a float table. Other workability additives such as citric acid can retard carbonation and give a longer setting time.

7. **Able to provide a suitable cured colour and texture**

   Aggregate in mortar should cure to a colour to match surrounding or original. Texture of a render should be compatible with surrounding. The factor which mostly influences cured colour and texture is the aggregate. The finer grains of the aggregate influence colour, and the coarser grains of an aggregate influence texture. Choice of an aggregate can either be trial-and-error, or an aggregate library can be built up, whereby samples of aggregates can be profiled (for matching) and sample blocks made of finished products which will give an idea of cured colour and texture.

8. **Absorption rate matching masonry units**

   Along similar lines to vapour permeability. For example, ideally the absorption rate (e.g. the rate at which moisture/water is absorbed) by a lime product should be equal, or slightly more than the host masonry. A significantly faster absorption rate may result in excess water penetration into a wall. A slower absorption rate may result in water movement through the masonry unit, rather than through the lime product (thereby transferring potential damage to the masonry).11

9. **Be reversible without damaging host masonry.**

11 British Standard - Absorption rate of stone BS EN 13755
No matter what product and method of application is chosen, it must be reversible without damage should this be desired in future. For example: Generally, soft pointing, render etc is always reversible. Grouting which penetrates a wall generally is not reversible without demolition of that wall.

Accordingly, lime products should not:

- Be stronger than the host masonry – which might result in breakage of that masonry.
- Have a lower rate of absorption than host masonry.
- Create a diffusion barrier (forcing moisture through host masonry).
- Promote adverse reactions with other materials (e.g. clay content in sandstone whilst carbonation occurs). Use example of flu-gas in brick chimneys where cementitious mortar is used.

It is these points which are fundamental to an understanding of the material properties of lime products, and the resulting dynamic with host masonry – upon which a realm of specification, conservation and research approaches are founded.

**Scottish Stone Liaison Group**

Whilst in Fife, I took the opportunity to meet with representatives of the Scottish Stone Liaison Group (SSLG) - a facilitation and lobby body for the use of stone in the construction industry in Scotland – having filled the void following the disbandment of the Natural Stones Institute. Their aim is to enhance availability, promote utilisation and advance knowledge and skills in design, specification and use of indigenous Scottish stone in restoration and new build projects. The group undertakes study, policy support, data production and survey on behalf of various government bodies – such as Historic Scotland (from whom they draw some funding), the British Geological Survey etc. SSLG facilitates talks between industry trainers – putting stonemasonry on the agenda for skills development.
etc, and works to ensure that training and curriculum in the stone sector meets industry expectations and needs (in partnership with the National Heritage Training Group).

I spent a few hours with Richard Groom, Heritage Training Coordinator of ConstructionSkills, who had been seconded to the Scottish Stone Liaison Group to undertake an analysis of all stonemasonry courses offered in Scotland, for the purposes of assessing consistency in training (deemed to be low) and to provide some moderatory function towards consistent training, which is in-turn fed into the national accreditation system through the Scottish Vocational Qualification framework. This gave me a very informed insight into the general state of the stonemasonry (specifically stone conservation) industry in the United Kingdom, which was very pertinent to the discussions held with various training organisations – discussions pertinent to the rationale of the second part of the fellowship – that of training, curriculum and accreditation. These points will be further discussed in Section 6 of this report.
4. The focus on analysis - each building as an archaeological artifact

Having undertaken formal training in the application of lime based conservation products, it became apparent that perhaps Australia isn’t that far behind with the actual application of products – and indeed some very good workmanship is apparent across the country. Nonetheless, I have witnessed on many occasions perfect workmanship grossly failing after a short period of time. Perhaps the inherent failures that we see in Australia are more often the results of a misunderstanding of material properties of lime products, and their dynamic interaction with the buildings and environments upon which they are used. Whilst clearly obvious in the use of cement, there is also room for error in the ineffective use of lime products – perhaps a well-intentioned misunderstanding.

Just as the Scottish Lime Centre Trust introduced the ‘nine streams of analysis’ talk up-front in most of their courses, these nine criteria for understanding a building, and specifying a solution, all require an in-depth understanding of the needs of that building and its use and environment. A ‘one size fits all recipe’ for the specification of lime products is still a long way from best practice, and leaves room for inherent failure of conservation approaches, albeit well-intentioned and partly on-track (nonetheless, certainly better than cement use).

I repeated in my head the concept of:

…..let the building tell you what it wants... not what you want to give it.

In Australia, we have some good standard approaches to the use of lime products, based on a cursory knowledge of ‘cement=bad lime=good’. There is a widespread mentality of ‘it worked on the last job, it’ll work on this one’. A false sense of confidence allows us to feel safe in the knowledge that we think we’re doing the right thing. And in many cases this does work... but, consider the following approach;
There is value in the philosophy of approaching a building as an archaeological artifact, rather than an example of merely an architectural type or period. A building is built by a certain person, under certain circumstances, for a certain purposes. Particularly in the colonial environment, they built using what they had, and what they knew. Not always perfect, often resulting in an makeshift or vernacular twist of traditions, but resulting in the unique and eclectic mix of colonial legacies – artifacts – that are the subject of today’s conservation efforts.

We forget, that whether or not our forebears followed correct tradition or methodology... one or two centuries later their buildings are still standing. Even though time has often taken its toll these buildings are still there – usually having reached a harmony with their environment, their use, and are comfortable in their old age. More often than not, conservation and restoration is only required because somebody in the past has neglected them, or interfered with the stasis that a building has achieved with its environment – often by misguided renovation or conservation. So why would we conserve them using something which isn’t compatible with what they’re used to – surely a better approach is to put ourselves in the shoes of their original builders, and take it back to grass roots.

Of course we can’t just pick up a contract document from 1830 and find out exactly how a builder approached his project. Whilst we have old trade manuals which tell us how work was generally approached (in a perfect world) but the reality, particularly in the colonial context, is that people made do with what they had. Each building is different, and has its own archaeological personality – a micro-vernacular being the variation in the composition of building materials, not always readily apparent, but potentially having great influence in the success of specifying replacement products.

Generally, a better conservation outcome can be gained through analysing materials, within any known regional or specific historical context, and approach conservation with a well informed like-for-like mentality – and keep the Burra Charter12 (and the like) advocates happy, whilst letting your building tell you what it has been comfortable with for centuries.

12 See ICOMOS Australia http://www.icomos.org/australia/burra.html
I attended a plaster repair workshop at the Weald and Downland Open Air Museum, which very strongly and effectively emphasised the principles of:

- Like for like repair in the first instance.
- Let the building tell you what it wants.
- *If it was good enough for them, it is good enough for you.*
- There are no 'recipes' for repair of traditional buildings – each must be assessed on a case by case basis.
- Use local materials were possible – e.g. those that were originally used.

But of course the methodology and procedure for ascertaining the detail behind these principles (e.g. what is 'like-for-like'? ) is the key to success in the application of that philosophy.

Whilst my experience in the UK surrounding the use of lime products shows that there is still a widespread ‘one size fits all’ mentality of products tried and tested over the last few decades, the approach outlined above of a case by case approach is rapidly overtaking that mentality. In depth analysis and testing of products to achieve a like for like outcome – maintaining the harmony of a building within its micro-vernacular is being assisted by material research, and development of a database of regional and periodical variation upon what was once seen as more standardised lime products.

**Charlestown consultants**

Through the Charlestown Consultants arm of the SLCT, the trust has established themselves as the Scottish (and probably UK) leaders in the archaeological analysis of lime based building products, in a bid to better understand material properties, and to also build a database of regionally available lime and aggregate products across the United Kingdom.
This knowledge, in addition to being a client-based consultancy practice (e.g. specifying solutions to case by case masonry conservation) feeds knowledge into the specific applications of the Charlestown Workshops training courses, and disseminates into the conservation philosophy of the approaches they teach and perpetuate.

**Analysis techniques - the basics**

The concept of ‘specify a pointing mix over the phone’ doesn’t come into play, with a rigorous testing program employed to understand a particular scenario prior to specification. The SLCT preach the value of the nine criteria for assessment of suitability of a lime product, each with different methodology for testing their properties. Testing is applied to both historic samples (analysis and matching) and new samples (performance/suitability testing), as well as the masonry unit itself (stone or brick)

Amongst the techniques learned were:

- Acid dissolution testing – to test whether lime is present in a sample at all.
- Acid disaggregation – to determine the amount of soluble lime products (binder) and to extract the raw aggregate.
- Testing for density, mass and void ratio, of a given sample.
- Testing for capillary rise and absorption rates.
- Compressive and flexural strength testing.
- Microscopic analysis of samples.
- Aggregate grading and basic visual identification.
Whilst the scope of learning these techniques was somewhat limited by time, and that a thorough knowledge each technique is a whole field of study within itself, my time in the SLCT laboratory and Charlestown Workshops gave me a good basic appreciation of the methodology upon which I can build in the future. Various British Standards give provide additional methodology for some of these sampling and testing methods.13

**Building a data library**

One of the keys to initiating the success of archaeological and historical approaches to conservation through the matching of traditional building materials, is to have data available which assists in the identification of material sources and types. Indeed, the SLCT have lead the way in the United Kingdom in amassing data on limes, sands/aggregates and lime product properties. They hold over 5000 samples of building materials in their archive. This includes an aggregate library, with analysis of over 1500 sand quarry samples from across the UK (English Heritage have also done similar research on aggregate analysis). SLCT are constantly building upon this data library when undertaking analysis of materials, and when samples of geological material become available.

By understanding the type, nature and source of traditional building materials, in light of known regional and historic contexts, a lot of information can be gleaned about a lime product without necessarily undertaking onerous laboratory testing. Of course, testing supports the assumptions that can be drawn from archaeological, historical or geographical analysis of context, but as a base dataset the value of such a library of samples cannot be underestimated.

- Limestone (or shell) samples from historically/archaeologically known sources.
- Building stone samples from historically/archaeologically known sources.
- Samples of aggregates and any other additives (e.g. hair) from historically/archaeologically known sources.
- Samples of different types of lime products from known buildings and periods.

The avenues of investigation and support of like-for-like matching of such samples is considerable, and presents a valuable base-set of research data.

13 E.g. BS4551, BS 6363 et. al. .
Construction Materials Consultants

Whilst the SLCT undertake basic diagnostic testing on lime products and samples, the more advanced testing is outsourced, with much of this more complex testing being undertaken by Construction Materials Consultants (CMC) in Stirling. I spent a day one-on-one with the Director of CMC, Bill Revie, who gave me an overview of the advanced diagnostic and testing techniques undertaken by that company. Broadly, the techniques of masonry conservation learned with CMC can be categorised into two streams:

- Where in the building/wall is a problem?
- What materials should be used to fix it?

I had previously attended a Masterclass at SLCT where Bill Revie had presented the basic principles of approaching masonry repair, and factors to be considered at the outset:

- Is replacement really necessary? (in-line with the ‘do as much as necessary but as little as possible’ philosophy).
- Is the face of the stone consistent, and will a repair, if not necessary, have an adverse impact? (e.g. aesthetic impact of a repair).
- Why did the stone fail in the first place? – fix the source of the problem as well as the factors that caused it.

In determining an approach to masonry repair, Bill outlined the principles of simple in-field diagnostics, incorporating the above questions. The two broad areas of testing involve looking for unusual areas of moisture in a masonry wall, or cavities behind the face of masonry – both of which would suggest a problem which requires conservation works. Moisture is the key contributor to decay of masonry. Without moisture, most other agents of decay are much less likely to occur. Besides the basic commonsense ‘look, touch, tap’ approach, more complex diagnostics were explained, which were more fully explained in the follow-up day in his lab in Stirling:

14 http://www.cmcstirling.co.uk/
- Infrared thermography – looking for subtle temperature variations in a masonry wall, which may indicate a different micro-environment that may be detrimental (e.g. a damp or hollow patch).
- Ultrasonic testing – blasting the face of a stone with ultrasonic sound waves to observe their movement through the substrate (can indicate hollows/voids in a wall).
- Moisture meter testing – to test whether a difference shown by infrared thermography indicates a patch of excess moisture.
- Salt testing – testing for the presence of salts and chlorides not normally present (e.g. brought in by excess moisture).
- Impulse radar – to test whether a difference shown by infrared thermography indicates a hollow behind the face of the stone.
- Borescope investigation – further investigating the size and nature of a cavity found by impulse radar (invasive).
- Hammer testing – a simple way of determining a likely cavity behind a stone face (can be damaging to stone).

Upon determining that a stone repair/replacement may be necessary, the practice of replacement stone choice was discussed. As explained above, historical and archaeological research can be the most valuable tool in choosing replacement stone, as it is always preferable to replace like-with-like. However this may not always be possible, given probably lack of historical data, or inability to access historic quarries (bear in mind the impact that may arise from reopening historic quarries). If historical stone matching is not possible or feasible, then visual observation (e.g. colour and texture) is usually the first tool employed in matching stone – it must be aesthetically compatible (or at least in-time be compatible through weathering). Visual testing can be aided by core sampling, scraping and analysis of powder drillings.

Apart from visual (aesthetic) qualities of replacement stone, just as the performance properties of mortars are important, the same is true of replacement stone. The strength, density, absorption ability (e.g. capillary action), porosity and saturation coefficient are all factors that will impact the performance of a stone, and its likely reactivity with its environment (e.g. other stone and lime products). For instance, replacement stone should be no denser or stronger than surrounding stone (which might push a decay problem into original stone), and permeability and porosity should be similar. These properties are dictated by the petrography of a stone, which can be determined by x-ray diffraction analysis.
5. Not just conservation - traditional lime products in new-build

Whilst the rationale of the fellowship was the examination of the use of lime products in restoration and conservation, the applicability of applying the ‘lime-revival’ into new-build cannot be ignored. In 1975, the use of lime was dropped from British Standards relating to new-building, marking the conquest of cement in the building industry (alongside, unfortunately, the restoration industry). This made the use of lime difficult for those who recognised its inherent qualities – rather than meeting a standard for building regulations, any use of lime had to demonstrate that it was fit for the purpose – adding another hurdle to its use in mainstream building.

The properties of lime products in restoration stand just as true in new-build, with breatheability, flexibility and permeability attributes just as relevant. When comparing the environmental friendliness of lime versus cement, then there are certain unmistakable advantages to lime over cement in any building job where strength is not a priority.

The preparation of lime requires much less energy input than that of cement – one example being that cement kilns require longer and hotter firing than lime kilns, therefore emits a smaller carbon footprint than that of cement. Also, perhaps the greatest flow-on advantage, is that lime, being breathable, flexible and permeable, allows a greater amount of much more environmentally sustainable building materials to be used, which cannot effectively be used with hard, brittle, impermeable cement products. Lime allows use of unfired clay bricks, hemcrete, adobe etc, all of which are much more sustainable than traditional cement based fired bricks. Buildings built with lime do not need expansion joints, as the use of lime throughout a building gives it a natural ability to move with its environment.

The manufacture of a product such as hemcrete is actually carbon negative, therefore its use, in conjunction with lime, actually absorbs more carbon than it emits. Also, lime, being soft and reversible, also allows the easy recycling of masonry units after a demolition, which may not be feasible with cement use.
I visited Lime Technology, a sustainable building innovation company in Oxfordshire, where the Director, Ian Pritchett, gave me a tour of the facility and provided details as to their lime-based building products. Lime Technology have developed a number of lime based products, such as mortars, renders, hemcrete walling systems and plasters, aimed at the new-build market and sold on the strengths of environmental sustainability and the advantageous properties of lime based products.

Ian’s background is in the use of traditional lime based products in conservation, however he has recognised that these products have applicability in the new-build market, and has established his business to meet that demand – having undertaken an extensive program of product development and testing. Whilst the short visit did not allow a great deal of detail to be discussed regarding the specific approaches to lime use in new-build, Ian gave a general overview of the approach to selling the concept of lime use through the environmental sustainability approach, and how that is providing an effective conduit towards a lime revival. This certainly has applicability in Australia alongside the promotion of lime products in conservation.

If it works for old, why can’t it work for new?

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15 www.limetechnology.co.uk/
6. Selling the concept - Heritage skills training

Although the primary aim of the fellowship was to build my own skills in a particular aspect of conservation practice, a key component was to also examine the operation of various heritage skills training programs – to be able to teach what I had learned. This is a fundamental part of the importance of the Churchill Fellowship program – meaningful dissemination of information to the Australian community upon completion of the fellowship.

Heritage skills training in Australia

Overall, heritage trade skills training in Australia is a very ad-hoc industry – relying mostly on smart marketing and ‘apprenticeship-ism’ by tradespeople who recognise and fill niche heritage markets (although not underestimating the importance of such). Despite a widespread recognition of the problem, there are no systematic and dedicated heritage trades academies in the country – the predominant formal means of qualifications being universities, short TAFE-style courses, and government agency run short courses.

Many universities offer cultural heritage management and conservation programs (e.g. Deakin, New England, Canberra, Sydney, UNSW), although these are mostly concerned with the theory and management practice of cultural heritage – and not trade based (apart from some short hands-on practical courses such as the summer school offered by Canberra University).

State heritage agencies offer some heritage skills training, such as the New South Wales Heritage Office, who run occasional 1-2 day courses, such as ‘lime days’, salt attack and rising damp seminars etc. as a means of providing basic training to industry and public. Similarly, Heritage Tasmania sponsor occasional field 

days such as the Restoration Central and Saving Our Stone public heritage events, in conjunction with Southern Midlands Council. Such courses, although very valuable in raising general awareness of heritage trades, are intended only as ‘tasters’ – and do not necessarily lead to any further training or accreditation.

In addition to these formal, and semi-formal programs, there is certainly a countless amount of informal training and perpetuation of skills through small business and sole operator tradespeople – quantifying that aspect of the industry is difficult, but it is likely that the greater proportion of heritage skills training comes about via such apprenticeship methods.

Through 2005-6, the NSW Heritage Office held workshops to discuss the decline and shortage of conservation skills in both the trade and professional sectors. These workshops were designed to inform input into the Productivity Commission’s Inquiry into Australia’s Historic Heritage Places, as well as to assist the state agencies to develop initiatives to address the issues recognised concerning heritage skills training. Whilst heritage skills did not manifest as a key issue in the Productivity Commission inquiry, the workshop findings did filter into many of the submissions to the review, and browsing such submissions, and the public hearing transcripts, provides a useful insight into the New South Wales (and wider) situation.

Many of the submissions discuss concerns regarding the lack of heritage trade skills, and the consequences for Australia’s stock of heritage places. Many submissions echo the need for a national policy approach to addressing the problem. Particular issues included the perception that current heritage education programs in Australia are poorly targeted, an aging heritage workforce with no incentive to replace, and inadequate regional access to heritage trades and advisors. At a follow-up workshop held by Heritage NSW, the key proposed solutions to these problems included:

- Development of a national heritage skills training strategy in response to a national skills audit.

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• The establishment of specialist skills institutes.
• Development of regional training and support institutes
• Provision of adequate accreditation schemes.

Further discussion on this topic was held at the 2007 Heritage Chairs and Officials of Australia and New Zealand conference, and formed the basis for a National Workshop on Practical Heritage Conservation Skills Development and Training, held in September 2007, hosted by the NSW Heritage Office. This workshop paid particular attention to the United Kingdom’s recent move to more systematic and cross-regional heritage skills training.

Since that time, no firm outcomes seem to have been delivered, however it is reassuring to know that at least one state heritage agency is taking a lead with the push to better promote and manage heritage skills trades – and that it is working its way onto the national agenda through cross-jurisdictional support (and consistency) from involvement of Heritage chairs and Officials of Australia and New Zealand. Heritage Victoria is currently undertaking a project assessing heritage skills training needs in that state, with a report due at the end of 2009. At the same time, Australia seems to be looking outwards onto the international scene to see what can be learned from other models. Very recently, Godden Mackay Logan (Heritage Consultants) were commissioned by the Heritage Chairs and Officials of Australia and New Zealand to undertake a needs assessment of heritage skills training in Australia and New Zealand – results of this study are forthcoming.

Heritage skills training in the United Kingdom

Assessing the need

Anecdotal evidence from the United Kingdom suggests that the latter part of the twentieth century saw a rapid decline in traditional building skills;²⁴ and in the late 1990s and early 2000’s some work was done on raising awareness on the need to take action, with groups such as the Heritage Lottery Fund,²⁵ and the Countryside Commission²⁶ producing documents which detailed the concerns at the decline in traditional building skills. Although these documents broadly detailed the need to address the issue, they did not provide any systematic plan for such. In 2005, it was estimated that England had a shortfall of around 6500 positions for specialist heritage tradespeople, to preserve England’s five million pre-1919 buildings, upon which £3.5 billion is spent annually.²⁷ It was not until 2005, that a report by the National Heritage Training Group (NHTG) on traditional building craft skills²⁸ set a significant benchmark in understanding the regional and national skills needs in England, and set various strategic goals for desired areas of improvement – namely in supply and demand of traditional building skills, materials and training provisions.

The National Heritage Training Group (NHTG) is a collaboration between ConstructionSkills (Government construction skills training body) and English Heritage. A key mandate of the NHTG is to inform the construction industry on heritage issues. The NHTG report was launched at the 2005 North East Heritage Skills Fair in Wallington, and made a series of recommendations for strategic improvement of heritage skills, based on supply and demand of skills, general awareness of skill requirements, availability of supplies, availability of training provisions etc. These points were also analysed upon a regional basis, as a means of ascertaining whether certain parts of England were more deficient than others.

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²⁵ Heritage Lottery Fund 1999: Sustaining our Living Heritage
²⁸ Ibid.
Generally, the report found that England was seeing an increased spend on pre-1919 building stock as well as an increased spend per building, however a general lack of understanding of the need for traditional skills use, coupled with an overall higher cost of such skills, was acting to inhibit skill growth – a very similar situation to that of Tasmania as described earlier in this dissertation. This report found that only around a quarter of tradespeople working on pre-1919 buildings had any formal heritage skills training, and that figure was rapidly falling. This report also found that in times of building ‘booms’ (e.g. where tradespeople can ‘pick and choose’ jobs) tradespeople are reluctant to take on small and specialised jobs, therefore complex heritage jobs were less likely to be favoured than more straightforward ‘modern’ building jobs – causing frustration for owners of heritage properties at the lack of available tradespeople\(^\text{29}\). The report also identified the most vulnerable of heritage skills – e.g. those skills which were most in danger of dying out due mostly to lack of training, not necessarily lack of demand.

As part of the 2005 NHTG report, a skills action plan was developed, which set key goals concentrating on skills development, and considering the apparent regional disparities outlined in the report. NHTG, in conjunction with ConstructionSkills and English Heritage, were designated as the lead partners in the implementation of the recommendations. As part of the action plan, 2007 also saw supplementary reports developed to address the same issues in Wales\(^\text{30}\) and Scotland\(^\text{31}\) - adding to the wider understanding of skills deficiencies in the United Kingdom. From that report, nine regional skills development hubs were formed (under widely varying structures) – the North of England Civic Trust’s *Heritage Skills Initiative* being one of these nine groups (see below). Varying levels of success have been observed between the hubs - funding sources being the main issue, reliant on the capacity of the auspicing body - for instance, only seven of the nine bodies have heritage skills coordinators.

On broader national policy, at the same time as the release of the NHTG report, England saw the release of the Leitch Report\(^\text{32}\), an interim report into skills, education and training in the United Kingdom. This interim report was followed in 2006, by a report to HM Treasury which seeks to improve the overall delivery


of education and training in England towards 2020. Whilst not heritage focussed, this initiative provides an overall national strategic framework in which specialist areas such as heritage skills might be promoted. It also might serve to provide leverage for funding, and alignment with national education and training initiatives. For instance, some of the key initiatives of the Leitch report, with relevance to heritage training are:

- Encouraging businesses to pledge to voluntarily train workers at work, and if insufficient progress is made by 2010, workers will gain a statutory right to such training.
- Vocational courses will only gain public funding if they are approved by the Sector Skills Councils.
- Shifting the balance of overall intermediate skill level of workers from Level 2 to Level 3 (very relevant to heritage with the recently introduced NQV Level 3 accreditation detailed below).

In 2008, a follow-up review of the 2005 NHTG report was produced, which gave an overview of the previous three years, and reported on new findings against the directions of the action plan. Pursuant to the findings of the 2005 report, and reaffirmed by the 2008 report, significant progress was reported on national strategic policy linkages, communications and marketing of heritage practice, alignment with established accreditation programs, demand stimulation, supply-chain analysis, cross-sectoral partnerships and mentoring/training the trainers schemes – amongst many others. Although still relatively early-days, the NHTG and associated partners/ linkages look set to provide a substantive analytical and stimulative framework to addressing the identified skill shortages in the United Kingdom.

**Accreditation systems**

The basic construction skills certification in the United Kingdom is the Construction Skills Certification Scheme (CSCS) card. In follow-up to the Leitch report, by 2010 workers in the construction sector must hold such a card, or be registered with an affiliated scheme. Many construction firms and their clients already insist

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that operatives hold a relevant CSCS card to work on site. Upon the basic CSCS card, tradespeople then add specific training modules along their chosen stream, aligned with the National Vocational Qualification System, as overseen by ConstructionSkills and the NHTG (or similarly, in Scotland, the Scottish Vocational Qualification System, as overseen by the Scottish Qualifications Authority). Authorised training bodies (such as the nine regional hubs established by the NHTG, and organisations such as the SCLT) deliver the training curriculum and issue the qualification under the NVQ or SVQ framework.

Perhaps one of the most promising initiatives arising from the 2005 NHTG report (and subsequent review) is the push for an increase in accredited heritage skills training aligned with the NVQ accreditation scheme, and the development of specific modules for heritage skills training, within the previously developed construction industry system. The 2008 NHTG report stated that only 50% of training providers expressed faith in the suitability of currently available heritage skills training aligned with the NVQ – and that 25% of training providers would be prepared to run accredited modules. Coupling this dissatisfaction and willingness to directly address the issue with the 2010 CSCS goal, means that the next couple of years are likely to present great opportunities to establish heritage skills training programs, aligned with the NHTG directions.

**Specific training organisations visited**

As part of my fellowship, various structures of skills training programs were examined, as a student, an observer and in meetings with training providers, accreditation agencies, government bodies etc. These also ranged from part day non-accredited courses, through to Masters degree courses in building conservation.
North of England Civic Trust

The North of England Civic Trust (NECT) is a not for profit body, based in Newcastle Upon Tyne, England. Established in the 1960s, the trust facilitates civic regeneration and conservation projects, such as heritage, community cultural development, arts etc, having undertaken £10 million worth of such projects in recent years. The NECT is a non-government body (but is partially comprised of local government managers and elected members).

Initiated by the North East Heritage Environment Forum, in response to the 2005 heritage skills report, the Heritage Skills Initiative (HSI) is the heritage skills arm of the NECT, being one of the nine regional bodies established by the National Heritage Training Group following the 2005 skills report. The HSI is managed by a steering committee, comprising of members from NECT, the NHTG, English Heritage, North East Museums Hub, Heritage Lottery Fund and the Learning and Skills Council. Bi-monthly steering committee meetings are held, and I was able to sit in as an observer in their May meeting, and provide a brief overview of the Australian heritage skills scenario.

Driven by a Heritage Skills Coordinator (Andie Harris), the HSI run an annual program of hands-on courses, ranging from plastering, cobbling, blacksmithing, drystone walling etc. Courses are run at a wide range of live-sites across the district. The HSI also facilitate regular heritage symposia and trade fairs. These are non accredited courses, aimed at a wide audience, such as property owners, heritage managers, as well as tradespeople who wish to up-skill. The HSI seeks to identify skills shortages within the region, and to link partners in training provision to address those shortfalls.

The courses offered under the HSI range from non-accredited taster days, to curriculum recognised under the NVQ system, to CPD accredited short courses. Courses may also be tailored to suit certain markets or groups upon request. The HSI also facilitate, in conjunction with the NHTG, regular ‘training the trainers’

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35 www.nect.org.uk
36 www.nect.org.uk/index.php?page=north-east-heritage-skills-project
courses, where the trainers of the courses (from other regional training hubs) meet to gain additional skills, and confer towards more consistent delivery and standard of the courses.

The key to the success of the NECT HSI seems to stem from secured funding – the management structure of the NECT has been fortunate thus-far in securing a reasonable level of funding. The success of the program relies on continued funding, which is not guaranteed.

Scottish Lime Centre Trust – Charlestown Workshops

Whilst I primarily attended the Scottish Lime Centre’s Charlestown Workshops as a student – to learn hands-on and theoretical skills in stone conservation, I also took the opportunity to observe the wider operation of that organisation as a training provider – this experience ranged from one-on-one days with trainers, discussions with the Director, and as an observer of course delivery. The Charlestown Workshops run around 18 different courses on masonry conservation and plastering, with the potential to tailor bespoke courses for clients upon request. See Section 3 for further detail on these courses37.

37 See also http://www.scotlime.org/
A limewashing course for Fife Council works crew at the SLCT headquarters in Charlestown (left). Simulated historic masonry walls in the Merryhill Workshops (right).

The SLCT run their training from the Charlestown Workshops – a training room at the Trust’s headquarters in Charlestown, and a recently converted agricultural shed at Merryhill, nearby. Lab-based training is delivered at the Trust’s laboratory in Charlestown. Like the courses offered by the NECT, the Charlestown Workshops offer a range of accreditation, from non-accredited homeowner courses, through to NVQ/SVQ accredited courses and masterclasses aligned with the National Progression Award in Masonry Conservation.
Essex County Council

Essex County Council is the only individual local government in England who operate an ongoing business unit which concentrates on heritage skills training programs. I spent a day observing a flint walling course, as well as time spent at Cressing Temple Barns, where many of the courses are staged. As part of Council’s conservation department, since 1997, they have offered a range of short courses (generally 1-3 days) in traditional building skills, ranging from lime
mortars, to flint walling to thatching. These courses are aimed at a wide audience, from homeowners to tradespeople, and although form no accreditation, these courses are designed as ‘tasters’ for those wishing to hone in skills or as a step to further training. The course program also includes CPD accredited lectures and events. Whilst the courses are administered by the Council, they are a separate and self-funding business unit of the Council – proof that heritage skills training programs can operate at no cost-burden to a government entity.

The Cressing Temple Barns at Chelmsford (left), and flint walling course at Wendens Ambo, near Cambridge, June 2009.

**Weald and Downland Open Air Museum**

Set on 50 acres in the Sussex countryside near Chichester, and established in the 1960s, the Weald and Downland Open Air Museum comprises of a collection of over 50 buildings, which have been saved from demolition all over England, and rebuilt/restored on-site at the museum. The museum is primarily a tourism
venture, attracting some 100,000 visitors per year. However, education and training are also a key component, with a very active heritage craft and trades training program.

The museum is considered a centre for excellence in traditional buildings skills training, from academic, to practical and recreational. The traditional building trades training program provided over 3000 student days of training in 2008, and offers a wide array of subjects from plastering, wheelwrighting, blacksmithing, lead windows, brickmaking, timber framing, right through to medieval baking, knitting leatherwork etc.

An afternoon was spent with Rebecca Osbourne, the Adult Education Officer at Weald and Downland, who detailed the management structure of the training courses, and how that sits within the museum management structure. Discussions were held as to how courses are developed – basically most of the courses are linking a suitable tutor, with an identified market of students. Identifying such markets is difficult, as often (particularly with non-conventional classes) it is not known whether there will be interest in a course until it is actually offered – and it is difficult to offer (and price) a course in the absence of knowing if it will be filled.

Nonetheless, Weald and Downland have made a great success in linking students with tutors, and providing the venue, administration and non-accredited awards for a huge array of courses. They have recently developed a NVQ accredited course in heavy timber framing, and Bournemouth University are in partnership with Weald and Downland for their Master of Building Conservation courses.

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38 See http://www.wealddown.co.uk/home-page-english.htm
The ‘Gridshell’ training facility at Weald and Downland (left). A plaster conservation course in the gridshell training room (right).

West Dean College and the Edward James Foundation

West Dean was established in 1971 by bequest of Edward James, who established the college by donation of the West Dean property. James was an influential patron of arts and culture, and wished for the estate to be used as a training facility for craft skills ‘to concentrate on helping young artists and craftsmen: and in teaching others to be artists and craftsmen’. The West Dean College training programs cover traditional craft, art, conservation and building skills, and the accreditation model runs along three streams:

- Continued professional development conservation masterclasses.
- Short courses.
• Full-time MA/Diploma courses.

Of most relevance to heritage skills training as examined here are the CPD conservation masterclasses. In all, fourteen building conservation masterclasses are offered annually, with a requirement of 10 for completion for the diploma (7 core plus 3 elective). Each class runs for 3 days, and is delivered at the West Dean teaching facilities (Sussex barns and ‘ruinette’). Each course is developed by the training coordinators, in conjunction with English Heritage, who are the accreditation body for the qualification, issued by West Dean College. CPD qualifications are provided by the Royal Institute of British Architects and the Institute for Historic Building Conservation.

The West Dean College (left). The West Dean ‘Ruinette’ facility – masonry training area (right).
Most of the training is undertaken in the ‘ruinette’ on site at West Dean – a purpose built building in which various replica building components have been erected, which demonstrate conservation issues upon which students can learn building and conservation skills. Rubble stone walling, flint walling, plastering, brick and render techniques are taught in the ruinette, with classroom learning delivered in the adjacent Sussex barns. Curriculum is developed in conjunction with English Heritage, and in partnership with Bournemouth University. Residential facilities are provided in the West Dean college building, as well as in other buildings on site.

The West Dean ruinette materials training area (left). Traditional plastering training area (right).
Penicuik House Trust

Penicuik House is the ruin of a 18th century sandstone Palladian style mansion, situated 10 km to the South of Edinburgh. The building was burnt out in the late 1890s, and has stood in a ruinous state since that time – the family converted the stables after the fire and have continued to live on site, maintaining the enormous grounds and suite of other buildings.

Established in the 1980s, the Penicuik House Preservation Trust, has worked since that time in preserving the building, and making the grounds available for public usage. A partnership with the Scottish Lime Centre Trust has recently been established, and funding has been obtained from Historic Scotland, the Heritage Lottery Fund, plus other partners and an endowment from the property owners (a total of £6,000,000 over six years), to undertake comprehensive stabilisation of the ruin. A key aspect of the project is to deliver education and training in the use of traditional building materials and techniques. Under the funding agreement, 16 stonemasonry apprentices are to be trained during the project. It is anticipated that 600 people per year will receive training at Penicuik House.

Part of the house has already been restored for use as a training centre, and I was fortunate enough to attend a three-day structural repair and ruin consolidation workshop as part of the first intake of students on the site. I also spent time discussing the project with the training coordinator and project manager (Gillian Ferguson and Stuart Beattie), who were able to share valuable experiences in establishing and operating such a collaborative partnership.

The Penicuik House project is an example of a collaboration between private property owners, a training body, and a public trust, which will have the outcome of preserving a ruin for public appreciation, whilst being used as a ‘live’ site for various levels of traditional building skills training (from short course to fully accredited apprenticeships).

39 http://www.penicuikhouse.co.uk/
With funding from the Heritage Lottery Fund, Knowsley Council (outskirts of Liverpool) have established a three-year Conservation Skills and Interpretation Program, which includes the Young Conservation Officers program. I spent an afternoon with the program coordinator of this program (Jane Wells) discussing the development and delivery of conservation skills training to 16-19 year olds – targeting this group with appropriate curriculum, level of engagement and appropriate teaching methods over a short course, for maximum success of delivery.

The program is designed to be delivered to small groups of hand-picked teenagers, by experienced tradespeople, under the guidance of the program coordinator. Delivery of the program includes ‘have a go days’, work shadowing, young apprentice schemes, as well as four-day residential courses for college students (e.g. bricklaying courses). So far, over 400 local students have been involved in the program, and in conjunction with a local museum a schools education pack has been developed which aims to allow ongoing outreach programs to continue beyond the life of the current project.

It is unfortunate that the Knowsley conservation skills project only received three years of funding, and is due to wind-up at the end of 2009. Nonetheless, this program is an exceptional example of how a local government agency can take on a heritage skills training program, and deliver it to youth – this type of model was not seen elsewhere in the UK, and has the possibility for adoption for other localities.

**Alan Gardiner & Associates**

Although not a specific training provider, I spent a morning with Alan Gardiner, a Building Surveyor based in Bolton (near Manchester). A current project being undertaken by Alan is the development of a heritage skills training component of a grant aided project to restore and develop an adaptive reuse for All Souls Church, Bolton. Alan ran me through the overall accreditation system in-place for tradespeople working on English Heritage Grade-A listed buildings, and the United Kingdom definition of a building surveyor – which differs greatly from that of an Australian Building Surveyor (UK surveyors undertaking the talks which would be more the domain of a conservation Architect in Australia. I sat in on a meeting between Alan, and Bev West, a lecturer in building surveying at Leeds Metropolitan University, which gave me an overview of the structure, issues and challenges of the profession of building surveying in the UK.

The key point gained form the discussions with Alan was that grant funded restoration offers an opportunity for the integration of heritage skills training programs as part of a public benefit. Examining the mandates of stakeholders in a restoration project, and identifying any such mandates relating to public benefit, community engagement or education can provide an inroad to convincing project managers and funders that a skills training program can value-add to a
project, and/or assist in the attraction of funds. Alan is developing a training manual for such models, using All Souls Church as the pilot (if fully funded), and has offered to pass the model on once completed.

**The Society for the Protection of Ancient Buildings**

One of the first organisations in the United Kingdom to offer heritage skills training, by way of a bursary scheme established in 1930, is the Society for the Protection of Ancient Buildings. I met with Douglas Kent at the SPAB office in London, where we discussed the overall training programs offered by SPAB, under their educative mandate. The SPAB facilitate a range of courses, from weekend homeowners courses, to week-long short courses, CPD accredited day events, and summer schools. Their flagship training programs are however the nine-month Lethaby Scholarship in building conservation, and the six month William Morris scholarship in traditional craft are examples of intensely focussed longer-term skills training under a bursary scheme. Whilst bursaries are offered in the United Kingdom under the Heritage Lottery Fund scheme, these are more focussed at financial assistance to employers in training apprentices in heritage trade skills. The SPAB bursary offers a wider ranging learning experience, structured as a six-month travel period working alongside various contractors and builders across the UK, followed by a three-month intensive training program in the field of choice. Alan Gardiner (see above) was a former SPAB scholar, and gave me additional first-hand insight into the benefits of the scheme. He also provided me with the names of past Australian scholars.

**Summary of heritage skills training facilities visited**

The above provides only a brief overview of the facilities visited, and my learning from informal discussions with various administrators of the courses and programs. This does not represent a comprehensive overview of training facilities in the United Kingdom, and was chosen more to demonstrate the spectrum of training models available.

My initial intent, when planning the fellowship, was to only visit the SLCT and Essex County Council, but I soon realised that every person I spoke to would refer me to at least two more – so it was a madcap fortnight of travelling around the country trying to maximise my time with these people.
My key interest was to examine local government based models, as my initial thoughts were that this would provide the ideal platform to launch Australian initiatives. Essex County Council certainly demonstrates the success of a cost-neutral, small-scale training program, and how this has widespread community benefit and benefit for the heritage resource – particularly for those who seek to gain some short but structured exposure to non-accredited skills training. Knowsley also demonstrates that a local government can, if resources exist, develop a very successful program aimed at a group which would certainly not ordinarily be exposed to such training.

The SLCT, Weald and Downland are exemplary examples of independent not-for-profit bodies which have established a very firm foothold in a broad range of levels of skills training. The key to their success is offering this broad range to identified target audiences, perpetuation of strong industry linkages, and establishing reputations as centres for excellence. In both cases, however, the training may not be sustainable in the absence of other income generating activities to sustain the public benefit of training, or to draw people to the locality of training.

Penicuik House (and through its partnership with the SLCT) is an example of how a private sector partnership can be successful – combining property owners with community benefit, training and good heritage outcomes.

West Dean and SPAB are great examples of formally accredited training, under the guidance of long-established and peak-body heritage organisations (English Heritage and SPAB). West Dean has certainly capitalised on a unique opportunity provided by the Edward James Foundation as a formal and academic facility dedicated to heritage craft skills – linkage to the National peak-body for heritage (English Heritage) as well as an academic accreditation body (Bournemouth University) has demonstrated that high-level partnerships can forge a very strong alliance towards meeting of common education mandates – further proving that partnerships are a key to the success of heritage trades skills programs.

In addition to the specific training providers visited, time spent with Historic Scotland, and Alan Gardiner provided a good insight into how both government and private organisations can integrate training into everyday restoration programs, and how permit conditions and conditions of grant might be able to play a part in stimulating heritage skills training.
Little of the above would be possible without the high-level government policy stimulating the need for training, as well as the industry and markets being tuned to that need also. Discussions with ConstructionSkills, the National Heritage Training Group, the Scottish Stone Liaison Group, and Historic Scotland all show that there needs to be an overarching policy framework to drive the desire and need for training. Industry shake-ups like the 2003 HNTG report, and the Leitch report on skills in the UK are key benchmarking documents which quantify the need and elaborate on the long-term policy framework that is required to address issues such as heritage skill trade shortages, which allows the on-ground groups (such as those outlined above) to leverage support and progress in a more consistent fashion.

A great deal has been done in the United Kingdom over the last few years, and hopefully the next decade will see a turning point in the advancement of heritage skills training. Australia should watch and learn from the UK experience – to forge international partnerships, adopt tried and tested models and avoid an Antipodean reinvention of the wheel.
7. Post-fellowship action plan

So, equipped with a head full of knowledge, a million more questions, 30kg of excess baggage in the form of books/brochures etc. – all combined with an urge to make some sense and order of information overload, it’s time to think about how I’ll put all of this into action.

Broadly, the information in my head came home in three compartments, although inextricably linked, those of:

- Lime use and sandstone conservation – products, methods, application.
- Building materials research – reading and analysing a building.
- Heritage skills training – getting it out there.

So, my battle plan is developed along these lines - each feeding into the other. Whilst the lessons learned have applicability to Australia in general, I have chosen to hone my action plan into Tasmania, for the reasons outlined below (e.g. the available heritage resource, the manageability of understanding a smaller population, and because it is my home turf). These ideas need not be limited to just Tasmania, and I encourage discussion between states on these topics.

**Lime and sandstone conservation**

At the end of the fellowship, I am not as convinced as I was that there is such a great problem in Australia with the actual practical application of lime based products in conservation works – there are some great stonemasons working who can render, plaster or repoint a wall – all with seemingly good conservation outcomes - in the short-term at least. Now, I am more convinced that there are problems with the misunderstanding of material properties, and how that impacts the longevity and durability of the products used, and consequences for a building where they are used. I am also more convinced that the overall philosophical approach to conservation works in Australia is too far skewed towards 'tried and tested mixes' – rather than the ethos of ‘like-for-like’ approach of
reading a building as an individual artifact. It is surrounding these points that I will base my post-fellowship plan to further research and disseminate such concepts.

**Understanding the local context**

The approach to addressing a building as an archaeological artifact in order to better understand the required dynamics of materials needs to be well informed by the local context – that of the historical context of those building at the time, the context of the availability of any imported materials, and the natural context of locally available raw materials.

Colonial masonry was chiefly influenced by the availability of:

- Stone, lime and aggregate (e.g. sand).
- Skilled tradespeople – stonemasons, limeburners, quarrymen.
- Processing infrastructure (e.g. limekilns).

To gain a knowledge of these factors, specific to an individual building, is a very onerous task – and may well be beyond the means and scope of any particular project. However, the development of a database of such information across a region can assist those undertaking such analysis. In its simplest form, to be able to quickly ascertain where materials were coming from at a particular time in a particular region, cuts a huge amount of conjecture out of specifying a like-for-like restoration product, for example, if we know that:

- A building was built in 1830.
- There was only one lime quarry and limekiln complex in the region in 1830.
- There was an appropriate sand available near to the building site compatible to that observed in a sample from the building.
• The building was built by a particular stonemason who quarried stone at that time from a known quarry site.

Then, without the need for onerous research, we can specify a type of lime and compatible aggregate for that stone, to a reasonable degree of accuracy – following a like-for-like approach. It will probably be found that in most instances locally procured resources were predominant – whether adequate or not. Looking at local traditions from an archaeological (and commonsense) approach might be much more effective than complex (and expensive) mineralogical analysis of materials. Coupling this with knowledge of the building, the current environment and type of use, we can specify a suitable product which addresses the diagnostic criteria as outlined above.

Whilst there is still some conjecture in this approach, given a good database it is not onerous, and easily accessible to anyone without the need for detailed (and expensive) testing. Of course, if desired such testing can still occur, just to make sure, but a broad approach would pick up on many more instances – and bring the average ‘got it right’ score up very easily.

Using Tasmania as a case study, the following initiatives would add greatly to achieving better outcomes in specifying lime products:

• An investigation into the colonial limeburning industry and available lime sources, concentrating on:
  o The location and type of kilns and how lime was being processed, e.g. understanding where (and when) limestone was being used as opposed to shell lime,
  o Gaining an understanding of how the burning process evolved over time and whether process (e.g. primitive burns) might influence final product etc (and how this might translate into current conservation issues).
  o Analysis of regional variation, and dispersal of products throughout regions – export distances, regional shortages etc.
  o The mineralogical composition of limestone from historic quarries, and what currently available product has the same properties. If currently available products are not compatible, what substitutes are appropriate?
• Collection of lime product samples, with analysis concentrating on:
  o Lime content (e.g. type via mineralogical analysis and matching with known quarries. Proportional content via dissolution analysis). Petrographic analysis if resources permit.
  o Aggregate type (extracted via lime dissolution and profiled in comparison with known source samples).

• Sample production using traditionally sourced products, mixing types of lime with types of aggregate in various proportions, as guided by historic sample analysis. Profiling of what mix proportions might be suitable to various regions through various time periods based on the historical context of available resources, processing plant and operators.

• Testing of properties of replicated such as:
  o Colour of end product.
  o Compressive and tensile strength.
  o Porosity and permeability.

• Coupling properties replicated product mixes with scenarios of building type, use and environmental conditions, to define a best fit product sourced from appropriate like-for-like materials, that will offer the required performance characteristics for various types of circumstances (e.g. meeting the diagnostic criteria of the SLCT model as best as possible).

This research would require significant resource inputs, for research time, testing costs (materials and equipment) and the results would need to be actively promoted and managed, and added to as further historical research comes to light, or as new samples are collected. Nonetheless, the benefits would be immeasurable in informing better practice in the conservation of masonry structures, and also provide a comparative dataset for further research into interstate, and overseas practices.
Teaching the philosophy

The philosophy of a case-by-case approach to the fine detailed specification of lime products, as opposed to a one size fits all recipe, is a philosophy which needs to be more widely promoted in Australia.

*Burra Charter* principles of use of traditional products, like for like replacement, and thorough research guiding conservation sets the scene for promotion of this specific philosophy - widespread acceptance of the principles of the *Burra Charter* as the Australian conservation ‘Bible’ means that there is certainly a framework in place for the perpetuation of this approach (which of course need not be limited to lime products). Beyond conservation philosophy, the practical advantages offered by well researched compatible products (e.g. material dynamics, durability, longevity) should also be stressed. This overarching philosophy must be deeply imbedded into any curriculum which is developed for heritage skills training.

Teaching the practical application

Whilst the above initiatives regarding the development of a database of raw materials and results of analysis of historic lime products would be of benefit to specifying lime products for restoration, the ability to analyse and test buildings and particular samples also needs to be more widely accessible in Australia. Diagnostic approaches such as those learned in the laboratory at the Charlestown Workshops, and at Construction Materials Consultants need to be disseminated in Australia. Opportunities exist for the demonstration of best practice in conservation approach to utilise these diagnostic approaches.

Just as it is considered important to educate the stonemasonry industry as to the lessons learned regarding the understanding of material properties of lime based products, it is also important to educate those driving the industry – architects, specifiers and clients as to the importance of good diagnostics, and how getting it right at the outset can increase the success of conservation works.
**Heritage skills training**

Whilst the primary aim of this fellowship was to up-skill myself in the use of traditional lime products in architectural sandstone conservation, a secondary (but no less important) aim was to learn how best to perpetuate such knowledge through heritage skills education and training.

**Determining market demand**

Whilst it is all well and good to assume that there is a demand for heritage skills, real numerical data is needed to support such assumptions. It is recommended that Australia undertake a report of similar lines to the 2005 NTHG report, to assess:

- What skills are deemed deficient?
- Are there regional deficiencies?
- Can the forecast restoration market support more trained tradespeople?
- Are there difficulties in material acquisition which fuel deficiencies alongside skill shortages?
- Are people willing to pay for up-skilled labour?
- Are there sufficient trainers?

Based on the array of heritage stock, Tasmania could be a manageable-sized pilot for such an investigation. The Tasmanian Heritage Register has around 6000 state-listed heritage buildings,\(^{41}\) which represents 38% of Australia’s state-level heritage listed buildings.\(^{42}\) The Tasmanian Heritage Council deal with, on

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41 See [www.heritage.tas.gov.au](http://www.heritage.tas.gov.au)

average, 330 applications per year for works to listed places,\textsuperscript{43} therefore around 6% of places on the Tasmanian Heritage Register have works undertaken to them per year\textsuperscript{44}.

Despite the number of heritage buildings, Tasmania has only 5% of Australia’s population, therefore the per-capita stock of heritage buildings is greatly in excess of the national average. It is likely that this per-capita imbalance results in a lack of tradespeople skilled in heritage practice, and a possible threat to the integrity of heritage buildings. Conversely, previous lack of population and development pressure might have been a factor in minimising development pressure on Tasmania’s heritage building stock, however lately in a climate of a surging real estate and ‘renovation’, demographic imbalances might now be more of a threat to the heritage resource – supporting the idea that Tasmania be used as a pilot for heritage skills market research.

**Developing a model for delivery**

This report has detailed a number of different organisational structures under which heritage trades skills can be delivered – and is by no means exhaustive. The types of organisations discussed include:

- Not for profit trusts/charitable organisations (e.g. SLCT, Weald and Downland).
- Civic partnerships (e.g. NECT).
- Grant aided trusts in partnership with benevolent bodies (Penicuik House).
- Peak government bodies (ConstructionSkills, Historic Scotland).
- Local government business units (Essex County Council).


\textsuperscript{44} Not including those places where an *Exclusion from Works Approval* certificate is issued, where there is deemed to be no impact upon heritage values. This number would be considerable more (e.g. probably double) if these were counted.
- Local government grant-aided projects (Knowsley Council).
- Commercial operators (Lime Centre).

Whilst it is beyond the scope of this report to provide an in-depth analysis of the feasibility of any of these models, it does serve to demonstrate that there is an array of administrative frameworks within which a heritage skills training program can be developed. Careful business planning, incorporating issues such as market demand, must be undertaken specific to any proposed model for skills training.

**The need for curriculum**

Within any organisational framework for the delivery of heritage skills training, there is a need for the development of curriculum – which must be in-line with best practice and industry needs/standards. Without such curriculum, there is the risk that any programs will result in inconsistent delivery and standards, or may not be assessable under any accreditation system.

Curriculum for any particular skill-set would need to be developed according to the target market – e.g. homeowners may not need the level of training that apprentices require. The curriculum must also be relevant to the market (e.g. the commonly needed skills, local materials/tradition etc).

It is critical that curriculum be developed in-line with the industry which it is deigned to serve. There is little point in teaching skills that are seen as superfluous to the industry – and they are the ones at the coal face who know what’s needed, and will ultimately dictate the level of competency expected. That said, well developed curriculum may add to areas of industry that do not necessarily recognise a possible better way of doing things – emphasising that those developing curriculum need an in-depth understanding of the way the industry works (again emphasising the need for market research).
The above broad concepts are not new. In fact, trades skills in Australia (and elsewhere) have long been taught under very effective systems of administration and curriculum development. Organisations such as the Housing Industry Association, Building and Construction Industry Training Board, Master Builders Association etc (or by any other names) have long been undertaking competent research and development in partnership with training providers to build a very strong core-set of trades training curriculum. Unfortunately, ‘less conventional’ trades (e.g. heritage) often do not get a look in, with research and development of trades skills concentrating on more mainstream ‘modern’ trades – with any attempt at heritage skills being left to the realm of short courses and ad-hoc events. Whilst a worthwhile attempt, lack of consistent curriculum, delivery and accreditation diminishes the value of such initiatives.

The approach to the development of curriculum, and the ‘selling’ of such to industry and markets, can be summarised as the following steps:

1. Define ‘competency’ – e.g. what end result should the curriculum be teaching students? This needs to be developed in conjunction with industry partners.
2. Create the qualification – e.g. the curriculum. What is being taught, and how, in order to instil the ‘competency’ defined in (1).
3. Assess market demand – e.g. in what specific fields are the skills shortages, and would there be enough work for people once trained?
4. Provide a centralized training body, to operate the on-ground delivery of training under a recognised accreditation framework – e.g. matching instructors, with students, with a qualification to meet the market demand defined in (3).
5. Instil the desirability of accreditation into the trade community, through education and competitive advantage before any moves for mandatory requirements.

The need for accreditation

Following the UK model, heritage skills training programs can be developed simply by developing curriculum in line-with industry needs, and slotted into existing trade accreditation systems. It really is that simple. The difficult part then comes with ‘selling’ the need for accreditation to the industry itself. Whilst the industry can easily drive the curriculum, accreditation is harder to sell. There needs to be a very slow implementation of accreditation - we need to convince the industry of the advantages of accreditation (e.g. market advantage – largely driven by education of the customer) well ahead of any mandatory accreditation.
Whilst we can immediately start to stimulate market demand for accredited tradespeople, e.g. permit authorities requiring certain accreditation for works to significant listed places, or through making a certain level of accreditation essential for grant aided or public projects, care needs to be taken to not make a need for accreditation too onerous for the industry in the short-term – bearing in mind that it is the industry which must support the development of curriculum. And of course it is counter-productive to require mandatory accreditation if the systems for gaining that accreditation are not yet in place.

It seems that the key to the success of the development of training programs is to convince the industry that formal training/accreditation systems are a) a competitive advantage, b) more desirable to customers, and c) something which could eventually be legislatively regulated. During the implementation of any widespread accreditation scheme, tradespeople must be given a good head start to get such accreditation widely dispersed amongst the industry. The reasons for, and advantages of, accreditation must be very strongly advocated within the industry, to 'sell' the concept to the industry, and allow them to make a conscious decision to get accredited.

**Training programs - who pays?**

The question with the viability of any training program, heritage no-less, is who pays? The UK models examined here are wide ranging in their economics. For instance, Essex County Council’s program is designed to be cost neutral to Council – participants pay for courses which covers materials, trainers and the coordinators costs. The program receives no council or external funding. The training component of the Penicuik house project benefits from Heritage Lottery funding. The SLCT could not operate a viable training program without the subsidised operational income deriving from consultancy. Weald and Downland’s courses make a profit, however are part of a wider heritage initiative – being a museum and tourism enterprise, so it is difficult to tell whether their courses would succeed as a standalone enterprise. Knowsley Council’s free program relies on a one-off three year grant which is about to dry up.

45 For instance, see their 2006 annual report
England is fortunate to have significant resource backing, for instance the Heritage Lottery Fund (HLF), established in 1993 with a particular focus of distributing proceeds from the National Lottery to heritage projects throughout the country. In 1999, the HLF commissioned specific research into the needs of heritage skills training in the United Kingdom, and found a significant shortfall in the supply of skilled heritage tradespeople.

England provides a number of training bursary schemes, to assist vocational students in heritage trades skills. For instance, the North East Historic Environment Forum offer two placements a year under Traditional Skills Bursary Program, providing six to twelve-month placements for students in traditional building skills. English Heritage provide up to ten two-year professional work placements annually for heritage skills. The Society for the Protection of Ancient Buildings offer building and traditional craft skills bursary schemes. Of major importance is the bursary scheme operated by English Heritage, NHTG, the National Trust and ConstructionSkills, funded by the Heritage Lottery Fund, which provides £900,000 over four years for heritage skills training. Launched in June 2007, this funding is directly pursuant to the initiatives detailed in strategy documents such as the 2005 NHTG report, and will provide around eighty bursaries over four years at NQV level 3 or higher.

The inconsistent and ad-hoc funding environment observed in the United Kingdom is not unique, and is likely to be the case in any Australian push for skills training. However, other industries (e.g. non-heritage) seem to be able to make a go of it. Consider current training stimulus models in operation, for instance the various state Building and Construction Industry Training Boards collect and administer a training levy, collected under the Building and Construction Training Act 1990, whereby a levy (0.2%) is payable on certain construction projects. The funds raised from the levy are used to provide training opportunities and enhance apprenticeship programs under the state boards. These provide subsidised training which may not ordinarily be available or achievable without a centralised administrative board or such subsidies (e.g. might not ordinarily be provided by small operators with apprentices).

It is possible that such a model might be applicable to heritage trade training – the imposition of a levy on conservation projects, with the funds channelled into skills development, might be a means of stimulating such training. Considering the survey responses outlined above, whereby respondents indicated that they
would tolerate cost-premiums in order to obtain reputable and skilled heritage tradespeople, then such a levy system might be appropriate – provided that there is a sufficient administrative framework.

Even in the absence of a separate heritage/conservation training levy, it might be feasible to consider attaching heritage trades skills training to the already diverse suite of accredited training courses currently eligible for assistance through the existing Building and construction Industry Training Board schemes – utilisation of an established and reputable framework already in-place.

Aside from training levies, which might be seen by some as an unreasonable (or inequitable) impost upon owners of heritage properties, another training stimulus scheme might be to attach a mandatory training outcome to state heritage grants. A 2007 report on the operation of the Victorian Heritage Grant Funding scheme recommended that large grants include a training plan/skills development component in order to be eligible for such grants – a concept which has not yet been adopted, but might be a very palatable way of ensuring funds are channelled into training without impost upon owners. Nonetheless, it is acknowledged that Australian heritage grant schemes are very limited, and an amount apportioned to training from already meagre schemes may not be sufficient to make a large difference.

These are funding options which should be explored and considered in conjunction with the embedding of heritage skills training firmly into national policy, with a real financial flow on effect into stimulating the training industry.

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47 For further discussion on heritage incentives in Australia, see; Environment Protection and Heritage Council WA (2006): *Making Heritage Happen: Incentives and Policy Tools for Conserving our Historic Heritage*.
Legislative backing

Whilst some Australian state agencies attempt to integrate skills perpetuation into their public heritage programs, this does not provide much more than a stimulus for people to go elsewhere to learn - if indeed such learning opportunities are available. Until heritage trades skills training is more deeply imbedded into government heritage management policy and direction, such training will continue to be opportunistic and ad-hoc. Nonetheless, state agencies are doing their part in lobbying for cross-jurisdictional approaches to the problem – certainly a positive step. However, until the notion of heritage skills training is embedded into both public and private sector conservation project management (and assuming that such training is consistently available), then the current situation will continue. Perhaps legislative insistence on a certain level of skills might be the stimulus to make heritage skills training more widely (and systematically) practiced. For instance, the United Kingdom NVQ3 system is not enforced as a statutory requirement for work on listed buildings; however it has been made clear that unless a good level of voluntary take up by the industry occurs, that may well be the case in the near future.

The current United Kingdom means of ‘imposing’ such standards and accreditation is through proactive education, or to promote standards (accreditation) so that the industry recognises the advantages of accreditation, and self-regulates. This might be best achieved through educating the industry that customers insist on accreditation, and that accreditation can give the trades a competitive advantage. This is the stance taken by the NHTG in their push for national accreditation systems and standards in England.

Certainly this could also be the case in Australia, where the birth of any mandatory requirement for qualifications must start with proactive education of the advantages, and of course the provision of the ability to gain those skills. Nonetheless, statutory insistence on a certain skill level is possible under some legislation. For example, Tasmania does have legislative backing to insist on standards or accreditation. Section 45 of the Historic Cultural Heritage Act 1995 (Tas) states that:
45. Supervision and standards

(1) As a condition of approving a works application, the Heritage Council may –

(a) set standards by which the works are to be carried out by the applicant; or

(b) require the applicant to engage suitably qualified persons to supervise or undertake the works or any part of the works

This is problematic however, in the absence of any formal or widespread accreditation program which sets a benchmark for such standards.

Tasmania – who is equipped to perpetuate heritage skills training?

There are a number of administrative/governance frameworks under which accredited heritage skills training can occur. Whether that be government (at any level), tertiary/vocational institutes, or commercial operators, it is critical that any skills training program be embedded in an organisational framework which allows a sufficient level of servicing and consistency, recognition of accreditation, and is able to align with wider or higher policy/initiatives.

If heritage trades skills curriculum can be developed in-line with non-heritage trades curriculum models, then it can reasonably be envisaged that the curriculum can slot into existing accreditation models. Just as the English NVQ model existed prior to the NHTG’s push for accredited heritage skills training, into which heritage skills slotted neatly, similarly Australia’s TAFE (or by any other name) model may be able to accommodate heritage trade skills curriculum, and provide the accreditation for such.

Unlike English Heritage, the Australian Government offers no direct input towards heritage skills training. As previously stated, the Productivity Commission enquiry into historic heritage did not consider heritage skills – despite the submissions stressing the perceived need. On a state level, Heritage Tasmania is the state government heritage agency and provides administrative support for the Tasmanian Heritage Council. Heritage Tasmania do, where possible, promote heritage skills, however this rarely extends beyond day-events, practice notes and sharing of the knowledge of their Heritage Advisers. Heritage Tasmania offers no accredited training courses. Similarly, other heritage advocacy agencies in Tasmania, such as the National Trust, Cultural Heritage Practitioners Tasmania etc.
do not offer training courses beyond one-offs. The Tasmanian Heritage Council, under s.7 of the *Historic Cultural Heritage Act 1995*, has a mandate to promote education and awareness of heritage issues, so may be placed to take a leading role in establishing industry linkages. Just as the recent *Memorandum of Understanding on Maintaining Standards and Best Practice in the Built Heritage Sector in England*, signed by the All-Party Parliamentary Arts and Heritage Group, ConstructionSkills, English Heritage and the National Heritage Training Group in March 2009 has set the precedent for partnerships to pursue heritage trades skills accreditation in England, there is no reason that such memoranda of understanding could not be established in Australia.

In order for any such training framework to succeed, there needs to be an alignment to an internationally recognised accreditation system, which in Australia are generally TAFE institutes (or similar). Striking the balance therefore between on-the-job/formal training, commercial linkages and formal accreditations is an essential consideration in any model. Such a model is certainly possible, and has worked effectively for many years in trades such as electrical, automotive etc. It has not yet, however, been extended to specific heritage trade skills in Australia.

An opportunity which is arising as a possible framework for the points outlined above is the 2009 establishment of The Tasmanian Skills Institute (TSI) – a evolution of the traditional TAFE institute. The TSI’s specific mandate is to work in partnership with Tasmanian businesses to develop the skills of Tasmanian workers – in bringing skills training into the commercial workplace. A large number of construction-based traineeships and apprenticeships are offered, however none of these are specifically heritage focused. Nonetheless, the concept of the TSI would certainly have the applicability to specific heritage trades – as has been seen in many interstate and international scenarios. This linkage should be explored in the first instance to potentially tap into this established and experienced framework.

In summary, Australia has a long way to go towards adequately addressing the apparent heritage skills shortages. As awareness is raised, as legislative protection becomes more adequate, and as the appreciation for heritage heightens, the demand for heritage trades skills will surely increase. Strategic, well planned and consistently implemented skills training is instrumental in ensuring that these skills are perpetuated, and ensure that Australia’s heritage resources will be effectively managed well into the future.
### Summary of post-fellowship action plan.

<table>
<thead>
<tr>
<th>Stream</th>
<th>Initiative</th>
<th>UK Linkage (see above)</th>
<th>Required partners</th>
<th>Comment on resources</th>
<th>Preconditions and timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Understanding the historical context of lime use</strong></td>
<td>Thematic research into the colonial limeburning industry - regional, economic and technological analyses</td>
<td></td>
<td></td>
<td>Low resource requirement. Some work already done on the Australian context.</td>
<td>Immediate.</td>
</tr>
<tr>
<td></td>
<td>Collection of geological information on traditional building materials - lime, building stones, aggregates. Build a typeset library of geological material, from both traditional sources and current sources.</td>
<td>SSLC, SLCT.</td>
<td>Mineral Resources Tasmania. University of Tas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establishment of a testing facility for the analysis and testing of both historic and new lime based products.</td>
<td>SLCT, CMC.</td>
<td></td>
<td>High level of resources and skill required to establish such a facility.</td>
<td>Medium term - although a precondition for many other initiatives.</td>
</tr>
<tr>
<td></td>
<td>Collect samples of historic lime products for analysis and profiling of the colonial lime industry.</td>
<td></td>
<td>Property owners.</td>
<td>Unachievable presently, but once testing facility is established, and skills available, resource requirements low. Ongoing management of dataset would require some resources.</td>
<td>Collection of samples can start immediately, however until testing facility is established adequate analysis is difficult.</td>
</tr>
<tr>
<td><strong>Understanding current lime use, and development of compatible products</strong></td>
<td>Seek to have the ‘each building as an individual artifact’ ethos promoted to the conservation industry, and provide the tools for implementation of this ethos</td>
<td></td>
<td>Industry.</td>
<td>Low resources requirement for selling the concept, but very high resource input required for providing the tools for implementation.</td>
<td>Immediate, although a better take-up rate will result from more advanced research and product development.</td>
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<tr>
<td></td>
<td>Undertake a survey as to the availability of lime products in Australia, and the research into product development and testing undertaken thus-far.</td>
<td></td>
<td>Industry.</td>
<td>Low resource requirement. Would be time consuming to undertake adequate and comprehensive survey.</td>
<td>Immediate.</td>
</tr>
<tr>
<td></td>
<td>Build a sample set of new lime products (e.g. a typeset), based on traditionally and currently available materials, and designed with the various performance criteria in-mind.</td>
<td>SLCT.</td>
<td></td>
<td>Low resource requirement.</td>
<td>Collection of geological information and understanding of historic context of resource acquisition is required first.</td>
</tr>
<tr>
<td></td>
<td>Explore options for the use of lime in new-build.</td>
<td>Lime Technology.</td>
<td>Housing Industry Association. Sustainable Living Tasmania.</td>
<td>Low resource requirement, although more research and product development might need to be undertaken to support the concept.</td>
<td>Immediate.</td>
</tr>
<tr>
<td>Development of heritage skills training programs and accreditation systems</td>
<td>Determine the market demand for various heritage skills sets</td>
<td>NHTG.</td>
<td>Industry, Tas Heritage Council, property owners.</td>
<td>Low resource requirement.</td>
<td>Determining market demand is essential in convincing industry and partners that heritage skills training is worthwhile.</td>
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</tr>
<tr>
<td>Seek linkages for the development and/or implementation of an overarching accreditation system for heritage trade skills</td>
<td>Formulate ways for the implementation of any accredited skills training into industry standards</td>
<td>SSLG, ConSkills, NHTG.</td>
<td>Tasmanian Skills Institute, Polytechnic, Universities. Industry.</td>
<td>A very large amount of skills and resources would be required. Some curriculum might be adapted from overseas models.</td>
<td>Linkages and in-principle support can be pursued immediately - implementation would need to be much more long-term.</td>
</tr>
<tr>
<td>Develop curriculum for heritage skills training, in line with industry standards and market requirements</td>
<td>Seek the establishment of a centralised heritage skills training institute.</td>
<td>State Government property managers, grant bodies (Tas Comm Fund, Tas Heritage Council, Urban Renewal &amp; Heritage Fund).</td>
<td>Training bodies, industry, funding bodies.</td>
<td>A very large amount of resources are required.</td>
<td>Long term, unless funding is obtained. Curriculum and accreditation systems are needed first.</td>
</tr>
<tr>
<td>Overarching policy</td>
<td>Develop initiatives and seek policy development which encourage a skills training component on publicly (or grant) funded conservation projects</td>
<td>English Heritage, Historic Scotland</td>
<td>Tasmanian Heritage Council.</td>
<td>Consideration would need to be given as to the resourcing consequences of allocating any percentage of funds for training. Would it be enough?</td>
<td>There's little point insisting on training/accreditation components if models for such are not available.</td>
</tr>
<tr>
<td>Explore the idea of required skill levels for work to very significant heritage places.</td>
<td>Lobby for heritage skills training projects to be included on the agenda for the fulfilment of education/training/public benefit mandates of relevant agencies.</td>
<td>Tasmanian Heritage Council, Heritage Tasmania, Local Councils, State Government property owners/managers, public historic sites.</td>
<td>Tasmanian Heritage Council, Heritage Tasmania, Local Councils, State Government property owners/managers, public historic sites.</td>
<td>May require significant resources, however such resources attached to education/public benefit mandates may already exist.</td>
<td>Immediate - however meaningful training/public benefit opportunities need to exist or be developed.</td>
</tr>
</tbody>
</table>