CONSERVATION MANAGEMENT PLAN

FOR THE EUSTON COURTHOUSE
39 MURRAY TERRACE, EUSTON

PREPARED FOR:
BALRANALD SHIRE COUNCIL
70 MARKET STREET (PO Box 120)
BALRANALD NSW 2715

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1. EXECUTIVE SUMMARY

Balranald Shire Council agreed to the preparation of the Conservation Management Plan for the "Euston Courthouse" in October 2022, and they provided funding for this Plan. Noel Thomson Architecture (NTA) was appointed as architect and heritage consultant for the Euston Courthouse Conservation Management Plan for future upgrading and conservation works.

Noel Thomson Architecture in preparing the Conservation Management Plan for the Euston Courthouse building at 39 Murray Terrace, Euston, attended the site in Late October 2022, held briefing session with Council Officer to obtain all relevant information so as to be able to formulate masterplan concept designs and scope of maintenance works for the Conservation Management Plan. Noel Thomson also took many photographs of the building's current condition and measured the building so as to be able to prepare Existing Conditions Plan and then Masterplan Options for the "Euston Courthouse" building.

This Conservation Management Plan is a Conservation Planning Document, which analyses the current context, condition, and management of the place [which has cultural significance] and provides conservation management policies and strategies for 'best practice' management for the "Euston Courthouse". The subject site - "Euston Courthouse" building is currently referenced as a heritage item (I6) "Courthouse", in the Balranald Local Environment Plan, 2010 – Schedule 5 Environmental Heritage.

The Conservation Management Plan (CMP) analyses the "Euston Courthouse" and grades the significance of spaces in accordance with Heritage NSW guidelines for developing Conservation Management Plan. From this and review of earlier 'Statement of Significance' for "Euston Courthouse" from the Balranald Shire Community Heritage Study, a new heritage assessment has been undertaken. A key component of this CMP is the conservation polices along with the management and maintenance policies and plans for "Euston Courthouse" with short term considerations, plans and checklist appended to this report. For the Management & Maintenance Plan and the Conservation / Maintenance Checklist refer to Appendix 4.

The guiding conservation policy is that "Euston Courthouse" shall be conserved and appropriately managed on an ongoing basis that respects its cultural and heritage significance for its continued use as a museum etc for the Euston Community. Importantly this CMP provides conservation policies (refer Section 6) that aim to improve the building and ensure that any change be consistent and sympathetic with the heritage significance of "Euston Courthouse" and its ongoing use.

Forming part of the Conservation Management Plan, the following tasks are to be undertaken in relation to "Euston Courthouse";

- Undertake a site visit of the property to record and review the issues
- Consult fully with Owners & Stakeholders in relation to the reporting and conservation polices.
- Investigate the history of the property, previous studies & related documents
- Complete the following tasks in relation to the CMP
    - Investigate the significance & prepare a current Statement of Significance in alignment with 'State Heritage Inventory' listing
    - Update the physical analysis & condition.
    - Provide Conservation Policies.
    - Provide proposed Conservation Management Plan for "Euston Courthouse."
    - Provide requirement for Maintenance Program / Schedule.
    - Provide Recommendations for future management, maintenance and conservation.

This Conservation Management Plan for "Euston Courthouse" should be adopted / endorsed, with review of this Plan within 10 years, or in the event of radical change to the property, or in ownership.

The main policy recommendations of this Conservation Management Plan are as follows;

- Burra Charter – Basis of Approach
- Control Change
- Management & Curtilage
- Services
- Safety Measures / Building Regulations

- Maintenance & Repairs
- Building Appearance & Form
- Intrusive Elements
- Conservation Advice & CMP Adoption
- Interiors
- Archaeology
- Adaptive Reuse & opportunities
- Significance and Conservation Funding
- LEP Requirements / Considerations

The Masterplanning section of the report identifies the constraints and opportunities, which arise as a result of the heritage significance of the "Euston Courthouse" and input from the building owner and stakeholders for the 'Conservation Management Planning' of the site. The "Euston Courthouse" is to be retained and upgraded in accordance with Conservation guidelines.

Following input, determine the best solutions for the future development of the "Euston Courthouse" and Building to meet anticipated future needs, particularly:

1. Provide accessible access to and within the building where possible and unisex accessible toilet facilities within the building

Note: For the Masterplan Concept Drawings incorporating above items refer to Appendix 3

Recommendation 1: is for the implementation of the Masterplanning works to the 'Final' design, noting that arrangements should be put in place to engage a full team of consultants with relevant experience, including heritage, services and structure consultants to assist in the preparation of tender / construction documentation.

Recommendation 2: is for the implementation of the Conservation Management Plan including the Masterplanning, Policy and Maintenance works and depending on funding approval undertake the upgrade and conservation works at the "Euston Courthouse" / Museum.

2. INTRODUCTION

2.1 Purpose

A Conservation Management Plan is a conservation planning document, which analyses the current context, condition, and management of the place [which has cultural significance], and provides conservation management policies and strategies for the 'best practice' management of the place taking into account client and 'external' requirements and current management structure for the "Euston Courthouse", Euston.

Balranald Shire Council agreed to the preparation of the Conservation Management Plan in September 2022 and they provided funding for this Plan.

Balranald Shire Council provided the following tasks to be undertaken in relation to the Conservation Management Plan for the Theatre Royal:

Tasks

1.1. Undertake a site visit to record and review the issues;

1.2. Consult fully with relevant Council Officers and Stakeholders, in relation to the project;

1.3. Investigate the previous studies & related documents;

1.4. Complete the following tasks in relation to the CMP

- 1.4.1 Obtain the physical analysis & condition.
- 1.4.2 Review evidence of potential significance and undertake analysis of evidence
- 1.4.3 Investigate the significance & prepare a current Statement of Significance.
- 1.4.4 Provide conservation policies.
- 1.4.5 Review the future uses after studying the constraints & opportunities.
- 1.4.6 Provide Conservation Management Plan options for the Euston Courthouse
- 1.4.7. Provide Recommendations for future management, maintenance and conservation.

Conservation Management Plan for: The Euston Courthouse building
Item Type: Built **Group:** Law and Order **Category:** Courthouse
Local Govt Area: Balranald
Address: 39 Murray Terrace, Euston NSW 2715
Statutory Address: Lot 59 DP 822092
Owner: Balranald Shire Council

PRESENT DAY EUSTON VILLAGE: Driving from Balranald, the Murray River irrigated farms begin near Euston. These Italian owned farms have mainly South-east Asian itinerant workers, with a few Korean and Seikh families, just as at Hillston and Mildura. About 300 people live in the village of Euston. There are also around 150 "grape block people" living in the surrounding irrigated farmlands. In contrast to the large Aboriginal population of its twin settlement across the river, Euston has a small Aboriginal population of locals. Lock 15 is the weir across the Murray River that enables local irrigation farming. It has some social significance for this reason and has previously been placed on the Council Plan heritage list. In 2013 it was in the process of being raised, to raise river levels for irrigation at Euston and to act as a detention basin to alleviate flood waters. This utilitarian concrete structure of recent origin and has little technical significance. It should not be included in a new local heritage list. Due to the high value product of table grapes grown in the Euston irrigation farms, the village has high potential for urban renewal and development investment. Euston's heritage showpiece is the old courthouse (the local police station is respectfully located at the rear). The courthouse has been acquired by council and provided as a facility to the local historical society. Euston Club, on the original Hotel site, is almost a twin settlement to the village of Euston. Gambling income from South-east Asian itinerant workers has combined with tax incentives for spending money on building improvements, to fund vast extensions. The Club runs poker machine parlours, bars, motel units and (soon) caravan areas. It has developed adjoining crown land into parking areas and a private riverside park (on crown land). The presence of irrigation farm money has been translated into some outstandingly high riverfront land prices at Euston. Robinvale is the Victorian twin settlement of Euston. It is a much bigger town. As soon as the Snowy Mountains Hydro Electric Scheme was finished, part of the Italian worker population moved to the irrigation areas. In places such as Robinvale they displaced the Australian soldier settlers. The irrigated town of Robinvale is the major service centre with Mildura being the commercial regional centre. It is an urban renewal area rather than a heritage town, with big Pacific Islander, Italian and local Aboriginal population.

Fig. 1: SixMaps - aerial view of Euston Courthouse building and shops/offices – Murray Terrace, Euston

2.2 Heritage Significance

With reference to Heritage NSW "Assessing Heritage Significance" an item will be considered to be of State or Local heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria:

HISTORICAL: ***Criterion (a):*** *An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*

ASSOCIATIVE: ***Criterion (b):*** *An item has strong or special association with the life works of a person or group of persons, of important in NSW's cultural or natural history (or the cultural or natural history of the local area).*

AESTHETIC: ***Criterion (c):*** *An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).*

SOCIAL: ***Criterion (d):*** *An item has strong or special association with a particular community or particular community or cultural group in NSW (or the local area), for social, cultural or spiritual reasons.*

RESEARCH POTENTIAL: ***Criterion (e):*** *An item has the potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of local area).*

RARITY: ***Criterion (f):*** *An item possesses uncommon, rare or endangered aspects of the areas cultural or natural history (or the cultural or natural history of local area).*

REPRESENTATIVENESS: ***Criterion (g):*** *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments.*

- *or a class of local area's cultural or natural places; or cultural or natural environments.*

Statement of Significance:

This Statement of Significance is an extract from Balranald Shire Heritage Study Review 2013 prepared by Noel Thomson and Peter Kabaila.

Historical and aesthetic significance. Built 1883, this courthouse is historically associated with law enforcement at the busy river port of Euston in the 1850's to 1900. The attractive Victorian style building makes an important contribution to the street. Acquired by the Shire Council in the mid 1970's it has been provided to the local historical society for displays and public visitation.

Fig. 2: Street view of Euston Courthouse – Murray Terrace, Euston

2.3 Design Guide for Heritage

A number of documents guide the protection and development of heritage places in Australia.
The Burra Charter and associated publications provide the overall framework for all work on heritage places, while a range of reports, policies, and plans set the parameters for individual sites and projects.

The Burra Charter:
The Australia ICOMOS Charter for Places of Cultural Significance 2013 (Australia ICOMOS 2013) guides all heritage work in Australia and is endorsed by federal and state government heritage agencies and community organisations. The charter defines the basic principles and procedures to be followed in the conservation of heritage places through 34 articles. These are relevant to all types of built heritage.

The Illustrated Burra Charter: Good Practice for Heritage Places (Australia ICOMOS 2004) explains and expands on the ideas and principles of each article, and complements this with examples drawn from across Australia to illustrate the application of the particular article to real places.

The Burra Charter practice notes provide practical advice on the Burra Charter and its application. They cover a wide variety of topics, recognising that heritage is an increasingly diverse field.

Statement of significance:
A statement of significance summarises why a heritage place is important from a heritage viewpoint, based on the NSW Heritage Significance Criteria, and provides the context for any development or new work. It allows those responsible for managing the site to explore ways to use heritage significance in a positive way, while also outlining the constraints particular to the item or place.

Each aspect of significance leads to obligations and constraints that need to be considered when designing new work. If a statement of significance has not been prepared as part of the listing process, it is highly recommended that one is prepared for approval by the relevant consent authority.

The statement of significance is essential to developing a conservation management plan and preparing a heritage impact statement.

Conservation management plan:
A conservation management plan (CMP) guides the care and use of a heritage place, including any new development. It is organised into three main parts - investigation, assessment, and management; and should include the following:

- a clear statement of the significance
- identification of the constraints and opportunities that affect the place (including the owner's needs)
- policies as to which fabric, or elements, need to be conserved
- an outline of what can be changed if and where any new development occurs, and the parameters for such development or the degree of change that is permissible.

A CMP includes the statement of significance and conservation policy, and contains detail about achieving the future viability of the place and retaining the maximum heritage significance in future development proposals.

Further information:
Conservation Management Documents: Statement of Best Practice, Guidelines and Checklists on Conservation Management Plans and Other Management Documents (Heritage NSW: 2021) includes a model brief for a conservation management plan.

The Conservation Plan (7th edition, James Semple Kerr, 2013) outlines the logical processes of the Burra Charter, and how to prepare a conservation plan to guide and manage change to a heritage item appropriately.

Statement of heritage impact:
A statement of heritage impact (also known as a heritage impact statement) explains the impacts on heritage significance of any proposal to alter a heritage item or place, including carrying out work within an Heritage Conservation Area. It includes an explanation of how the proposed development will affect the heritage value of the place.

Further information: Statements of Heritage Impact (Heritage NSW: 1996; revised 2002 and 2022)

2.4 Background & Overview

The Balranald Shire Council acquired the Euston Courthouse building in the 1970's and its objective is to develop a conservation management plan to guide Council in appropriate resource allocation and work program to ensure the longevity of the building, including undertaking appropriate building inspection/s to understand the state of repair and prioritising a works plan.

It is noted that the Building is a listed heritage item (I6) in the Balranald Shire Council Local Environmental Plan 2010 – Schedule 5 Environmental heritage. Council expects the development of the conservation management plan to take inspiration from Heritage NSW's guidance documents on conservation management plans and conservation management strategies.

Council seeks to maintain the building within available resourcing and look to future funding opportunities to conserve and restore the building to continue the use of the much-loved public / historical building.

Balranald Shire Council engaged Noel Thomson Architecture in 2022 to prepare Conservation Management Plan for the Euston Courthouse with Noel Thomson visiting the site in late October 2022.

The Conservation Management Plan is to include the following sections;

1. Introduction
2. Analysis of Historical Significance
3. Analysis of Physical Evidence
4. Heritage Significance
5. Conservation Policy Development
6. Conservation Management Plan Documentation
7. Management Plan and Maintenance

2.5 Acknowledgments and Bibliography

This document has been prepared by Noel Thomson of Noel Thomson Architecture Pty Ltd with the assistance of;

- Balranald Shire Council Staff - Ray Mitchell
- Euston-Robinvale Historical Society Inc - Jim Holland & Bev Harbinson
- James Barnet - Chris Johnson, Patrick Bingham Hall, Peter Kohane
- Historic Courthouses of New South Wales - Peter Bridges
- Historic Courthouses of Victoria - Michael Challinger
- Historic and Heritage Court Houses in New South Wales - Lachlan Turner
- Balranald Shire Community Heritage Study 2006-2007 - Heritage Archaeology
- Balranald Shire Heritage Study 2013 - Noel Thomson and Peter Kabaila
- CSU Regional Archives - Magistrate & Police Records
- Trove website: https://trove.nla.gov.au/
- Euston History: https://www.robinvaleeuston.com/history-timeline/
- Heritage NSW: https://www.heritage.nsw.gov.au/search-for-heritage/publications-and-resources/

3. ANALYSIS OF HISTORICAL SIGNIFICANCE

3.1 Brief History of Euston / Robinvale

Balranald Shire is one of western New South Wales most important settlement areas and one of the few to have sites on the World Heritage List. The first recorded visitor to this area was Captain Sturt in his tour of exploration in 1830.

Edmund Morey, the first settler, left Lower Murrumbidgee Station, Canally, with an aboriginal, Bulla, a dray and stock and settled Euston Station in 1847. He was 17 years of age.

The name 'Euston' originated from 'Euston Hall', the home of the Earl of Grafton, Suffolk, England. Morey originally built a log cabin and some 40 years later build a spacious homestead. The original Euston run comprised some 2,000,000 acres.

Euston was originally known as 'Boomiaricool'. In 1865, Euston had a School. In the 1870's it was a thriving river port, visited by paddle steamers and barges. There was a Post Office, 2 stores, a police station with 2 policemen, a courthouse, a public hall, a "bond store", and a church. The Courthouse had a whipping post. There were also 2 hotels; the Royal was later owned by Reg Ansett (Ansett Airlines) and the Euston Club is built on the site of the original Shailers Hotel. The Punt at Euston was operating before 1866 when the first report of the town of Euston appeared in Bailliere's Gazetter. "On 1st May 1867 Euston became a link in the direct telegraph route of Sydney to Adelaide. The route came via Deniliquin, Moulamein and Balranald to Euston and went on through Wentworth to South Australia and Adelaide."

In 1876 the settlement at Euston was described in the following terms in an article 'The Riverine Trade (No. IV): Down the Murray', *The Argus* (newspaper, 5 February 1876, p. 9). "Euston is a crossing-place for sheep and cattle. There is a Custom-house officer here, though I should judge that his avocations were not of an extremely onerous nature, and the township also possesses a post and telegraph office. If the building can be taken as a type of the township, Euston has not a long life before it. The walls appear as if spilt apart by an earthquake. The hotels and about a dozen small houses constitute the remainder of the township."

Eventually the great Overland Telegraph through the Australian Centre (and notably Alice Springs) would be completed to Darwin to link by cable and land-wire to the centre of the Empire, London. There was a court house with a whipping post, police station, hotel, boiling down works and eucalyptus factory. The latter produced "Bosisto's Parrot Brand Eucalyptus". Euston was also a changing station for coaches. Charlie McMahon ran a passenger and mail coach from Swan Hill through Euston to Wentworth and Broken Hill. After the death of the river trade Euston went into economic decline but picked up when a bridge was built across the Murray River in 1924, connecting Euston to Robinvale on the Victorian side of the River. (2013 heritage study review)

Today; Euston is a small service centre on the banks of the Murray River. Typical of the prevailing agriculture of the Riverina, it is completely surrounded by vineyards. The township grew on the site of the Boomiarcool Station, established by the young Edmund Morey in 1846 at what was then the western limit of European settlement. This station grew to one million acres by 1946, by which time it was known as Euston, named after an estate in Suffolk, England. From the 1850s the land was devoted to wool production and the town developed as a river port with a wharf and ferry. It was also the site of a major river crossing and a punt was in service to carry supplies across the river. A considerable increase in trade resulted in a Customs House being established for stock movements and goods. During this period considerable pastoral development also took place, resulting in the establishment of a boiling-down works and wool-scouring plant. Euston Courthouse was established in the early 1850s. Most notable of Euston's industries was a Eucalyptus oil processing plant. Euston was proclaimed a town in 1885 although its economic status declined along with the river trade. The building of a railway and road traffic bridge across the Murray joining Robinvale in Victoria to Euston revitalised the town and after World War II, with the development of irrigation, the dry lands around Euston were transformed into a vast agricultural area. Vineyards and vegetable crops continue to be main economic mainstays in the area (2007 heritage study).

Timeline: Euston and Surrounds https://www.robinvaleeuston.com/history-timeline/

Prior to European settlement the area around Euston and Robinvale had been occupied by the Latje Late Aborigines for at least 30,000 years.

1830: Charles Sturt passed through the area on his expedition down the Murray River.

1836: Major Thomas Mitchell had passed through the area on the expedition known as "Australia Felix". The township grew on the site of the Boomiarcool station, established by seventeen-year-old Edmund Morey in 1846 at what was then the western limit of European settlement.

1847: John and Mary Grant took up a grant of 20 square miles (5,180 ha) on the Murray. They were able to provide the early paddle steamers with fresh vegetables. The area eventually became the town of Euston.

1853: William Randell in the paddle steamer Mary Ann and Captain Francis Cadell in the Lady Augusta reached Euston having travelled from the mouth of the Murray River.

1860s: The land was devoted to wool production and the town developed as a river port with a wharf, ferry, courthouse, police station, hotel, a boiling-down works, wool-scouring plant and Eucalyptus factory.

1865: Euston had a police station, a courthouse and a whipping post outside the Courthouse.

1883: The current Courthouse was built.

1885: Euston was proclaimed a town.

1924: The railway reached Robinvale.

1928: A construction of a railway and road traffic bridge across the Murray joining Robinvale in Victoria to Euston helped sustain the town.

1948: The huge Southern Cross windmill was erected.

2004: The NSW Road and Traffic Authority and VicRoad began construction of a new bridge across the Murray. It was finished in 2006.

Source: © Mrs Jenny Black

3.2 History of Euston Courthouse

Euston Courthouse is now the home of the Euston/Robinvale Historical Society, a group of volunteers dedicated to preserve the written, photographic and oral History of Euston, Robinvale and surrounding areas. The first Euston Courthouse was established in the early 1850's. In 1865, Euston had a Police Station, Courthouse and a Whipping Post on this site. In many rural townships the courthouse was often the most significant and utilised building in town. As populations grew, the courthouse gave towns an anchor point and sense of arrival as a town of significance.

Euston Court House was constructed in 1880 by builder F.M.H Parkes, with the design likely to be by the Colonial Architect James Barnet. The building was extended to the south by one room 3 in 1899 by Hocking Bros builder to the likely design of Government Architect W.L. Vernon. The building undertook various minor changes over the years when major renovations were undertaken to the Police residence in 1964. By 1978 the need for a new police station was established with design prepared by the Government Architect J.W Thomson, with the original 2 cells and exercise yard being demolished to allow for the construction and access to the new Police Station at the rear of the site completed in 1979.

The court proceeding were suspended in the mid 1980's with the Courthouse closed in 1989. The Euston Historical Society was established in 1981 which aim is to preserve the written and photographic history of Euston and Robinvale. Council having purchased the building c1990's this has provided the Society with a place to meet and prepare museum and historical displays in the building. RMS have established an office in the building which currently operates infrequently.

Trove / NLA articles on Euston Courthouse

The Hay Standard and Advertiser for Balranald, Wentworth, Maude.. Wed 7 Apr 1880 Page 6 EUSTON.
from our own correspondent March 28
As a proof of the importance of Euston, I notice that the Government have recently completed a very spacious and handsome court house, at an expense, I understand,
of some 300 pounds. The townspeople are also expecting to have a new school built, which is much required.

New South Wales Government Gazette (Sydney, NSW : 1832 - 1900)
Tue 7 Sep 1880 [Issue No.359] Page 4632 Government Gazette Notices
NOTICE is hereby given that a Court of Petty Sessions for the revision of the Electoral Roll for that portion of the Electoral District of Wentworth, which is included in the Police District of Euston, "will be holden at the Court-house, Euston, on Thursday, the 7th day of October next, at the hour of noon. Notices of claims and objections must be lodged with the undersigned on or before the 16th day of September next. Court-house, Euston, 26th August, 1880. WILLIAM JONES, Acting Clerk of Petty Sessions.

Government Gazette of the State of New South Wales (Sydney, NSW : 1901 - 2001)
Fri 6 Mar 1936 [Issue No.47] Page 1173 TENDERS.
Euston Police Station—Repairs and Renovations. Tenders. Specification, etc., at Police Station, Euston; Court-house, Balranald; and District Work Office, Hay.) quantities available.)
E. S. SPOONER, Minister for Works and Local Government

Fig. 3: c1905 the Euston Police Station and Courthouse, Euston NSW – Heritage Victoria

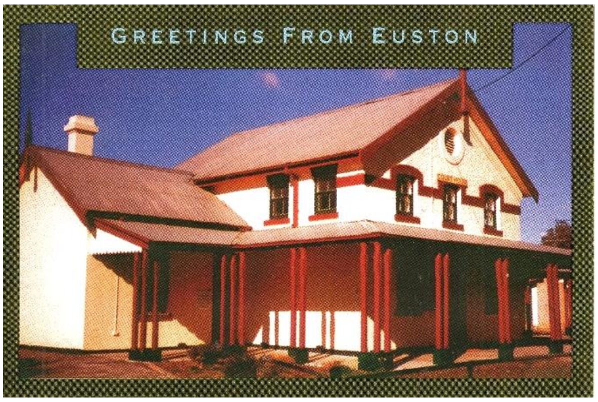
Timeline: Euston Courthouse

1880: The current Courthouse and Police Station was built, which consisted of Courtroom, Magistrates Office, Police Station & Police Residence, 2 cells and an exercise yard. Builder: F.M.H Parkes
1885: Euston was proclaimed a town.
1899: The additions at the south side Courthouse – one room was constructed which was later used as a Clinic. Builder: Hocking Bros
1936: Police Station forming part of the Courthouse complex had repairs and renovations undertaken.
1963 & 1968: Further repairs undertaken with cells and exercise yard still retained.
1978: Dept of Public Works prepares designs for new Police Station at the rear of the property – the cells and exercise yard demolished.
1979: The current Police Station to the rear of the property was built, with infill north verandah being removed/restored and painting of the Court building.
1981: Euston Historical Society was established to preserve the written and photographic history of Euston and Robinvale.
1984: Court proceedings held up
1989: The current Courthouse closed.
c1990's: Balranald Shire Council takes ownership of the Courthouse and with the assistance of the Euston Historical Society establishes a museum.
c2000: The Euston Courthouse undergoes further maintenance & renovations and painting of the Court building.

Historical Photographs

Euston Police Station / Courthouse c1936

Euston Courthouse - December 1966



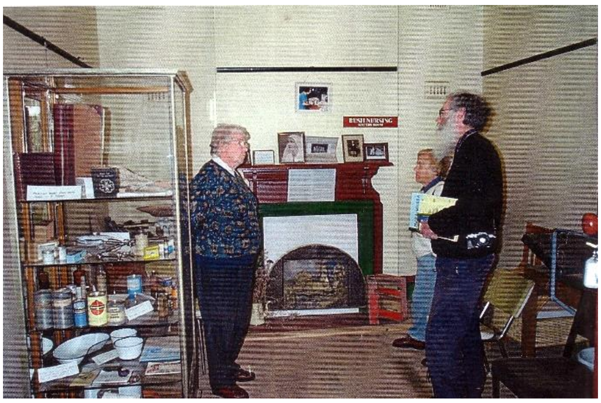
Euston Courthouse Postcard c2000

Euston Courthouse 2004

Euston Courthouse c2009

Euston Courthouse c2020

Euston Courthouse / Museum – old court display c1990



Euston Courthouse / Museum – Nurses room display c1990

4. ANALYSIS OF PHYSICAL EVIDENCE

4.1 Definitions/Glossary of Heritage Terms

This section identifies and defines heritage terms used in the Burra Charter, the *Heritage Act* 1977

adaptation means modifying a ***place*** to suit compatible uses

alter in relation to a heritage item means to: make structural changes to the inside or outside of the heritage item or make non-structural changes to the detail, fabric, finish or appearance of the outside of the heritage item, including changes resulting from painting previously unpainted surfaces, providing that the same colour scheme and paint type is used.

compatible use means a use that involves no change to the culturally significant ***fabric***, changes which are substantially reversible or changes which require a minimal impact.

conservation means all the processes of looking after a place so as to retain its ***cultural significance***. It includes maintenance, and may according to circumstance, include ***preservation***, ***restoration***, ***reconstruction*** and ***adaptation*** and will commonly be a combination of more than one of these.

conservation management plan means a document prepared in accordance with the NSW Heritage Office guidelines which establish the heritage significance of an item, place or heritage conservation area, and identify conservation policies and management mechanisms that are appropriate to enable that significance to be retained.

cultural significance means aesthetic, historic, scientific, or social value for past, present or future generations.

curtilage means the area of land (including land covered by water) surrounding an item or area of heritage significance which is essential for retaining and interpreting its heritage significance.

demolish a heritage item or a building work, relic, tree or place within a heritage conservation area means wholly or partly destroy or dismantle the heritage item or building, work, tree or place.

environmental heritage means those places, buildings, works, relics, movable objects, and precincts, of State or local heritage significance.

fabric means all the physical material of the ***place***.

heritage item means : a, building, work, archaeological site or place specified in an inventory of heritage items that is available at the office of the council and the site of which is described in Schedule X (insert reference to the schedule of the plan containing a written description of heritage item sites) and shown (insert how it is shown, for example, by diagonal hatching) on the map marked ".........."

heritage significance means historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value.

in the vicinity means surroundings, context, environment or vicinity of a heritage item

item means a place, building, work, relic, movable object or precinct.

local heritage significance means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.

maintenance means the continuous protective care of the fabric, contents and setting of a place and is to be distinguished from repair. Repair involves ***restoration*** or ***reconstruction*** and should be treated accordingly.

material affectation means changes made to an item or place that will affect the heritage significance of that item or place and inclusive of more than just change to the fabric of that item or place.

movable object means a movable object that is not a relic.

place means an area of land, with or without improvements.

precinct means an area, a part of an area, or any other part of the State.

preservation means maintaining the fabric of a place in its existing state and retarding deterioration.

reconstruction means returning a place as nearly as possible to a known earlier state and is distinguished by the introduction of materials (new or old) into the fabric.

renovation in relation to a building or work means: the making of any structural changes to the outside of the building or work or the making of non -structural changes to the fabric or appearance of the outside of the building or work, including changes that involve the repair, plastering or other decoration of the outside of the building or work.

restoration means returning the existing fabric of a place to a known earlier state by removing accretions or by assembling existing components without the introduction of new material.

setting means the area of influence or setting of a heritage item which may vary from the surrounding garden and fields of a country house to the pavement of an urban building.

State heritage significance means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.

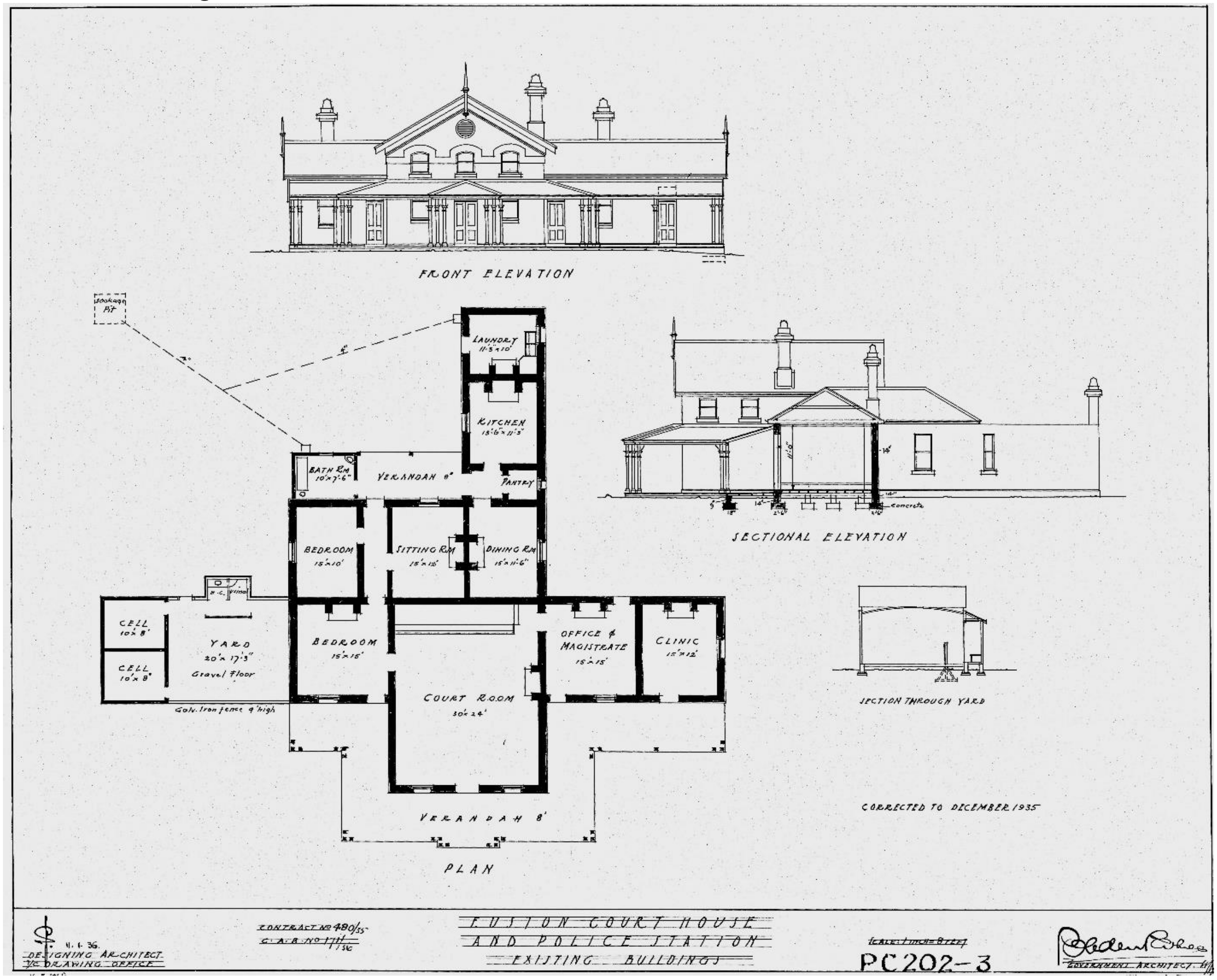


Fig 4: Early Government Architects Office Floor Plan - 1936

4.2 The Euston Courthouse - Building Condition

The condition of the building is fair with some signs of movement evident with cracking throughout the building and the southern end with evidence of 'rising damp' at internal and external wall areas.

The original c1880 front section of the building consists of former Courtroom, office for the Magistrate (now RMS) Clinic Room (south addition c1899), sitting room + 2 bedrooms (display rooms). The later added c1936 rear area consists of the bathroom, closed in verandah, dining (research room), kitchen and laundry + internal and external 'leanto' toilets.

The cell block and exercise yard have been removed c1978 for access to the new Police Station construction behind the Court House. The rooms remain relatively intact, however need building repairs, upgrading for access compliance issues and minor restoration so that the museum can operate with more functionality and better usage of rooms.

Structure stability & condition: The wall structure should be stable and structurally sound, however in several locations throughout the building deterioration (rising damp, blistering of paint & drumminess to plaster, etc) and movement/cracking are evident that require attention.

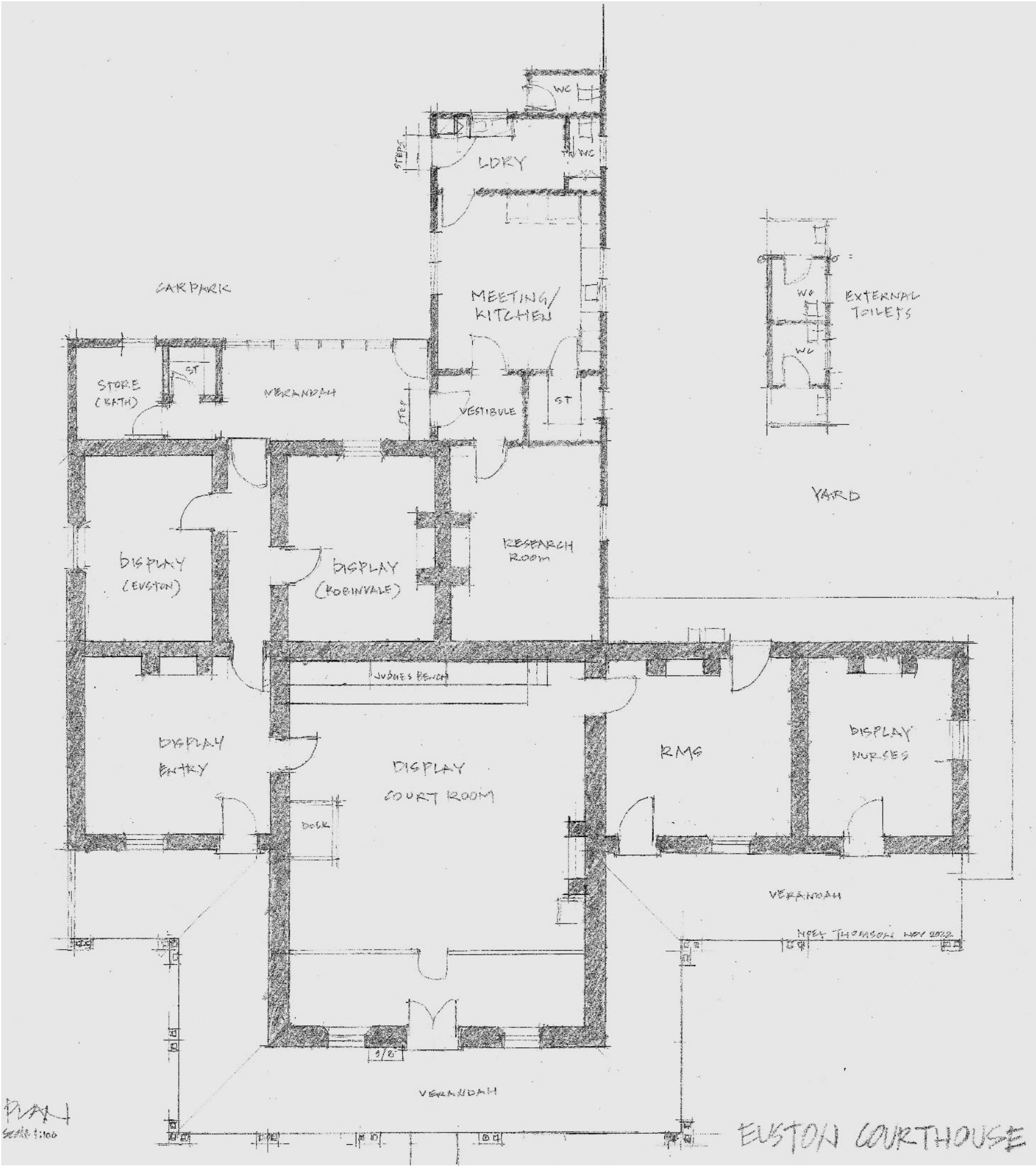


Fig 5: Existing Conditions Plan – Noel Thomson Architecture 2022

Note: Rising Damp and surface deterioration of bricks and render evident to walls in several locations – treatment required to address dampness; see "Salt Attack and Rising Damp" extract explaining rising damp below - refer Fig 6 and Appendix 5 for the complete technical guide.

Note: Cracking currently to brickwork / walls in several locations - repairs and monitoring required, with action for rectification either structural underpinning of footings or structural expanding resin injection under footings to stabilise the walls and restrict ongoing movement.

7 **Rising damp**

Figure 6 Section through a solid wall showing the path of rising damp which is caused by the suction of porous masonry. The pores effectively form a network of capillaries which draw soil moisture against gravity. Damp rises in the wall and eventually evaporates from the wall surfaces. As well as damaging masonry materials, the dampness may lead to fungal rot and insects (borers and termites) in the floor timbers. Today it is normal building practice to include a moisture barrier known as a damp-proof course (DPC) across the base of the wall below all floor timbers and at least 150 mm above ground level

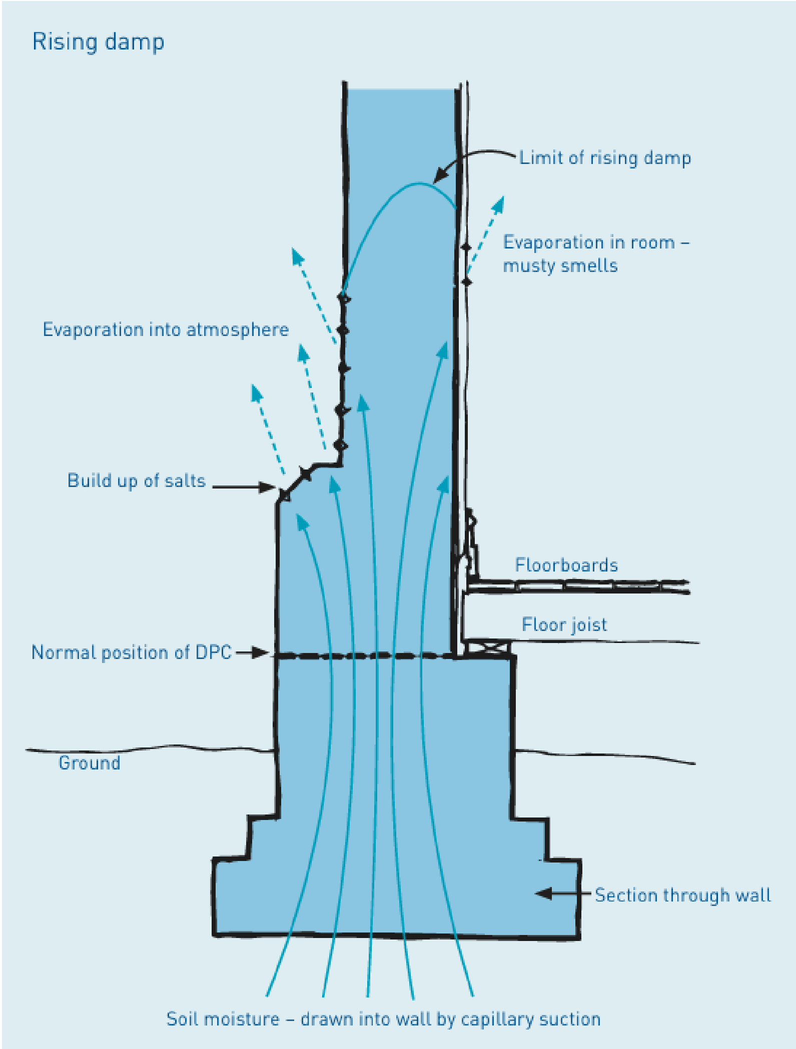


Fig 6: "Salt Attack and Rising Damp" – Technical Guide extract

Health & safety hazards: Flooring tiles to "Judges stage" and to rear Store / Bathroom contain 'asbestos'

North wall linings to back sunroom (infilled verandah) and internal and external to store/cupboard are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Wall linings to airlock off kitchen & walls to kitchen above picture rail height + walls to pantry off kitchen are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Wall and ceilings linings to back laundry & toilet are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Note: for further information refer to Asbestos Inspection Report / Register dated 4 June 2019 (by All Clear Inspections) forming part of the Euston Courthouse - Management & Maintenance Plan – see Appendix 4.

Photographs of Building Issues


Evidence of rising damp at external wall


Evidence of rising damp at external wall


Evidence of rising damp at internal wall


Evidence of rising damp at internal wall


Evidence of movement cracking at internal wall


Evidence of movement cracking at internal wall


Evidence of deteriorated cladding at external wall


Evidence of deteriorated cladding at external wall

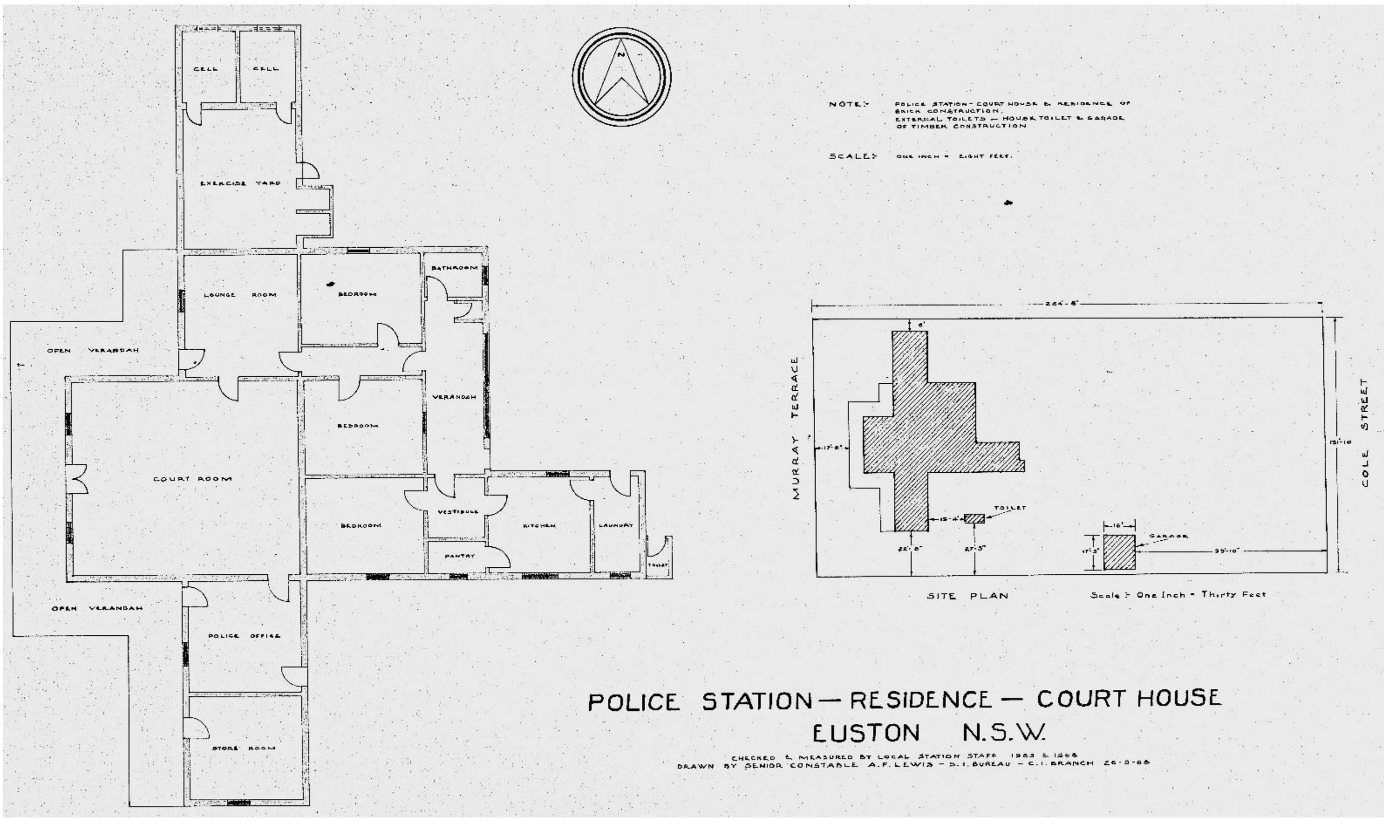


Fig 7: Euston Courthouse, Police Station + Residence – 1974

4.3 The Euston Courthouse - Recent Works

It is noted the cell blocks and exercise yard at the Euston Courthouse and Police Station were demolished in 1978/1979 to make way for new police station to the rear of the property and associated subdivision occurred.

Following the construction of the new Police Station the Public Works Department NSW proposed the demolition of the later added rear extensions (kitchen, laundry) and verandah and infill to front verandah – refer Fig 8 below.

The courthouse having been closed in 1989 was subsequently purchased by Balranald Shire Council with the building being home to the Euston / Robinvale Historical Society and is now known as the “Courthouse Museum”

The Euston Courthouse underwent some restoration and painting works in the early 2000s, noting the restoration of the front /north verandah back to its original condition (removal of infill section as proposed in the 1980s demolition plan) and painting in a new colour scheme undertaken.

There recently has been issues with ‘rising damp’ to the walls of the c1899 addition and some treatment has occurred to rectify the issue, with drainage addressed and a new concrete path laid at the south and east side of the building.

In 2019 a ‘Hazardous Inspection’ was undertaken at the former Courthouse building which identified several of concern from ‘asbestos’ flooring to linings at walls and ceiling in the rear c1935 constructed rooms (kitchen, laundry. Bathroom, Store & Pantry areas - refer to Asbestos Inspection Report / Register dated 4 June 2019 (by All Clear Inspections) forming part of the Euston Courthouse - Management & Maintenance Plan – see Appendix 4.

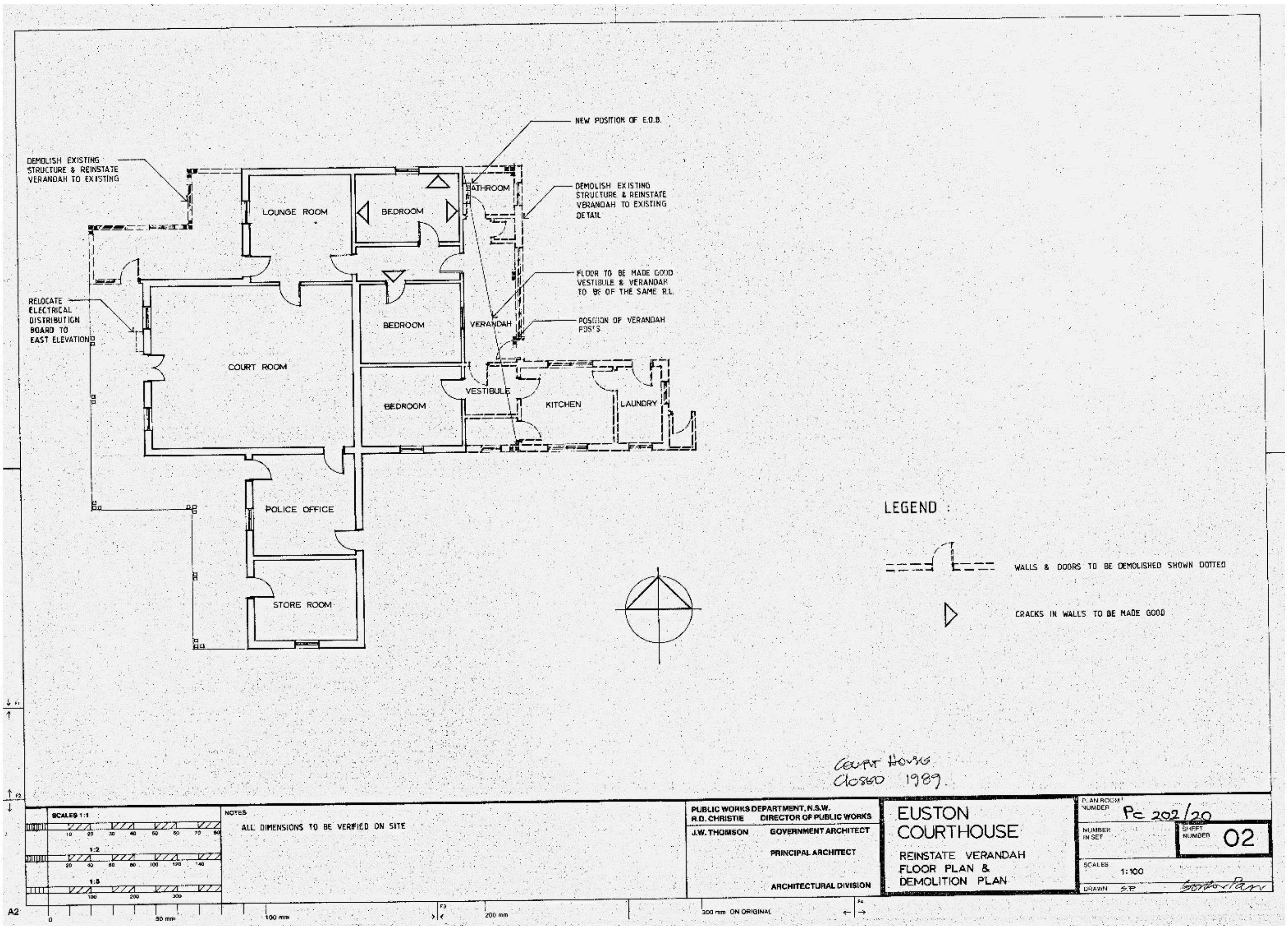


Fig 8: Euston Courthouse, Plan Station + Residence Demolition Plan 1989

5. HERITAGE SIGNIFICANCE

5.1 Current Status / Listings

Currently the Euston Courthouse is a Locally listed heritage item “Courthouse” (I6) which acknowledges this significance for the township. The listing description for the “Courthouse” appears in the Schedule of Environmental Heritage of the Balranald Local Environmental Plan 2010.

5.2 Statutory Heritage Lists

Only lists based on legislation have statutory standing in NSW. Heritage items with statutory protection include:

- items of local heritage significance listed on Schedules to Local Environmental Plans
- items of special significance to the people of NSW listed on the State Heritage Register
- NSW items on the Register of the National Estate (the Commonwealth has limited powers to restrict the actions of its agencies which affect these items).

Statutory lists of heritage items advise owners and the community of special places and objects which should be kept for future generations to appreciate and enjoy. Owners of items on these lists need to make an application to a consent authority, such as a local council or the Heritage Council, before they can make major changes. The consent authority has the responsibility of approving only those changes that respect the heritage significance of the item

Most of the items on local heritage schedules are of local heritage significance. But some items listed by local councils are also of State significance.

The State Heritage Register:
The State Heritage Register was created in April 1999 as a result of amendments to the Heritage Act, 1977. The Heritage Council seeks public comment before recommending the listing of items to the Minister for Urban Affairs and Planning. Listings are published in the Government Gazette.

5.3 Other Heritage Lists

The State Heritage Inventory already includes some cross-references to heritage items in New South Wales that are identified by organisations such as the National Trust, the Art Deco Society, the Institution of Engineers and the Royal Australian Institute of Architects.

In most cases these non-statutory lists cannot be used to control future changes to the items. Their value is to alert the community, local councils and the Heritage Council to significant items that may need to be listed on the State Heritage Register or Local Environmental Plans lists. The Courthouse building is **not listed** on the following heritage registers;

- Register National Trust of Australia (NSW)
- Register of the National Estate
- Royal Australian Institute of Architects - Register of Significant Buildings
- NSW Heritage State Heritage Register

5.4 The Burra Charter

The Burra Charter (2013) The Australia ICOMOS Charter for Places of Cultural Significance is used as a guideline in assessing heritage significance. The Burra Charter provides guidance for the conservation and management of places of cultural significance. The Charter sets a standard of practice for those who provide advice, make decisions, about, or undertake works to places of cultural significance, including owners, managers and custodians.

Article 26.1 of the Burra Charter states that:
“Work on a place should be preceded by studies to understand of the place which should include analysis of physical, documentary and other evidence, drawing on appropriate, knowledge, skills and disciplines.”

Once the place has been studied, the cultural significance can be assessed. Article 1.2 of the Burra Charter defines ***cultural significance*** as the *“aesthetic, historic, scientific, social or spiritual value for past, present or future generations.”*

5.5 Heritage NSW / Office Guidelines

The evaluation criteria for the assessment of cultural significance were developed by the NSW Heritage Council in association with amendments to the NSW Heritage Act 1977. They were developed with the goal of national consistency and community understanding and replaced the previously used ***State Heritage Inventory (SHI)*** assessment criteria. The ***State Heritage Register (SHR)*** criteria were gazetted followings to the Heritage Act and have been in force since April1999.

Assessment in this report has been made using these criteria for listing on the State Heritage Register. Criteria are outlined in the publication *Assessing Heritage Significance – Heritage Office 2001.* Under each section a place is assessed to be of **STATE** or ***LOCAL*** or **NO** heritage significance.

STATE: Of significance to the State of New South Wales

LOCAL: Of significance to the Local Government area

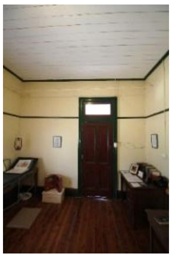
5.6 Grading of Significance

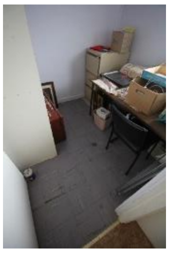
Grading reflects the contribution the element makes to the overall significance of the item. In accordance with the Heritage NSW Guidelines for Assessing Heritage Significance, the following five grades of significance have been defined.

Different components of a place may make a different relative contribution to its heritage value. Loss of integrity or condition may diminish significance. In some cases it may be useful to specify the relative contribution of an item or its components. While it is useful to refer to the following table when assessing this aspect of significance it may need to be modified to suit its application to each specific item.

Grading	**Justification**	**Status**
Exceptional	Rare or outstanding elements directly contributing to an item's local or state significance. High degree of intactness. Item can be interpreted relatively easily	Fulfils the criteria for local or state listing = 5
High	High degree of original fabric. Demonstrates a key element of the items significance. Alterations do not detract from significance.	Fulfils the criteria for local or state listing = 4
Moderate	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfils the criteria for local or state listing = 3
Little	Alterations detract from significance. Difficult to interpret.	Does not fulfill the criteria for local or state listing = 2
Intrusive	Damaging to the item's heritage significance.	Does not fulfill the criteria for local or state listing = 1

Area	**Photograph**	**Status / Rating**
Main Facade of Courthouse – facing Murray Terrace	 	**5**

Southern wing / facade	  	**4**
East Wing / 1960's extension façade + toilets	  	**3**
East Wing / 1960's extension rear facade	  	**3 / 4**
Northern Wing / facade / verandah	  	**4**
Courthouse facade / verandah details	   	**4**
Couthouse facade / verandah details	   	**4**
Nurses Room	   	**4**
Court Room	  	**4 / 5**

Court room – details	   	**4 / 5**
Former Police Residence - Lounge room / entry / display	  	**4**
Former Police Residence - Bedroom - Robinvale Room	  	**4**
Former Police Residence - Bedroom - Euston Room	  	**4**
Former Police Residence - Hall & verandah (infilled)	   	**2**
Former Police Residence - Bathroom / Store	   	**3**
Former Police Residence - Bedroom / Research Room	  	**3 / 4**
Former Police Residence – Kitchen / Meeting Room	  	**3**

Former Police Residence – Laundry / Toilet	  	**3**
Outdoor Toilet	   	**2 / 3**

5.7 Assessment of Significance

With reference to Heritage NSW "Assessing Heritage Significance" the assessment of significance against Heritage NSW Criteria is as follows:

An item will considered to be of **STATE** or **LOCAL** heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria:

HISTORICAL:
Criterion (a): *An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*

The Euston Courthouse is of heritage significance to the people of Balranald Shire. It is representative of the law enforcement and civil services provided in the district for over 100 years until its closure in 1989.

ASSOCIATIVE:
Criterion (b): *An item has strong or special association with the life works of a person or group of persons, of important in NSW's cultural or natural history (or the cultural or natural history of the local area).*

The Euston Courthouse is important due to its 1880 design and probable association with colonial architect James Barnet and the design for the 1899 addition and likely association with government architect W.L Veron.

AESTHETIC:
Criterion (c): *An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).*

The Euston Courthouse has aesthetic significance due to its imposing 'Victorian' style facade with gable end and 3 arched windows and render band facing Murray Terrace and with its 'symmetrical' design by the highly regarded colonial architect of the period.

SOCIAL:
Criterion (d): *An item has strong or special association with a particular community or particular community or cultural group in NSW (or the local area), for social, cultural or spiritual reasons.*

The Euston Courthouse is important due to its association with current association with the Euston Historical Society, which started using the Court house from the mid 1980's as an archive for all the written and photographic history that the Society has collected over the years.

RESEARCH POTENTIAL:
Criterion (e): *An item has the potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of local area).*

The Euston Courthouse is home to the Euston Museum and encompasses a great variety of local history. A more formal detailing of this history, including a formal history of the Courthouse building including architect and builder, would be beneficial however new research opportunities are limited.

RARITY:
Criterion (f): *An item possesses uncommon, rare or endangered aspects of the areas cultural or natural history (or the cultural or natural history of local area).*

The item is not rare or unique to NSW but does form part of an important collection of NSW Government buildings.

REPRESENTATIVENESS:
Criterion (g): *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments.*
- *or a class of local area's cultural or natural places; or cultural or natural environments.*

The Euston Courthouse is representative of a good example of an early 19^{th} Century New South Wales Courthouse.

5.8 "Euston Courthouse" Statement of Significance

The former "Euston Courthouse" building has historical and aesthetic significance. Built in 1880 to the probable design of colonial architect James Barnet, this courthouse is historically associated with law enforcement for over 100 years at the busy river port of Euston from the 1880's until its closure in 1989. The attractive 'Victorian' style building has aesthetic features and makes an important contribution to the street. Acquired by the Shire Council in c1990's, it has been provided as a meeting place for the local historical society and for their heritage displays and public visitation.

6. CONSERVATION POLICY DEVELOPMENT

INTRODUCTION:

The **guiding conservation policy** is that the Euston Courthouse shall be conserved and appropriately managed in a manner respecting its cultural & state heritage significance. That the features intrinsic to that heritage significance are conserved, and that change be consistent and sympathetic with the viable use or uses.

6.1 Burra Charter – Basis of Approach

POLICY 1.1
All conservation work and development will be carried out in accordance with the principles of The Australia ICOMOS charter for the conservation of places of cultural significance (the Burra Charter) in its current form.

POLICY 1.2
The statement of significance in this plan, together with any additional detailed research and assessments and scope of works, will guide future decisions and work on the place.

POLICY 1.3
Prior to undertaking work to any fabric on any building as having Significance, a statement of heritage impact consistent with NSW Heritage Manual procedures, shall be prepared which;

- Verifies the assessment of Significance through detailed investigation, recording and evaluation by conservation professional.
- Confirms the relevant policies applicable to the Significance and level of intervention proposed.
- Establishes a comprehensive specification applicable to the proposal, based on conservation policies from this Plan.

POLICY 1.4
All available documentary and physical evidence is to be reviewed as a guide, prior to any work being undertaken.
All work to be undertaken on the basis of known evidence. Conjecture, guesswork or prejudicial estimation is not acceptable.

POLICY 1.5
Retention, enhancement and retrieval of significant characteristics should be adopted as opportunities arise, after consideration of the changing needs and circumstances of the site and its users.

6.2 Control Change

POLICY 2.1
Ensure that sufficient consultation related to changes occurs between the stakeholders and Balranald Shire Council and Heritage NSW (as required).

POLICY 2.2
Ensure that changes provide for retention and enhancement of all significant fabric and items as identified in this Conservation Management Plan.

POLICY 2.3
Ensure that the Conservation Management Plan as referenced in this Conservation Management Plan is updated for any future works, then adopted and carried out in the recommended priority/staged order proposed.

POLICY 2.4
Ensure that all proposals are fully funded prior to works commencing on site.

POLICY 2.5
Ensure that all changes to the building have been vetted / approved by an experienced and professional conservation ‘consultant’ prior to any conservation works being undertaken.

POLICY 2.6
Prior to undertaking any changes or conservation works to the building ensure that approval for Works has been obtained from the NSW Heritage Council.

6.3 Management and Curtilage

POLICY 3.1

Centralise the management of the heritage place where possible. Establishment and implementation of a Management Structure for the Euston Courthouse in accordance with the below guidelines shall be undertaken as a priority. A Management Structure should be established that is capable of the following:

- Provide and manage levels of authority and responsibility for the stakeholders.
- Devise, implement and supervise conservation works / maintenance activities.
- Enhancing and develop the Cultural Significance of the site.
- Establishing visitor related activities which support appropriate interpretation and promotion.

POLICY 3.2

The curtilage for the site shall cover both the Euston Courthouse and the adjacent Police Station and Residence allotment, that form part of the original town survey allotment.

POLICY 3.3

Decisions must be made in the context of the use of the Euston Courthouse and the whole site and its significance. Efficient and appropriate use should be made of the Euston Courthouse and site/buildings, while also having regard to the amenity and value to the community.

6.4 Services

POLICY 4.1

Prior to the installation of new services, heritage architect/consultants opinion to be sort. New services should not generally be chased into brickwork or superimposed on fabric in visible locations while brackets; mountings and fixings should not damage significant fabric.

POLICY 4.2

All redundant services should be removed and the surrounding fabric made good, in particular where these services are exposed and visually intrusive,

POLICY 4.3

External lights should be in keeping with traditional fittings, of appropriate design and unobtrusive. Lighting levels should provide safety at night for attendance by historical members.

POLICY 4.4

Solar photovoltaic collectors if ever to be provided / considered for the building - the objective is to place these intrusive modern services onto roofs at the rear of the building where not visible from the street. This is a requirement so as to have NO impact on the heritage significance of the building.

POLICY 4.5

Any proposal for the installation of a new mechanical air conditioning system for the building has to be placed externally and internally where there is no visual impact.

6.5 Safety Measures / Building Regulations

POLICY 5.1

Conflicts between Fire Safety requirements and conservation recommendations should at first be referred to heritage architect/consultant and the ‘Fire Advisory Panel’ of Heritage NSW as appropriate.

POLICY 5.2

All works shall meet the performance requirements and provisions of the National Construction Code / Building Code of Australia for Fire, Egress, Disabled & Access and Essential Services, as administered by Balranald Shire Council.

POLICY 5.3

With the current occupation and the use of the building as a ‘Museum’ where entry by the public occurs, the building is to be brought up to ‘standard’ as per the ‘Premises Standard’ where disabled access and accessible amenities are required for the building. The access and amenities are to be in accordance with AS1428.1 “Design for access and mobility, Part 1: General requirements for access”

6.6 Maintenance and Repairs

POLICY 6.1

Undertake all tasks as set out in the Scope of Works for implementation in accordance with this Conservation Management Plan and with the minimum intervention in the significant fabric. Ensure that Balranald Shire Council approval is obtained prior to undertaking any works.

POLICY 6.2

Use of the Management and Maintenance Plan as advised by this Conservation Management Plan.

POLICY 6.3

As part of the 'Total Asset Management Planning', the owners/stakeholders (adopted Management Structure) shall include forecast expenditures sufficient for a five year Maintenance Plan.

POLICY 6.4

Consultants, staff and tradespeople must have appropriate qualifications for the tasks including sound conservation experience working on heritage buildings.

POLICY 6.5

In accordance with the "Burra Charter" Significant fabric must not be damaged by maintenance and repair activity. Trades will need to adhere to the conservation requirements for making good the surrounding materials and finishes if damaged.

POLICY 6.6

Roofs, awnings, gutters, box gutters downpipes and drains, weatherboards, brickwork & dampness are to be subject to regular inspection, repair and maintenance.

Note: Several lower brick walls are impacted by rising damp - further investigation and solutions are to be prepared for the works to address this issue with response to consider the impact on significant fabric.

POLICY 6.7

Health & safety hazards: There has been a Hazard Inspection Report undertaken that identifies certain materials / linings that contain asbestos:

- The asbestos containing materials marked as is in poor condition should be removed as a matter of importance due to their deterioration and potential for exposure.
- The asbestos containing material marked as is in fair condition should be stabilised and scheduled for removal during refurbishment.
- The asbestos containing material marked as in good can be left insitu and monitored regularly for any deterioration/damage and reassessed during future inspections

Note: for the Asbestos Inspection Report / Register dated 4 June 2019 (by All Clear Inspections) forming part of the Euston Courthouse - Management & Maintenance Plan

6.7 Building and appearance form

POLICY 7.1

Adaptation, which does not adversely affect the character and significance of the Euston Courthouse may be permitted within areas of building, however the following alterations may not be acceptable;

- The removal of primary internal walls
- New openings for doors and windows in significant rooms and external original walls
- Externally mounted plant and equipment
- Attached and exposed services and conduits
- Where there appears to be no feasible alternative for mechanical plant & equipment and exposed services, they should be accommodated and screened with a discrete envelope, painted in a similar colour to the surrounding material

POLICY 7.2

The Euston Courthouse building should retain its principal form including the floor layouts, roofs, mass, decoration, fenestration and access points. Work to areas of significance should be limited to preservation, restoration and reinstatement. All work, which could have a detrimental impact on the external form, is not acceptable.

POLICY 7.3
External materials, finishes and colour schemes for the Euston Courthouse building should be based on site investigation and scope of works. Prior to undertaking any changes to the external appearance Seek Council Approval

6.8 Intrusive Elements

POLICY 8.1
Intrusive elements, such as later added mechanical plant to the east side the "Euston Courthouse" building should be screened so as to eliminate or reduce their detrimental impact on the significance of the Theatre building.

POLICY 8.2
The making good of fabric associated with the removal of intrusive elements must be completed without further damage, and in a manner consistent with the Burra Charter principles of *restoration or reconstruction.*

6.9 Conservation Advice and CMP Adoptions

POLICY 9.1
The Conservation Management Plan is a guide for the future care and maintenance of the Theatre Royal. Experienced and professional conservation advice should be utilised for all conservation works.

POLICY 9.2
A comprehensive copy of all relevant archival materials should be assembled for reference use on site and stored in a secure manner at the Theatre Royal. A similar copy should be lodged with the Balranald Shire Council for reference and safe keeping. The following should be included;

- Copies of all drawings and plans
- Copies of all available photographs
- A copy of the Conservation Management Plan
- A copy of the Management and Maintenance Plan
- A copy of the Maintenance Plan / Checklist
- A copy of relevant records relating to building maintenance contractors and works.

POLICY 9.3
Masterplanning for the Euston Courthouse building and site elements has been prepared and form part of this Plan. Priority should be given to the documented works that are highlighted - Refer Appendix 3.

POLICY 9.4
A commitment is to be made to consult stakeholders and Balranald Shire Council in regard to the adequate care and maintenance of the Euston Courthouse building and site.

POLICY 9.5
The ICOMOS Burra Charter recommends that a Conservation Management Plan should contain provision for adoption and review. Balranald Shire Council to adopt this Conservation Management Plan. Review this plan within 10 years, or in the event of radical change to the Euston Courthouse building, or in ownership and major changes in use or circumstances. When the detailed design for the alterations to the components of the building are completed, seek Council approval

POLICY 9.6
On adoption / endorsement of this Conservation Management Plan, Balranald Shire Council shall make this Plan available to the general public and place a copy in the Balranald Library.

6.10 Interiors

POLICY 10.1
Ensure that all uses are sympathetic with the conservation of significant building fabric and finishes within the former Courthouse building.

POLICY 10.2
Where appropriate, reinstatement of significant items should be based on archival research and be consistent with the Burra Charter principles, in particular;

- Rear verandah

- Doors and windows
- Timber joinery - skirtings, architraves
- Light fittings and fixtures
- Ceilings and floors

6.11 Archaeology

POLICY 11.1
Where works are proposed which involve excavation, an archaeological assessment should be made to determine the possibility that relics may be revealed. This is particularly the case in the rear yard adjacent to the outdoor toilets.

POLICY 11.2
Where there is a possibility that relics may be exposed, specialist advice should be obtained from NSW Heritage, prior to the commencement of work. An Archaeological investigation should then be undertaken to assess, identify and record evidence of previous development.

POLICY 11.3
Where archaeological evidence is revealed at a works site, excavation should cease until advice has been obtained from a suitably qualified professional/archaeologist.

6.12 Adaptive Reuse and Opportunities

POLICY 12.1
Encourage and support research directed at increasing the knowledge and understanding of the significance of the Euston Courthouse at a local level (Euston/Balranald Community) and promote through the Balranald Tourist Information Centre and Balranald Shire Council. The following areas of research are worthy of detailed investigation;

- Detailed history of the establishment of the Euston Courthouse
- The operation of the Courthouse and it's standing within the community

POLICY 12.2
Support the development of temporary exhibitions, in conjunction with Policy 13.2 with the objective of attracting the support of the community.

POLICY 12.3
Maintain contact with 'Courthouses' and regional museums within the region to exchange information and skills related to the historic use of the site – Law & Order & Policing.

6.13 Significance and Conservation Funding

POLICY 13.1

Balranald Shire Council has noted the significance of the Euston Courthouse to the community with its heritage listing (item I6) "Courthouse" in the Schedule 5 Environmental Heritage of the Balranald Local Environmental Plan 2010.

POLICY 13.2
Secure ongoing funds to maintain the heritage building in the future for the project. Link conservation works and proposed new works together using conditions of approval, a heritage agreement, or another appropriate mechanism, so the conservation works are integral to the project.

Balranald Shire Council should pursue funding of the upgraded and conservation works for the Euston Courthouse and other issues raised in this Conservation Management Plan.

16.14 LEP Requirements / Considerations

POLICY 14.1
If/when the 'Works' to the heritage listed "Courthouse" are to be undertaken; with reference to the Balranald Local Environmental Plan - 2010, Clause 5.10 Heritage Conservation and the following sub-clauses would apply;

(1) Objectives
The objectives of this clause are as follows:
"(a) to conserve the environmental heritage of Balranald, and

(b) to conserve the heritage significance of heritage items and heritage conservation areas including associated fabric, settings and views,"

(2) Requirement for consent

Development consent is required for any of the following:

"(a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance):

(iii) a building, work, relic or tree within a heritage conservation area."

(3) When consent not required

"However, development consent under this clause is not required if—

(a) the applicant has notified the consent authority of the proposed development and the consent authority has advised the applicant in writing before any work is carried out that it is satisfied that the proposed development—

- *(i) is of a minor nature or is for the maintenance of the heritage item, Aboriginal object, Aboriginal place of heritage significance or archaeological site or a building, work, relic, tree or place within the heritage conservation area, and*
- *(ii) would not adversely affect the heritage significance of the heritage item, Aboriginal object, Aboriginal place, archaeological site or heritage conservation area,"*

(4) Effect on heritage significance

"The consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. This subclause applies regardless of whether a heritage management document is prepared under subclause (5) or a heritage conservation management plan is submitted under subclause (6)."

(5) Heritage impact assessment

"The consent authority may, before granting consent to any development:

(a) on land on which a heritage item is situated, or

(b) on land that is within a heritage conservation area, or

(c) on land that is within the vicinity of land referred to in paragraph (a) or (b),

require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned."

7 MASTERPLAN

INTRODUCTION:

This section of the report identifies the constraints and opportunities, which arise as a result of the heritage significance of the Euston Courthouse and input from stakeholders. The Euston Courthouse is to be retained and upgraded in accordance with Conservation guidelines and final 'Masterplan' drawing.

7.1 Preparation of a Masterplan

It is important that an in-principle agreement with the full range of stakeholders for the Euston Courthouse / Museum is reached for the preparation of a conservation management plan. Based on the appreciation of constraints and opportunities for the building and the operational aspects, this detailed conservation management plan is developed.

Refine all options for potential upgrade which is to include conservation practices for the former Euston Courthouse in the preparation of the Masterplan and if necessary set stages for the works to be undertaken. Complete all necessary consultations and prepare a 'Cost Plan' to prove the viability of the proposal and in seeking opportunities for grant funding.

Balranald Shire Council provided the following tasks to be undertaken in relation to the Conservation Management Plan and Masterplan for the Euston Courthouse;

1. Consult fully with relevant Council Officer's / Director and user groups of the 'Courthouse Museum'
2. Following consultations, determine the best solutions for the future development and upgrade of the Euston Courthouse to meet anticipated future needs, particularly:
   - 2.1 Provide for accessible amenities and disabled access to most parts of the building as part of the upgraded museum for a better experience by museum staff and the visiting public.
   - 2.2. address the building movement / cracking issues and the rising damp evident at walls throughout the building, addressing the deteriorated weatherboards that require replacement, addressing the 'hazardous materials' highlighted in the 2019 Inspection Report and the repainting of the building.

Noel Thomson prepared briefing notes from the site visit and instructions from Council officer where review of current museum operations undertaken and input into masterplanning was obtained. From this meeting an outline of opportunities and restraints were highlighted;

Priorities are to provide accessible entry and amenities to the building and address building movement and rising damp issues - see below;

1. The 'accessibility' to all areas of the building and the requirement for accessible toilet facilities to be provided within the building or as an extension.
2. Maintenance issues raised; need to address building movement / cracking, moisture / rising damp,
3. Paint the outside surfaces of the building in an appropriate colour scheme.

The initial Masterplan concept sketch options were prepared and form part of this Conservation Management Plan. Currently the building is operated as a museum for the front rooms and the rear area of the former police residence (kitchen, bedroom, laundry, etc) is used by historical society/museum members for research, meetings, ablutions, etc.

Noel Thomson Architecture has prepared Masterplan Concept Design – Final, with the basis of the design as outlined below;

1. The addition of a ramp to the front / main entry to the building / museum for access for people of all abilities.
2. The addition of a ramp for access by historical society/museum members for to the rear areas of the building where meetings and research are undertaken
3. The addition of new accessible amenities to the rear of the building, replacing the existing toilet for use by visitors and historical society/museum members
4. The highlighting of areas where building repairs and maintenance including areas of damaged masonry work due to movement, 'rising damp', deteriorated weatherboards, etc

Note: Refer to Fig 9 for the Masterplan Concept Sketch Drawing

Note: for all Masterplan Concept Sketch Drawing Options - Refer to Appendix 3.

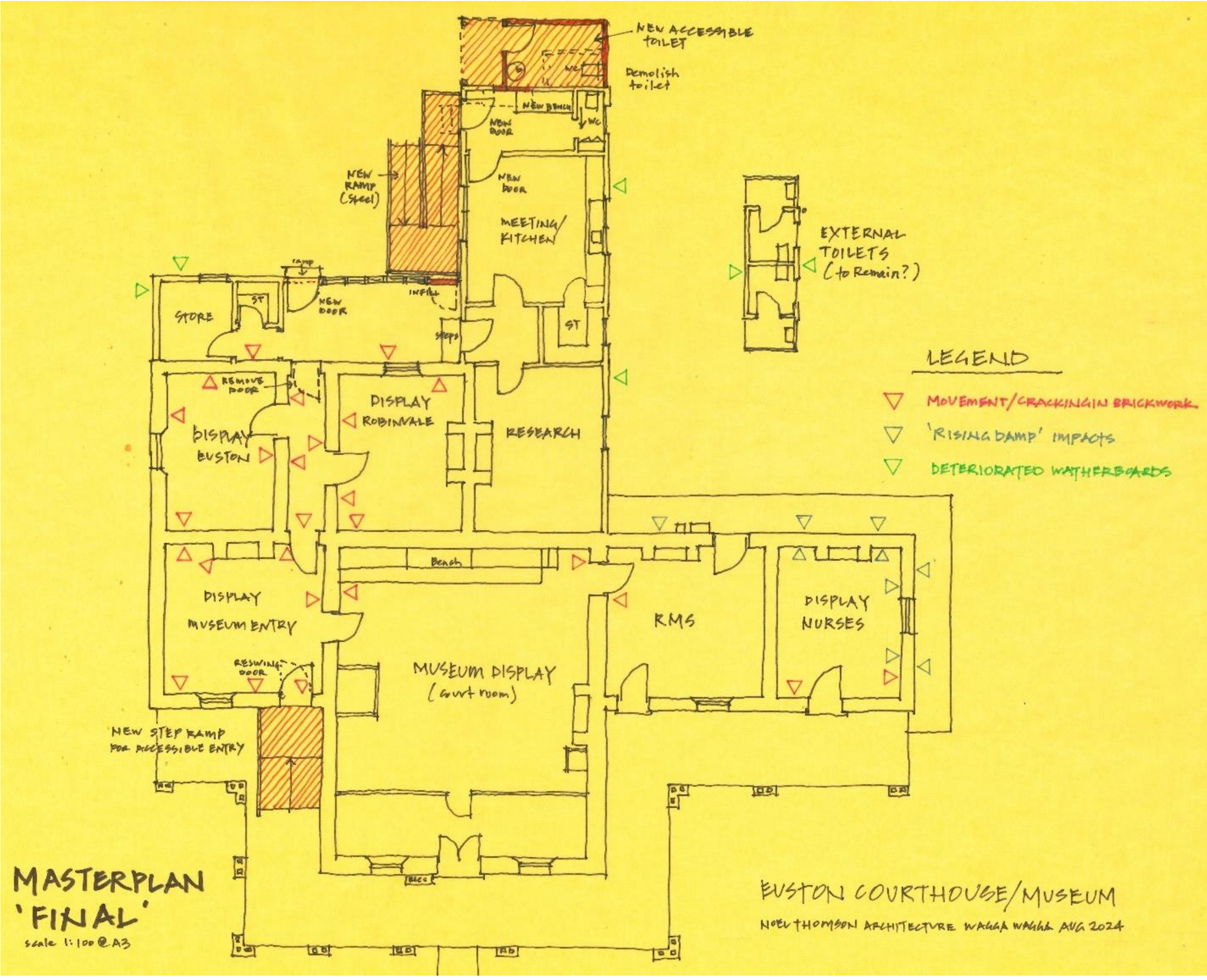


Fig. 9: Masterplan Final for the former Courthouse building – Noel Thomson Architecture 2024

Building Accessibility Requirements:

Legislative framework for Accessibility Requirements to Buildings include the;

- Disability Discrimination Act 1992 (DDA)
- NSW Anti Discrimination Act 1977
- Disability (Access to Premises – Buildings) Standards 2010
- National Construction Code 2022 (Vol 1 Building Code of Australia)
- Australian Standards, particularly ◦ AS1428.1 2009 as amended ◦ AS1428.4.1 2009 as amended

In accordance the above where Disability access to all buildings including heritage buildings is required, the provision for access must work within the principles of The Burra Charter for heritage conservation.

Therefore, the Masterplan Concept Sketch Drawing for the Museum (*former Courthouse building)* includes the following;

1. The addition of a ramp to the front/main entry to the building/museum for access for people of all abilities.
2. The addition of a ramp for access by historical society/museum members for to the rear areas of the building where meetings and research are undertaken
3. The addition of new accessible amenities to the rear of the building, replacing the existing toilet for use by visitors and historical society/museum members

For examples of similarly installed entry ramps, accessible steel ramps and accessible toilets refer Fig 10 photographs below;

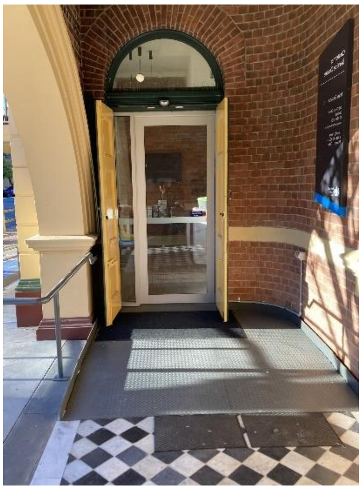


Fig 10: Steel overlay Ramp (Entry) *Accessible steel ramp (rear)* *Accessible toilet (rear)*

7.2 Implementation of a Masterplan

Arrangements should be put in place to engage consultants with relevant experience, including heritage, architectural, services and structural consultants to assist in the preparation of tender / construction documentation for the implementation of the Conservation Management Plan and Masterplan designs.

The cost of conserving the significant parts of the building, the provision of "accessibility" requirements and upgrade to the building and potential upgrading services to an acceptable standard is likely to be in excess of the available Council resources in the short term. As is often the case with projects such as these, staged implementation of the works is likely to be the adopted strategy.

In determining priorities, both cost and need have been considered. One of the major expenses will be the cost of providing the "accessibility" requirements. There may also be considerable costs in rectifying / addressing the building movement and rising damp issues.

High priority works are for the "accessibility" requirements and for the conservation / maintenance repairs which will assist in the long-term structural capability of the building. Medium priority works are for the 'restoration' of deteriorated cladding areas and the removal of any 'hazardous materials' and low priority work is the external painting in a new colour scheme. The works have been set out below in stages as the likelihood is that the works will be implemented progressively. Depending on the availability of funding, construction works could be staged as follows in order of priority as follows;

Stage 1: Investigate and review solutions for rising damp, seek quotes and install appropriate damp-proofing to address 'rising damp' issues

Stage 2: Install compliant accessible ramps to entry and rear areas and accessible toilet amenities to meet the requirements of NCC/BCA and AS1428.1.

Stage 3: Building repairs and maintenance including areas of damaged masonry work due to movement / cracking, window and cladding repairs and internal / external upgrades, etc

Stage 4: Removal of 'hazardous materials' including '*asbestos*' linings to walls and ceilings in the building

Stage 5: Further conservation works, building repairs and maintenance that that will enhance the internal and external areas of the building.
Paint the building internal and external surfaces as required.
Review roofing and guttering as per Management and Maintenance Plan.

8. MANAGEMENT AND MAINTENANCE PLAN

INTRODUCTION:

This section of the report identifies the management and maintenance tasks, which arise as a result of the heritage significance of the Theatre Royal. Guidelines are required to ensure the appropriate management, statutory approvals and maintenance tasks are followed.

8.1 Recommendation for works

The Euston Courthouse is to be retained and upgraded in accordance with Conservation guidelines.

Complete essential conservation works that are required to prevent further decay to the building fabric and establish clear management and operational guidelines for all contractors, staff and visitors, so that they are aware of the heritage value of the building/site.

8.2 Statutory Controls and Opportunities

Given the Euston Courthouse is Heritage Listed, as with all development, Council will require a Development Application and an application for a Construction Certificate for the proposed building works. In regards to a Development Application the works are to be fully described in a Heritage Impact Statement completed by a heritage architect/consultant. This is to ensure that the general character of the works are sympathetic with the significance of the building, and that the details for 'change' does not detract from the heritage architecture.

This Conservation Management Plan (CMP) may then be proposed to Balranald Shire Council as a document for consent, allowing for minor works, which are covered within the agreed CMP to be exempt from a continual approval process.

8.3 Management

Following the implementation of the proposed new Management Structure for the Euston Courthouse building, the adoption of this Conservation Management Plan is critical for the buildings ongoing management.

The policies in this Conservation Management Plan should direct and support all future decisions concerning the site including those involving restoration, reinstatement and new construction.

It is highly recommended that an experienced heritage architect/consultant be retained to consistently advise on conservation and development issues. This will ensure that documentation and proposed works are always based on sound advice, relative to the heritage significance of the Euston Courthouse and the statutory requirements and approvals.

8.4 Maintenance

The Conservation Management Plan lists the works, which may be defined as corrective maintenance. These items are designed to bring the building to an acceptable standard. This will apply to the building fabric and also to the appropriate character of the materials, finishes and workmanship. The Management & Maintenance Plan must then cover the following requirements;

- Planned maintenance: For example cleaning of roofs and gutters, deterring roosting pigeons, external painting, etc.
- Emergency corrective maintenance: For example health, safety and security issues.
- Maintenance tasks may be carried out by staff in some instances, but mostly by specialist contractors and tradespeople. It is essential that all personnel are familiar with the tasks and any specific requirements dictated by the heritage status of the materials and finishes.
- It is important that contractors involved with tasks such as air-conditioning and communications are aware of the heritage significance of the building to ensure that inappropriate works (materials and workmanship) are not undertaken.
- There are many examples, particularly on external elevations, where services have been fixed to walls. The first alternative should be to attempt a concealed route either on the inside or the

outside. Where this is not possible, screen the item / service with an appropriate material and colour. The screen is not to disguise or imitate but to reduce the visual impact of the object.

Recommendation is for the preparation of Management & Maintenance Plan and Maintenance Checklist documentation separate to this Conservation Management Plan.

Note: For documentation refer Appendix 4

Appendix 1 – Current Building Photographs

Appendix 2 – Existing Building Layout + Archival Drawings

Appendix 3 – Masterplan Drawings - Plan Layout

Appendix 4 – Management & Maintenance Plan and Maintenance Checklist

Appendix 5 – Salt Attack and Rising Damp - Technical Guide

NOEL THOMSON FRAIA
Architect and Heritage Consultant
<u>Noel Thomson Architecture Pty Ltd</u>

AUGUST 2024

APPENDIX 1 – CURRENT BUILDING PHOTOGRAPHS: 2022

EXTERNAL

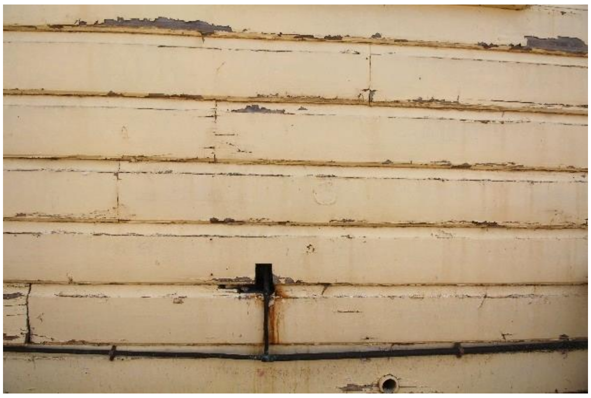
1: Front/Murray St facade

2: O/A Building – west facade

3: Rear extension – south facade

4: Rear extension – south facade

5: View of deteriorated weatherboards



6: View of deteriorated weatherboards

7: View of window + weatherboards

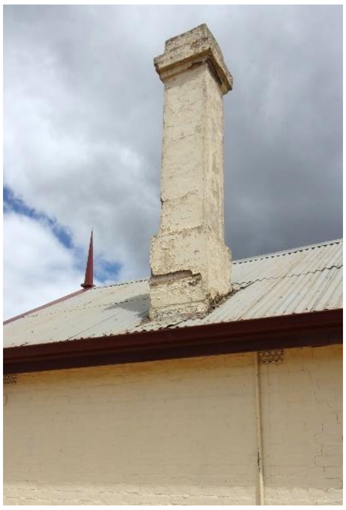
8: View of window + weatherboards


9: View of window + weatherboards

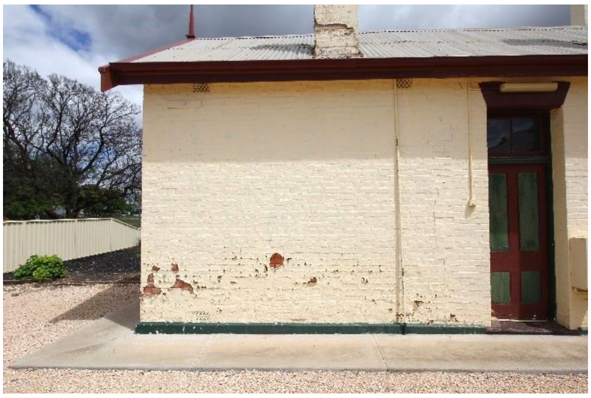

10: View of junction – b/w original + extension


11: View of junction – b/w original + extension


12: View of chimney


13: View of chimney


14: Original building – east facade


15: East facade showing 'rising damp'


16: East facade showing 'rising damp'


17: South facade showing 'rising damp'

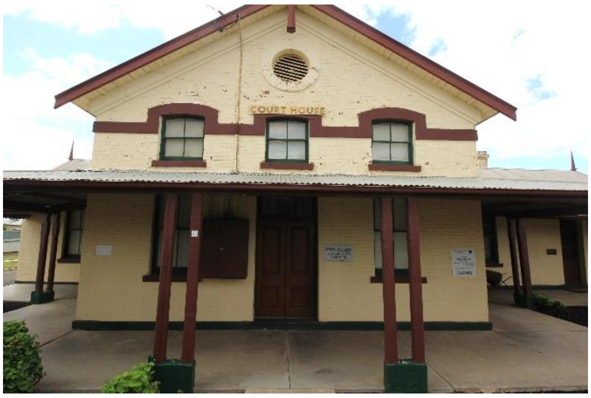
18: South facade showing 'rising damp'

19: South facade showing 'rising damp'

20: West Facade – south wing

21: West facade + verandah

22: Main west facade



23: Main west facade + verandah

24: West facade north wing

25: West facade north wing + verandah


26: North facade – brcik + infill rear verandah


27: North + East facade - infill rear verandah


28: East facade infilled rear verandah


29: Junction between verandah + extension


30: View of rear extension


31: East view of rear extension + toilet


32: Rear outdoor toilet


33: Rear entry at verandah

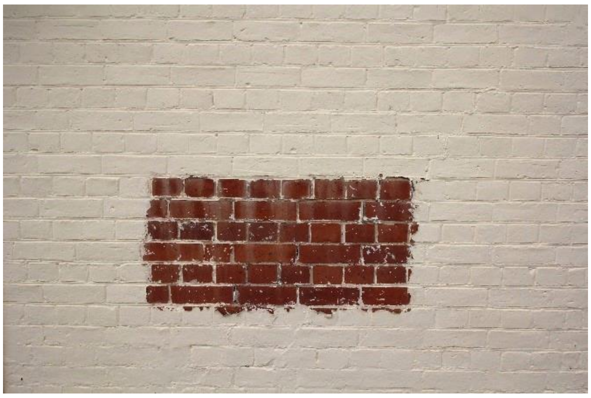

34: Deteriorated weatherboards north wall


35: Deteriorated weatherboards north wall


36: View of rear extension – infilled verandah


37: North facade - brickwork deterirated at base


38: North facade – brickwork + vent


39: North facade – paint removal test


40: View of verandah barge


41: West facade – entry to Museum


42: North Wall of Courtroom


43: Concrete paving at verandah


44: Concrete paving at verandah


45: North verandah - concrete


46: Later electrical SB


47: Original Courtroom entry


48: Concrete paving at verandah


49: Concrete paving at verandah


50: Concrete paving at verandah

51: South wall of Courtroom

52: Verandah post / path detail

53: Concrete paving at verandah

54: Door Detail

55: Window Detail

56: paving at South Side

57: Verandah post / plinth detail

58: Wall base detail

59: Wall base detail

60: External Toilet from west

61: External Toilet - south west view

62: External toilet north view

63: External toilet east view

64: External toilet west view

65: Deteriorated weatherboards

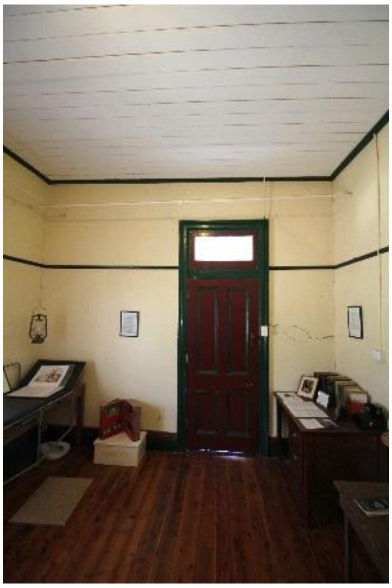
66: East toilet

67: West toilet

68: Internal view toilet

INTERNAL

69: Nurses Display east wall / fireplace



70: Nurses Display west wall / door

71: Nurses Display south wall / window

72: Nurses Display fireplace

73: Nurses Display floor

74: Nurses display ceiling


75: Nurses display structural tie rod / cracking


76: Nurses display structural tie rod / cracking


77: Nurses display structural tie rod / cracking


78: Nurses Display ‘Rising Damp’ issues


79: Nurses Display ‘Rising Damp’ issues


80: Nurses Display ‘Rising Damp’ issues


81: Courtroom West wall / Entry


82: Courtroom West Wall “seating”


83: Courtroom West Wall "seating"


84: Courtroom South Wall/fireplace

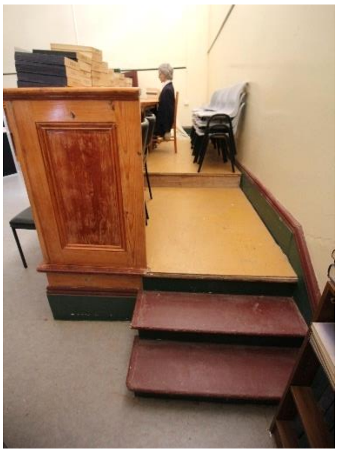

85: Courtroom Dock


86: Courtroom + Judges bench


87: Courtroom door detail


88: Courtroom door detail


89: Courtroom + Judges bench

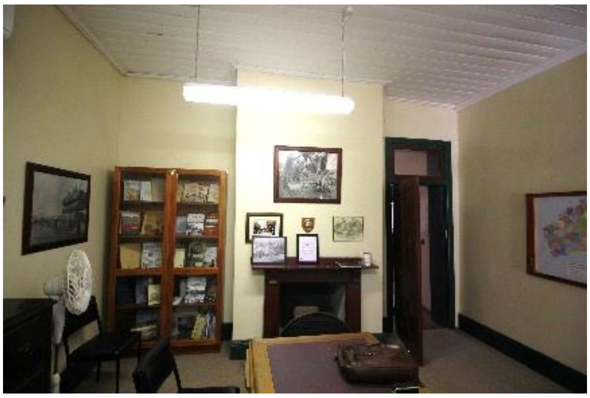

90: Courtroom + Judges bench


91: Courtroom – overall view


92: Courtroom ceiling north


93: Courtroom ceiling south


94: Courtroom fireplace


95: Entry Room – east wall/ fireplace


96: Entry room north wall


97: Entry Room south wall


98: Entry Room west/entry wall


99: Entry Room flooring


100: Entry Room fireplace


101: Hall door fanlight


102: Entry door Fanlight


103: Entry Room – cracking at walls


104: Entry Room – cracking at walls


105: Entry Room – cracking at walls


106: Entry Room – cracking at walls


107: Entry Room – cracking at walls

108: Hall - east

109: Hall - west

110: Hall floor

111: Hall - cracking at walls

112: Hall - cracking at walls

113: Hall - cracking at walls

114: Euston Room – North wall/window

115: Euston Room – West wall

116: Euston Room - East Wall

117: Euston Room floor

118: Robinvale Room - south wall/fireplace

119: Robinvale Room n- orth wall/door

120: Robinvale Room - west wall

121: Robinvale Room - wast wall/window

122: Robinvale Room fireplace

123: Robinvale Room ceiling

124: Robinvale Room - cracking at walls

125: Robinvale Room - cracking at walls

126: Robinvale Room - flooring

127: Robinvale Room - flooring

128: Bath/Store – flooring, window, wall + door views


129: Hall


130: Rear infilled verndah

131: Store - shelving

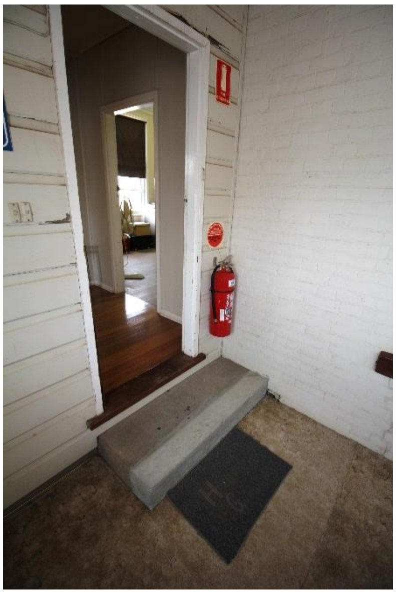

134: Store - flooring

135: Store - ceiling


136: Infill verandah – north wall


137: Infill verandah – window


138: Infill verandah south wall


139: Infill verandah steps to vestibule


140: Infill verandah view of wall/ceiling


141: Door view – showing 'gap'

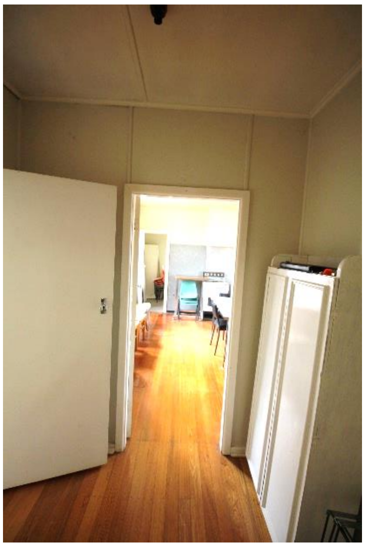

142: Infill verandah oringinal window detail


143: Infill verandah door/hall detail

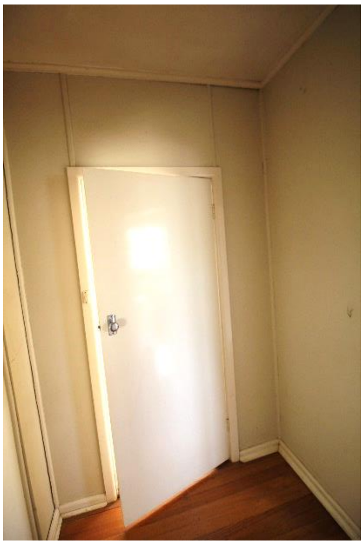
144: Infill verandah cracking at wall

145: Infill verandah cracking at wall

146: Vestible – south wall



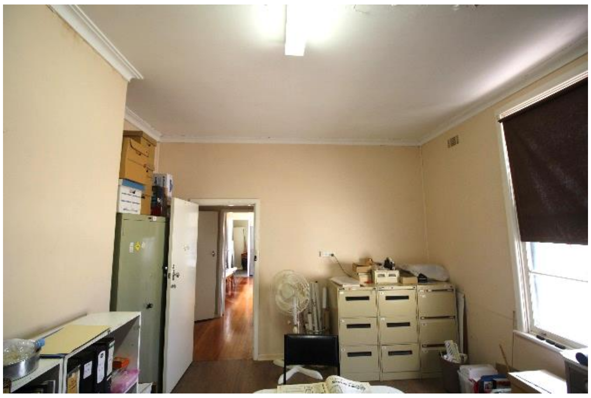
147: Vestible – east wall



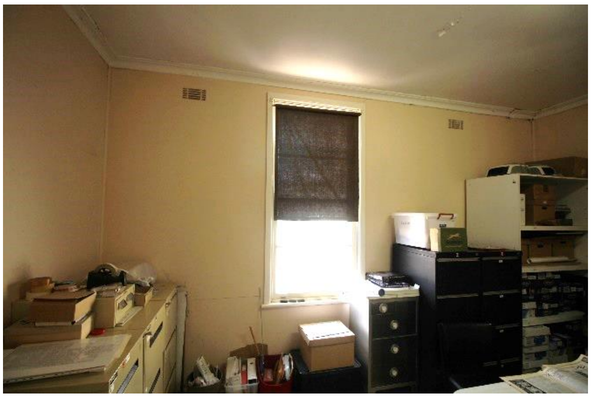
148: Vestible north wall/door

149: Research Room – ceiling west out

150: Research Room – north wall/fireplace



151: Research Room - East wall/door



152: Research Room - south wall/window


153: Research Room ceiling


154: Research Room flooring


155: Research Room Ceiling + damage


156: Research Room flooring


157: Kitchen - south wall/cabinetry


158: Kitchen - east wall/ceiling


159: Kitchen - north wall/window


160: Kitchen - west wall/doors

161: Kitchen flooring

162: Kitchen ceiling

163: Pantry window/shelving

164: Pantry shelving

165: Pantry flooring

166: Laundry - east wall/window

167: Laundry - west + north walls

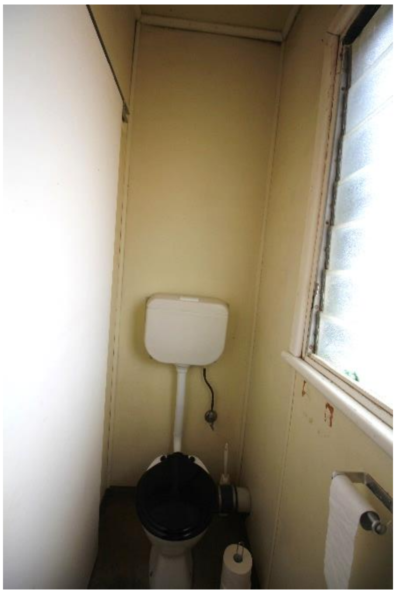
168: Laundry - north wall/ door


169: Laundry - south wall/toilet door


170: Laundry flooring

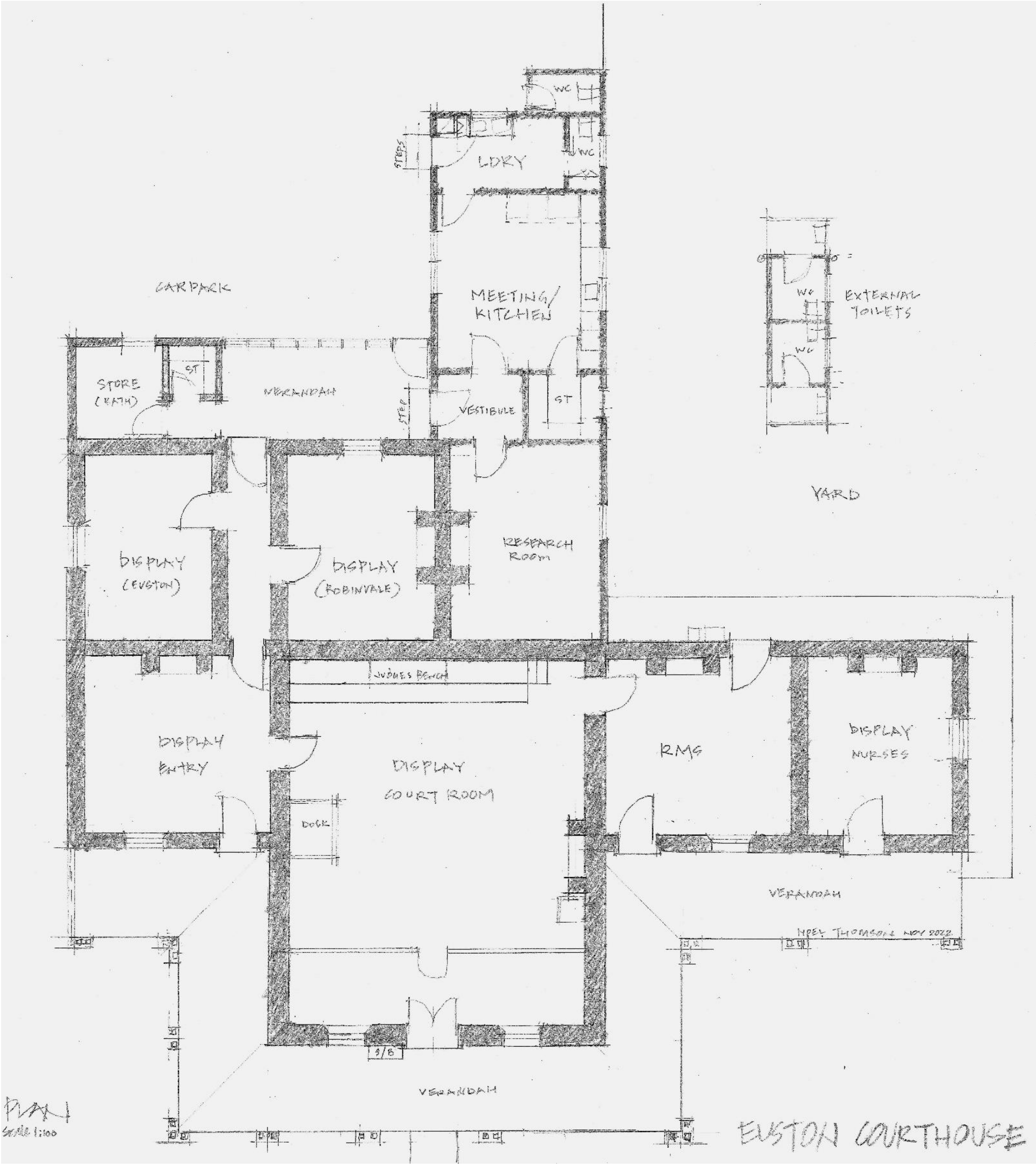

171: Laundry ceiling

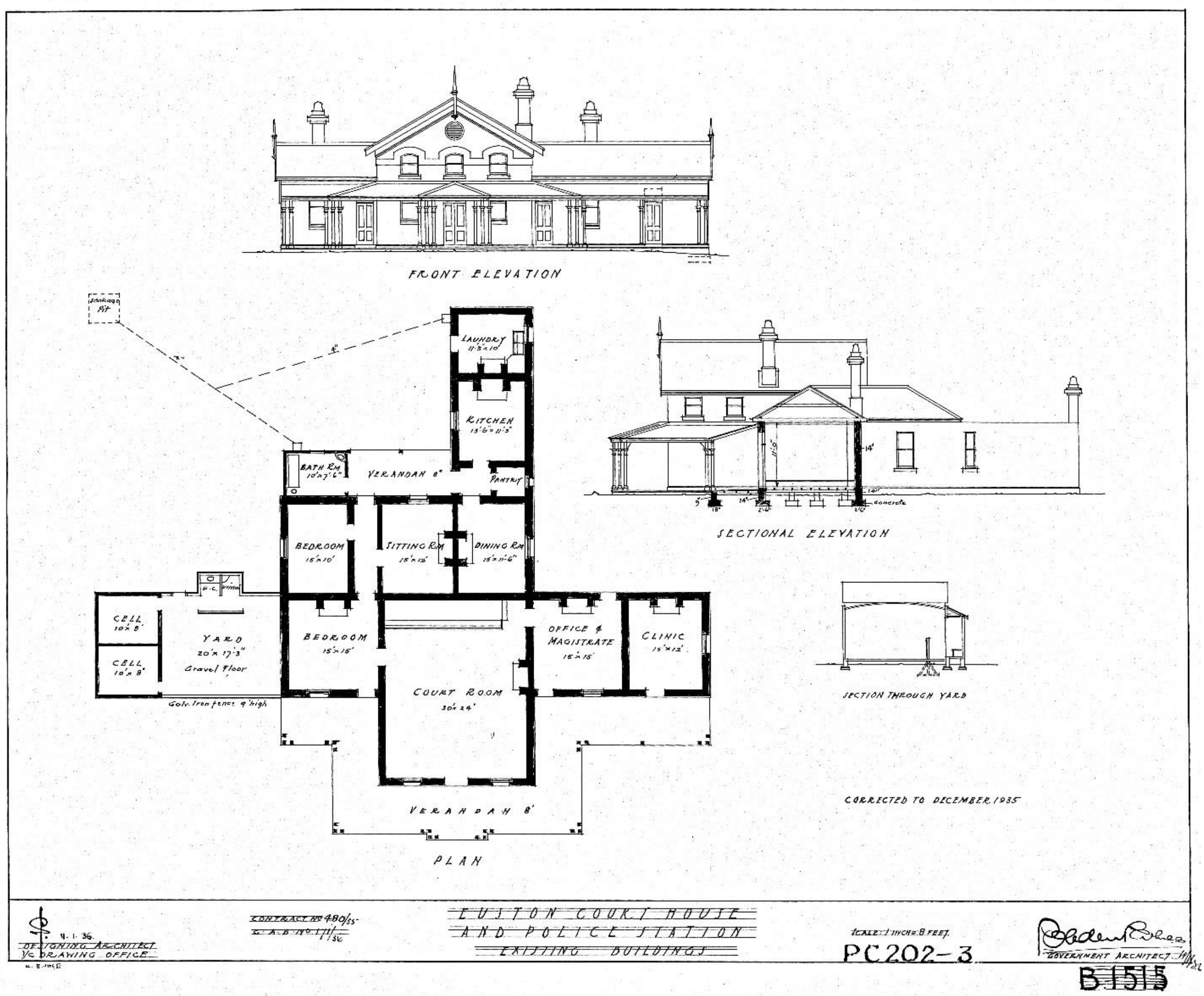

172: Laundry movement at cornice

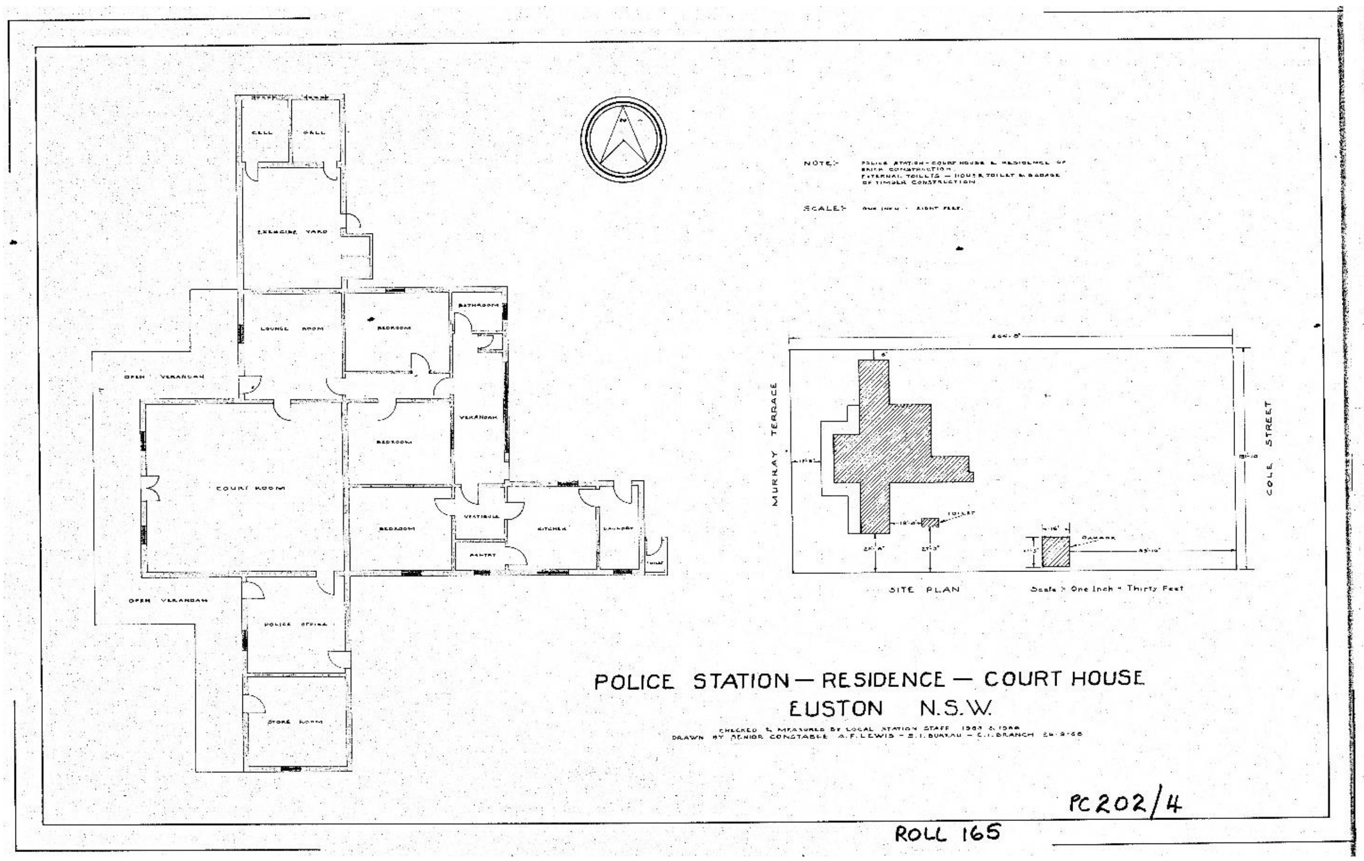

173: Toilet

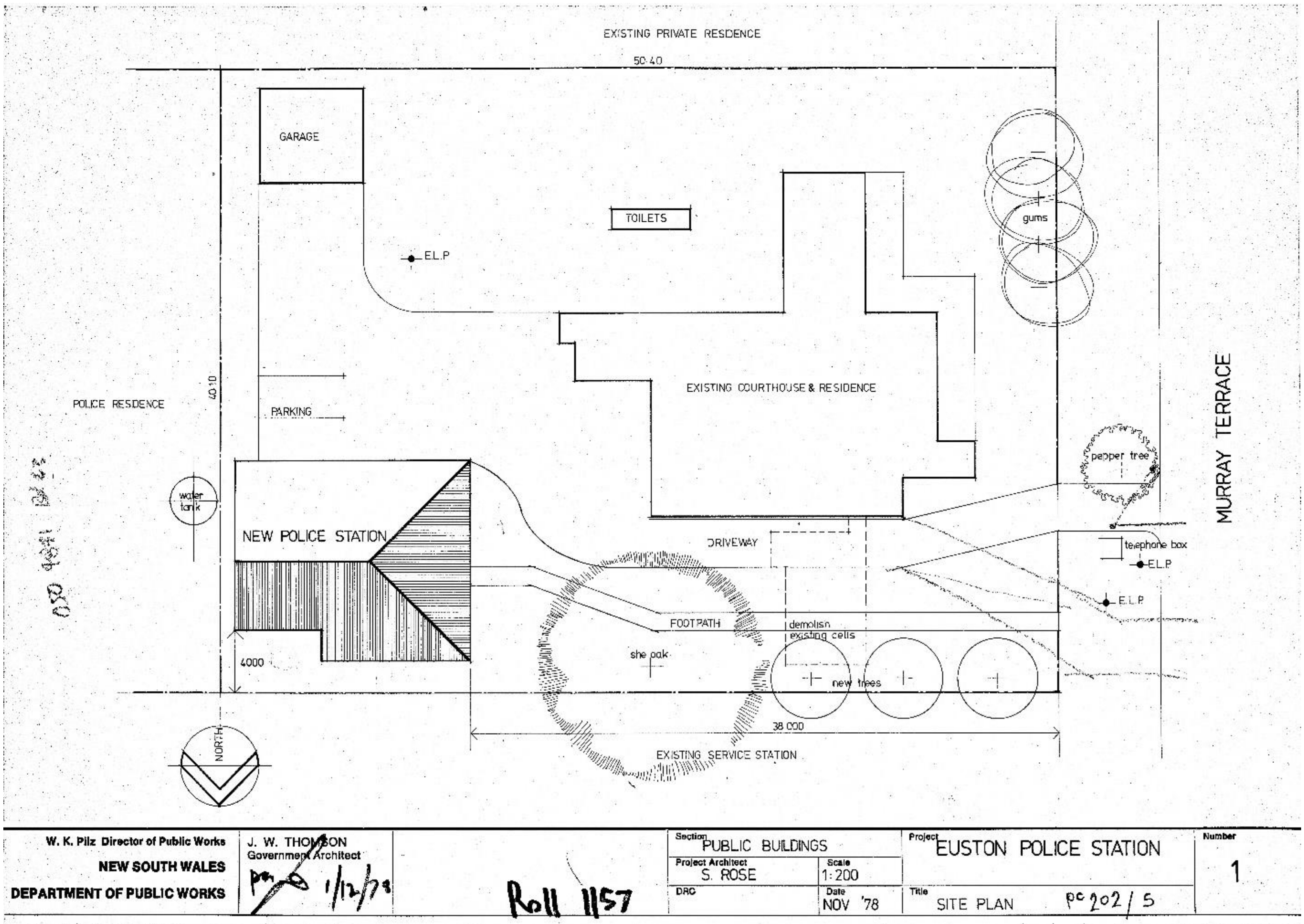

174: Toilet cupboard

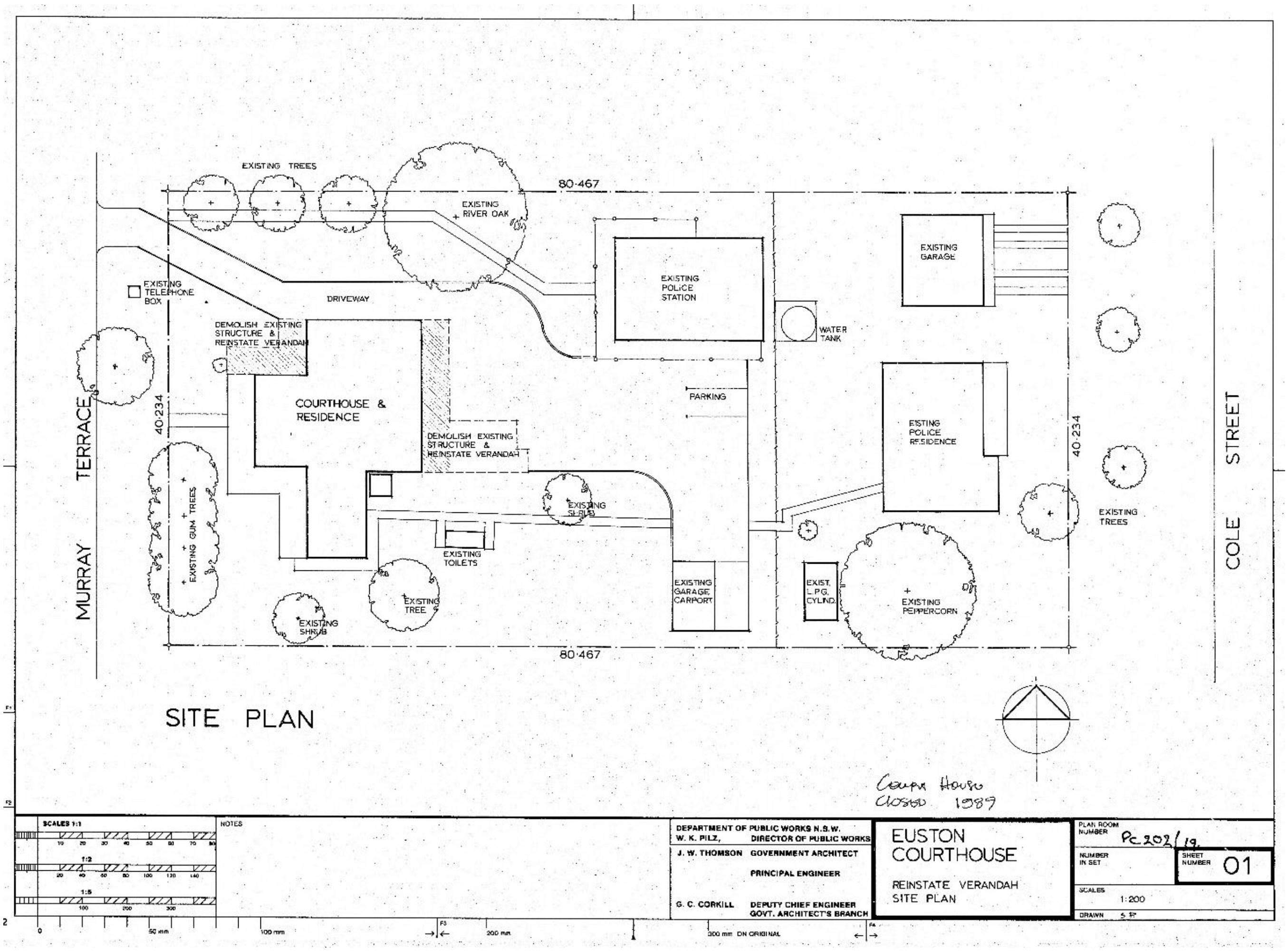
APPENDIX 2 – EXISTING BUILDING LAYOUT + ARCHIVAL DRAWINGS

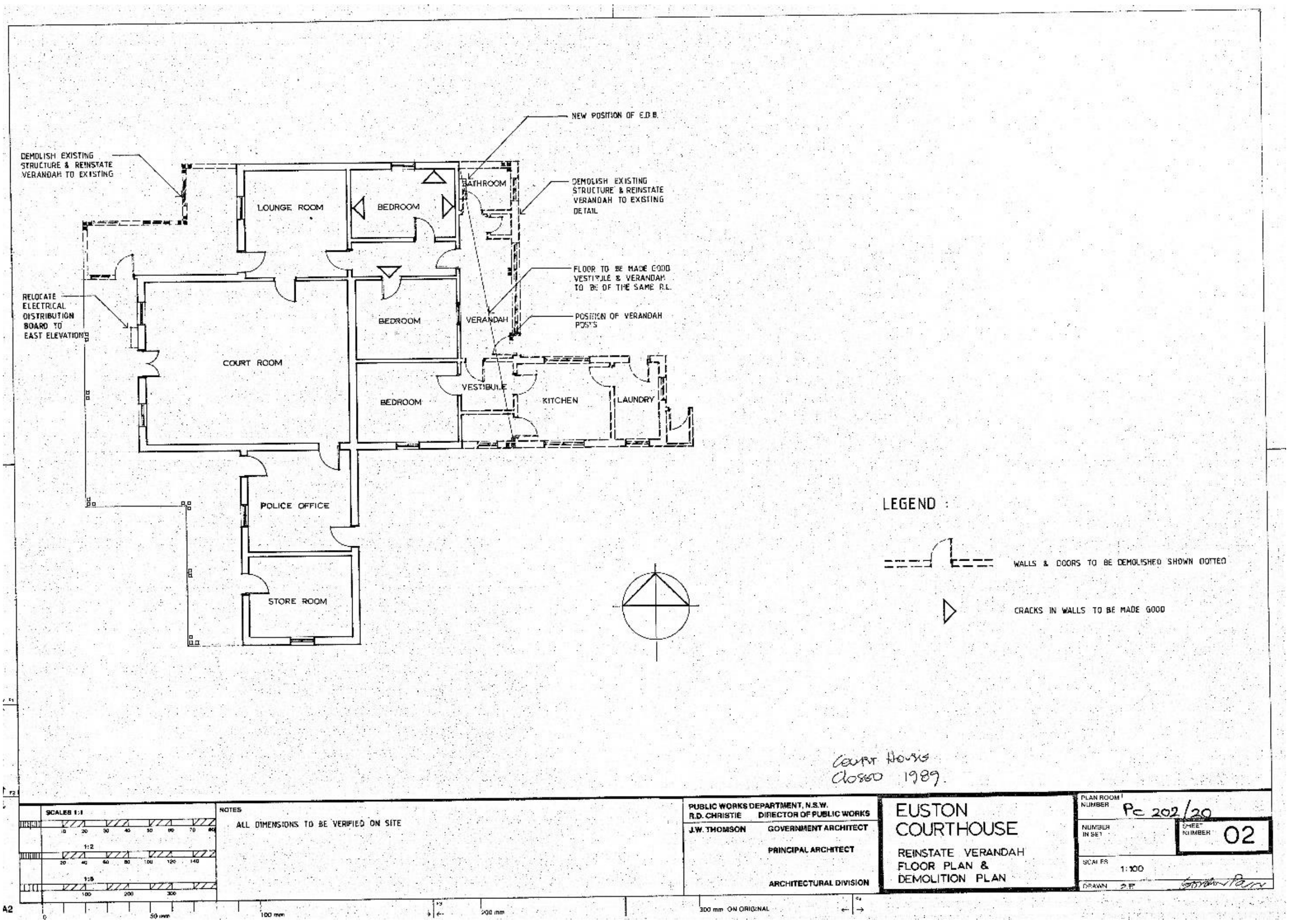


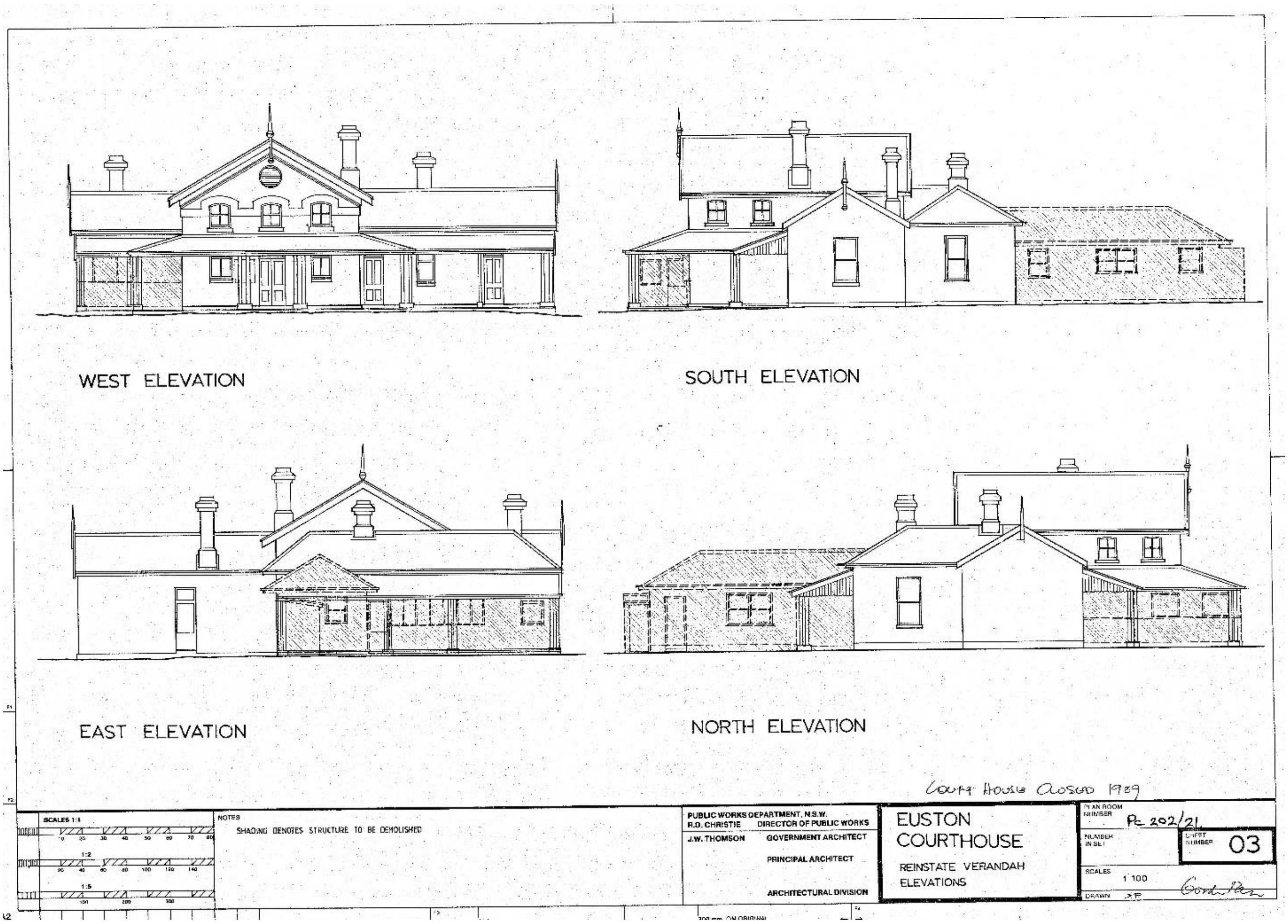

FRONT ELEVATION
LAUNDRY 11'3"x10'
KITCHEN 15'6"x11'3"
BATH RM
VERANDAH 8'
PANTRY
BEDROOM 15'x10'
SITTING RM 15'x15'
DINING RM 15'x11'6"
CELL 10'x8'
CELL 10'x8'
YARD 20'x17'3"
Gravel Floor
Galv. Iron fence 9' high
BEDROOM 15'x15'
OFFICE & MAGISTRATE 15'x15'
CLINIC 15'x12'
COURT ROOM 30'x24'
VERANDAH 8'
PLAN
SECTIONAL ELEVATION
SECTION THROUGH YARD
CORRECTED TO DECEMBER 1935
DESIGNING ARCHITECT
VC DRAWING OFFICE
EUSTON COURT HOUSE
AND POLICE STATION
EXISTING BUILDINGS
SCALE: 1 INCH = 8 FEET
PC202-3
GOVERNMENT ARCHITECT
B1515


CELL
CELL
EXERCISE YARD
LOUNGE ROOM
BEDROOM
BATHROOM
OPEN VERANDAH
VERANDAH
BEDROOM
COURT ROOM
BEDROOM
VESTIBULE
KITCHEN
LAUNDRY
PANTRY
OPEN VERANDAH
POLICE OFFICE
STORE ROOM
NOTE:
SCALE:
MURRAY TERRACE
COLL STREET
SITE PLAN
Scale: One Inch = Thirty Feet
POLICE STATION — RESIDENCE — COURT HOUSE
EUSTON N.S.W.
PC202/4
ROLL 165

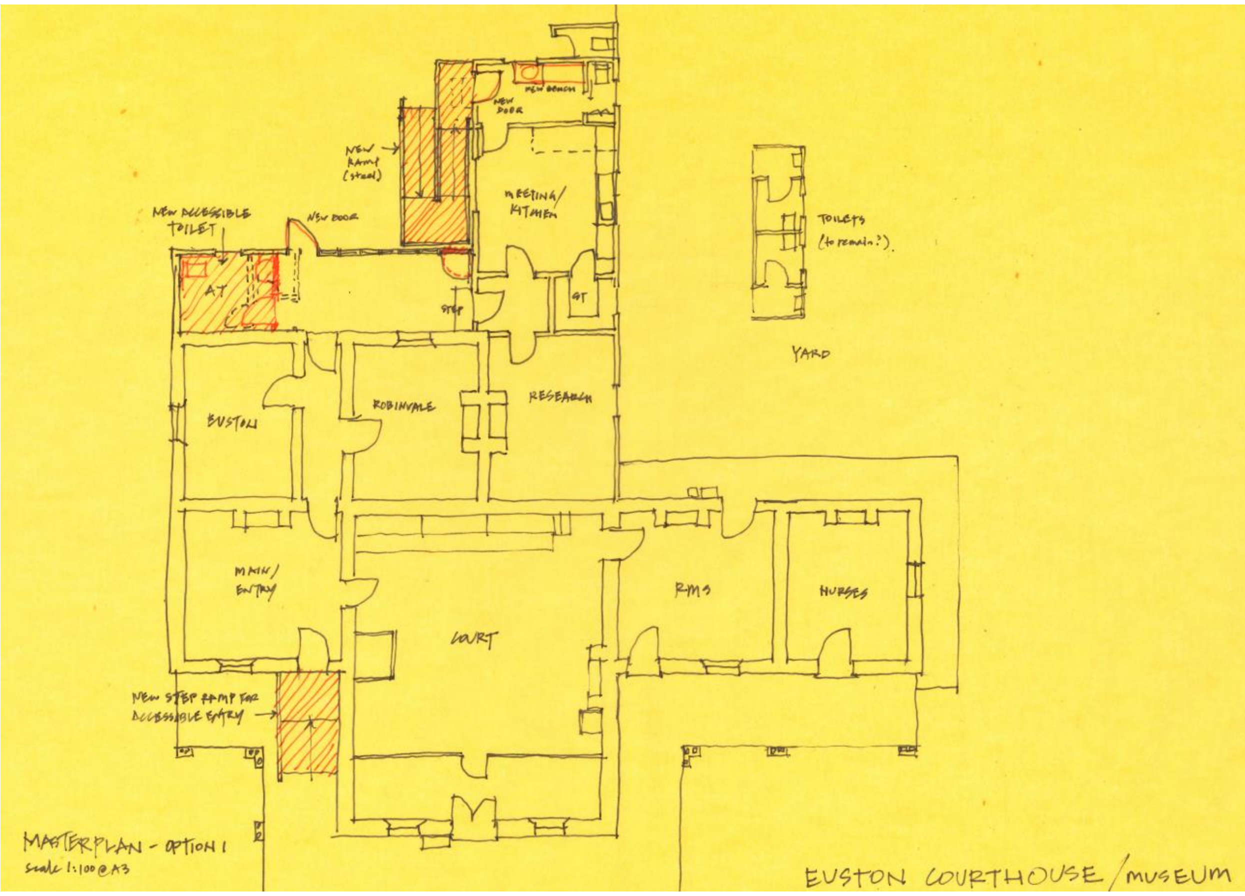

EXISTING PRIVATE RESIDENCE
50·40
GARAGE
TOILETS
E.L.P
gums
EXISTING COURTHOUSE & RESIDENCE
40·10
POLICE RESIDENCE
PARKING
MURRAY TERRACE
pepper tree
water tank
NEW POLICE STATION
DRIVEWAY
telephone box
E.L.P
E.L.P
FOOTPATH
demolish existing cells
she oak
4000
new trees
38 000
NORTH
EXISTING SERVICE STATION
W. K. Pilz Director of Public Works
NEW SOUTH WALES
DEPARTMENT OF PUBLIC WORKS
J. W. THOMSON
Government Architect
1/12/78
Roll 1157
Section PUBLIC BUILDINGS
Project Architect S. ROSE
Scale 1:200
DRG
Date NOV '78
Project EUSTON POLICE STATION
Title SITE PLAN
PC 202/5
Number 1

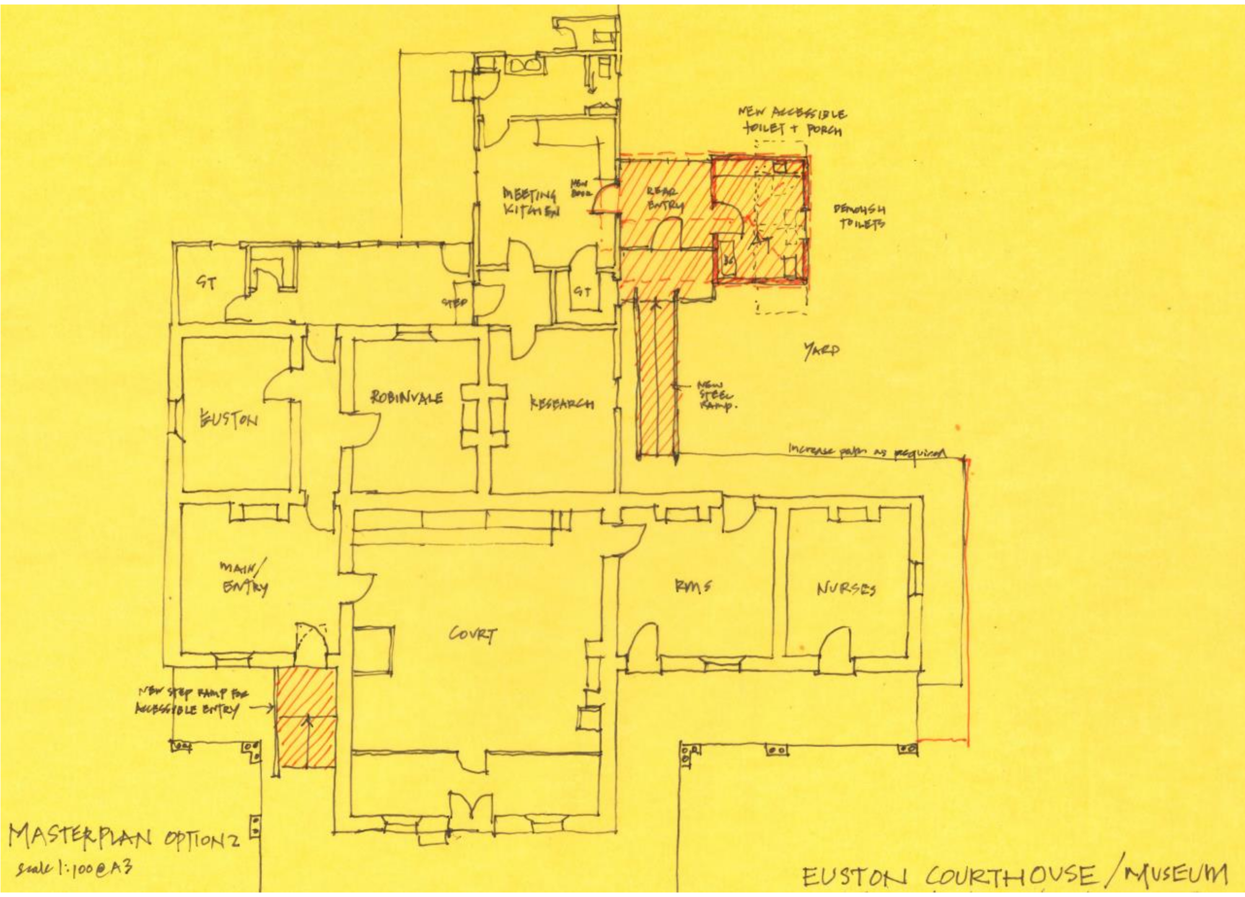

EXISTING TREES
80·467
EXISTING RIVER OAK
EXISTING POLICE STATION
EXISTING GARAGE
EXISTING TELEPHONE BOX
DRIVEWAY
DEMOLISH EXISTING STRUCTURE & REINSTATE VERANDAH
WATER TANK
COURTHOUSE & RESIDENCE
PARKING
EXISTING POLICE RESIDENCE
40·234
40·234
MURRAY TERRACE
COLE STREET
DEMOLISH EXISTING STRUCTURE & REINSTATE VERANDAH
EXISTING GUM TREES
EXISTING SHRUB
EXISTING TREES
EXISTING TOILETS
EXISTING TREE
EXISTING SHRUB
EXISTING GARAGE CARPORT
EXIST. L.P.G. CYLIND.
EXISTING PEPPERCORN
80·467
SITE PLAN
Court House Closed 1989
SCALES 1:1
1:2
1:5
NOTES
DEPARTMENT OF PUBLIC WORKS N.S.W.
W. K. PILZ, DIRECTOR OF PUBLIC WORKS
J. W. THOMSON GOVERNMENT ARCHITECT
PRINCIPAL ENGINEER
G. C. CORKILL DEPUTY CHIEF ENGINEER GOVT. ARCHITECT'S BRANCH
EUSTON COURTHOUSE
REINSTATE VERANDAH
SITE PLAN
PLAN ROOM NUMBER Pc 202/19
NUMBER IN SET
SHEET NUMBER 01
SCALES 1:200
DRAWN S.R.

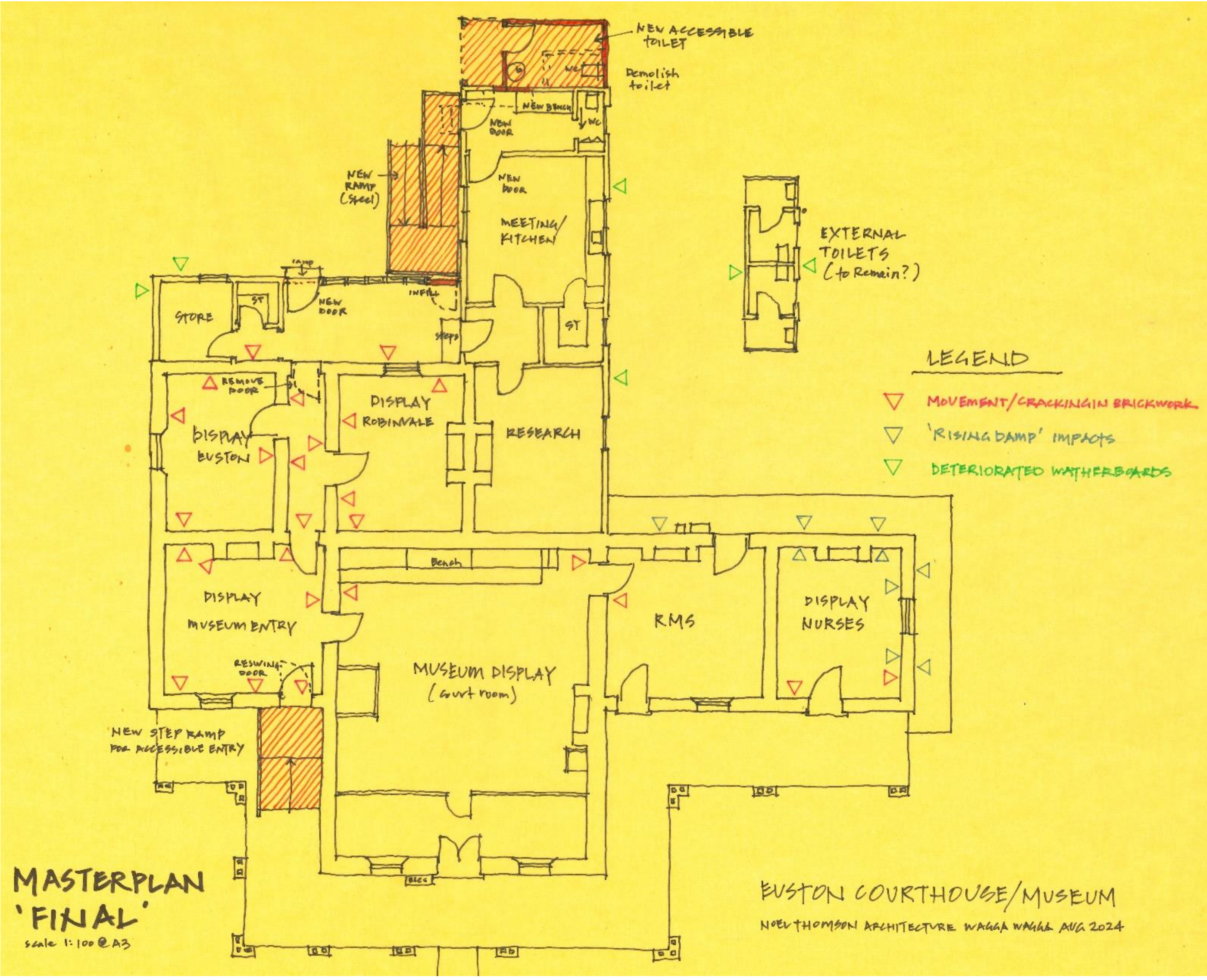

NEW POSITION OF E.D.B.
DEMOLISH EXISTING STRUCTURE & REINSTATE VERANDAH TO EXISTING
DEMOLISH EXISTING STRUCTURE & REINSTATE VERANDAH TO EXISTING DETAIL
RELOCATE ELECTRICAL DISTRIBUTION BOARD TO EAST ELEVATION
FLOOR TO BE MADE GOOD VESTIBULE & VERANDAH TO BE OF THE SAME R.L.
POSITION OF VERANDAH POSTS
LOUNGE ROOM
BEDROOM
BATHROOM
COURT ROOM
BEDROOM
VERANDAH
BEDROOM
VESTIBULE
KITCHEN
LAUNDRY
POLICE OFFICE
STORE ROOM
LEGEND :
WALLS & DOORS TO BE DEMOLISHED SHOWN DOTTED
CRACKS IN WALLS TO BE MADE GOOD
Court House Closed 1989.
NOTES
ALL DIMENSIONS TO BE VERIFIED ON SITE
PUBLIC WORKS DEPARTMENT, N.S.W.
R.D. CHRISTIE DIRECTOR OF PUBLIC WORKS
J.W. THOMSON GOVERNMENT ARCHITECT
PRINCIPAL ARCHITECT
ARCHITECTURAL DIVISION
EUSTON COURTHOUSE
REINSTATE VERANDAH FLOOR PLAN & DEMOLITION PLAN
Pc 202/20
02
1:100


WEST ELEVATION
SOUTH ELEVATION
EAST ELEVATION
NORTH ELEVATION
Court House Closed 1989
NOTES
SHADING DENOTES STRUCTURE TO BE DEMOLISHED
PUBLIC WORKS DEPARTMENT, N.S.W.
R.D. CHRISTIE DIRECTOR OF PUBLIC WORKS
J.W. THOMSON GOVERNMENT ARCHITECT
PRINCIPAL ARCHITECT
ARCHITECTURAL DIVISION
EUSTON COURTHOUSE
REINSTATE VERANDAH ELEVATIONS
Pc 202/21
03
1:100

APPENDIX 3 – MASTERPLAN DRAWINGS - PLAN LAYOUT







NEW ACCESSIBLE TOILET
Demolish toilet
NEW BENCH
WC
NEW DOOR
NEW RAMP (Steel)
NEW DOOR
MEETING/ KITCHEN
ST
EXTERNAL TOILETS (to Remain?)
RAMP
INFILL
STORE
ST
NEW DOOR
STEPS
LEGEND
MOVEMENT/CRACKING IN BRICKWORK
'RISING DAMP' IMPACTS
DETERIORATED WATHERBOARDS
REMOVE DOOR
DISPLAY EUSTON
DISPLAY ROBINVALE
RESEARCH
Bench
DISPLAY MUSEUM ENTRY
RMS
DISPLAY NURSES
RESWING DOOR
MUSEUM DISPLAY (Court room)
NEW STEP RAMP FOR ACCESSIBLE ENTRY
MASTERPLAN 'FINAL'
scale 1:100 @ A3
EUSTON COURTHOUSE/MUSEUM
NOEL THOMSON ARCHITECTURE WAGGA WAGGA AUG 2024

APPENDIX 4 – MANAGEMENT & MAINTENANCE PLAN AND MAINTENANCE CHECKLIST

EUSTON COURTHOUSE

Management & Maintenance Plan

Owner;

Balranald Shire Council
70 Market Street, Balranald
Tel: (03) 5020 1300
council@balranald.nsw.gov.au

Prepared by;

Noel Thomson Architecture
20 Churchill Ave, Wagga Wagga

October 2023

Euston Courthouse

Conservation Guidelines

The Burra Charter guides all cultural heritage management practices in Australia. It establishes the following principles for the management of heritage places, including heritage buildings:

Article 2. Conservation and management

2.1 Places of cultural significance should be conserved.

2.2 The aim of conservation is to retain the cultural significance of the place.

2.3 Conservation is an integral part of good management of places of cultural significance.

2.4 Places of cultural significance should be safeguarded and not put at risk or left in a vulnerable state.

Article 3. Cautious approach

3.1 Conservation is based on a respect for the existing fabric, use, associations and meanings. It requires a cautious approach of changing as much as necessary but as little as possible.

3.2 Changes to a place must not distort the physical or other evidence it provides, nor be based on conjecture.

Article 4. Knowledge, skills and techniques

4.1 Conservation should make use of all the knowledge, skills and disciplines, which can contribute to the study and care of the place.

4.2 Traditional techniques and materials are preferred for the conservation of significant fabric. In some circumstances modern techniques and materials, which offer substantial conservation benefits may be appropriate.

Hierarchy of interventions

The Burra Charter recommends the following hierarchy of interventions in the management of heritage places:

1. *Conservation* is the preferred option. *Conservation* means all the processes of looking after a *place* so as to retain its *cultural significance.* It generally involves taking efforts to retain the existing fabric of the place or building.
2. *Maintenance* means the continuous protective care of the *fabric* and *setting* of a *place*, and is to be distinguished from repair. Repair involves *restoration* or *reconstruction*.
3. *Preservation* means maintaining the *fabric* of a *place* in its existing state and retarding deterioration.
4. *Restoration* means returning the existing *fabric* of a *place* to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material.
5. *Reconstruction* means returning a *place* to a known earlier state and is distinguished from *restoration* by the introduction of new material into the *fabric*.
6. *Adaptation* means modifying a *place* to suit the existing use or proposed use.

Building Significance & Listings

1. Listed heritage item

Euston Courthouse is a local listed heritage item (I6) in the Balranald Local Environmental Plan 2010 - Schedule 5 Part 1 heritage items.

2. Statement of Significance

Historical and aesthetic significance. Built 1883, this courthouse is historically associated with law enforcement at the busy river port of Euston in the 1850s to 1900. The attractive Victorian style building makes an important contribution to the street. Acquired by the Shire Council in mid-1970's it has been provided to the local historical society for displays and public visitation.

Policies for the management of the building

1. Understanding the building

It is a principle of conservation that work on a significant building should be based on a proper understanding of the building and its problems.
It should be noted that buildings move, sink, bend and weather with age and may not need to be straightened or kept in "as new" condition.

2. History and cultural significance

The history of the place with all its alterations and additions and repairs needs to be known. The significant elements of a building must be identified so that informed decisions can be made on whether an element would be preserved rather than replaced.

A conservation management plan for the building, which includes a survey of the building fabric and a condition report, will answer most of these questions. Further information on this subject can be found on at Heritage Council of NSW and Heritage NSW website.

Information about the history of the building should be available to those undertaking and to do the work on the building possibly as an appendix to a scope of works/ specification.

3. General guidance for repairs and maintenance

Maintenance and repairs should be undertaken in accordance with Heritage NSW – (NSW Department of Planning and Environment) guidelines for the maintenance of heritage assets, Information Sheet ***"How to Carry Out Work on Heritage Sites and Buildings"***.

4. Conserve existing fabric

Efforts should be made to ensure that as much of the original fabric as possible is retained, when works are being undertaken on the building. All work to be undertaken in accordance with Heritage NSW guidelines for the maintenance of heritage assets, ***"Maintenance Series"*** in particular the following brochures;

- Information Sheet 1.1 Preparing a Maintenance Plan
- Information Sheet 1.2 Documenting Maintenance and Repairs
- Information Sheet 2.1 Rising Damp
- Information Sheet 4.1 Corrugated Roofing
- Information Sheet 5.1 Wood Preservation
- Information Sheet 5.2 Timber Repairs.
- Information Sheet 5.3 Patching Old Floorboards

5. Total Asset Management

For NSW Government agencies, the maintenance plan forms part of a total asset management strategy. Total asset management is aimed at improving value for money from public sector assets. (Refer to Heritage Asset Management Guidelines, 2nd edition, published by NSW Department of Public Works and Services in 1996.) Whether in public or private ownership, good management of heritage assets should include effective conservation planning aimed at retaining heritage values, and effective maintenance programs to direct money effectively and wisely.

Recording the asset

As a building manager, you need to know and record in detail what you are managing. Without this information you cannot decide on a maintenance policy or estimate your expenditure for a budget. Basic information that a building manager needs to have includes:

- plans, showing location of all elements,
- easements and construction details
- age and condition of the building
- services details
- maintenance requirements
- names and contacts of those responsible for maintenance
- dimensions and areas of accommodation
- local council requirements
- heritage listings
- reports on the building, including a conservation management plan details of previous conservation works.

6. What is Maintenance?

What is maintenance? Maintenance is defined by the Burra Charter1 as the continuous protective care of the fabric, contents and setting of a place. Maintenance can be categorised according to why and when it happens, as:

corrective maintenance

- work necessary to bring a building to an acceptable standard (often as recommended by a conservation plan) such as treatment for rising damp; or

planned maintenance

- work to prevent failure which recurs predictably within the life of a building, such as cleaning gutters or painting; or

emergency corrective maintenance

- work that must be initiated immediately for health, safety, security reasons or that may result in the rapid deterioration of the structure or fabric if not undertaken (for example, roof repairs after storm damage, graffiti removal or repairing broken glass). A daily response system detailing who is responsible for urgent repairs should be prepared.

7. Why have a maintenance plan?

The main reason for a maintenance plan is that it is the most cost-effective way to maintain the value of an asset. The advantages of a plan are:

- the property is organised and maintained in a systematic rather than ad-hoc way;
- building services can be monitored to assist their efficient use;
- the standard and presentation of the property can be maintained;
- subjective decision making and emergency corrective maintenance are minimised.

When buildings are neglected, defects can occur which may result in extensive and avoidable damage to the building fabric or equipment. Neglect of maintenance can also give rise to fire and health & safety hazards.

Health & safety hazards:

Flooring tiles to "Judges stage" and to rear Store / Bathroom contain 'asbestos'

North wall linings to back sunroom (infilled verandah) and internal and external to store/cupboard are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Wall linings to airlock off kitchen & walls to kitchen above picture rail height + walls to pantry off kitchen are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Wall and ceilings linings to back laundry & toilet are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining.

Note: for the Asbestos Inspection Report / Register dated 4 June 2019 (by All Clear Inspections) refer Appendix D

8. Maintenance plan

The maintenance of the building is about;

- Resource management
- Providing a safe environment for stakeholders and users
- Creating a physical environment that is 'fit for purpose'

Accountabilities:

1. The 'Asset/Building Manager' reports to the Director/General Manager for the upkeep of the building; and for approval of the maintenance budget.
2. The 'Asset/Building Manager' is responsible for the development of the Annual Maintenance Plan and the Assets Register to record the purchase or disposal of plant and equipment.
3. Recommendations for major upgrade expenditure are to be included in the formulation of the annual budget for Council approval.
4. The Director delegates responsibility for all maintenance activities to the Asset Manager.
5. This plan is to be read in conjunction with relevant policy documents including the Council's Workplace Health and Safety Policy and the Risk Management Policy.

Responsive Maintenance:

There will always be maintenance emergencies that need to be attended to. A maintenance request book is to be kept at the Euston Courthouse's (Museum/Research) office. Stakeholders must make requests for maintenance through the request book.

Planned Maintenance:

Routine: The stakeholders are responsible for the day-to-day cleaning of the Museum (former Courthouse) and for the following maintenance items.

- Movement of furniture, seating, equipment, etc
- Minor repairs to seating
- Classroom comfort features
- Minor repairs to curtains & cleaning
- Minor door repairs
- Cleaning of minor graffiti immediately it appears
- Minor landscape maintenance

Planned: Maintenance for the following will be carried out by Contractors:

- Locks, must be carried out by a professional locksmith
- Repairs to light fittings and supply & install of light tubes and globes
- Maintenance & checking of fire extinguishers
- Regular inspections of gutters and down pipes
- Repainting of internal & external surfaces
- Any plumbing issues and replacing tap washers, cisterns, etc
- Wall, ceiling and door repairs where damage has occurred

Preventative

Protection of Council's assets and safety of stakeholders and users requires a regular cycle of upkeep of the building, plant and equipment. The 'Asset/Building Manager' is responsible for arranging the following;

Monthly/Annually:

- Annual checking of electrical equipment by professional tradespeople
- Annual pest control treatment
- 6 Monthly filter checks and cleaning for air-conditioning units and exhausts
- Annual checking of air-conditioning via maintenance contract with professional tradespeople
- Annual inspection of ceilings, floors, paving, plumbing, partitions, internal painting, door hinges & hardware, locks, grilles
- Replacement of glass where necessary

Every two years:

- Hardware/furniture replacement where necessary

Every five years:

- Internal painting

Every ten years:

- External painting
- Replacement of floor coverings
- Replacement of guttering

Every twenty five years:

- Roof refurbishment/replacement
- Replacement of electrical wiring, switchboard upgrade

Material containing asbestos:

- The asbestos containing materials marked as is in poor condition should be removed as a matter of importance due to their deterioration and potential for exposure.
- The asbestos containing material marked as is in fair condition should be stabilised and scheduled for removal during refurbishment.
- The asbestos containing material marked as in good can be left insitu and monitored regularly for any deterioration/damage and reassessed during future inspections

Note: for the Asbestos Inspection Report / Register dated 4 June 2019 (by All Clear Inspections) refer Appendix D

Appendix A: Management Plan

Building element	Conservation Policy
Roof structure & cladding	The roof structure and cladding should be conserved. The integrity of the roof should be maintained by ensuring that the roof structure is sound and corrugated iron sheets are securely fixed. Fixings should be checked regularly in accordance with Euston Courthouse Conservation / Maintenance Checklist. Replacement sheets must be corrugated galvanised iron of identical profile to the existing. Sound second-hand galvanised iron may be used.
Guttering and drainage	Guttering and drainage should be maintained in a functional condition. Storm water should drain away from the building. Replacement guttering must be galvanised iron of identical profile to the existing.
Wall structure	The wall structure should be conserved and check brickwork faces for deterioration and movement/cracking. Note: Cracking currently to brickwork / walls in several locations – monitoring required. Note: Rising Damp and surface deterioration of bricks and render evident to walls in several locations – treatment required. Joinery/timbers should be checked for intactness and any sign of deterioration. If repainting required, to be painted to match a previous known colour scheme. Repairs to timber work should be undertaken in accordance with the recommendations of Heritage NSW guidelines for the maintenance of heritage assets - refer 'Information Sheet' series.
Floor	The floor should be maintained to ensure its ongoing integrity as a component of the building. Where required floorboards should be repaired in accordance with the recommendations of Heritage NSW guidelines for the maintenance of heritage assets. For reference see 'Information Sheet' 5.3 Patching Old Floorboards.
Ceilings	Where possible existing ceiling should be retained. Any replacement elements should reflect the materials, style and profile of the existing.
Doors	Original doors should be retained where possible. Any replacement should reflect the materials, style and profile of the existing door being replaced.

Appendix B: Action Plan

Priority	Works to be performed
1	Ensure guttering on the main roof is functional and drains away from the building. Replace damaged, failed or missing guttering and downpipes.
2	Repairs to the building, including: • upgrading of brickwork where impacted by movement + rising damp and deterioration evident, • stabilisation of timber windows & doors, • replacement of deteriorated timber weatherboards, • upgrading / add toilets to meet current standards, • painting of the building to reflect a known earlier colour scheme.
3	For doors, replacing damaged or missing components as required.
4	Secure external doors & windows to reduce/stop vandalism.

Note: For detailed Action Plan & Checklist refer to Appendix 3: Euston Courthouse Conservation / Maintenance Checklist

Appendix C: Sample Maintenance Plan

Date	Activity	Frequency	Records of actions undertaken
January	Review timber floor finish throughout	Annually, each January	Date
	Internal painting as designated - say 5 year program	Annually, each January	Date Building area details
	Termite check, upgrade	Annually, each January	Date Company contact details
	Electrical testing and tagging	Annually, each January	
	Fire equipment / extinguisher maintenance and service	Bi-annually, each January and July	Date Company contact details
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
February	Door latch, lock, hinge – check, maintenance & repairs	Bi-annually, February, August	Date
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
March	Internal/external pest control	Bi-annually – March and September	Date Company contact details
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
	General landscape maintenance, fertilizer insecticide, herbicide, mulch as needed	Each March, August, December	Date Fertiliser / chemicals used
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
April	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
May	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	Air-conditioning unit and toilet / kitchen exhaust servicing	Bi-annually – May and November	Date Company contact details

	External lighting check and maintenance	Monthly	Date
June	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
July	Fire equipment / extinguisher maintenance and service	Bi-annually, each January and July	Date Company contact details
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
August	Door latch, lock, hinge – check, maintenance & repairs	Bi-annually, February, August	Date
	General landscape maintenance, insecticide, herbicide, mulch	Each March, August, December	Date Fertiliser / chemicals used
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
September	Internal/external pest control	Bi-annually – March and September	Date Company contact details
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
October	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date
November	Air-conditioning unit and toilet / kitchen exhaust servicing	Bi-annually – May and November	Date Company contact details
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date

December	Security and Key access update	Annually	Date
	General landscape maintenance, insecticide, herbicide, mulch	Each April, August, December	Date Fertiliser / chemicals used
	Taps, basins, pans, hot water, etc check and maintenance	Monthly	Date
	Internal lighting check	Monthly	Date
	External lighting check and maintenance	Monthly	Date

Appendix D: Asbestos Inspection Report / Register

00059

ALL CLEAR INSPECTIONS

ALL CLEAR INSPECTIONS

Asbestos Inspection Report

49 Dobney Avenue, Wagga Wagga, NSW, 2650, Australia
P: 02 6925 5225
info@allclearinspections.com.au

REPORT DETAILS

Balranald Council

Courthouse - Euston Murray Terrace

DATE OF INSPECTION

04/06/2019

TIME OF INSPECTION

11:30 AM

INSPECTOR

Greg Goldspink

PHOTO OF THE PROPERTY

Asbestos Inspection Report

49 Dobney Avenue, Wagga Wagga, NSW, 2650, Australia

P: 02 6925 5225

info@allclearinspections.com.au

REPORT DETAILS

Balranald Council

Courthouse - Euston Murray Terrace

DATE OF INSPECTION

04/06/2019

TIME OF INSPECTION

11:30 AM

INSPECTOR

Greg Goldspink

PHOTO OF THE PROPERTY

CONTENTS

1.0 SUMMARY OF ASBESTOS CONTAINING MATERIALS LOCATED.

Asbestos Containing Materials that were visually identified or found through sample analysis.

ASBESTOS CONTAINING MATERIALS WAS IDENTIFIED IN THE - REFER TO AUDIT FORM.

1.1 NOTES

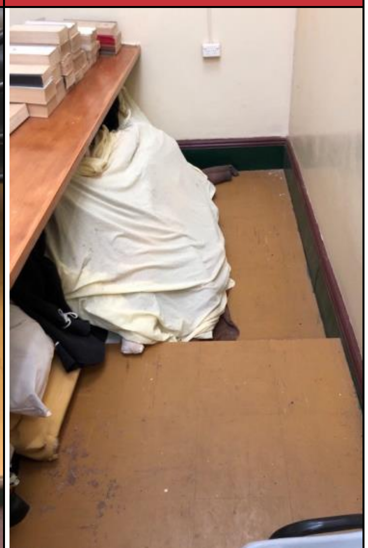
- NO INSPECTION TO CONCEALED AREAS. PRECAUTION TO BE TAKEN WHEN ENTERING CONCEALED UN INSPECTED AREAS AS THESE AREAS COULD CONTAIN ASBESTOS AND MUST BE TREATED AS ASBESTOS UNTIL SAMPLING CAN BE DONE TO CONFIRM THE MATERIAL.
- NO INSPECTION TO ELECTRICAL SYSTEM - RECOMMEND SEEKING FURTHER ADVICE FROM A LICENSED AND PRACTICING ELECTRICIAN.
- ALL TENANTS SHOULD BE FURNISHED WITH A COPY OF THE ASBESTOS AUDIT REPORT AND HAVE THE REPORT READILY AVAILABLE FOR TRADESPEOPLE ENGAGED TO CARRY OUT REPAIRS/ALTERATIONS OF THE PROPERTY.
- ANY RENOVATIONS/ALTERATIONS INVOLVING THE PRODUCTS AND MATERIALS NOTED IN THIS REPORT REQUIRES PRECAUTION TO PROTECT WORKERS AND OR A SPECALIST CONTRACTORS INVOLVEMENT.

ASBESTOS REGISTRY AUDIT FORM

1.0 ASBESTOS REGISTRY AUDIT FORM

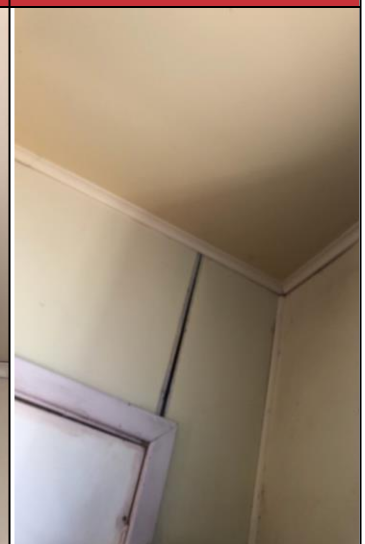
TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIAL	SAMPLE TAKEN	SAMPLE NUMBER	SAMPLE SIMILAR TO	SAMPLE LOCATION
FLOOR TILE 1	YES	1		Judge room stage flooring.
FLAT SHEET 1	YES	2		North wall to back sunroom and internal and external to cupboard.
FLAT SHEET 2	NO		2	All ceiling sheets to back skillion, sunroom, kitchen.
FLOOR TILE 2	YES	3		Floor tiles to back north store room.
FLAT SHEET 3	YES	4		Walls to back airlock off kitchen & walls to kitchen above picture rail height + walls to pantry off kitchen.
MOULDED SHEET 1	NO			Wall sheets below picture rail height to kitchen (blue).
FLAT SHEET 4	YES	5		Wall and ceilings sheets to back laundry & toilet.
PIPES 1	NO			Pipe to old wood stove in kitchen.
FLAT SHEET 5	NO		5	All eaves to back of courthouse and external toilet.

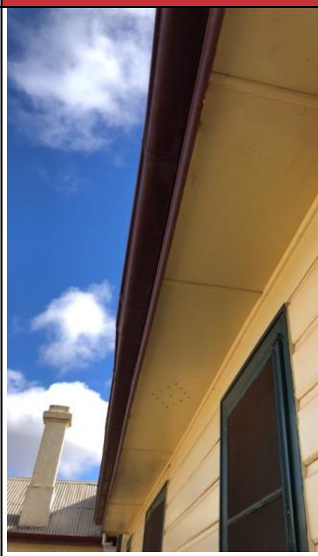
TYPES AND FORMS OF ASBESTOS PRODUCUCTS & MATERIALS	ASBESTOS TYPE	CONDITION	PRIORITY	NOTES
FLOOR TILE 1	NON-FRIABLE **ASBESTOS DETECTED** **CH, OF**	GOOD	LOW	Low traffic area.
FLAT SHEET 1	NON-FRIABLE **ASBESTOS DETECTED** **CH, OF**	GOOD	LOW	
FLAT SHEET 2	NON-FRIABLE **ASSUMING ASBESTOS DETECTED** **CH, OF**	**FAIR**	**MODERATE**	**Paint flaking on some areas, recommend painting.**
FLOOR TILE 2	NON-FRIABLE **ASBESTOS DETECTED** **CH, OF**	**FAIR**	**HIGH**	**Broken tiles, Replacement Recommended.**
FLAT SHEET 3	NON-FRIABLE **ASBESTOS DETECTED** **CH, OF**	GOOD	LOW	
MOULDE SHEET 1	NON-FRIABLE **ASSUMING ASBESTOS**	GOOD	LOW	
FLAT SHEET 4	NON-FRIABLE **ASBESTOS DETECTED** **A, C, CH**	**FAIR**	**MODERATE**	**Some cover strips required to seal edges of fibro.**
PIPES 1	NON-FRIABLE **ASSUMING ASBESTOS**	GOOD	LOW	
FLAT SHEET 5	NON-FRIABLE **ASSUMING ASBESTOS DETECTED** **A, C, CH**	GOOD	LOW	

TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIALS	IMAGE	IMAGE
FLOOR TILE 1 **ASBESTOS DETECTED** **CH, OF** Judge room stage flooring.		
FLAT SHEET 1 **ASBESTOS DETECTED** **CH, OF** North wall to back sunroom and internal and external to cupboard.		

TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIALS	IMAGE	IMAGE	IMAGE	IMAGE
FLAT SHEET 2 **ASSUMING ASBESTOS DETECTED** **CH, OF** All ceiling sheets to back skillion, sunroom, kitchen.				
FLOOR TILE 2 **ASBESTOS DETECTED** **CH, OF** Floor tiles to back north store room.				

TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIALS	IMAGE	IMAGE	IMAGE	IMAGE
FLAT SHEET 3 **ASBESTOS DETECTED** **CH, OF** Walls to back airlock off kitchen & walls to kitchen above picture rail height + walls to pantry off kitchen.				
MOULDED SHEET 1 **ASSUMING ASBESTOS** Wall sheets below picture rail height to kitchen (blue).				

TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIALS	IMAGE	IMAGE	IMAGE	IMAGE
FLAT SHEET 4 **ASBESTOS DETECTED** **A, C, CH** Wall and ceilings sheets to back laundry & toilet.				
PIPES 1 **ASSUMING ASBESTOS** Pipe to old wood stove in kitchen.				

TYPES AND FORMS OF ASBESTOS PRODUCTS/ MATERIALS	IMAGE	IMAGE	IMAGE	IMAGE
FLAT SHEET 5 **ASSUMING ASBESTOS DETECTED** **A, C, CH** All eaves to back of courthouse and external toilet.				

NOTES

No access to external toilets. Assuming fibro walls and ceiling are similar to sample 5.
Limited access to sub due to low clearance. Inspection from manhole only. Take precaution if entering this area.
Flat and/or racked sections to roof. No access or inspection.

3AD1B87E-6123-440C-B550-7BBA41CC2CBC

If removal, maintenance or repair tasks need to be carried out upon any of these items please refer Section 8.6 “Maintenance Work Flow-Chart” - on how best to proceed. These products do not pose a risk from exposure to airborne fibres so long as the materials are not disturbed or have work carried out upon them. I.e. cut sanded, drilled etc. Attachment 8.6 contains a summary of health risks.

THE ASBESTOS CONTAINING MATERIALS MARKED AS IS IN POOR CONDITION SHOULD BE REMOVED AS A MATTER OF IMPORTANCE DUE TO THEIR DETERIORATION AND POTENTIAL FOR EXPOSURE.

THE ASBESTOS CONTAINING MATERIAL MARKED AS IS IN FAIR CONDITION SHOULD BE STABILISED AND SCHEDULED FOR REMOVAL DURING REFURBISHMENT.

THE ASBESTOS CONTAINING MATERIAL MARKED AS IN GOOD CAN BE LEFT INSITU AND MONITORED REGULARLY FOR ANY DETERIORATION/DAMAGE AND REASESSED DURING FUTURE INSPECTIONS.

2.1 REMOVAL OF ASBESTOS

Any samples identified during this inspection as priority immediate or high and/or having deteriorated to an unserviceable condition should be removed as soon as practical. Potential for exposure exists.

2.2 POLICY DEVELOPMENT FOR ASBESTOS CONTAINING MATERIALS

We recommend that specific policies on different aspects of asbestos management be developed and documented in Workplace Health & Safety Plans and Quality Systems. We would suggest the following topics be covered:

- •Asbestos product management: comprising care, maintenance, repairs & clean up of damaged areas
- •Responsibilities of contractors and sub-contractors regarding asbestos on this site

2.3 SIGNAGE & LABELLING

In accordance with the Workplace Health & Safety Regulations an asbestos materials register notification sign shall be affixed to “an appropriate prominent place”. This applies only to the buildings that contain “asbestos material”.

The register must be on-site and is to be made available to:

- Workers and their representatives

• Any other employers within the premises
• Any person removing ACM
• Any person engaged to perform work that may disturb ACM
• Any other person who might be exposed

3. SCOPE OF THE INSPECTION
The purpose of the inspection report was to determine the presence of any asbestos materials in the building in accordance with Workplace Health & Safety.

This report specifically refers to a visual inspection on areas of the building that were safely accessible at the time of the inspection to identify Asbestos Containing Materials which may be in the building.

Reference may be made to other Asbestos Containing Materials that are not thermal or acoustic insulation and as such are not covered by the legislation.

Workplace Health & Safety Amendment Regulation (No.1) 2000, Section 69 refers to “asbestos materials” installed in the building, including in essential plant in or on the building. The Workplace Health and Safety Regulations – 1997 defines “asbestos materials” as “installed thermal or acoustic insulation materials comprising or containing asbestos”.

Examples of installed thermal or acoustic insulation materials comprising or containing asbestos would be: • Asbestos lagging on steam/hot water pipes
• Asbestos material sprayed on steel beams
• Asbestos millboard installed in air-conditioning ductwork where heater banks are present

This type of material may be referred to as friable asbestos products, which means that it is loosely bound and could quite easily liberate fibres to the air if disturbed.

The more common use of asbestos in building products is fibro sheeting, pipe work and some vinyl floor tiles. The asbestos fibres in this type of material are bound into a matrix of cement, plastic or resin and as such are not likely to be liberated into the air if disturbed.

The contents of this report are not privileged and may be distributed to third parties including future owners and occupiers of the relevant property. This concession is made on the proviso that the report is only reproduced in full and that alterations are not made to the report without the express permission of ALL CLEAR INSPECTIONS.

All Materials / Products located will be classified as suspected Asbestos Containing Materials unless samples are taken and tested.

4.0 METHODOLOGY OF THE INSPECTION

The inspection report survey involved visually inspecting each accessible area of the building for thepurpose of identifying Asbestos Containing Materials, as defined under the Workplace Health and Safety.

The process of identifying asbestos materials is as follows:

• Gathering information – age of building, type of building products used.
• Visual inspecting – gaining access to all areas available safely.
• Taking samples – samples are taken where possible of suspect materials and products, all samples are sent and tested at a competent & accredited laboratory.
• The Asbestos Register will identify the samples taken and tested, it may also refer to other materials within the property which in the consultants opinion are similar, however while the materials may appear similar they may not be identical.
• Report and summary – the report outlines findings, health risks and if asbestos is present.
• The presence of asbestos or asbestos containing materials installed in a building or plant & equipment can only be confirmed visually and backed by sample analysis in a certified laboratory. An appropriately qualified person will take samples of suspected materials and have them analysed in a laboratory to confirm the presence of asbestos. Therefore limiting samples taken will decrease the confidence in the Asbestos Audits findings and the Asbestos Materials Report generated from it.
• There is no device or instrument at the moment that can automatically detect asbestos.

5.0 LIMITATIONS OF THE INSPECTION

ALL CLEAR INSPECTIONS has made every effort to identify all Asbestos Containing Materials contained within the building, together with basic items of plant and equipment but no warranty, expressed or implied, is made to the completeness of this inspection and report. During the course of a visual non-destructive asbestos inspection it may not be possible to identify the presence of all asbestos materials. In many instances, asbestos materials may be present in areas that cannot be accessed without implementing destructive sampling techniques.

Such areas may include:

• Wall cavities & internal pipe work
• Penetrations in solid walls and concrete floor slabs
Iintegral parts of machinery, plant and pipe work
• Fire dampers and reheat units within air conditioning ducts, and
• Inaccessible service ducts / risers
• No air monitoring has been carried out during this inspection Samples were not taken of suspect materials that may have placed the inspector at risk of injury or death at the time of the inspection. High-risk asbestos situations that may be identified during an inspection may include internals of electrical switchboards and substations. Generally it is impossible to locate all asbestos within a building in the course of an audit. This is due to factors such as,
• To avoid damage to the building-asbestos may be hidden behind walls or floors/floor coverings or above fixed ceilings

• Plant or equipment within the building which contains an asbestos component included by the manufacturer •No plant or building plans available indicating hidden asbestos usage.
• Minimising the inconvenience or delay while an asbestos audit is underway
•No access to lifts, lift shafts and rooms, air conditioning ductwork, airways and other internal construction elements such as plumbing or electrical risers/conduits.
• Services located below wall surfaces "chased" in insulated material.

Relying on an asbestos inspection or audit
• An Asbestos materials report can only indicate such asbestos as was found in the course of the inspection. For the reasons outlined above it should never be relied upon solely to indicate the presence of all or no asbestos. The findings must be considered together with the specific limitations and scope of the inspection which was undertaken, and all other documentation on the building. (Refer Maintenance Work Flow-Chart – 8.6)

6.0 LEGISLATIVE REQUIREMENTS
The current Workplace Health and Safety Regulations require that the owner of a building or plant that contains any asbestos ensures that:
• Asbestos which is unstable or poses a significant health risk is removed as soon as reasonably practicable; and
• Policies and procedures are established to control the asbestos and prevent (or where not reasonably practicable to minimise) the exposure of any person to airborne asbestos fibres.

The policies must address the following:
• The steps that can be taken to restrict access to the place where the asbestos is situated.
• The steps that can be taken to prevent disturbance of the asbestos.
• Work practices in the vicinity of the asbestos materials.
• Notification of the existence of an asbestos register.
• Regular inspections by a competent person; of the asbestos (at least annually) and earlier if the nature or location of work in the vicinity of the asbestos materials changes;
and
Any asbestos removal work done is required to be carried out by an "asbestos removalist". Any maintenance work done on, or in the vicinity of, materials which contain asbestos is required by legislation to be carried out in accordance with the Australian Code of Practice for Asbestos Work. It is necessary to ensure that all asbestos products are removed prior to any demolition, removal, maintenance, operational or construction work which may damage or disturb asbestos product/s.

7.0 TERMS USED IN ASBESTOS REGISTERS

CONDITION

G. Good: Showing no, or very minor signs of damage and/or deterioration of the material.
F. Fair: Showing small amounts of damage and/or deterioration of the material.
P. Poor: Showing large amounts of damage and/or deterioration of the material.

PRIORITY LEVELS

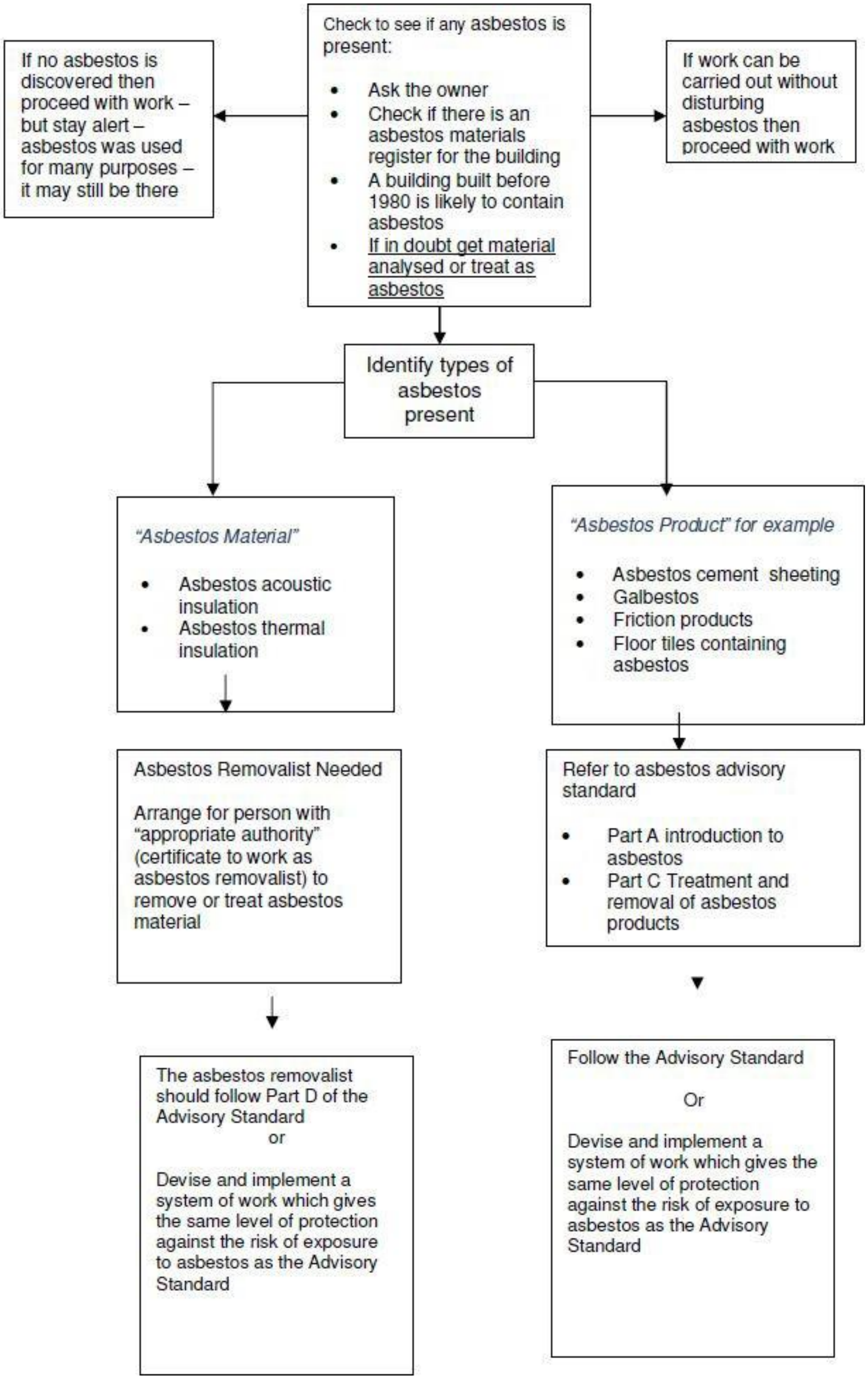
I. Immediate: Materials deteriorated to an unserviceable condition and as such should be removed as soon as practical. Potential for exposure exists.
H. High: Deterioration of material is evident. Stabilise the material, prevent further deterioration and review option to remove material.
M. Medium: Minor deterioration of material is evident. (eg. Structural integrity affected; breakdown of castable legging etc.) Planned removal should be allowed for in Maintenance Budget.
L. Low: Leave in situ and monitor condition. Should be reassessed in conjunction with future inspections and reports.

ASBESTOS LEGEND

NAD:	NO ASBESTOS DETECTED.
CH:	CHRYSOTILE ASBESTOS.
A:	AMOSITE ASBESTOS.
C:	CROCIDOLITE ASBESTOS.
UMF:	UNKNOWN MINERAL FIBRES DETECTED
SMF:	SYNTHETIC MINERAL FIBRES DETECTED
OF:	ORGANIC FIBRES DETECTED

MAINTENANCE WORK FLOW-CHART
Every time – before every job

3AD1B87E-6123-440C-B550-7BBA41CC2CBC



9.0 HEALTH RISKS OF ASBESTOS – GENERAL HEALTH

Asbestosis, mesothelioma, pleural plaques and lung cancer are the recognised diseases caused by asbestos and are all as a result of inhalation of airborne asbestos fibres. Hence for asbestos containing materials or products to pose a health risk airborne fibres must be generated either through degradation or high energy mechanical action.

The degree of asbestos fibre release, and hence inhalation exposure, is in part dependent upon the matrix material binding the asbestos, general condition and product type. The highest health risk is associated with exposure to amphibole asbestos (amosite, crocidolite) with crocidolite being cited as the material of greatest concern. Chrysotile (a serpentine mineral) is considered to be of lesser but still significant concern.

Asbestos types:
• Chrysotile is commonly known as white asbestos.
• Amosite is commonly known as grey or brown asbestos.
• Crocidolite is commonly known as blue asbestos.

Asbestos Cement Products

Asbestos cement products were commonplace building materials prior to 1986. Many building product manufacturers in Australia didn’t phase out the use of asbestos in their products until the early 1980’s and then it was a gradual process.

Imported building products can still contain asbestos either through legislation that allows a certain percentage of asbestos in products in that country or no legislation at all in countries that still mine it.

These products consist of asbestos fibres bound in a cement matrix and the degree of fibre release depends on the condition of the material.

The main health risk with asbestos cement products is from maintenance or similar activity where the material is worked upon (mechanical energy applied) resulting in airborne dust.

It can also be prone to weather, storm damage and the cement matrix does react and break down in acidic or polluted atmospheric conditions (i.e.; industrial areas) over a period of time.

Vinyl Floor Coverings

With vinyl floor covering, asbestos may be present in any of the following:
• The vinyl body of the tile or sheet.
• A fibrous backing felt/insulation under the tile or sheet.
• A fibrous adhesive, putty or grout used to fix the tile.

Asbestos contained in the vinyl body of the tile or sheet is held in a stable matrix. The very low rate of wear does not normally give rise to fibre release considered to pose a significant health risk. A health risk may arise when asbestos fibres are released due to maintenance work or when the flooring is friable due to age.

Asbestos adhesive or putty is sometimes used to coat the back of vinyl tiles or sheet. This product does not pose a risk to exposure from airborne fibres, so long as it is not disturbed or worked upon. Asbestos backing felt/insulation or asbestos adhesive is normally not exposed and does not represent a significant health risk.

However, when exposed due to wear or damage to the overlaying vinyl these materials upon further wear or abrasion may liberate fibres depending upon the amount of abrasion and the age and condition of the material.

10.0 GLOSSARY OF TERMS

Action Taken: This section is provided for the building owner/manager to record any works carried out altering the status or condition of products, eg "sheeting removed May 2004". This will make the annual update if required easier and more detailed.

Amosite: Grey or brown asbestos: This is a Amphibole mineral and has straight harsh grey to brown fibres and was often used in situations where additional strength was required such as high temperature asbestos pipe insulation as well as heat resistance such as fire rating.

Asbestos: Asbestos is a naturally occurring mineral which is fibrous in nature. Asbestos is found in veins surrounded by other rock. The vein consists of bundles of fibres held together reasonably firmly to form a solid rock, Mechanical milling breaks the fibres away from each other, leaving free fluffy fibres. Further mechanical action can break the fibres down into finer and finer fibres. This is because asbestos tends to break along the length of the fibre, not across the length of the fibre. Asbestos fibres can be extremely fine, with fibre diameters smaller than a micrometre (one one-thousandth of a millimetre) being fairly common.

It differs from other minerals in its crystal development. The crystal formation of asbestos is in the form of long thin fibres. Asbestos is divides into two mineral groups – serpentine and amphibole. The division between the two types is based upon the crystalline structure. Serpentines have a sheet or layered structure where as amphiboles have a chain like structure.

These minerals do not have any detectable odour or taste. Asbestos can be found naturally in soil and rocks in some areas. Asbestos fibres are resistant to heat and most chemicals and have great tensile strength. Because of these properties asbestos has been mined for use in a very wide range of building materials, friction products and heat resistant fabrics.

Asbestos removalist:

An employer whose business or undertaking includes asbestos removal Work; or a self employed person whose work includes asbestos removal work.

Avoid damage and abrasion:

As far as practicable limit activities on or adjacent to material such that significant damage to the material that will release respirable fibres is avoid, eg; avoid drilling, cutting, sanding, etc. For softer or more friable materials this also mean lighter or repeated impacts (such as opening or closing doors with asbestos door seals or heavy wear areas for asbestos felt backed vinyl).

Chased:

Where pipe work (usually hot water pipes) has been fitted into channels carved out of brickwork or concrete walls and insulated using plaster type filler asbestos. (This is not common in the Northern states of Australia but is important in the Southern states where heat loss due to low temperatures meant that hot w3ater piping needed to be insulated).

Chrysotile:

White asbestos: This is a Serpentine mineral and considered to be of lesser but still significant concern than brown or blue asbestos. White asbestos has "curly" fibres. This property allows it to be woven e.g. fire resistant suits or gloves.

Crocidolite:

Blue asbestos: This is a Amphibole mineral and has straight blue fibres and the fibres are very fine. Blue asbestos tends to have been used in situations where acid resistance was required as well as being a common material used for fire rating of steel structural beams.

Essential plant:

includes – •Air conditioning plant; and
•Boilers; and •Cooling towers; and
•Escalators; and
•Lifts; and
•Piping.

Friability:

The potential for a product containing asbestos to release breathable fibres depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit or release fibres. The fibrous or fluffy sprayed on materials used for fireproofing, insulation or sound proofing are considered to be friable and they readily release airborne fibres if disturbed. Materials such as asbestos containing vinyl floor tile or asbestos containing sealants are generally considered non friable and do not emit or release fibres unless subjected to mechanical energy operations such as sawing or sanding operations. Asbestos cement pipes or sheet can emit or release airborne fibres if the materials are cut or sawed or if broken up in demolition operations.

Friable:

Non bonded asbestos fabric or material can be in a powder form or can be crumbled, pulverised or reduced to powder by hand pressure when dry.

Monitor Condition:

Carry out regular general observation of the condition of the material to note any changes.

Non Friable:

Material / Product which contains asbestos fibres are bonded by cement, vinyl, resin or other similar material.

Owner:

of a building – means a person who – •Holds title to the building •Has effective management or control of the building and any essential plant in it and includes a person who manages a building as agent for a person mentioned above.

Conservation / Maintenance Checklist for Euston Courthouse, Euston

This conservation / maintenance checklist should be completed every twelve months or after severe weather events

Name of person completing the checklist: ________________________________ **Date completed:** / /

Foundations			
Area of inspection	**What to look for**	**Comments**	**Initials**
Foundation movement or instability of wall bases & structural members	Look for cracks or deterioration in walls, particularly near corners of building.		
	Inspect the sub-floor areas for signs of moisture or deterioration of stumps, floor bearers and joists.		
	Inspect the external masonry at sub-floor areas for signs of moisture (rising damp) or deterioration of mortar and blocks.		
Adjacent vegetation	Inspect vegetation / landscape areas where growing against the building for areas of damp and movement related to vegetation.		
Levels around building	Check that verandah/paths where adjacent/up against walls. Ensure that they are sloping away from the building.		
Site drainage around building	Check that water is running away from the building, Look for ponding of water in wet weather.		

Walls			
Area of inspection	**What to look for**	**Comments**	**Initials**
Walls & wall framing	Check condition of masonry walls to ensure they are sound. Look for cracking & dampness (crumbling surface due to salts, etc) and check for signs of wall movement.		
	Look for deterioration of exposed timbers, windows moving apart, doors sticking or locks not matching indicate settlement		
	Where appropriate ensure paint finishes are stable / in good condition and protect timber from deterioration.		
	At rear extension look for deterioration of timber weatherboards/ wall cladding, windows, doors, etc		
	At rear infilled verandah & store cupboard, wall linings are 'Fibro' (contains asbestos) and check for deterioration of paint finish or lining		
Penetrating damp	Look for changes in colour or discolouring of wall materials, bubbling of finishes, powdering on surfaces, etc. Damp is often related to overflowing eaves or gutters.		

Roof			
Area of inspection	**What to look for**	**Comments**	**Initials**
Roof covering material	Look for holes in metal roofs through rust or damage – mainly at fixings, where sheets are lapped, at ridge and flashings and roof penetrations. Repair/replace as required.		
Fixings to roof covering	Inspect for loose fixings, loose metal sheets, etc and appropriately secure as required. Note: loose fittings can indicate batten failure.		
Ridge / roof flashings and roof penetrations	Check ridge and roof flashings (at walls), roof penetrations, etc that they are sound and secure.		
Gutter & downpipes	Inspect gutter and downpipe joints for cracks/rust. Are there drips at underside? Are there loose or missing brackets to gutters and downpipes.		
Falling damp	Check to ensure that water is not leaking into the building during heavy rain. If leaks occur check for sources at wall/roof junctions, etc.		
Generally	Remove debris and leaves and check vents / pipes penetration, etc Avoid combining dissimilar metals that will react with each other.		

Doors and windows			
Area of inspection	**What to look for**	**Comments**	**Initials**
General	Check for corrosion of structural members; embedded metal may be seen in fixings or lintels. Inspect doors for loose jambs, decay at threshold and damage to / correct function of locks. Check windows for broken glazing and correct operation (sashes, casements non-binding, etc)		
Condition of frames	Check for signs of dampness (rot) at timber window frames and deterioration at joints. Look for cracks in glazing from frame or surrounding movement.		
Water entry through window units	Check internal surfaces around frames for stains – as this may indicate water seepage through the frame, window units & surrounding walling.		

Services			
Area of inspection	**What to look for**	**Comments**	**Initials**
Stormwater	Inspect for dish drains and pits blocked with rubbish, leaves or silt. Check whether stormwater drains correctly and not into the sewer system.		
Sewerage	Inspect sewer lines for blockages. Inspect sumps for damaged covers / grating. Ensure surface water is not drained to sewer. Ensure hose taps discharge into gullies and that gratings sit square are operable and not damaged. Check correct operation of toilet cisterns and for secure and undamaged toilet pans, basins, etc		
Water	Inspect taps for drips and ease of operation. Are taps supported / secured (to walls) correctly. Look for wet / damp areas at walls, cupboards, etc as this may indicate a leaking pipe.		
Electricity	Check if light bulbs are operating correctly or for damaged light fittings. Check for secure fixings of light fittings to walls & ceilings. Check for loose wiring / conduits and unsupported cabling, particularly in roof spaces.		

General			
Area of inspection	**What to look for**	**Comments**	**Initials**
Floors	Check for evidence of damp, evidence of condensation, sub floor ventilation, springiness in floor, evidence of white ants/termites, condition of floor material, etc.		
Floor Finishes **(Carpet, Tiling, etc)**	Check for movement cracking, 'wear & tear' on floor finishes to ensure good condition of floor material/finishes.		
Walls & Finishes	Check walling material - plaster, tiling, etc for condition and for any underlying issues. Check condition of plaster work and ensure 'solid' – repairs cracks & damaged areas as required – repaint to approved colour scheme and heritage advice.		
Paintwork	Look for peeling or deteriorating paint finish, type and condition of paint system used on various elements: • Timber structural members • Timber fascia, eaves, trim, architraves • Doors and partitions • Plaster finishes • Ceilings Repaint to approved colour scheme and in accordance with heritage advice.		
Stairs, Ramps & Handrails	Check stairs, ramps and handrails for condition and compliance with regulations – upgrade as required in accordance with heritage advice.		

General			
Area of inspection	**What to look for**	**Comments**	**Initials**
Timberwork and joinery	Check condition of doors, frames, architraves, cabinetry, wall framing, timber panelling to walls or partitions.		
Lighting and power	Check mains connection to building, main distribution board, sub boards (if applicable). Check general wiring, general purpose outlets, locations and safety/operation. Check all fittings within the building, including lights etc.		
Heating & cooling systems + exhaust systems	Check condition of heating and cooling systems in all areas of the building, and exhausts at kitchen & toilets		
Ceilings	Check condition of ceilings for movement and upgrade any damaged/water affected areas.		
Toilets	Check condition of toilet fixtures & fittings or special items – ensure correct operation.		
Fittings and fixtures	Condition of shelves and benches at kitchen. pantry, etc.		

APPENDIX 5 – SALT ATTACK AND RISING DAMP - TECHNICAL GUIDE

TECHNICAL GUIDE

Salt attack and rising damp

A guide to salt damp in historic and older buildings

David Young for: Heritage Council of NSW · Heritage Victoria · South Australian Department for Environment and Heritage · Adelaide City Council

Cover photographs

Left: Rendering the base of walls in a hard cement render is a very common, but poor treatment. The damp simply rises in the masonry behind and comes out above the render, which in this case has already been extended once. Maitland, NSW.

Centre: A boundary wall of rubble limestone in Gawler, SA, showing extensive loss of stone and mortar due to salt attack and rising damp. Damage such as this can be made worse if there is a watered garden on the other side of the wall. Salt from inorganic fertilisers will add to the decay.

Right: A house wall in suburban Melbourne with the tar and sand damp-proof course showing as the dark line above the third course of bricks. Although the walls may be dry above, there is now a need for maintenance of the mortar joints below the damp-proof course. They should be repointed in a weak lime and sand mix to control salt attack and so protect the surrounding bricks while also re-instating the structural integrity of the wall.

Authorship

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Contents

BOXES

DIAGRAMS (WITH FIGURE NUMBERS)

Part 1
Understanding salt attack and rising damp



1 Introduction

This guide aims to provide owners, consultants and contractors with sufficient information to understand what causes salt attack and rising damp (and also falling and penetrating damp) and to diagnose and identify appropriate repairs for cases commonly seen in Australia. While emphasis is given to buildings of heritage value, the principles apply to all older buildings.

Salt attack and rising damp are two separate but interrelated processes; both must be understood if damage is to be minimised and if corrective measures are to be successful. While the term rising damp has been commonly used to cover both aspects, it tends to overlook the role of salt, an issue that will become increasingly important as our buildings get older and as our soils become more saline.

Salt damp is a term widely used in South Australia to refer to high salt concentrations associated with rising damp. The term is quite apt, as it combines the two concepts of salt attack and rising damp. Though less an issue in some parts, the problem of high salt concentrations affects buildings across much of Australia, and so the term salt damp has begun to be used in other States. Salt damp is used throughout this guide to mean the combination of salt attack and rising damp.

This guide is divided into two parts: Part One (Sections 1–9) covers some background and provides an understanding of how salt attack and rising damp damage buildings, while Part Two (Sections 10–25) deals with diagnosis, maintenance and repair.

Those with insufficient time should at least read the next section (The Basics) which includes a summary of the Seven Key Steps needed to manage a salt damp problem. It also has some common Questions and Answers and important Dos and Don'ts.

Technical terms are explained in a glossary at the rear and there is a bibliography for further reading. Boxes containing illustrations or discussion of particular issues are distributed through the guide.

The approach recommended by this guide is to treat a salt damp problem as one requiring thorough understanding of the causes, as well as ongoing attention if it is to be managed successfully. Approaching salt damp as a simple question of which damp-proofing technique should be employed, is neither the right question, nor is it likely to lead to a good outcome. There are many buildings with mild cases of salt damp which need attention, but which do not warrant insertion of a damp-proof course (DPC), at least in the short to medium term. This guide outlines a structured approach to salt damp problems so that appropriate methods and level of repair can be identified. This often enables retention of original fabric to be maximised and therefore heritage value to be retained.

2 The basics

Figure 1 The dense bluestone base courses of this Melbourne building help reduce upward movement of moisture. Dense stones such as bluestones and granites are commonly seen as base courses around Australia.

Figure 2 Typical salt damp damage in Adelaide, with decay of the bricks extending from about 0.5 to 1.2 metres above ground. There are no obvious signs of salt because it has been washed off by rain. Paler (underfired) bricks are more susceptible to salt attack than the darker, more well-fired ones.

Rising damp is caused by capillary suction of the fine pores or voids that occur in all masonry materials. The capillaries draw water from the soils beneath a building against the force of gravity, leading to damp zones at the base of walls. Many traditional buildings were constructed on footings of dense stone which helped reduce the upward passage of water (Figure 1). In modern construction rising damp is prevented by the insertion of a damp-proof course (DPC) which is generally a 0.5 mm thick sheet of polyethylene (plastic). Because many nineteenth century buildings were constructed without DPCs and because some DPCs have failed, been bridged, or damaged, there are now common problems of dampness at the base of walls. In most cases that dampness will have salt associated with it.

Salt attack is the decay of masonry materials such as stone, brick and mortar by soluble salts forming crystals within the pores of the masonry. As the salt crystals grow the masonry is disrupted and decays by fretting and loss of surface skins. The salt commonly comes from the soils beneath and is carried up into walls by rising damp. When the dampness evaporates from the walls the salts are left behind, slowly accumulating to the point where there are sufficient to cause damage. Repeated wetting and drying with seasonal changes leads to the cyclic precipitation of salts and the progressive decay of the masonry.

One of the difficulties for the casual observer is that salts are not always apparent, and so their role is often not appreciated (Figure 2).

As well as the quality of building materials, and of construction and subsequent maintenance, climate and soil conditions are strong determinants of the severity of salt damp problems. Across Australia the wide range of climate and soil types leads to a great diversity in the degree and extent of salt damp. Adelaide is well known for its bad salt damp; this is because it has hot drying summers and very salty soils, whereas in Sydney the more humid climate and lower salt levels means the decay rates are slower. Age is another important factor; many buildings that have only a mild damp problem at present may, with time, accumulate sufficient salts to cause major decay.

Once salt concentrations are high enough to cause damage repairs will only be successful if they include treatment of both the damp and the salt.

The next three pages contain important information: some common Questions and Answers, a summary of the Seven Key Steps needed to manage a salt damp problem and some fundamental Dos and Don'ts.

2.1 Question and answers

Q My house has bad damp and there is salt bursting through the interior paintwork. Which of the damp-proofing treatments should I use?

A Wrong question. You first should make sure that the source of dampness is minimised and carry out other basic housekeeping measures. Work through the Seven Keys Steps to deal with the problem. Depending on the circumstances, you may need to use a combination of several methods. Be aware that many damp-proofing contractors specialise in one treatment method only, so seek independent advice.

▶ See the Seven Key Steps on the next page and also Part 2 of this guide.

Q Unlike the first enquiry, my house seems to have dampness in some places but no signs of salt. Does it need a damp-proofing treatment?

A Not necessarily. The problem may be eliminated or minimised to an acceptable degree by basic housekeeping measures, such as attention to plumbing and drainage. Check these first and make any repairs needed before considering damp-proofing.

▶ See Section 12: *Good housekeeping*

Q There is mould on the timber inside the built-in cupboard in the corner of the living room. What should I do?

A Mould is due to high humidity, the source of which should first be identified. If it's because of damp walls, the problem may be solved simply by ensuring that the existing underfloor ventilation is working properly. Clean out vent grilles and monitor air flow. More vents may be needed if changes to the house have blocked previous air passages.

▶ See Section 12.3: *Underfloor ventilation.*

Q Our school chapel has damp patches in the wood blocks of the parquet floor. Years ago there was some damp treatment to the walls at one end. Could they be related?

A Yes. When we inspected the outside we found that the ground had been built up over the damp-proof course, which was the reason for the previous (unnecessary) treatment. It is very likely that the underfloor spaces are too damp because of moisture penetrating through the walls from the built-up ground. Lower ground levels to expose the DPC, check underfloor ventilation and make sure all gutters, downpipes and drains work properly. Monitor for a year before making further changes.

▶ See Sections 11: *Diagnosis* and 12: *Good housekeeping*

Q I'm having split-system air conditioning installed in my old stone house and the contractor wants to put the external fan unit against the side wall. Could that be a problem?

A Yes, it could. As well as detracting from the aesthetic qualities of your house, the fan blowing warm air against the wall will encourage evaporation and focus salt damage on the area behind the unit. Site the fan unit, and the condensate drain, well away from valuable old walls.

▶ See Section 6: *Salt attack.*

Q We had our historic presbytery treated for damp with chemicals, yet the mortar is still eroding from between the bricks. Have the chemicals failed and should we have it done again?

A Not necessarily — the water-repellent zone formed by the chemicals may be working OK as a damp-proof course. The problem may be salts remaining in the walls above. Remove the salts and monitor before considering any further damp-proofing treatment.

▶ See Sections 6, 13, 14 and 16.3 and also Figure 43.

2.2 Seven Key Steps to dealing with salt damp

This is a summary of the Seven Key Steps to successfully dealing with salt damp. These steps are explained in detail in Part 2 of this guide beginning with Section 10: *Approach*.

1. Accurate diagnosis of the cause

- is it rising damp? or is it falling damp? or a combination? or
- is the damp penetrating sideways from a localised source, or
- is it condensation on internal surfaces?
- is there an existing DPC that is buried or otherwise bridged?
- how bad is the problem — does it really need major works?
- is there a lot of salt? what is its source?

2. Good housekeeping is fundamental

- ensure gutters and downpipes are working
- ensure rainwater is carried well away from base of walls
- ensure site is well drained — no ponding against walls
- minimise splash from hard pavements into walls
- maintain about 200 mm between DPCs and ground level
- check for and fix any plumbing leaks, including sewers
- check for fungal rot, borers and termites in damp floor timbers
- ensure adequate (but not too much) underfloor ventilation
- monitor changes, for these may be sufficient.

3. Treat mild damp sacrificially

- use weak mortars in eroding joints, or
- weak plasters and renders to control damage
- monitor changes before considering further treatment
- ongoing sacrificial treatments may be sufficient.

4. Remove excessive salts

- remove surface salt deposits by dry vacuuming, then
- use captive-head washing for near-surface salts
- use poultices of absorbent clay and/or paper pulp
- use sacrificial plasters, renders and mortars.
- monitor effectiveness — re-treat if necessary
- periodic maintenance treatments as required.

5. Review results before proceeding

- allow at least one year of monitoring
- account for unusual events — storms, floods, drought, etc
- routine maintenance activities may be sufficient.

6. Inserting damp-proof courses

- undersetting with mechanical DPC, and/or
- slot sawing with mechanical DPC, and/or
- impregnation of chemical DPC, and/or
- active electro-osmotic damp-proofing.
- install DPCs at a level that will also protect floor timbers
- monitor for 'leaks'.

7. Desalinating walls

- when salts abound, do not just insert DPC
- also remove excessive salts from above DPC
- use poulticing, captive-head washing and sacrificial treatments
- monitor annually for further salt attack
- re-treat if necessary until salts are reduced to a less harmful level.

2.3 The Dos & Don'ts of damp

Dos:

Do go out in the rain (the heavier the better) and check gutters and downpipes for blockages, leaks and overflows. Also check around the base of the building for water lying against walls. Fix leaks and make any improvements needed to site drainage.

Do check for the presence of a DPC — and ensure that it is continuous, and not 'bridged' by built up paving and garden beds.

Do remember that damp walls increase the risks of fungal rot and termite attack to floor timbers — always check beneath timber floors.

Do consider the possibility that your old building may have had previous treatments for rising damp, and that these may be obscuring the extent of the problem. Thorough investigation before commissioning works will be important to defining the nature, scope and likely costs of any repairs.

Do clean out existing air vents regularly — and monitor results before deciding to add new ones.

Do consider the possibility of salt attack decay into wall cavities — always inspect cavities for accumulation of debris (and corrosion of ties).

Do consider the implications of drying out the soils beneath your building. If it is founded on reactive (expansive) clay soils excessive drying could lead to structural cracking as a result of differential settlement. On reactive soils the challenge is to strike a balance between limiting cracking and minimising rising damp. The unhappy medium might be a bit of each.

Do get independent advice — that way there should be no pressure to use a particular product or system. Check your adviser's credentials.

Don'ts:

Don't use hard cement mortar to repoint failed lime mortar joints — that will just drive the damp further up the wall and may also damage the bricks.

Don't even think about sealing walls with water-repellent coatings.

Don't mulch your walls. Move garden beds away from the base of walls and remove irrigation to prevent spray and ponding against walls.

Don't dismiss the old tar and sand DPC — reduce the damp 'stress' on the walls, repair the DPC, use sacrificial mortars in the joints if necessary, and monitor results before considering an expensive new DPC.

Don't undertake insertion of any form of DPC until all the basic housekeeping measures have been completed and their effectiveness assessed over a period of time (at least a year).

Don't accept the cheapest quote for chemical dampcoursing without checking the contractor's references and the details of the proposed works such as drill hole spacing and depth, and how the contractor will determine when sufficient fluid has been impregnated.

Don't try to get away with using less chemicals and then locking in the inevitable damp with waterproof plasters — your client has read this too!

3 Previous investigations

▶ The first edition of this guide was jointly published in South Australia in 1995 by the Heritage Branch, Department of Environment and Natural Resources and the City of Adelaide under the title *Rising Damp and Salt Attack*.
See *Further Reading* for details of the publications mentioned in this section.

In South Australia in the 1960s and 1970s there were many cases of failed damp treatments as the salt damp problem was poorly understood. So many complaints were made to consumer affairs that the State government established a Salt Damp Research Committee which operated in the period 1974 to 1982. The committee produced several reports and guides, held a national conference in 1978 and commissioned scientific research.

More recently, the developing problem of soil salinity across large parts of Australia has resulted in previously sound buildings succumbing to salt damage as rising water tables bring salts closer to the land surface. Increasing soil salinity is not only an issue for the major dryland and irrigated areas such as the Murray Darling Basin. It is also a problem in coastal areas, where expanding cities and towns are exposing and building on soils containing salts, including the problematic acid-sulphate soils.

The NSW Salinity Strategy was launched in 2000 and a component, the Local Government Salinity Initiative, provides training, education and technical support. The Initiative has produced a series of booklets and guides, and has held several conferences on urban salinity. Note that, in respect of damage to buildings, the terms salinity and urban salinity are synonymous with salt damp.

Responding to increasing salinity problems, some local councils are requiring higher standards of construction of modern buildings, particularly in regard to concrete slabs and footings for housing. This guide is about existing buildings and is focused on those that have deficient, absent or bridged damp-proof courses. Even buildings with good damp-proofing are not immune to salt damage and many will require ongoing maintenance to control the problem (Figure 34).

4 Porosity and permeability

All masonry materials, whether stone, brick, mortar, earth or concrete block, are to some degree porous: that is, they contain voids or pores. Porosity is measured as a percentage of the volume of the material and ranges from 0.1% for fresh marbles to an extreme 50% for some limestones. Common porosities of sandstones, limestones, bricks and mortar used in traditional construction are in the range 10–30%. Denser materials such as granites, bluestone and slate have porosities around 1-5%. Porosity is a rough guide to durability: the higher the porosity, the less durable will be the material. Pore size is an important factor: materials with a lot of very small pores are generally less durable than materials with fewer but larger pores.

The degree to which the pores in a material are connected is known as permeability. Closed cell foam has lots of pores but little permeability, whereas a kitchen sponge depends on both porosity and permeability for its capacity to absorb water and release it again when squeezed out. Most masonry materials have some permeability: water and air can move through them to varying degrees. Some materials are relatively impermeable and these include granite, marble, slate and dense concrete. Totally impermeable materials such as plastic DPCs are often described as impervious.

5 Walls breathe

When a wall warms up after a cool night, the air contained within its pores expands as it warms and a small proportion moves out of the wall via the connected pores. As the wall cools down again the air within contracts and air moves back into the wall from the atmosphere. And so masonry walls 'breathe' – out as they warm and in as they cool. Breathing occurs on a daily basis, or more frequently in periods of variable weather; breathing is shallow when there is little temperature variation and deepest when the daily range is greatest. Of course, walls don't actually breathe in the human sense: they just sit there while changes in temperature (and air pressure) do the work, but the 'breathing' analogy is a convenient way of understanding frequent exchanges of air from masonry to atmosphere and back again.

If the air drawn into a wall is humid and if the wall material cools below the dew point then some of the water vapour in the humid air will condense as water droplets within the pores of the masonry, though the wall will still be 'dry'. During warmer and drier times some of this water will evaporate and leave the wall as it breathes out. And so apparently dry walls commonly contain water, the amount varying with changes in the season and climate. If there are salts or other hygroscopic (moisture-attracting) materials in the masonry then the amount of water drawn into (and retained in) the wall can be sufficient to make the wall visibly damp, even in dry weather.

Anything that prevents a masonry wall breathing will reduce its life expectancy. Coatings that are designed to seal the surface of masonry walls (and so 'protect' them) risk trapping moisture behind the coating and causing a damp problem elsewhere, such as on the other side of the wall. If there are appreciable salts in the wall, the damage caused by the inappropriate use of coatings can be dramatic (Figure 3).

Figure 3 Inappropriate use of water repellent coating, trapping moisture and salts and causing loss of the sandstone's natural case-hardened surface. Beneath this 'skin' the stone can be quite weak.

6 Salt attack

Figure 4 Thin needles of salt extruding from the top of a window arch. A slipped roofing slate punctured the copper roof gutter, allowing rainwater to wash salts into the stonework.

Figure 5 Salt attack in bricks causing disruption and loss of the fireskin, the harder outer surface that develops during firing in the brick kiln.

Salt attack (or salt weathering) is the term used to describe the damage caused by soluble salts crystallising within the pores of masonry materials. Salts are brought into the porous masonry in solution in water by a variety of means described later under Rising, Falling and Penetrating Damp (Sections 7 & 8). During a dry period, when the water evaporates from the wall, the salt will be left behind (as salts can't evaporate) and the salt solution in the wall will become more concentrated. As more salts are brought into the wall the salt solutions are further concentrated as the moisture evaporates. When the solution reaches a condition known as saturation, or supersaturation (depending on the type of salt), crystals will begin to form.

When the rate of evaporation from the wall surface is low (such as in humid climates, or in cellars and basements with little air movement) the evaporative front may be at or very near the surface, in which case salt crystals will grow as long thin needles, extruding from the wall face (Figure 4). This is known as efflorescence and is commonly seen as a relatively harmless white powder on the surface of new brickwork.

However, when the rate of evaporation is much greater, the evaporative front will be inside the wall and salts will crystallise within the pores of the masonry (subflorescence). The force exerted by rapidly crystallising salts is very high and sufficient to disrupt even the strongest masonry material. Crystal growth leads to either grain-by-grain loosening, which produces fretting and crumbling of the surface (particularly to soft mortars) or to delamination of a complete skin, such as the case hardening found on many sandstones (Figure 3) or the fireskin on bricks (Figure 5).

Cyclic wetting and drying is an important driver of salt attack decay. When salts first disrupt masonry they enlarge the pores slightly. After a cycle of wetting and drying, salts fill the enlarged pores and the new crystal growth further disrupts the masonry and enlarges the pores some more. Each cycle may produce only tiny changes, but cumulatively they result in the progressive decay of the masonry material.

6.1 Which salts?

Salts consist of a combination of positively and negatively charged ions known as cations and anions. The table below shows those that make up the salts commonly encountered in walls.

Cations (+ve)	**Anions (–ve)**
Sodium (Na^+)	Chloride (Cl^-)
Potassium (K^+)	Sulphate (SO_4^{2-})
Magnesium (Mg^{2+})	Nitrate (NO_3^{2-})
Calcium (Ca^{2+})	Carbonate (CO_3^{2-})

Salts may consist of a combination of any cation with any anion, provided there is a balance of positive and negative charges. Thus sodium chloride (table salt) is written NaCl, while sodium sulphate is Na_2SO_4 and calcium chloride is $CaCl_2$. Sodium chloride, sodium sulphate and calcium sulphate (gypsum) are commonly found causing salt attack problems in walls.

Salt attack can occur simply through changes in humidity. Some salts have water (H_2O) combined in the crystal structure and may exist in several different hydration states. These include sodium sulphate, which can exist as Na_2SO_4 or as $Na_2SO_4{\cdot}10H_2O$, and is a particularly damaging salt. Salts that are deliquescent at normal humidities, such as magnesium chloride ($MgCl_2{\cdot}6H_2O$) are also problematic; they attract water from moist atmospheres, dissolve, and then crystallise again when the humidity drops, or on rapid cooling.

Not all the possible combinations of cations and anions shown in the table are very soluble and hence damaging. Calcium carbonate ($CaCO_3$) is relatively insoluble, which is fortunate as it is the principal component of limestone, marble and the cured lime in mortars.

▶ For information about testing for salts go to Section 11.3 *Chemical analyses for salts*. Do-it-yourself salt testing is explained in Box 4.

The amount of salt required to cause damage will vary and will depend on the type of salt(s), the nature and condition of the masonry, including its pore structure (pore size and distribution) and the cohesive strength of the material. A general rule of thumb is that more than about 0.5% by weight of salt is considered cause for concern and reason for considering salt removal (desalination).

Sources of salts in walls may be one or more of the following:

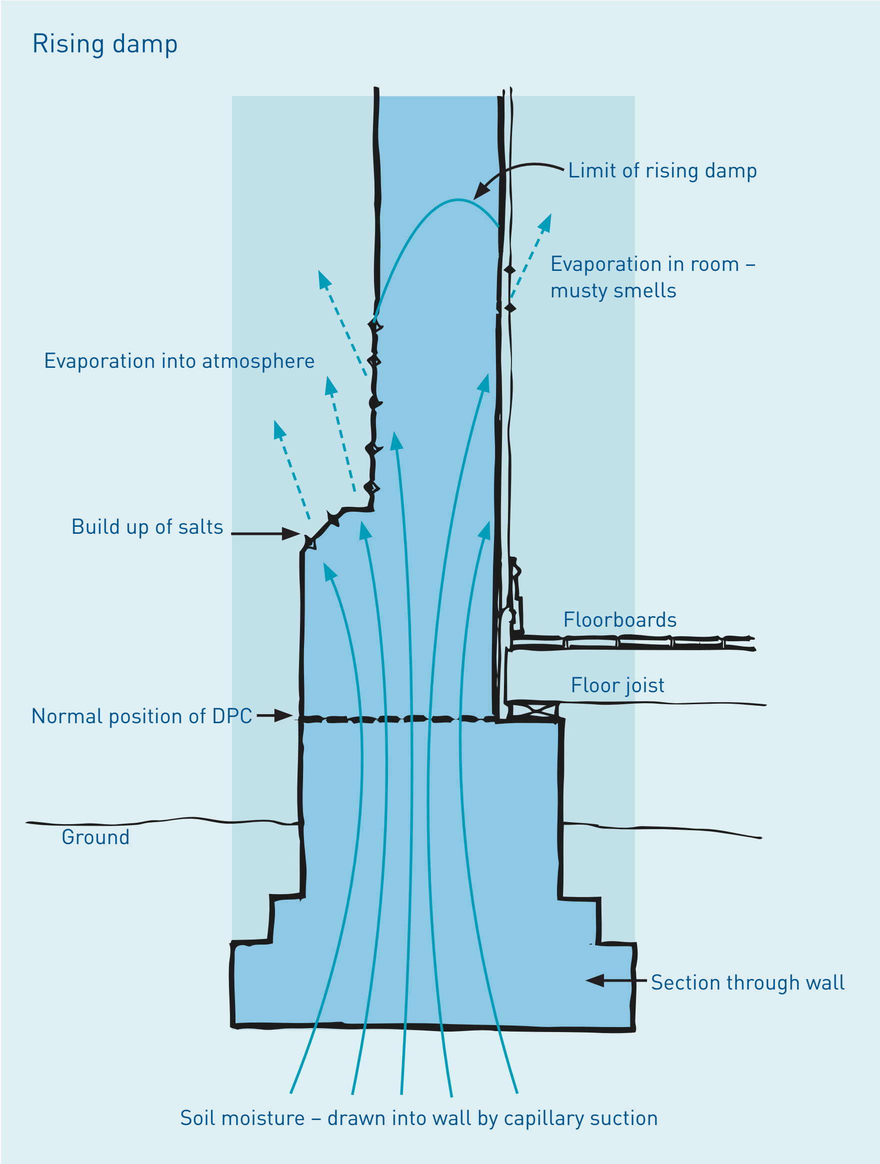
- saline soils and groundwater
- sea-spray for coastal sites
- air-borne (meteoric) salts — even in inland locations
- air pollutants
- inorganic garden fertilisers
- biological sources — pigeon droppings, micro-organisms, leaking sewers
- salt naturally occurring in the stone, brick clay, or mortar sand
- salty water used for puddling brick clay or mixing mortar
- salts used for de-icing roads in cold climates
- cleaning compounds that contain (or react to produce) salts in walls.

The type of salt may be a guide to its source; e.g. high levels of nitrate salts may indicate leaking sewers or confirm that a building was once a stable.

7

Rising damp

Figure 6 Section through a solid wall showing the path of rising damp which is caused by the suction of porous masonry. The pores effectively form a network of capillaries which draw soil moisture against gravity. Damp rises in the wall and eventually evaporates from the wall surfaces. As well as damaging masonry materials, the dampness may lead to fungal rot and insects (borers and termites) in the floor timbers. Today it is normal building practice to include a moisture barrier known as a damp-proof course (DPC) across the base of the wall below all floor timbers and at least 150 mm above ground level



Rising damp is caused by capillary action (or suction) drawing water from the ground through the network of pores in a permeable masonry material. Capillary suction becomes stronger as the pore size gets smaller; if the pore size is fine enough damp may rise many metres in a wall, until the upward suction is balanced by the downward pull of gravity (Figure 6).

In practice, the height to which water will rise in a wall is limited by the rate of evaporation of water from the wall surfaces. The evaporation rate for external surfaces is related to the nature of the masonry materials, surface coatings, climate, season and siting. In Australia the normal exterior height limit for rising damp ranges from 1.0 to 1.5 metres above ground level, whereas in cooler, more humid climates damp may rise several metres before evaporating. The evaporative zone is commonly from 0.5 to 1.2 metres above ground level. There is often little evaporation up to 0.3 metre

Figure 7 Typical blistering of paintwork and damage to internal plaster due to the combined effects of rising damp and salt attack. The skirting is a cement moulding and also shows salt damage.

above ground because the air near the ground is more humid and is more slowly moving. Trees, gardens, fences and nearby buildings will influence the particular circumstances.

Heating, ventilation and air-conditioning play a critical role in determining the height to which damp will rise on internal walls: the more ventilation the lower will be the damp zone. Air-conditioners generally dehumidify the air in a room and increase ventilation rates. The addition of heating or air-conditioning will increase the rate of drying and so increase the associated decay. Air-conditioning systems can draw moisture through solid masonry walls and their introduction into older buildings can be problematic.

As moisture evaporates from either face of a wall, more moisture is drawn from below. The process is dynamic: there is often a continuous upward flow of moisture, slowing or stopping only in dry weather and particularly during droughts. The rate of flow depends on the supply of water, evaporation as described, and the permeability of the masonry.

Rising damp may show as a high-tide like stain on wallpaper and other interior finishes, and when more severe, as blistering of paint and loss of plaster (Figure 7, and also Figure 15). Musty smells are common in poorly ventilated rooms and particularly in cellars and basements (see Box 1: *Damp rooms may be unhealthy*). Externally, a damp zone may be evident at the base of walls with associated fretting and crumbling of the masonry (Front cover & Figure 2).

Damp rooms may be unhealthy

Damp conditions promote the growth of moulds, tiny members of the fungal kingdom that include rots and mushrooms. Moulds have the potential to cause health problems. Inhaling or touching mould or mould spores may cause allergic reactions in sensitive individuals. Moulds can also cause asthma attacks in people with asthma who are allergic to mould. Research on mould and health effects is ongoing. Indoor mould growth can and should be controlled by controlling moisture levels. Keeping walls relatively dry is a sensible precaution. In building science terms, surface relative humidities (the relative humidity of surfaces such as walls) should be kept below 80% for periods of a month at a time. This is readily achieved in well-ventilated housing in warmer parts of Australia.

Box 1

7.1 The damp-proof course (DPC)

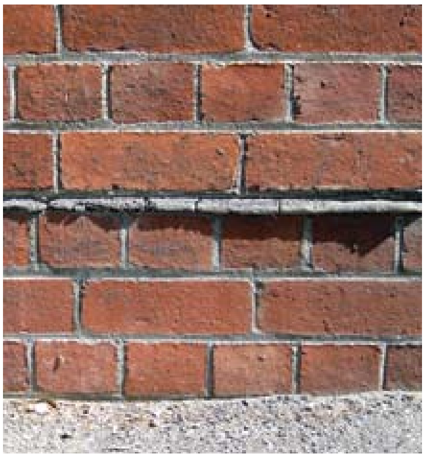


Figure 8 Many late nineteenth and early twentieth century DPCs were a mix of tar and sand that was laid hot. Being viscous, some have harmlessly extruded a little under the weight of the overlying masonry.

To prevent rising damp it is now normal practice to build in an impervious barrier at the base of the wall just above ground level and below any floor timbers. This is known as the damp-proof course (DPC) or sometimes just as the dampcourse. Modern DPCs include the common embossed black polyethylene sheeting. The standard thickness is 0.5 mm and there is a heavy duty grade, which is 0.75 mm thick and has a higher impact resistance, providing improved resistance to damage during laying. Careful building practice is necessary to ensure that the DPC is not punctured or otherwise damaged during construction, and that it forms a barrier across the full thickness of the wall.

Many nineteenth century buildings in Australia were built without DPCs. By the third quarter of the nineteenth century the need for damp-courses seems to have been recognised, though not always practised. Early DPCs included roofing slates laid in mortar with an overlapping second layer, sheets of glass, lead, hardwoods, bitumen-impregnated fibre, felt or paper, and various asphalt and tar-based compositions, including a widely used tar and sand mix which was laid hot (Front cover & Figure 8).

Some of the most effective DPCs used were glazed hard-burnt ceramic tiles or bricks, often with perforations allowing ventilation (Figures 9 & 10). These DPCs were laid without mortar in the perpendicular joints to prevent moisture passage through permeable mortar. The open joints also allowed through-wall ventilation. It is a great pity that glazed brick units suitable for DPCs are not made today as they have many advantages.

Figures 9 and 10 Hard burnt and glazed ventilating ceramic tiles and bricks. Made for the purpose, these are among the best dampcourses ever used, particularly the example at left from 1879. At right is a 1930s example which (together with its adjacent brickwork) is a remedial undersetting of an 1840s church of rubble limestone. Both examples were laid with open perpendicular joints to prevent damp travelling through the permeable mortar. In both cases salt attack is damaging the masonry below the DPCs — and each building will need treatments to control the salts (see Sections 13 & 14).

More recent DPCs have included thin copper or aluminium sheets coated with bitumen and then with talc or mica flakes to prevent adhesion when rolled. These have not performed well in corrosive (i.e. salty) environments. There is also a composite DPC which has a metal core coated in bitumen with an external coating of polyethylene. Because the plastic coating is very thin (0.1 mm) it is easily damaged, exposing the metal which is then susceptible to corrosion. Waterproofing additives for mortars have been commonly used, generally in the first three courses of brickwork above the concrete footing. Mortar additives should not be relied on as a sole means of damp-proofing.

Very few DPCs are truly durable and damp-proof; of currently available materials, only polyethylene has proved impermeable and resistant in very corrosive environments. *The Building Code of Australia* (see Box 8) has provisions for acceptable damp-proof course materials.

While most early DPCs would not meet modern standards, many have performed quite well, particularly where the rising damp 'stress' on the wall is relatively low. Existing DPCs, such as those based on asphalt and tar, should not be assumed to be defective simply because they are old. The better ones continue to perform well today.

7.2 Bridging the DPC

Rising damp is often caused by bridging the damp-proof course: a moisture pathway or bridge that negates the effect of the DPC. Bridges may be caused by rendering or plastering over the DPC. Pointing over the external face of a DPC will also cause a bridge, though it is important to be aware that asphalt or tar-based DPCs were often specified to be pointed over in hard cement, so as to retain the viscous DPC while minimising permeability. Examples where this pointing has failed are common, with the DPC extruding slightly from the joint (Figure 8). Poorly installed DPCs that do not form a barrier across the entire wall thickness will be bridged by mortar in the joints or cavity. Concrete floors or external paths can form a bridge if the concrete, or the fill beneath, abuts the DPC without some form of vertical damp-proofing. Build-up of garden beds and pavements against walls can also bridge the DPC (Figure 11). To be effective a DPC needs to remain about 200 mm above ground or paving level.

▶ For more advice on the position of DPCs go to Box 2: *Location of damp-proof courses.*

Bridging the damp-proof course

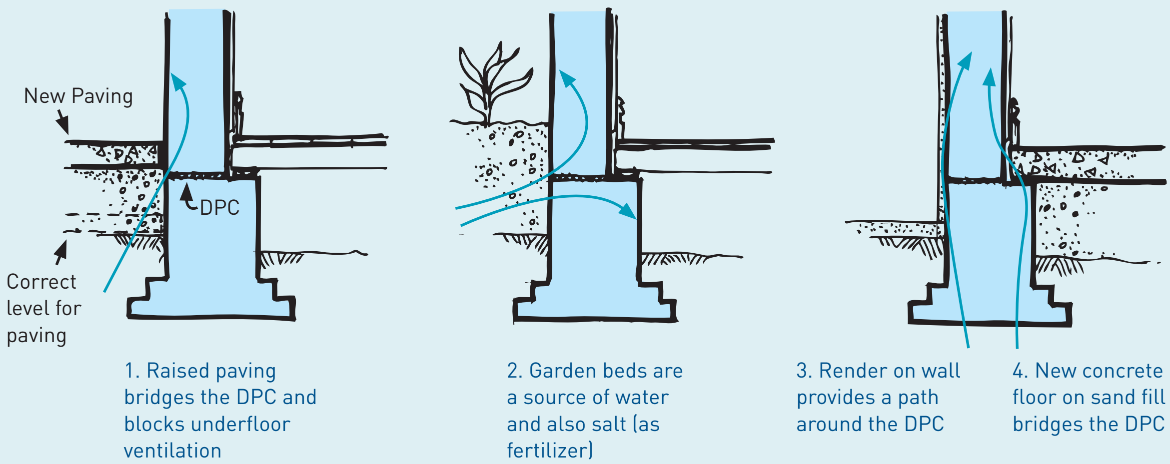


Figure 11 Bridging the damp-proof course. Four examples of how changes to a building can create a path, or bridge, around an existing damp-proof course. Bridging by build-up of paving or garden beds is a common cause of rising damp problems. See also Figures 29 and 49 for further examples of bridging.

7.3 When the damp contains salt

By itself, rising damp causes wet walls and musty smells but limited decay of masonry (except to particularly susceptible materials, such as those containing swelling clays — some earth materials and some clay-rich sandstones and limestones). It is when salt is present in the soil that salt attack combines with rising damp to cause substantial decay. In practice some salt is likely to be associated with most cases of rising damp, particularly in older buildings that have accumulated salts over a long period of time. Thus it may be that an old building with deficient, absent or bridged DPCs is badly damaged, despite relatively low salinity in the soil beneath. The importance of time is considered further in Section 9: *Further factors*.

Once rising damp has drawn enough salt into the wall so that the concentration of salt in the masonry is higher than in the soil below, the very presence of the salts helps to perpetuate the damp, increasing the problem. This is because of the hygroscopic and deliquescent nature of many salts: their tendency to attract water and then dissolve into it (think of the dinner table salt shaker in humid weather). Deliquescence keeps salty walls wet in humid weather and then solute suction (the osmotic pressure of a salt solution) draws more water towards the higher concentration of salts, compounding the capillary suction and adding to the rising damp (Figure 12).

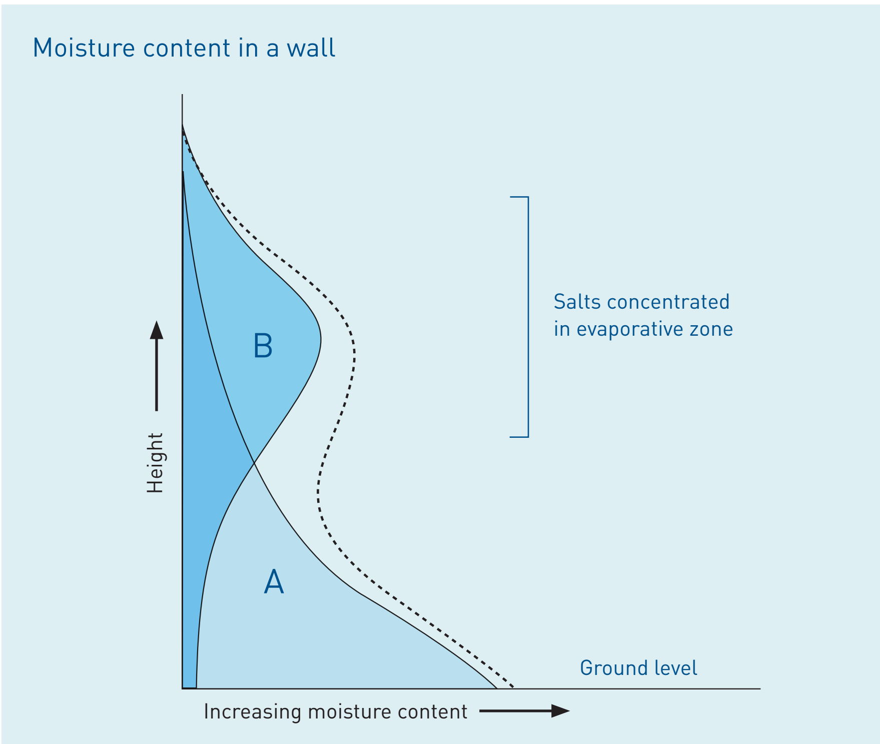


Figure 12 Moisture content in a masonry wall due to A, capillary action (rising damp) and B, hygroscopic salts. The total moisture content is shown by the dashed line and is the sum of A and B. The relative contributions of A and B to the total will depend on the amount and nature of the salts in the soils beneath, on the climate (humidity, temperature and wind speed) and on time (the older the wall the longer it will have had to accumulate salt).

8 Other forms of damp

Most damp-related decay is caused by salt attack in combination with rising damp, but other forms of damp can also cause substantial damage.

8.1 Falling damp

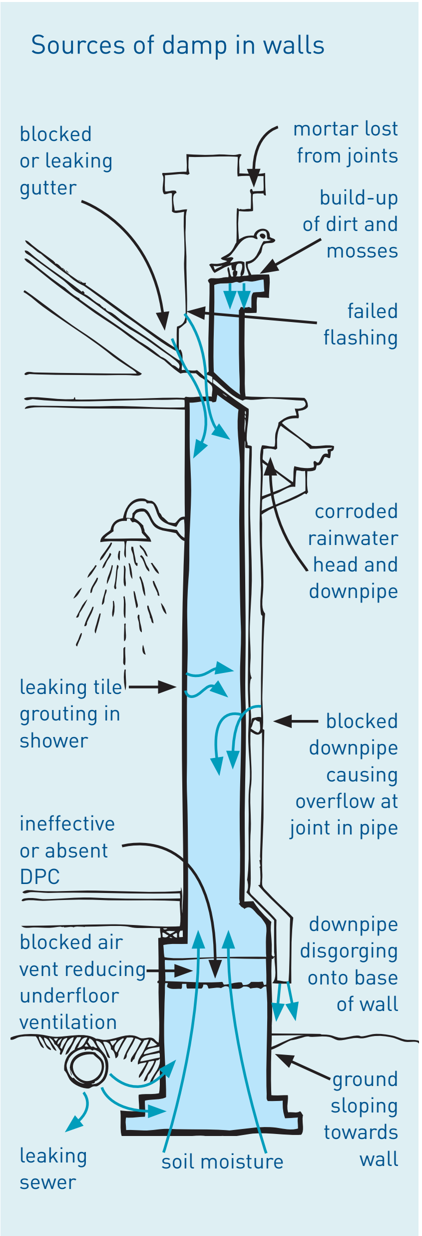


Figure 13 (above) The many sources of damp in walls.
Figure 14 (right) Two examples of falling damp. Overflow from the blocked rainwater head is made apparent by dark green algae. The coping above the rainwater head is allowing water through to the stones below. Salt attack is causing these stones, above and to the left of the rainwater head, to decay.

As the name suggests, falling damp is moisture entering masonry walls from above and percolating downwards through the network of pores that most materials possess. The numerous sources of falling damp (Figure 13) include failed roof coverings, blocked or leaking gutters, failed flashings and joints that have lost their mortar. Build-up of dirt and mosses on upper surfaces of parapets and cornices encourages water retention which in turn promotes downward percolation through the masonry. Most cases of falling damp lead to relatively localised patches of damage.

The typical debris that builds up in roof gutters and on parapets (such as fallen leaves, bird manure, mosses and dirt) contains weak acids which will contribute to masonry decay by slowly dissolving weaker components leading to progressively more porous and permeable materials. Salts also accumulate on the tops of buildings, not only near the coast, where sea spray is a major factor, but even in central Australia, where wind storms whip up salts from the dry salt lakes and where tiny particles of salt rain from the sky. Though the rates of accumulation of air-borne salt are relatively low, with time a building can absorb sufficient salt to cause damage, particularly when it is all concentrated at one point, such as the top of a blocked downpipe or rainwater head. The importance of regular maintenance of gutters and downpipes cannot be over-emphasised (Figure 14).

As with rising damp, the damage caused by falling damp happens not where the moisture enters the masonry, but at the point where it evaporates from the wall surface and leaves the salts behind (Figures 4 & 14). Tracing damp back to the point of entry can be difficult, particularly when the masonry is rendered and/or painted and the moisture is trapped behind the render or paint coating.

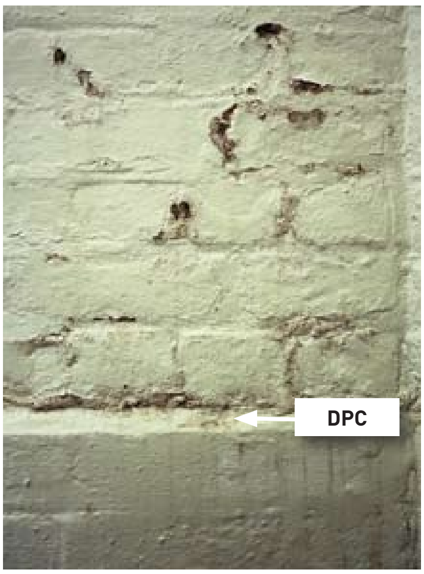
8.2 Penetrating damp

Penetrating damp can be due to leaking water or waste pipes; to failure of tile-grouts in kitchens, bathrooms and laundries; or to defective mortar joints in external walls. Leaking grouting in shower alcoves is particularly common and often shows as damp patches and blistering of paint in the room next to the bathroom. Persistent drips from air-conditioning condensate drains or hot water system overflows can also be a problem. Sources of penetrating dampness such as plumbing leaks can sometimes be difficult to trace and may require a range of sophisticated techniques, including acoustic detection, thermal imaging, moisture meter surveys and the use of tracer gases.

Construction faults may cause penetrating damp. Mortar droppings (snots) caught on ties in wall cavities can provide a pathway for water to travel from outer leaf to inner leaf and so negate the point of having a cavity. Substantial accumulations of snots at the base of the cavity can produce large damp patches on interior surfaces. Prior to the introduction of cavities, all walls were solid and relied on good workmanship and their thickness to limit rain penetration. On the prevailing wind side of a house, 230 mm (nine inch) walls commonly leaked and were often rendered to fill cracks in mortar joints, improve water shedding and reduce water entry. The alternative use of modern paints for this purpose can be problematic, for while limiting water entry, they will also prevent the wall drying rapidly and so may increase, rather than reduce, interior dampness problems.

Like falling damp, penetrating damp generally produces small, localised patches of dampness and decay. Exceptions are cellars and basements, where ground and surface water may penetrate laterally through the walls due to the failure or lack of external damp-proofing or drainage. In these cases damage may be widespread and at first sight may appear to be due to rising damp (Figures 15 & 16). Accurate diagnosis will be critical to successfully managing or remedying such a damp problem.

Figures 15 and 16 In both these examples of penetrating damp the walls are wetter above the DPC than below. At right moisture is penetrating horizontally from a concrete floor, while on the left (in a basement) moisture is coming through the wall from the ground outside. Had the left hand example been an external surface, the paint would have prevented rain from flushing salts out of the wall.



9 Further factors

This section begins with the factors causing salt attack and considers rates of decay in Australia in contrast to those of the United Kingdom. Some important considerations in the management of a salt damp problem are then discussed, providing a theoretical basis for the recommended approach and remedial works of Part Two.

9.1 Factors causing salt attack

For salt attack to occur there must be a combination of the following factors:

- permeable masonry
- available moisture
- available soluble salts
- evaporation

All four factors must be present for decay caused by salt attack to occur. Conversely, decay can be prevented by removing any one factor. While ostensibly an attractive path to preventing salt attack, in reality it is impossible to completely eliminate any one factor.

Permeable masonry. People have sought to make masonry materials impermeable by applying water repellent coatings, which have led to many failures as moisture and salt are trapped behind the coatings (Figure 3).

Available moisture. Preventing moisture entering masonry is one of two factors over which we have some (but not total) control. We can minimise water entry by good design and detailing and by good repair and maintenance practices, but we cannot totally prevent water entry. As noted in Sections 5: *Walls breathe* and 6: *Salt attack*, moisture may enter walls as vapour, and salt attack may be triggered simply through changes in humidity.

Available soluble salts. Salts abound and we cannot change that, but we can reduce the amount of salt in our walls (see Section 14: *Removing excessive salt*), though we will never remove it entirely, nor remove the need for periodic maintenance to control salt attack.

Evaporation. Where there is no evaporation there is no salt attack, the most obvious example being buried masonry such as footings, which if kept wet will not decay. This principle is used in partially uncovered archaeological sites where parts of buildings are displayed through windows into the ground. To prevent salt attack, the masonry in such sites must be kept moist 100% of the time (and there must be no evaporation of that moisture) which means sophisticated temperature and humidity controls. Keeping above ground walls permanently wet in order to prevent evaporation is impractical.

9.2 Rates of decay — comparison with the UK

Our building tradition derives from the United Kingdom where the climate is cooler and wetter than ours and so the rate of transpiration of moisture through walls is lower, though the walls themselves may be wetter. Condensation is a more significant problem, and the misdiagnosis of damp problems as due to rising damp is common. In contrast, the hotter and drier, temperate Australian climate promotes rapid evaporation from wall surfaces and hence greater rates of transpiration of moisture due to rising damp. When coupled with relatively saline soils, the result is much higher rates of decay in this country than in the UK. And so younger Australian buildings can be in worse condition than the much older buildings of northern Europe.

9.3 What to fix — the damp, the salt, or both?

Like our building tradition, our building repair tradition also comes from Europe, and so we have tended to focus on the damp, rather than on the salt. Yet both must be dealt with if our buildings are to be maintained in the long term. Failure to understand this has led to remedial treatments that may have successfully inserted a new damp-proof course but haven't stopped decay, because salts are left in the walls above the new DPC and continue to cycle in and out of solution with changes in humidity. Although the main source of moisture is removed (and the further supply of salt reduced) decay will continue, albeit at a slower rate. **Best practice treatment of salt damp involves removal of salts as well as cutting off or minimising the rising damp.**

9.4 Managing salt attack with maintenance

Consider the hypothetical (and common) case of a 100 year old house which is well built, with brick walls and lime mortar, and sits up on a well drained block with no ponding of surface water against the walls. Yet the lime mortar of the lower 5–10 courses of brickwork is eroding and in places the loss is up to 50 mm. The bricks are in reasonable condition, showing only the first signs of deterioration. There is no damp-proof course and not a lot of dampness in the walls. On the inside the plasterwork is in good condition with only a few small areas of blistering beneath paint coatings. It is tempting to think that as the house has lasted 100 years, the decay will not be much worse after another 20 or 30 years. Postponing action on this basis would be wrong, as Figure 17 shows. While this graph is notional, it is based on conservation science and an understanding of the rate of decay of materials.

Figure 17 The rate of salt attack decay follows an exponential curve in which there is a long period of little or no decay as salt slowly accumulates in the pores of the masonry. Then when the salt has filled the pores there is a rapid acceleration of decay — the condition of a 100 year old building may be twice as bad after only another 10 years.

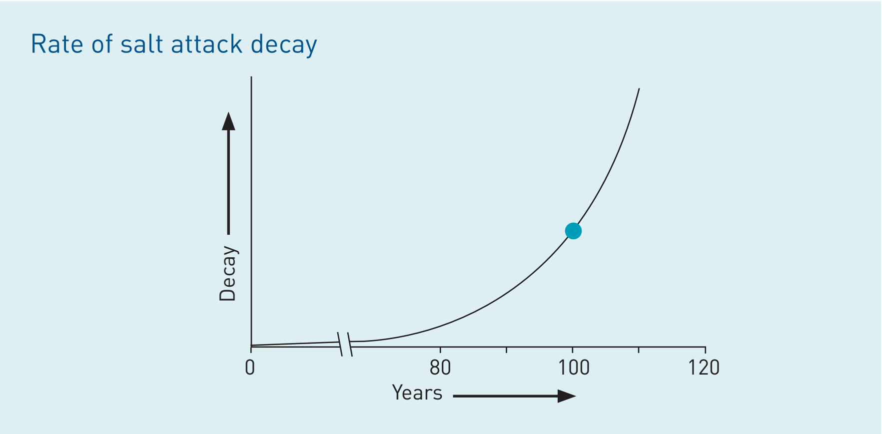


Figure 18 Extensive loss of lime mortar due to salt attack. The bricks remain sound — protected by the weaker mortar. Any further mortar loss risks local collapse of the brickwork. Successful repair may require dismantling and reconstruction as is done when undersetting (See Section 16.1).

There is a long period of almost no decay (in this case about 80 years) during which time salts are slowly accumulating within the masonry. Only then do they fill the pores sufficiently to cause significant salt attack decay. By the time the house turns 100 the decay has accelerated to near its maximum rate (the slope of the line), and in only ten more years the decay will be twice as bad as it is now. There are two important lessons from this. The first is that procrastination is not an option — something must be done, and done soon, or sufficient mortar will be lost to cause partial collapse of the walls (Figure 18).

The second is that, by reversing the decay and its cause, it will be possible to effectively reset the position on the graph back to a point where there is little decay. This is shown in Figure 19 which assumes that we have reversed the decay (i.e. put mortar back in the walls) and removed the immediate cause (by taking the salt out) so as to reset the decay clock back twenty years.

▶ For advice on mortar mixes and desalination go to Section 13: *Treating mild damp sacrificially* and Section 14: *Removing excessive salts*.

Repointing, the process of putting mortar back into joints between bricks and stones, is relatively straightforward. Removal of the salts can be achieved partly by raking out the weak mortar containing the salt and partly by desalinating the masonry, though we will never get all of the salt out which is why the vertical line does not go all the way down to the baseline.

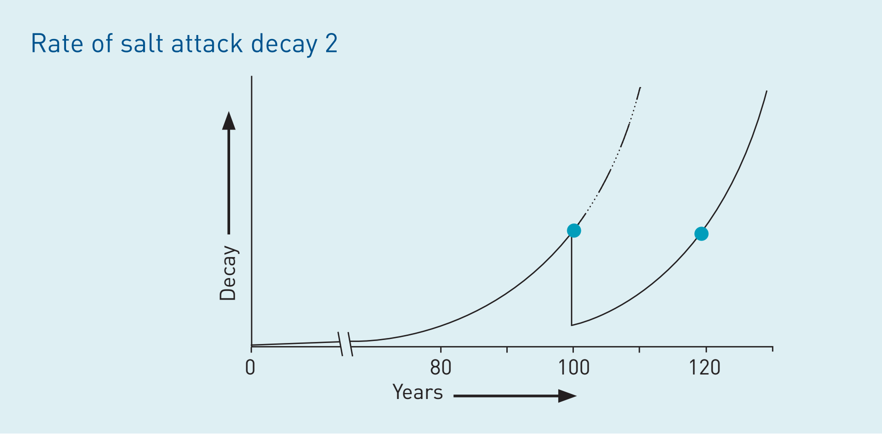


Figure 19 After 100 years decay is reaching its maximum rate and something must be done. By putting mortar back in the walls and by removing the salts we can reset the decay clock back twenty years. The vertical line at 100 years does not go all the way to the baseline because is impractical to remove all the salts. This is an approach which requires ongoing maintenance — every twenty years in this hypothetical case.

Clearly, this treatment does not cure the salt damp — instead it is a maintenance approach of managing the problem and preventing it from getting worse. Like any maintenance it will require periodic renewal — in this hypothetical case, every twenty years.

Importantly, this approach buys time. By reducing salt concentrations so that decay is minimised, the owners and managers of a building have time to review its moisture regime and to determine an appropriate course of action, which may or may not include insertion of a damp-proof course. This is particularly important where the masonry is of heritage value and an objective is maximising retention of historic material.

The foregoing is not an argument for never inserting a DPC. There are many situations — masonry materials with high suction and moderate to high permeability, buildings on low-lying or otherwise poorly drained sites, and sites with heavy clay soils that produce temporary high water tables during rain periods — where a DPC will be an essential part of dealing with a salt damp problem. But for those on well-drained sites and with only mild decay (perhaps because of a partially effective DPC, or low permeability materials), managing the decay by minimising the salts and the moisture 'stress' on walls will at least buy time for consideration of further options. As well as reducing intervention in masonry of heritage value, it may prove to be a cost-effective approach in the long term.

Location of damp-proof courses

The *Building Code of Australia* (see Box 8) Deemed-to-Satisfy Provisions generally require a damp-proof course to be installed in new buildings a minimum of 150 mm above ground level. This is to allow for some subsequent build up of ground level without risking bridging of the DPC. The BCA clearance above ground varies for different circumstances and may be reduced to as low as 50mm in areas protected from the weather by carports, verandas and the like. These provisions have been developed for modern construction practices and are not necessarily the most effective for traditional building forms. There is no upper limit for a DPC and this means that they can be, and often are, more than a metre above ground level, particularly on sloping sites. This negates part of the point of having a DPC as most evaporation from Australian walls takes place in a zone from 300 to 1200 mm above ground level.

This guide recommends that remedial DPCs be installed between 150 and 250 mm (two to three courses of standard brickwork) above finished ground level, with an ideal of 200 mm. Good maintenance practices should be used to ensure that ground levels do not build up and that the 200 mm clearance is maintained. Where the ground slopes, the DPC should be stepped to follow the slope, and so the maximum height may need to locally exceed 250 mm. The minimum height of 150 mm is important to counter the effects of splash from rain strike on adjacent pavements (see Section 12.2: *Site drainage*). Consider installing the DPC at a higher level (250+ mm) in situations where rain splash from hard pavements cannot be avoided. DPCs should always be installed below all floor timbers. Where the floor is below ground level, some form of vertical DPC may be required to prevent moisture penetrating sideways to the timbers. An air drain (Box 5) may be appropriate.

The point of these recommendations is to keep the size of the potential evaporative zone below a DPC to a minimum in order to limit decay due to salt attack (Figures 10 & 34). Decay below a DPC will require ongoing maintenance. See Box 7: *Potential negative impacts of DPC installation* for an additional perspective.

Box 2

Part 2
Diagnosis, maintenance and repair

10 Approach

This part of the guide begins with a series of Seven Key Steps which should be followed when dealing with a salt damp problem. These are the steps already outlined in Section 2: *The Basics*. The steps and their section numbers are:

11	Key Step 1	Diagnosing the cause — and the importance of getting it right
12	Key Step 2	Good housekeeping — to minimise the damp 'stress' on walls
13	Key Step 3	Treating mild damp sacrificially — to control salt attack
14	Key Step 4	Removing excessive salts — when normal methods are not enough
15	Key Step 5	Reviewing results before proceeding — important
16	Key Step 6	Inserting DPCs — and the different types available
17	Key Step 7	Desalinating walls — as DPC insertion alone is not enough

Not all steps will be necessary in every case: indeed after diagnosing that the problem is actually a broken downpipe in Step 1 and then repairing it in Step 2, there may be nothing more to do. At the opposite extreme there will be buildings where the extent of damage and the rate of decay are so great that Steps 3, 4 and 5 might be omitted. Different parts of a building may need different treatments — sacrificial treatments may be sufficient for some parts, while other parts may require one or more types of DPC together with desalination. Taking the process step by step is recommended for most circumstances as it ensures that unnecessary work is not done and that more expensive works can be anticipated and planned for over a period of time. Consideration of treatments and options should happen at each stage.

Importantly, it will be apparent from these steps that the decision about inserting a damp-proof course, and what form(s) that should take, are decisions for later in the process.

Following the Seven Key Steps are sections dealing with particular aspects of treating salt attack and rising damp:

18 Cavity walls
19 Inserting chemical DPCs in internal walls
20 Out of sight, out of mind: the need for improvements to practice
21 Repairs to interior plasterwork
22 Repainting — and allowing walls to breathe
23 Cellars and basements — their particular circumstances
24 Old treatments that should no longer be considered.

The dos and don'ts of damp, a series of points and reminders about good and bad practice when dealing with salt attack and rising damp, is included in Section 2: *The basics*. A glossary of technical terms and a bibliography of further reading are incorporated at the end of the guide.

When dealing with listed heritage buildings always check for any planning or heritage approvals that may be required before undertaking any works.

11 Diagnosis

Figure 20 Evidence of previous treatment with hard impermeable plaster. Damp is evaporating from above and below the impermeable zone.

Accurate diagnosis of the cause and extent of a damp problem is important. Failure to correctly identify the source of moisture can lead to wasteful and unnecessary repairs which do not solve the problem. Among the questions that should be asked of each case are:

- is it rising, falling or penetrating damp, or a combination of two or more?
- is the problem none of these but just condensation on internal surfaces?
- is there a damp-proof course?
- is the damp problem reasonably uniform around the building, which may suggest failure of the DPC? or
- is it just in one part, suggesting bridging, or a localised source such as a leaking pipe, or failed gutters and downpipes?
- is there a localised source of salt, such as an old brine tank, or fertiliser stockpile?
- where do the hot water system overflow and air-conditioning condensate drains run?
- are there signs of a previous treatment (Figure 20) and what is its nature?
- what is the condition of underfloor spaces, including dwarf walls and floor timbers?
- what is the condition inside the wall cavities?

Because there may be more than one cause of a dampness problem it is wise to complete a thorough investigation, even though a likely cause has already been identified. Ideally, inspections should be undertaken before and after a dry spell to avoid the possibility that rain may have washed salts back into the walls, making their presence less obvious. Follow-up inspections allow monitoring of changes and are highly recommended.

11.1 Independent advice

Advice should be sought from an independent specialist, so avoiding bias towards any particular commercial treatment. Such advice might be provided by consultants specialising in the field and by architects, engineers, licensed builders or building consultants. When seeking suitable consultants always ask for references and evidence of their experience in this type of work. It may be appropriate that their investigation be undertaken according to Australian Standard AS4349.0—2007, which provides for inspection of "particular technical aspects". Such an inspection should include a thorough investigation of all walls (inside and out), stormwater drainage and external site conditions such as paving against walls. The condition of the masonry walls should be described, as should the nature, condition and location of damp-proof courses. Wall cavities and spaces beneath timber floors must be inspected and an assessment made of the existing underfloor ventilation. Be aware that soil in underfloor spaces may have been treated with organochlorine termiticides — always take appropriate safety precautions.

▶ Ask your State heritage agency to identify possible advisers.

11.2 Moisture meters

Moisture content of wood and masonry materials can be conveniently measured with hand-held meters. These are of several types, measuring one or more of several related electrical properties, including the conductivity (or conversely, the electrical resistance), the impedance, or the fringe capacitance of a material. The presence of water can significantly alter these properties.

Some meters have two sharp probes which are pressed against, or pushed into, the material, some have smooth sensor pads and some have both. Using meters equipped with sensor pads rather than sharp probes avoids damage to finishes such as paint and wallpapers, which is important for buildings of heritage value, but there is a place for both types in surveying walls.

Because the presence of salts also has a considerable effect on the electrical properties (e.g. increasing conductivity) meters cannot distinguish between relatively dry but salty walls, and those that are wet but free of salt. Great care is needed in interpreting their results. It is common in salty walls to get a reading of greater than 100% moisture content, an unreal figure, leaving no room for the masonry itself! The only valid result is a zero figure indicating no moisture and no salt, though as different materials have different electrical properties, figures above zero may not necessarily indicate the presence of any moisture or salt. Further, a moisture meter survey may find high 'spots' which are actually due to buried cabling, pipes, or other metal objects.

Caution: Moisture meters should never be used as the sole basis for diagnosing a damp problem. Because soluble salts considerably change the electrical properties of masonry, moisture meters should never be used on their own to prove that a wall is unacceptably damp.

Although moisture meters should be used with caution, they can be very useful aids for quickly mapping the extent of damp patches in walls. Always check high on a wall (well above the rising damp zone) for any moisture that may indicate another source of damp. Meters are also useful for monitoring changes over time — use the same meter to ensure reliable comparisons.

Moisture meter survey

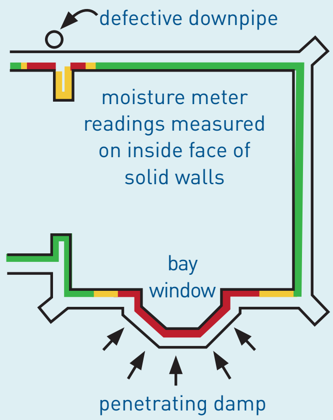


Figure 21 Moisture meter survey with results shown colour coded as on meter; red = high, yellow = moderate, and green = low.

In addition to a numerical readout, some meters show their results on a colour coded scale of red, yellow and green (high, moderate and low). Using this simple scale is often the best way to survey a building as it gives a quick guide that is easily read and understood. Figure 21 shows the results of such a survey measured on internal surfaces of solid walls. Most of the dampness is around the bay window but there is a patch on the opposite wall that is due to a failed downpipe allowing water to run down the outside of the building. The water percolates through the solid wall to produce the narrow red zone measured on the inside. This zone can be traced well up the wall proving that the source is not rising, but falling damp.

More accurate on-site measurements of moisture content can be obtained using carbide meters. They require samples collected from the wall using an electric drill. For greater accuracy still, samples taken from the wall are kept in sealed containers until tested in a laboratory for the weight loss of oven-dried material. An assessment of the moisture that is due to the presence of hygroscopic salts can then be obtained by allowing the dried samples to reach equilibrium in a controlled atmosphere of 75% relative humidity and reweighing. This is the only method that will distinguish between moisture due to rising damp and that due to hygroscopic salts (see Figure 12).

11.3 Chemical analyses for salts

Depending on the nature and scale of the project there may be value in understanding the type and quantity of salts present. Understanding how much salt is in a wall may be important in deciding on the extent of remedial works and, later, to determining the success of desalination treatments. As noted in Section 6.1, a general rule of thumb is that more than about 0.5% by weight of salt is cause for concern. A knowledge of the type of salts will help understand their source and may point to a particular problem (see Box 3).

Contaminated materials

Beware of contaminated materials such as sands and other aggregates. Chemical analysis of the strong efflorescence in the photograph shows it to be predominantly magnesium sulphate (epsomite), a very soluble salt. Its origin is almost certainly from contaminated dolomite quarry sand used as a bed for the concrete paving in the foreground. A former quarry produced a dolomite aggregate for concrete and roadmaking and the crusher fines (quarry sand) were widely used as a bed for paving bricks and concrete. Some parts of the quarry contained pyrite (iron sulphide) which, on exposure to the atmosphere after crushing, oxidised to liberate sulphuric acid.

This in turn attacked the dolomite, producing magnesium sulphate. Although the upper parts of the wall are protected by the 1980s DPC, action will now be required to conserve the stone below. Always specify sands and aggregates to be free of soluble salts, sulphide mineralisation and other contaminants. Store sands in covered containers on building sites.

Box 3, Figure 22

▶ Ask your State heritage agency for advice on local laboratories that undertake such tests.

Full chemical analysis for both the type and quantity of salts requires carefully controlled sampling and a chemical laboratory with a range of analytical equipment. All the cations and anions (except carbonate) listed in Section 6.1 should be analysed for, using techniques such as ion chromatography for the cations and inductively-coupled plasma atomic emission spectrometry for the anions. Simpler and cheaper (but less accurate) tests are available for both the type and quantity of salts. Test strips (akin to litmus paper) are available from laboratory chemical suppliers and can be used as indicators of the presence of particular salts such as sulphates or nitrates. These strips are only semi-quantitative: they indicate whether there is a lot or a little of the salt present.

The total amount of soluble salt (without distinguishing between the types) can be calculated by measuring the electrical conductivity of a solution of a sample taken from the wall. This is known as the total dissolved solids (TDS) or total soluble salts (TSS) method and is explained in Box 4: *Do-it-yourself salt testing*. Some moisture meters come in a kit which includes blotting paper that is wetted and then pressed onto the wall for a short period to absorb any salt. The meter is used to measure the increased conductivity of the paper.

Another method involves dissolving the salts from a known mass of sample, filtering out the insoluble solids, then evaporating the liquid, leaving behind the salts, which are weighed. These tests are also available from analytical laboratories. Combining TDS testing with the use of test strips for particular salts can often provide enough information for effectively managing a salt damp remediation project.

Ideally, collect samples from mortars rather than bricks or stones, as the mortar is readily repaired and patches on bricks and stones can be disfiguring. Where the mortar is appreciably less permeable than the surrounding masonry, salts are likely to accumulate in the bricks or stones, rather than the mortar. In these circumstances it will be necessary to sample the bricks or stones in order to obtain valid results. Each situation will need to be judged on its merits, the aim being to obtain samples that are representative of the wall as a whole. Record sample locations accurately so that repeat samples can be obtained from nearby to test the effectiveness of later desalination treatments.

Do-it-yourself salt testing

Reasonably accurate determination of total dissolved solids (TDS) can be made by measuring the electrical conductivity of solutions of samples taken from the walls. Equipment required includes sample jars, deionised water, an electrical conductivity meter, good scales that will read to 0.1 gram and a mortar and pestle for breaking down samples to small particle sizes.

A convenient way of obtaining the conductivity meter and associated calibrating solution and sample jars is the 'Salt Bag', a product of the NSW Department of Primary Industries' Wagga Wagga Agricultural Institute, www.dpi.nsw.gov.au/agriculture/resources/soils/salinity/general/salt-bag. While the Salt Bag is intended for monitoring water and soil salinities in agriculture, it can also be applied to salt in walls.

Using an electric drill, collect samples from known depth intervals in a wall (0–10, 10-20 and 20-40 mm are commonly tested, though more may be required if there are salts deeper in the wall). If needed, the samples should be lightly crushed with a mortar and pestle to break up any lumps. Weigh out 5 grams of each sample and add to 50 ml of deionised water. Shake thoroughly and allow a little time for the salts to dissolve. Measure the electrical conductivity of the solution. With aid of the Soil & Water Salinity Calculator supplied in the Salt Bag, determine the salt content of the solution in parts per million. Multiply the result by 10 to account for the initial ten-fold dilution. Convert from parts per million to percent by dividing by 10,000.

Box 4

12 Good housekeeping

This section is about the basic measures which should always be undertaken to minimise the rising damp 'stress' on the base of walls. These measures may reduce the severity of an existing problem to an extent that major works (such as DPC insertion) are not necessary. Any treatment proposal that does not include or take account of the effect of these measures should be dismissed.

12.1 Maintenance

Figure 23 Maintenance, maintenance, maintenance. Here a roof gutter has rusted through and the colourful green damp zone is due to splash.

Maintenance is important. Too often damp problems are the result of neglect and bad housekeeping: circumstances that can be avoided. Regular maintenance of roof drainage systems, including gutters and downpipes, will involve cleaning gutters and rainwater heads, re-aligning gutters to ensure correct falls towards downpipes, and repairing leaks as soon as they are discovered. Ideally, roof drainage should be inspected during periods of heavy rain so that overflows and other failures can be identified (Figure 23). Are the stormwater systems adequate — are there enough downpipes and are gutters and downpipes of sufficient size?

At the bottom of the downpipes, stormwater shouldn't discharge onto the base of walls, but should flow into a gully basin or sump with an adequate connection to the stormwater system or to a downslope outfall. The gully basin or sump should be big enough to prevent splash, capture all water and permit cleaning or rodding of the stormwater pipe below. There should be ground level inspection points (IPs) on all bends and along long straight runs. The common practice of running downpipes straight into PVC risers prevents access for clearing blockages — such access is essential for good maintenance.

Maintain ground levels around buildings so that the DPC is about 200 mm above ground. This is to ensure that DPCs are not bridged by gardens and paving, and also to prevent rain splash from entering the wall above the DPC. Ideally, ground levels should also be below floor levels. See also Section 12.2: *Site drainage* and Box 2: *Location of damp-proof courses.*

Where a building has timber floors, regular checks of underfloor spaces for fungal rot, borer and termite activity are essential, as they are associated with high humidity, and hence high moisture levels, in adjacent masonry. Rising damp and termite problems often go together.

12.2 Site drainage

Figure 24 Garden beds against walls almost guarantee salt damp problems. Here the DPC was buried by 300 mm of soil — five courses of sandstone have been severely damaged.

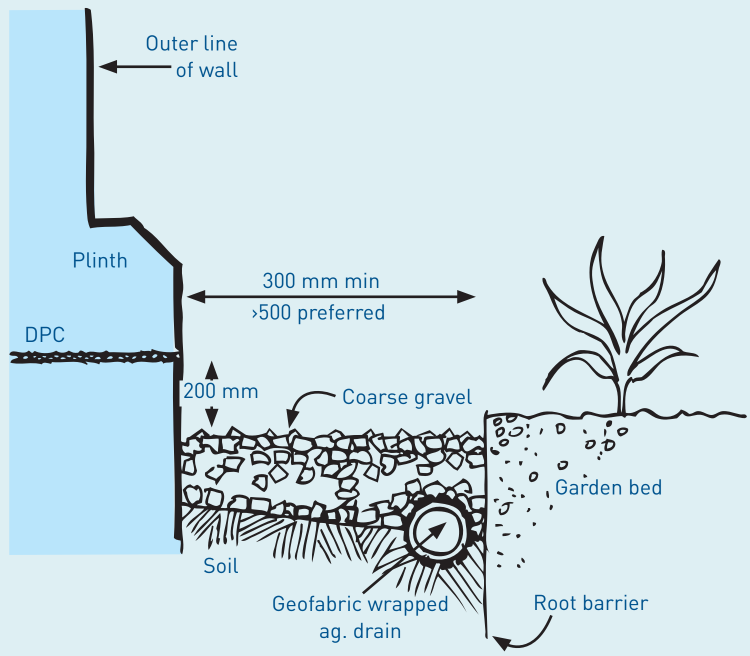
Figure 25 Sterile zone between wall and garden — paved with coarse gravel to allow rainfall in and evaporation out. Drainage is provided by an agricultural drain wrapped in geofabric. Garden sprinklers are replaced with drippers and are kept at least 500 mm away from walls.

It is important that water does not lie (pond) against the base of walls. Surrounding paths and ground levels should be sloped so as to drain water away from walls: the first metre should have a fall of about 25 mm (1:40) and where possible, the low point should be 1.5–2.0 metres away from the building. A spoon drain at the low point is a traditional and effective way of removing surface water. Though open, it is readily cleaned.

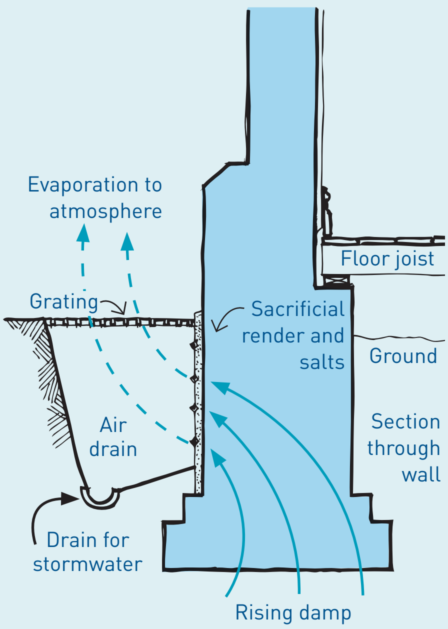
Gardens against walls are particularly bad — soil levels build up as mulches are added, fertilisers contribute soluble salts and watering by enthusiastic gardeners washes it all into the walls (Figure 24). Garden beds should be pulled back and a sterile zone at least 300 mm wide left against the walls. Sprinkler systems should be replaced with drippers and kept well away from walls (Figure 25).

The nature of any paving adjacent to walls is also important. Hard paving contributes to damp problems as it encourages rain to splash up into walls. Further, impervious hard paving will prevent evaporation of soil moisture encouraging it to be transpired via the walls (Figure 28). Coarse gravel is the ideal material for the zone adjacent to old walls as it limits splash from rain while also allowing evaporation of soil moisture (Figure 25). Deliberately permeable paving slabs made of no-fines concrete or resin-bound aggregate offer some potential, although the upper surfaces should be rough and angular to deflect rain strike.

Sterile zone against wall



Air drains



Air drains — a possible control measure

Air drains offer some potential to control damp by encouraging evaporation to occur at the lowest possible level. The evaporative zone can be lowered by excavating a trench against the building and exposing the bottom parts of the walls. The advantages of this measure include protecting valuable internal plasters or murals, and reducing underfloor moisture levels. This in turn reduces the risk to timbers from fungal rot, borer and termite attack.

If salt attack is anticipated, a sacrificial render should be applied to the wall face: this is discussed in Section 13. The trench needs good stormwater drainage to prevent ponding against walls. Ideally, the top of the trench should be left open or covered with a metal grating that allows good ventilation and ready inspection of the wall face. While sealing over the top, and providing some means of ventilation is a method of using the space against the walls, it is not recommended because decay could then occur where it cannot be seen or readily repaired.

Air drains are not a new idea: they have been widely used in various forms in the construction of older buildings to provide daylight and to keep basements dry.

Air drains should never be installed in reactive clay soils without geotechnical engineering advice; there is a risk of structural cracking should the soils dry too much (see Box 6).

Importantly, air drains may not work! They will only be successful when the rate of evaporation from within the drain will be high enough to ensure that all drying takes place at that level. This may be impossible in cool damp climates where ground level humidities are high and rising damp climbs several metres up walls. Air drains may only work in hot, dry climates where evaporation rates are already high and where rising damp climbs only a short distance up walls before evaporating.

Further, air drains will not lower damp zones in walls if there are already a lot of salts present. This is because the salt-contaminated zone will wet up during humid periods (due to the deliquescent nature of the salts) and then solute suction (the osmotic pressure of the salt solution) will draw more water towards the highest concentration of salts, effectively adding to the capillary suction and maintaining the rising damp at the present level (see Figure 12). Desalination is essential if air drains are to work (see Section 14: *Removing excessive salt*).

Before installing air drains, consideration should be given to their potential impact on the archaeological resource that may be present adjacent to the building.

Box 5, Figure 26

Ground levels may need to be lowered to expose a buried DPC. This can sometimes be difficult in old city areas, where the progressive build-up of road pavements due to resurfacing has left buildings sitting in low-lying ground surrounded effectively by a levee bank. Air drains offer some potential for lowering the evaporative zone in walls (see Box 5: *Air drains — a possible control measure*).

An in-ground drainage system may be required to lower groundwater levels, or to cut off water running down a slope. A word of caution here. Where buildings are founded on reactive (expansive) clay soils and subsoils, changes to site drainage may upset a pre-existing moisture balance and lead to soil shrinkage and structural cracking of walls as the clays dry out — droughts produce a similar effect. In these circumstances an appropriate treatment might be a compromise between controlling damp and controlling cracking (see Box 6). If wetted-up soils are essential to maintaining stability in the walls then further intervention and additional expense will be needed to deal with the inevitable increase in damp problems. Advice should be sought from a geotechnical engineer if structural cracking due to clay soils is a problem.

The cracking vs. damp compromise

Some soils and sub-soil strata are very reactive to changes in moisture content. They contain clay minerals such as smectite or montmorillonite which expand when wet and shrink when dried with resulting volume changes of up to 50%. These are problem soils for buildings and are commonly associated with structural cracking of masonry walls, particularly those of traditional construction set on flexible footings of stone or brick rather than reinforced concrete. Reactive soil problems can be aggravated by planting large trees with aggressive root systems too close to buildings. Thirsty trees are very efficient at extracting moisture from clay soil, leading to shrinkage and settlement of building foundations, and potentially, substantial damage. The problem is made worse during prolonged droughts.

Geotechnical engineers seek to manage reactive soils by maintaining them in a stable state, the aim being minimal change in moisture content. This is often achieved by the use of impermeable paving around a building, sometimes as a complete concrete apron with integral vertical walls of concrete at the outer limit of the paving. Impermeable plastic membranes are often used instead of concrete and are sometimes also laid beneath timber floors to further limit drying of clay soils. Alternative solutions include in-ground watering systems with automatic controls to maintain soil moisture at a constant proportion.

These solutions almost always mean an increased risk of rising damp and an associated risk of fungal and insect attack to floor timbers. In particular, impermeable aprons around (or under) a building with absent or ineffective damp-proof courses are a guarantee of subsequent damp problems in the masonry walls (see Section 12.4 and Figure 28). The conflicting objectives of minimising soil moisture for damp control, and maintaining soil moisture for crack control, mean that a compromise may be necessary. Where the cracking problem is mild, the compromise may be semi-permeable paving, perhaps coupled with an in-ground watering system. Where the cracking problem is severe and an impermeable apron is the only practical solution, then rising damp should be anticipated and appropriate treatment planned and budgeted for.

Where there is structural cracking due to reactive clay soils, advice should be sought from a geotechnical engineer. That advice should account for any remedial treatment for rising damp that may be required as a result of the need to maintain soil moisture around the base of the building.

Box 6

12.3 Underfloor ventilation

Figure 27 Semi-circular sections of PVC piping catch salt and other debris from sacrificial plasters and mortars on the walls beneath the floor of a church. Bedded on the same sacrificial mortar mix as that used for the walls, the pipes prevent the recirculation of the salts through the soils below and are cleaned out annually. White salts are visible on the stones in the centre of the photograph.

Maintaining underfloor ventilation is an important part of controlling damp, as it allows ever-present soil moisture to evaporate beneath the floor and to pass out through the vents in the base of the walls. The moisture 'stress' on the walls would be much greater without this ventilation; so would the moisture content of floor timbers, with the consequent risk of fungal rot, borer and termite attack. Mould growth in built-in cupboards can be a sign of insufficient underfloor ventilation.

Dust and cobwebs should be regularly cleaned from vent grilles, and any obstructions, such as paving, planter boxes or dense shrubs, ought to be removed. Make sure that surface water isn't directed through the vents. Before deciding to add new vents, clean out the existing ones and monitor the results for a period, as this may be enough to improve airflow sufficiently. New air vents (matching the original) may be warranted when previous air passages are blocked by changes or additions to a building.

The use of adjustable sliding vent grilles enables reduction of venting in hot dry weather and retention of cool air beneath a house with the added benefit of energy savings. However, they do require an attentive owner to ensure they are not left closed when most needed during cold wet weather.

In cases of bad decay, the vent passages themselves may be totally blocked with debris from decaying masonry. This is partly due to the very function of vents — providing for evaporation — which concentrates drying, and hence salt attack, on the surfaces of the vent passages. In a situation like this, consider lining the passages with rigid plastic liners. Linings may need perforating to allow for the ventilation of wall cavities. It is important that wall cavities should still drain freely; if the linings restrict drainage new weep holes will need to be cut in nearby perpendicular joints.

Controlling evaporation of moisture from sub-floor walls or from adjacent soils is one of the fundamentals of successfully managing rising damp. The emphasis is on control because there can be too much of a good thing. Too much underfloor ventilation may lead to salt attack on the inside faces of walls and on dwarf walls supporting floors. This could lead to unseen damage and could become dangerous. Regular inspection of underfloor spaces is therefore important. Where higher rates of ventilation are needed to manage dampness it may be necessary to apply sacrificial plasters to vulnerable walls (Section 13) and to catch debris from them so that salts are not recirculated (Figure 27).

Changes to floor finishes may be enough to tip the balance towards too little evaporation. For example, an unfinished timber floor may be found to be cold and draughty in winter and so is modernised. Gaps beneath the skirtings are sealed with compressible foam; and new vinyl sheeting, or a polyurethane finish on the floorboards forms an effective seal, reducing previous circulation. New vents may be needed to restore adequate ventilation in this situation.

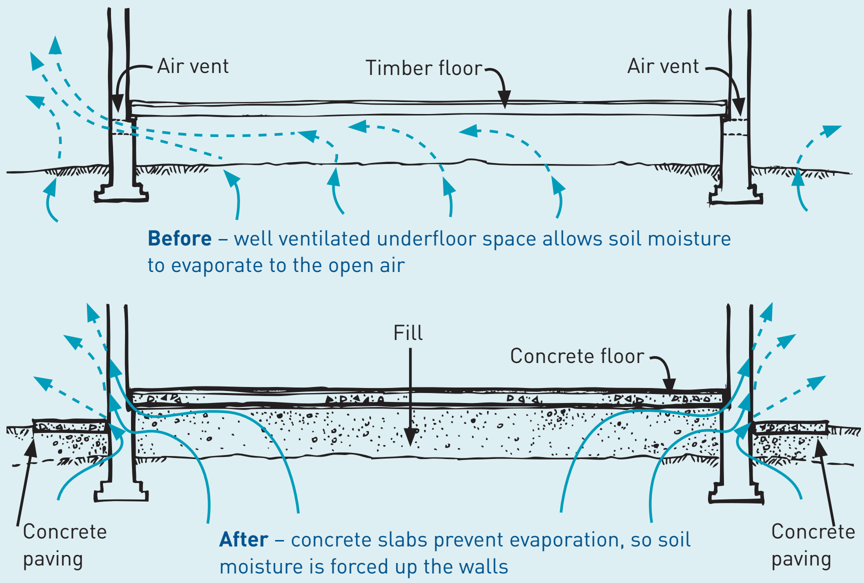
Remember that underfloor ventilation is also important for reducing the risks of fungal rot and termite attack to floor timbers; a balance must be struck that keeps the timber relatively dry, preferably with a moisture content below about 20% by weight.

12.4 Concrete floors and paving

One of the worst mistakes made by renovators is to remove a ventilated timber floor and replace it with a concrete slab poured on sand or other fill. The concrete and its associated damp-proof membrane (DPM) prevent evaporation, and the soil moisture rising beneath the building becomes focused on the walls. Rising damp problems are almost guaranteed, whereas before there may have been no significant damp, even though the walls may have lacked effective DPCs (Figure 28). This is also the reason why external paving should be permeable.

Figure 28
Concrete floors and external paths can cause rising damp in old walls.

Concrete floors can cause rising damp



The same effect can often be seen in old houses with tiled or concrete front verandas. Because of absent, bridged or ineffective DPCs, moisture rising beneath the semi-permeable veranda floor is forced up the front wall, causing decay. Very often this may be the only rising damp in the house. Ensuring that roof drainage takes stormwater well away from the veranda may reduce the damp stress on the front wall. However, eventually sufficient salts may accumulate to damage the walls and veranda floor and a more invasive solution will be required. Figure 29 illustrates one such solution, which enables the retention of most of the veranda. Old concrete verandas were laid without a damp-proof membrane (DPM) and are semi-permeable. Replacing such a veranda with a new one laid on a DPM (or sealing the surface of the old one) will add to the moisture stress on the walls.

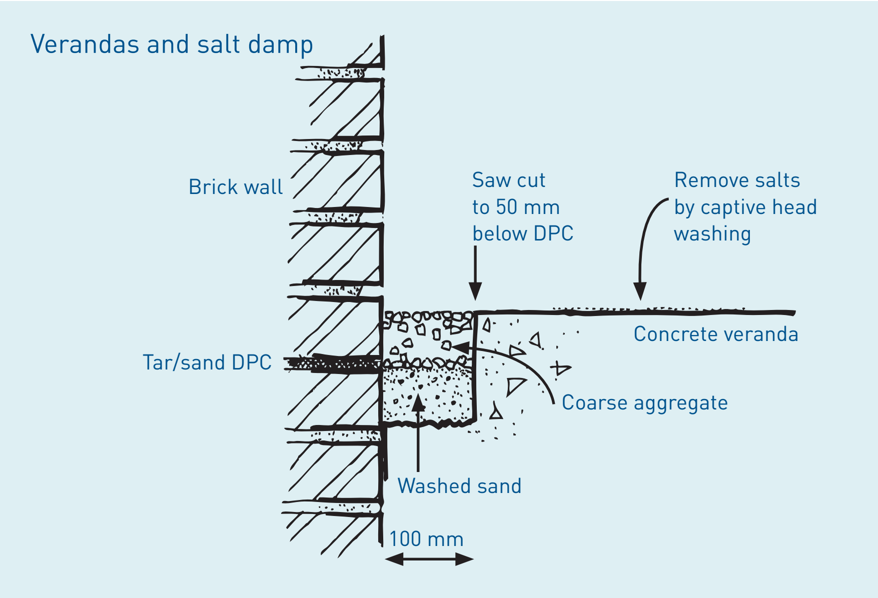


Figure 29
Damp rising through a concrete veranda is causing damage to the adjacent front wall and is beginning to damage the veranda itself. In this case the veranda was laid too high and bridges the DPC. One approach would be to replace the concrete at a lower level. Another, which avoids the cost and the loss of original fabric is shown here. By cutting a narrow trench against the wall and filling the bottom with washed sand, moisture can evaporate and salts will accumulate in the sand. The sand and gravel will need to be replaced periodically, perhaps annually. Captive-head washing or poulticing may be needed to remove salt from the concrete floor (see Section 14: *Removing excessive salt*).

12.5 Repairing a tar and sand damp-proof course

Many tar and sand DPCs decay due to oxidation of the tar, leaving crumbly friable material. Excessive decay endangers the structural stability of the wall and should be repaired. There is little experience with such repairs in Australia and so the following is offered on an experimental basis only.

After raking out the decaying DPC back to reasonably sound material, use a long thin brush to prime the remaining DPC and the joint surfaces of brick or stone with a diluted water-based bitumen rubber material. Use masking tape to prevent spills of bitumen on the face of the bricks or stones. Then use a 'mortar' of the bitumen and well-graded, washed sand in proportions of about 1:2.5–3 bitumen to sand to repoint the joint, compacting tightly with jointing keys (tools) that fit within the joint. If chemical impregnation is also planned it should be undertaken after the repairs to the DPC have thoroughly cured.

13 Treating mild salt damp sacrificially

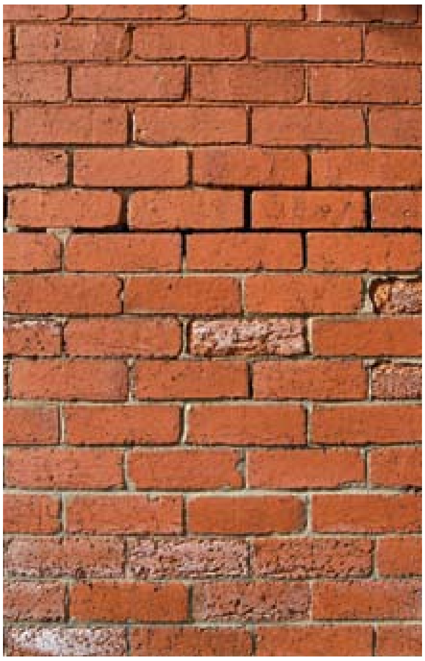


Figure 30 The wrong response to salt damp. Nine courses of brickwork have been repointed in cement mortar, driving the damp even further up the wall and leading to salt attack damage to the bricks. Whereas the original lime mortar was weaker than the bricks and acted sacrificially, the new cement mortar is less permeable, forcing some of the damp to evaporate through the bricks — causing the obvious salt attack decay — and the rest to rise further in the wall. Traditional construction relies on mortars that are weaker than the bricks, partly for the reasons above and also so that any structural cracking will be expressed in the mortar, where it is less obvious and readily patched.

A sacrificial treatment is designed to decay over a period of time, and in doing so, to protect the original masonry. Such treatments use deliberately weak mortars and plasters (or renders) to encourage salt attack to erode the new mortar or plaster rather than the original fabric. They can be useful ways of controlling mild salt damp. Coupled with attention to ventilation, site drainage and the other aspects of good housekeeping, they may limit the decay to such an extent that it becomes a manageable problem that can be lived with — without the need for the expensive insertion of a DPC.

Consider the common case of a building with mild damp in which the lime mortar is decaying from the lower courses of brickwork (the case discussed in *Managing salt attack with maintenance* at 9.4). An all too common (and wrong) response would be to repoint the joints in a hard, dense, cement mortar. This may stop the decay of the mortar, but will transfer the problem to the bricks if they are now the more permeable material. Evaporation will then take place through the bricks, promoting their decay due to salt attack. Alternatively, if the bricks are relatively impermeable, the damp may rise further up the wall and attack the lime mortar higher up. Both outcomes occur in the example shown in Figure 30 — the bricks are decaying and the damp is rising further up the wall. The recommended approach, in which the joints are repointed with a deliberately weak mortar, retains a permeable zone which will continue to decay — but in doing so it protects the surrounding bricks or stones. Because it allows evaporation, it also reduces the risk of the damp rising further in the wall. The salt damp is thus controlled — but not cured — and will require ongoing maintenance. Repointing mortar joints is much cheaper and easier than replacing bricks.

The same principle can be applied to plasters or renders. By using weak plasters the evaporative front (and hence decay) is moved from the original masonry out into the new plaster. Provided there is sufficient evaporation from the sacrificial plaster, decay can be limited to the lower parts of a wall. These treatments are the opposite of the incorrect practice of rendering the base of affected walls with dense, relatively impermeable cement renders. This simply prevents the evaporation of moisture, which continues rising up the wall until it can evaporate above the render, starting the problem all over again (Front cover & Figure 54).

Figure 31 Sacrificial plaster decaying as intended. Plastic sheeting is used to catch the salts and prevent their recycling through the soils and walls.

As they crumble, sacrificial mortars and plasters will produce a dust of sand, lime and salt which should be collected and periodically removed, rather than allowing the salt to re-enter the soil and so be recycled up the wall. When protected from rain strike (internally, in a cellar, or on a veranda) a drop-sheet of strong plastic sheeting can be useful (Figure 31). An alternative treatment, using half round PVC piping beneath a timber floor is shown in Figure 27.

Sacrificial mortars and plasters are designed to crumble and decay and will need ongoing maintenance in the form of periodic patching and, eventually, replacement. Because salts are rarely distributed evenly across a wall, they will decay differentially, and thus require selective patching. Their decay may not be aesthetically acceptable, making them unsuitable for some situations, particularly occupied interiors. More rapid desalination treatments (Section 14) may be needed.

13.1 Sacrificial mixes

The formulation of sacrificial mortar mixes will depend on the particular situation and may vary for different parts of a building. A starting point might be a 1:3 or 1:4 lime: sand mix. If the wall is well protected (such as in a cellar) a weaker mix like 1:5 or 1:6 may be suitable. Where exposed, a sacrificial plaster can be limewashed to provide some additional durability and improve its aesthetics (though take care not use a modern limewash containing resins such as acrylics, as they will prevent breathing: see Section 22). The limewash will fret off with salt attack and so the colour of the sand in the mortar may be important. Re-applying limewash may be the best approach aesthetically.

The performance of sacrificial mortars and plasters can be improved by adding what are known as porous particulates in place of some of the sand. Porous particulates include crushed lightly-fired bricks and crushed porous limestones; their purpose is to provide additional pore space within which the salt can crystallise, thus extending the life of the mortar or plaster. They have a further benefit: their pore space carries water during mixing and application, and that water helps ensure better curing of the lime. There is little experience with porous particulates in Australia and so it is difficult to recommend particular mix proportions. Experiment by replacing half to one part of sand with half to one part of a porous particulate material.

The use of inert short fibre reinforcement has been shown to improve the durability and long term serviceability of some sacrificial renders.

▶ More details about mortars, their materials, mixes and the repointing of joints can be found in a separate document in the same series as this Technical Guide.

14 Removing excessive salt

While sacrificial treatments (coupled with good housekeeping) may be sufficient for many mild cases of salt damp, additional treatments — beyond normal building work — may be needed to reduce high concentrations of salt. Commercially available desalination treatments include: poultices, to actively suck salt from masonry; and captive-head washing, which removes salty wash water with a vacuum system. Researchers have tested electro-kinetic removal of salt, demonstrating its effectiveness in pilot trials. Electro-kinetic salt removal is related to electro-osmotic drying of walls (see Section 16.4).

The decision to proceed to desalination treatments might be made when it is apparent that an otherwise well-made and well-cured sacrificial mortar or render is showing early signs of breaking down after say a year. Rather than waiting until it needs replacing again, it may be better to prolong its life by desalination treatment. In the case of a sacrificial mortar, an advantage of such a treatment is that the bricks or stones are also desalinated, considerably reducing the overall salt load on the mortar.

14.1 Dry vacuuming

Surface deposits of salt (such as those shown in Figures 4, 5, 27, 30 & 50) should be removed using an industrial vacuum cleaner fitted with a brush head. Brushing alone will work, but the vacuum has the advantage of capturing the salt, preventing its recycling through the soils beneath.

14.2 Poultices

Figure 32 Absorbent poultice shortly after application to an interior wall from which plaster has been removed. The poultice is left on the wall until it is dry, which may take 2–3 weeks depending on weather conditions.

Poultices are made of absorbent materials whose fine pore size produces a high suction when in contact with the masonry. Suitable materials include diatomaceous earth and highly absorbent clays such as attapulgite. To these may be added other materials like paper pulp which provides a framework or reinforcing. Poultices are purpose-made by conservators working on sculpture or museum objects. In recent years, a commercial poultice material has been developed in Sydney for use on masonry.

Poultices are applied wet to dryish masonry; the water contained in the poultice soaks slowly into the wall and dissolves salts, while the poultice shrinks onto the wall face (Figures 32 & 33). As the wall dries, water carrying salts in solution is drawn back to the surface by the high suction created by the fine pores in the poultice. The water evaporates and salts precipitate within the poultice, which is left on the wall until it dries out; this may take several weeks, depending on the weather. The poultice is then removed, taking the salt with it. Two or three cycles of poulticing may be required to reduce salt concentrations down to an acceptable level.

One approach with salty walls is to carry out two cycles of poulticing and then use a sacrificial plaster (Section 13) to control the remaining salts. This method has the advantage of rapid salt reduction with the poulticing, while enabling the sacrificial plaster to last longer — as it has less work to do — improving its appearance over a longer term. Always make sure that the substrate is suitable for poulticing; it may be too fragile or too susceptible to moisture.

14.3 Captive-head washing

These systems use a water jet spray within a hood or jacket which also contains a powerful vacuum to capture the dirty water and prevent it being spread over the masonry. They are used principally for cleaning dirt and grime from walls, and have some potential to remove surface and near surface salts, although there is limited experience with their use for this purpose. They will only ever be partially effective, as they must compete against the initial high capillary suction of the masonry, which will draw some of the water inwards, taking some salt with it.

Captive-head washing may be a useful way of reducing surface salts in bricks and stones prior to sacrificial repointing of the joints. That way the new mortar will have less salt to contend with and should last longer. An alternative would be to use a poultice, which would remove more salt, but which may not be warranted in many cases, particularly given the relative ease and speed of the captive-head washing. The choice will be a compromise between the need to remove salt and the complexity and cost of the treatment.

Other washing treatments have been tried without much success. They have generally been based on a period of spraying the walls with a fine mist, followed by a drying phase to bring the salts to the surface, and then either flushing the salts off with more water, or sponging them off by hand with damp sponges.

14.4 Monitor effectiveness of treatment

Figure 33 A square section of dried poultice has been cut out for chemical analysis. Sampling of the same point during subsequent cycles of poulticing is aided by a marker such as the galvanised nail in the bottom left of the 'window'.

Desalination techniques such as those described will never remove all salts from walls. Although most salts occur relatively close to the surface (because that's where most evaporation happens) there will be some deeper in the masonry which will slowly migrate towards the surface and accumulate there. With time these salts may reach high enough concentrations to warrant a further cycle of poulticing or captive-head washing in order to minimise decay. The results of all desalination treatments should be monitored for their effectiveness over time.

In the simplest cases monitoring might consist of a close visual examination looking for signs of efflorescence, or for early signs of decay of sacrificial mortars and plasters which might indicate the more damaging subflorescence. Inspections should be repeated after a dry spell to avoid the possibility that rain may have washed salts back into the wall just before the first inspection. In larger projects sampling and chemical analyses for salts may be warranted, and should be undertaken before and after desalination treatments.

As well as sampling the masonry for its salt content, poultice materials can be sampled as they are about to be removed from the wall (Figure 33). The results will not be comparable with those from the wall itself but can be used to monitor the effectiveness of poulticing over a series of cycles; later cycles will generally draw less salts, although experience suggests that sometimes the second cycle will draw more salt than the first. While a reduction in salt content will demonstrate the declining efficacy of further poulticing, it will not prove conclusively that the wall has been desalinated: only samples taken from the wall will do that. However, sampling the poultices has the advantage of not damaging the masonry: this may be important, particularly in high-value works such as sculpture.

See Section 11.3: (under *Diagnosis*) for further information on sampling and analysis.

15 Reviewing results before proceeding

This is a review step in the process. It is important to take the time to assess the effectiveness of the treatments to date before more invasive (and costly) work is considered. Have the good housekeeping, sacrificial treatments and desalination measures reduced the damp 'stress' on the walls to the point where they are relatively dry? Is the rate of decay now minimal and not sufficient to warrant further action for the moment? While this may be the case, it is important to understand that periodic desalination and renewal of sacrificial mortars will be required to control the salt damp to this minimal level. Even so, this may be the best outcome, as it removes the need for the more expensive and invasive insertion of damp-proof courses.

As discussed in Section 9.4: *Managing salt attack with maintenance*, there will be many situations where inserting a DPC is an essential part of dealing with a salt damp problem. In the more severe cases this will be obvious from the beginning and for these the intermediate steps of sacrificial treatments, desalination and review can be omitted, and the project can proceed directly to DPC insertion and associated desalination. It is for the less severe cases where the final outcome is less clear that Key Steps 3, 4 and 5 will be of most benefit.

Among things that should be considered during the review is the impact of unusual events, such as storms and floods, which may have temporarily added to moisture levels in walls and floors. Conversely, a long period of drought may lead to an incorrect assessment that the damp has been successfully controlled. There is no substitute for a thorough understanding of the building fabric and its behaviour over an extended period of time.

16 Inserting a damp-proof course

In many cases of severe damp the only effective solution is the insertion of a new damp-proof course. Done well, it can provide a permanent cure to rising damp to the masonry above the DPC; an important proviso is that salts must also be removed. Regular inspections will be necessary to check that the new DPC is not being compromised by the failure of guttering systems or because of bridging by built-up gardens. Sacrificial mortars used to control salts above the DPC may need periodic maintenance. It may also be necessary to maintain the wall beneath the DPC, using sacrificial treatments or more active salt-removal techniques, such as poulticing (Figure 34; see also Figures 9 and 10 and Box 7: *Potential negative impacts of DPC installation*). Inserting a DPC should only be contemplated after undertaking the housekeeping of Key Step 2 (Section 12).

Figure 34 Stonework below the DPC needs attention as salts accumulate and the mortar and bluestone erode. In the first instance sacrificial treatments should be used to manage the problem. The 1879 ceramic DPC is doing an excellent job of protecting the sandstone above it, although where it steps down the slope it is compromised by hard paving that is laid too high, allowing splash onto the stone (see Box 2: *Location of DPCs*).

The position of the new DPC in relation to ground level and to floor timbers is important; advice on these aspects is given in Box 2: *Location of damp-proof courses* and Section 19: *Inserting chemical DPCs in internal walls*.

New DPCs can be inserted by a range of techniques including:

- **undersetting**, in which sections of the base of a wall are progressively rebuilt in new materials, together with a DPC
- **slot sawing**, where a horizontal slot is sawn through a wall allowing insertion of a sheet DPC
- **chemical impregnation**, where water repellent chemicals are introduced into a wall via a series of drilled holes
- **active electro-osmosis**, in which an electrical current is used to drive water downwards against capillary action.

These techniques are explained in the following sections. Depending on the particular circumstances several DPC insertion techniques might be needed on the one building — all in combination with the management of salts by sacrificial treatments (Section 13) and/or desalination (Section 14).

16.1 Undersetting

Figures 35 and 36 Undersetting to install new damp-proof courses. At left sections, known as pins, are removed from a cavity wall, while at right a pin has been rebuilt on a plastic DPC, the end of which is rolled up ready for use in the next section. In the case of cavity walls, such as at left, the inner leaf also needs to be treated, using one of the methods described in this guide. Where solid walls are being underset, such as on the right, the entire thickness of the wall must be removed and rebuilt to allow a DPC to be installed across the full width of the wall. Partial undersetting of a solid wall is bad practice as the damp will continue to rise through the remaining portion.

The traditional physical means of introducing a new DPC is the technique known as undersetting, or masonry replacement. Undersetting should not be confused with underpinning, which is a treatment for structural cracking due to settlement or footing failure. In undersetting, sections of the base of the wall are removed down to the footing and progressively replaced with new materials and a DPC. Small sections (or pins) of brick or stonework are removed (including all decayed material), leaving pillars to support the wall structure (Figure 35). A DPC is incorporated as each pin is rebuilt; after the new mortar cures the top joint is packed tightly to take up the load of the wall (Figure 36). Adjacent sections are then removed and rebuilt until the whole wall has a new base incorporating a continuous DPC. Figure 37 is an example of undersetting carried out in the 1930s.

Undersetting is skilled work requiring great care. Do not attempt it without specialist advice. Undersetting of high walls may need structural engineering advice. While it may look precarious, the high compressive strength of masonry materials means that the load of a wall can be supported on the remaining brickwork despite the removal of a substantial proportion. In some cases, particularly in thick walls of rubble masonry, it is necessary to provide additional support for the overlying wall while sections are being rebuilt.

Figure 37 Undersetting from the 1930s. New bricks and stones have been inserted up to a line above the window sill on the left. Bricks below the DPC are visibly damp (see also Figure 10).

Though the most expensive, undersetting is the best method for dealing with very severe salt damp because it removes salt-laden masonry as well as inserting a new DPC. No other technique combines both aspects. Additionally, undersetting permits ready inspection inside a wall (whether solid or cavity) which may be important to understanding the extent of decay and the nature of repairs needed (see Section 18: *Cavity walls*).

A disadvantage of undersetting from a heritage conservation viewpoint is that it requires the removal of original fabric. The use of new materials may be more of an issue where good matching to the original is not possible. If the stones or bricks are generally sound and the decay is limited to the mortar, this can sometimes be overcome by dressing off the latter and soaking the stones or bricks in successive baths of fresh water to remove salts, without drying between baths. Conductivity meters can used to show when salt concentrations in the wash water have reached a minimum. The desalinated stones are then rebuilt into the wall together with a new DPC. It is important that skilled stonemasons are engaged to carefully match the appearance of the rebuilt masonry with that of the original wall.

16.2 Slot sawing

Figure 38 Insertion of a DPC by slot sawing. A mortar joint is sawn out with a chainsaw allowing insertion of DPC sheeting. As salt-laden stone is left above the DPC, the technique must be combined with desalination to be successful.

Another physical method involves sawing a horizontal slot through the wall along a mortar joint, inserting a DPC membrane and repacking the joint. Like undersetting, the work is done in stages to ensure adequate support for the wall. Sawing is done by hand with a masonry saw, or with a chainsaw with specially hardened blades. The technique is limited to regular masonry with continuous horizontal courses (such as brickwork) and relatively soft mortars. Dense bluestones and granites will blunt saw blades. Random rubble masonry cannot be cut, though it may be possible to saw-cut a mortar joint if the masonry is in regular courses, or where there is a failed DPC. In thick stone walls where the core often comprises small irregular pieces of rubble, sawing can be impractical, particularly if there are voids with loose stones which may drop into the saw-cut.

DPC sheeting is inserted into the saw-cut, which is then packed with stiff mortar and tightly rammed to take up the load of the walls (Figure 38). After the mortar cures the next section of joint can be sawn out and work progresses around the walls. A potential problem with this method is the perforation of plastic DPCs owing to the (correct) use of sharp sands and the ramming necessary to pack the joint tightly. Thicker (0.75 mm) DPC material is recommended in these cases.

A neat version of this method uses a series of overlapping envelopes made of DPC polyethylene and sealed at the edges. After insertion in the wall, a non-shrink grout is pumped into each envelope in turn through a nozzle on the outer edge. The advantage is that the envelope expands to tightly fill the space left by the saw-cut and so supports the weight of the wall when the grout has cured. Excess envelope material and grout are trimmed off, leaving two DPCs with grout in-between.

The slot sawing method has the advantage over undersetting of reducing disruption to existing historic masonry. By itself, it is an appropriate technique in circumstances where there are no salts in the wall above the new DPC, such as a relatively new building constructed without any, or defective, damp-proofing. **However for older walls, which in Australia will almost certainly contain salt, slot sawing must be combined with sacrificial treatments and/or desalination for it to be successful.**

16.3 Chemical impregnation

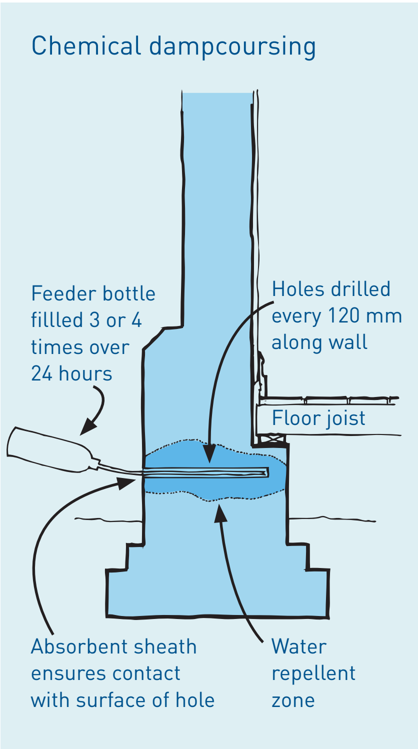


Figure 39 Chemical dampcoursing. Cross-section through a solid wall showing the gravity-fed system. Note that the new water-repellent zone should be installed below all floor timbers.

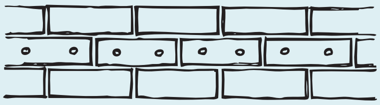
Chemical impregnation is now the most frequently used treatment for remedial dampcoursing in Australia. The principle is to create a water-repellent zone at the base of walls by inserting appropriate fluids into a series of pre-drilled holes. The fluid permeates through the pore structure of the masonry, meeting fluid from the adjacent drill holes and curing to form a continuous water-repellent zone. Such treatments have been used in Australia for about thirty years. In the UK, where they been used for fifty years, there is a British Standard which gives recommendations for the procedures to be used in diagnosing and treating rising damp by chemical methods (see *Further reading*).

A range of chemicals has been used for this purpose, the most common today being alkyl and alkoxy- siloxanes (commonly shortened to siloxane) which are carried in an organic solvent at a rate of about 5–7% by weight. Following impregnation, a catalyst in the fluid triggers the formation of a gel, the solvent evaporates and a water-repellent silicone resin is left lining the pores of the masonry. The treatment will prevent rising damp but will not stop water under pressure, so impregnation techniques cannot be used where there is a hydrostatic head such as may occur when tanking a cellar or basement.

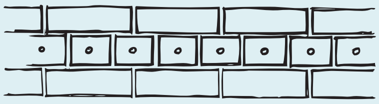
Other chemicals used include aluminium stearates and potassium and sodium siliconates, but their use has declined in favour of siloxanes.

Water-based versions of silanes and siloxanes have been developed in response to concerns about health issues associated with volatile organic solvents. These materials are emulsified as viscous 'creams'; they have a relatively high concentration of active ingredient and a small proportion of water as carrier. They are comparatively new on the Australian market and there is limited experience with using them. Early indications suggest that there is some variation between products.

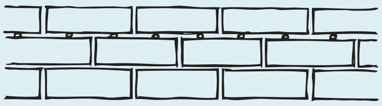
Drilling patterns



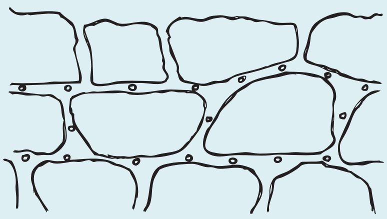
Drilling pattern for stretchers



Drilling pattern for headers



Drilling pattern for mortar joints



Drilling pattern for dense rubble stonework

Figure 40 Drilling patterns for chemical impregnation. The first two examples are for low-pressure injection into the bricks and the last two for treating the mortar joints by either low-pressure injection, gravity-fed fluid, or water-based cream. Where a wall 230 mm (one brick) thick is to be injected, a header course should be drilled for preference. Where a stretcher course is to be drilled the stretchers on the other side of the wall must also be drilled, either from the other side, or from this face in sequence — by drilling and injecting the visible stretchers first and then drilling through the same holes to the other stretchers and injecting them in a second phase. The same sequential approach is applied when cavity walls are accessed from one side only.

Holes about 10–15 mm in diameter are drilled about every 120 mm in a line along the base of a wall, such as in a mortar joint. In bricks, two holes are drilled in every stretcher and one hole in every header (Figure 40). The holes are drilled to within about 30 mm of the other side of the wall or brick (Figure 39).

Where the masonry consists of hard and dense rubble stonework, it may be impractical to drill into the hard stone; and penetration of dampcoursing fluid into dense materials may be imperfect. The rubble construction means that there is a lot of mortar with potential for voids. In these circumstances some suppliers advise enveloping the dense material with dampcourse fluid through holes drilled into the mortar above, below and to the sides of each stone (Figure 40). Thick walls of irregular rubble may be difficult to fully impregnate.

Fluid is delivered into the holes by either a tube or a lance depending on whether it is to be gravity-fed or injected under low pressure (Figures 41 & 42). The choice of technique is to some extent determined by the nature of the masonry: gravity-fed diffusion is suitable for porous mortars and soft bricks, while normal bricks can be injected under low pressure (20–70 psi, 150–500 kPa). High pressure injection (greater than 150 psi, 1000 kPa) risks the blowout of weak mortars and imperfect coverage in sound materials due to viscous fingering, a process in which the fluid advances as a series of fingers, leaving gaps between.

Water-based creams are delivered by a cartridge or caulking gun fitted with a narrow tube that reaches the rear of the holes. Creams are generally applied to mortar joints, as the more porous mortar permits better diffusion and penetration of the emulsion.

Critical to the success of any chemical treatment is the formation of a continuous water-repellent zone through the entire wall thickness. This may be difficult to achieve and must be judged by the operator, whose experience and skill are essential to a good result.

Each of the three techniques described:

- low pressure injection of solvent-based fluid
- gravity-fed diffusion of solvent-based fluid
- diffusion of water-based cream

permit prolonged or multiple applications of fluid or cream, which allows the operator to add more if there is any doubt about the adequacy of coverage.

Figure 41 and 42 Chemical impregnation. On the left: the gravity-fed system in which small plastic bottles are filled with a lance. Depending on the nature of the masonry and thickness of the wall the bottles are filled three and sometimes four times. Open holes just above the drilled line are used to indicate extent of penetration. On the right: low-pressure injection in progress on an interior wall from which plaster has been removed. Note the variation in the permeability of the brickwork; the brick on the left is already saturated and the lance is moved on while the central brick slowly fills with fluid.

The following should be considered when contemplating a chemical DPC:

- chemical impregnation should not be attempted where the mortar or masonry is weak and crumbling: treat only relatively sound materials
- voids in thick walls may lead to loss of fluid. Where voids are large, it may be necessary to fill them with grout prior to chemical impregnation (grouting may be desirable anyway to re-establish the integrity of the wall). This needs to be evaluated prior to commissioning any treatment
- in a small proportion of cases the chemistry and mineralogy of the substrate may affect the curing and water-repellency of the fluid or cream
- very wet walls may limit diffusion of gravity-fed fluid or cream
- for the treatment to be successful the wall must be allowed to dry thoroughly after impregnation, particularly during winter months
- good operators may use more fluid than might otherwise be necessary in order to be certain of thorough penetration through the full wall thickness
- dampcoursing fluid and creams are expensive and so there is a cost pressure on contractors to use less
- unscrupulous contractors might dilute the fluid with additional solvent, leading to insufficient water-repellency, or space the drill holes at wider intervals than recommended leading to incomplete coverage
- injection of fluid may displace saline moisture in the wall, forcing it higher up, where it may cause decay to susceptible materials not previously damaged. It is advisable to use a desalination poultice at the same time as the injection
- never drill and impregnate directly into an old tar and sand DPC — it may not be working well, but perforating it will not help

- the solvents used may dissolve polystyrene insulation in cavity walls; and may dissolve tar or bitumen from existing DPCs and spread it through the masonry, leaving a brown stain on the surface
- fumes and fire safety issues with solvents must be managed
- the position of the chemical damp-proof zone in relation to ground level and to floor timbers is critical to achieving a good result. See Section 19: *Inserting chemical DPCs in internal walls* and Box 2: *Location of damp-proof courses* for important advice on these aspects
- chemical impregnation treatments can be used in the zone below existing DPCs. This may be useful where the existing DPC is too far above ground level (see Box 2: *Location of damp-proof courses*), and/or where reducing evaporation to the exterior (and therefore transferring it to the underfloor space) is an appropriate solution
- the treatment may leave a row of unsightly plugged holes; when filling them, care is required to accurately match the surrounding material.

▶ See Section 6.1: *Which salts?* for an explanation.

Importantly, chemical impregnation provides only a barrier to rising damp; it does not prevent salts in the walls above the new damp-proof zone from cycling in and out of solution with changes in humidity, and so continuing to cause damage. **Chemical impregnation must be combined with sacrificial treatments and/or desalination for it to be a successful treatment for salt damp** (Figure 43).

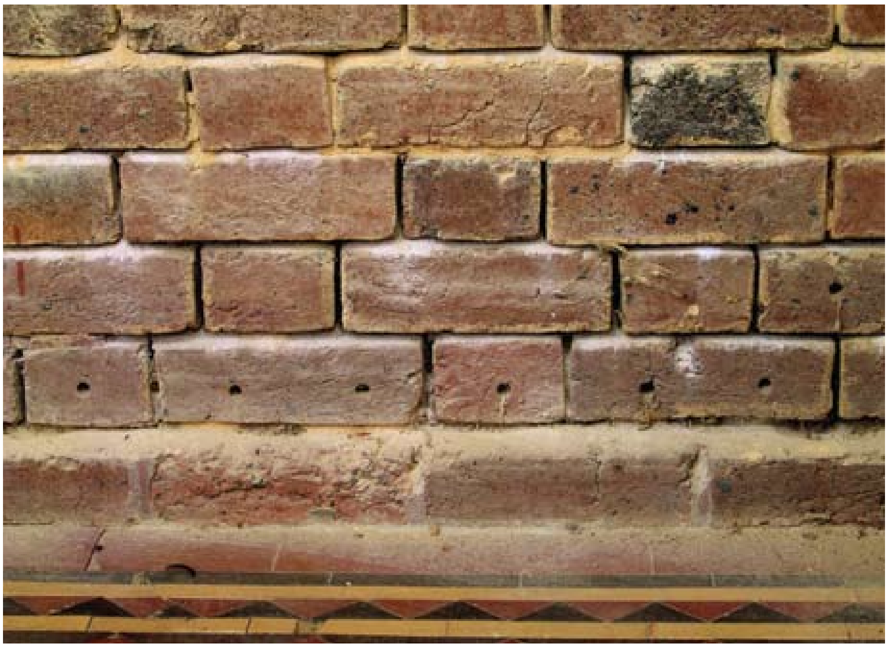


Figure 43 Despite chemical impregnation, decay continues to the brickwork above the treated zone. This is because salts remain in the wall and can cycle in and out of solution with changes in humidity, causing ongoing salt attack decay. The yellow sand is what remains of a sacrificial mortar applied at the time of chemical impregnation. The white material is a mixture of the original lime mortar and salt. Further treatment should include raking out the salty mortar and repointing in a sacrificial mix and possibly poultice desalination, together with an assessment of the effectiveness of the chemical DPC. Note that extensive repointing may bridge the DPC, and so it may need re-treatment once the new mortar is well-cured. Alkaline-stable damp-course fluids should be used.

16.4 Active electro-osmosis

Electro-osmotic damp-proofing is based on the scientific observation that water moving through a porous medium creates an electrical potential difference which is known as the 'streaming potential'. By using an active current to superimpose an electrical potential, water can be driven in a chosen direction. This is exploited in various ways including the dewatering of wet silts and clays to allow the excavation of construction sites.

Both passive and active approaches have been used in applying electro-osmosis to the treatment of rising damp.

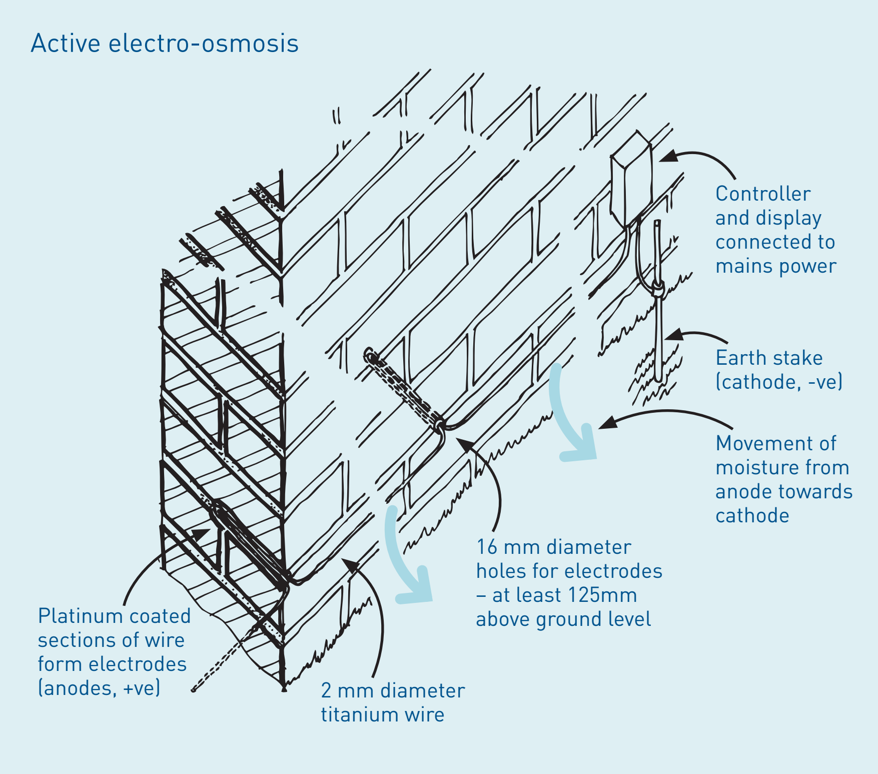
Passive electro-osmosis was widely used across Australia in the 1960s and 70s and gained a notorious reputation on account of the many failures of the technique. Most claimed successes can be attributed to other works undertaken at the same time, including repair of gutters and attention to ventilation and site drainage. Proponents of the method argued that by electrically connecting the damp zone of the wall to the ground, the electrical potential could be negated and the moisture flow stopped. A continuous copper strip was looped into holes drilled into walls and laid into a raked-out mortar joint (or left behind skirting boards) about 300 mm above ground level. The copper strips were earthed to the ground to complete the circuit.

There is no scientific basis to the passive system — it is the movement of water through the porous medium that creates the electrical potential, not the other way around, and so simply earthing the resulting charge will not prevent the damp from rising, as capillary suction is unaffected.

On the other hand, **active electro-osmosis** is based on applying an active DC current to drive water down a wall in a similar manner to its use for dewatering building sites. Although the technique was available in the 1960s it was not much used due to the cost of electricity and because the copper strips (or electrodes) were rapidly corroded in salty walls.

In recent years a more advanced version of active electro-osmosis has been introduced to Australia from the United Kingdom. This system uses titanium wires with platinum-coated electrodes to overcome the corrosion problem. It has an electronic controller that reduces power consumption to a minimum and has a display that enables monitoring of voltage and current (Figure 44).

Figure 44 The active electro-osmosis system showing arrangement of electrodes. The platinum-coated sections of titanium wire that form the anodes are looped into holes drilled in the wall approximately one metre apart and are set in a rich cement mix to form an electrical contact with the surrounding masonry.



The following should be considered when contemplating active electro-osmotic treatment of rising damp:

- the system must remain switched on at all times
- later building works may cut through the cables, though the risk is reduced by running the cables in continuous loops
- there are no chemicals such as organic solvents involved in the process
- the system has received a current CSIRO Appraisal (see *Further reading*) indicating it "is suitable for counteracting rising damp in new and existing buildings", though similar 'fit-for-purpose' assessments have not been made by the UK Building Research Establishment (BRE) or the British Board of Agrément (BBA)
- electro-osmosis requires a material that has high surface charges and fine pores, such as old underfired bricks. Treatment of materials such as limestones with large pores is unlikely to succeed
- there are some concerns as to its function at low moisture levels when the transport of water as a liquid ceases and is replaced by evaporation and condensation of vapour. At very low moisture levels this may not matter
- because active electro-osmosis dries the wall below the line of electrodes it has the potential to protect floor timbers, even though the electrodes may be installed at, or just above, floor level (see Section 19: *Inserting chemical DPCs in internal walls*)

- active electro-osmosis may be useful as a supplementary damp-proof course where the existing DPC is too far above ground level (see Box 2: *Location of damp-proof courses*)
- stray currents may cause corrosion of steel reinforcing in concrete and of pipes and other buried metals
- the effectiveness and long term performance of active electro-osmosis in very salty walls is unclear.

As noted in Section 14 *Removing excessive salt* there is a related phenomenon, electro-kinesis, which is being investigated as a possible means of desalinating walls. The interrelationship between electro-osmotic dewatering and electro-kinetic desalination warrants further investigation.

While active electro-osmosis may remove salt already in solution below the electrodes, there remains the issue of salts above the electrodes which are free to continue causing damage with changes in humidity. **Like chemical impregnation and slot sawing, active electro-osmotic damp-proofing must be combined with sacrificial treatments and/or desalination for it to be a successful treatment for salt damp.**

Potential negative impacts of DPC installation

Installing a DPC in a wall may reduce the evaporative zone on the external face from a height of about 1000 mm down to about 200 mm. This means that moisture evaporation through this zone will be increased by a factor of five times, assuming that evaporation from all other wall surfaces is unchanged. This has implications for the masonry below the DPC, which may begin to decay rapidly as a result and may require additional remedial treatments such as desalination.

Two treatments might be considered in this situation. By chemically impregnating all of the exposed masonry from ground level up to 200 mm, a new DPC can be installed without leaving an evaporative zone below it. Secondly, active electro-osmosis may keep the zone above ground level dry. High salt concentrations should be removed from this zone prior to the use of either chemical impregnation or electro-osmotic treatments.

Alternatively, where both salt levels and rates of evaporation are relatively low (and where the site is well drained) it may be appropriate not to install a DPC but to manage the ongoing salt attack and rising damp using sacrificial treatments and minimising the rising damp 'stress' on the walls. This will mean that evaporation (and hence decay) will continue to occur over a broad zone, but will be much less intense; so the rate of surface loss will be lower at any one point than it would be if the zone were to be narrowed.

Also note that where installing a DPC reduces evaporation the risk of fungal rot and insect attack to floor timbers will be increased, due to higher humidities in the underfloor space.

Box 7

17 Desalinating walls

The works of this last of the Seven Key Steps are similar to those of Key Step 4 (Section 14: *Removing excessive salt*) which should be referred to for details. The works consist of two or more of:

- dry vacuuming
- poulticing
- captive-head washing
- sacrificial treatments.

They are undertaken in combination with the insertion of a DPC; the focus is on removing as much salt as possible from above the new DPC.

Desalination may be needed in combination with all of the methods of DPC insertion. Even with undersetting there may be a need for desalination: particularly where costs and/or a shortage of matching replacement materials limit the height up to which undersetting is carried, and so desalination is needed to manage salts that remain higher in the walls. With chemical injection it is useful to begin poultice desalination prior to injection, as explained in Sections 16.3 and 21. Where electro-osmotic damp-proofing is to be used, remove as much salt as possible prior to switching on the current.

Despite thorough desalination there will still be the need for annual monitoring for further salts migrating to the surface from deeper within the walls. Follow-up desalination and sacrificial repointing may be required until most salts are removed from the masonry. Monitoring may reveal a localised area of dampness indicating a 'leak' in the new DPC which may need remedial injection or other corrective action. In addition there will always be the need for maintenance of the wall between the DPC and ground level; this will commonly require the use of sacrificial treatments.

Building Code of Australia

The annually updated *Building Code of Australia* (BCA) is a uniform set of performance-based technical provisions for the design and construction of buildings and other structures throughout Australia. The BCA contains mandatory Performance Requirements accompanied by optional Deemed-to-Satisfy Provisions. In relation to rising damp the BCA provides Deemed-to-Satisfy Provisions for:

- acceptable damp-proof course materials;
- location of damp-proof courses; and
- ventilation of sub-floor spaces.

The BCA details minimum requirements for building work and is given legal effect by building regulatory legislation in each State and Territory. It is generally applied to new buildings and new building work only. Application of the BCA to new work on existing buildings is triggered when the scale of works reach certain thresholds that vary between States. In some States it may be necessary to bring an entire building into compliance due to the extent of construction work, irrespective of whether work is being conducted in that area. When works to an existing building are only repairs (such as remedial damp-proofing) then the BCA is not called up, though it provides a useful reference as a construction standard. The Australian Building Codes Board is currently (2008) considering issues related to salinity, that may result in changes to the BCA.

Box 8

18 Cavity walls

Figure 45 Decay of an inner leaf of brickwork into the cavity. This would not have been discovered had the wall not been opened up for undersetting of the outer leaf. The decay means that evaporation is occurring in the cavity in preference to the interior of the house. Multiple paint coatings or previous repairs of interior plasters with dense impermeable materials may be an explanation. Whatever the cause, the implications of decay occurring where it cannot be seen are profound. The inner leaf must be treated, using one of the methods described in this guide.

Prior to the late nineteenth century all brick and stone walls were of solid construction, although thick stone walls may have consisted of two leaves with a rubble-filled core that often contained voids. Solid walls, particularly those made of 230 mm (nine inch) brickwork are susceptible to moisture penetration during prolonged driving rain. The cavity wall was developed in response to this problem and became the dominant twentieth century means of domestic building until the advent of brick-veneer construction.

In domestic construction cavity walls generally consist of two leaves of brick 110 mm (4.25 inches) thick with a 50 mm (2 inch) cavity. Metal ties are built in at regular intervals to bind the two leaves together. Cavity walls stay dry on the inside because any moisture that penetrates the outer leaf runs down the cavity and out through weep holes left in perpendicular joints at the base of the wall. Critical to their success are the correct detailing and use of flashings and the care taken in construction to prevent mortar droppings (snots) from accumulating on the wall ties, and so providing a moisture bridge across the cavity. A pattern of "dots" of moisture on an inside face can be a sign of a cavity bridged at the wall ties.

Salt damp can be particularly problematic in cavity walls because of the risk of decay inside the cavity where it cannot be seen (Figures 45 and 46). In normal circumstances most decay should occur at the external surface of the wall (because that is where there is most evaporation — see Section 9.1: *Factors causing salt attack*). Some decay can be expected on interior surfaces, particularly if the rooms are heated and air-conditioned.

Unfortunately, 'normal' circumstances are progressively removed as successive owners seek to deal with a damp problem by sealing it in. Hard waterproof plasters and multiple paint coatings on interior surfaces; and dense cement renders, cement repointing of joints, as well as paint coatings on external surfaces; all reduce evaporation from these surfaces and increase the likelihood that evaporation inside the cavity will become dominant, leading to unseen decay.

While Figure 45 shows an example of decay of an inner leaf, more severe decay is likely on the inside face of an outer leaf, as shown in Figure 46.

Despite repointing with hard mortars, water will enter the wall through the bricks and through cracks between the new mortar and bricks as well as through failed DPCs. And if walls have been sandblasted they will be particularly liable to water penetration as both bricks and mortar will be much more permeable than before. Where the bedding mortar was relatively weak (because it was to be finished in a stronger pointing mortar) it will be susceptible to rapid decay into the cavity.

Severe decay of the outer leaf will lead to the accumulation of debris at the bottom of the wall, bridging the cavity with saline material and causing dampness inside the building. Wall ties will be more susceptible to corrosion in the saline environment and ultimately the outer leaf will become structurally weak — all of it unseen from the outside. Buildings close to the coast will be particularly at risk of this type of damage from sea spray.

When inspecting damp problems in old buildings with cavity walls it is essential that the inside of the cavities be checked for decay, bridging and the corrosion of wall ties.

Inspection of cavities will often involve removal of vent grilles, and removal of bricks at corners to get a clear sighting along the cavity. Borescopes, industrial versions of medical endoscopes, use fibre optics to enable viewing through narrow holes drilled through mortar joints. They are commonly used to detect mortar snots on wall ties. Because they involve minimal intervention they can be useful tools for determining the need for further opening up.

Repair of an outer leaf that is found to be decaying into the cavity may involve its progressive removal and reconstruction using the undersetting technique described in Section 16.1. If the decay is only to a weak mortar then the bricks can be soaked to remove salt and reused in the wall. A new DPC should be inserted at the same time. Even if repair of the outer leaf is not (yet) warranted, the bottom of the cavity should always be cleared of debris.

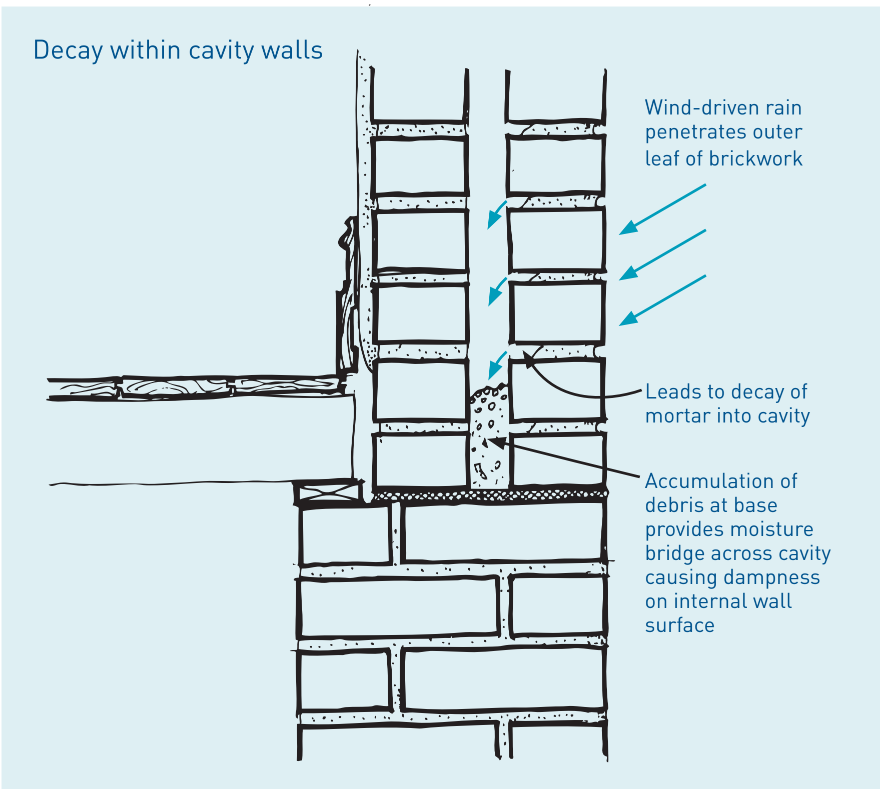


Figure 46 Section through a cavity wall showing deterioration of the inside face of the outer leaf due to moisture penetration through the brickwork. Such decay is more likely where the wall has been sandblasted, making the outer surface more permeable, and where the DPC is not effective, allowing rising damp to compound the problem. Even with a perfect DPC, decay into the cavity may be a problem, particularly near the coast where sea spray carries salt into walls.

19 Inserting chemical DPCs in internal walls

A common practice when chemical dampcourses are being installed in internal walls is to remove the skirting boards and plaster and to drill into a course of bricks just above floor level, as shown in Figure 47. It must be understood that this is a compromise between the good practice of installing the DPC as low as possible on the one hand, and minimising cost and disruption to the building owner on the other. While the new DPC will protect the overlying masonry, wet bricks will remain below in contact with floor timbers, with the consequent risks of fungal rot, borer and termite attack.

It is bad practice to cut costs and minimise disruption by drilling at a steep angle from above skirtings which are left in place. When salt damp is severe enough to warrant DPC insertion, skirtings should always be removed and their backs inspected, as they may be damaged by rot and termites.

As shown in Figure 47 the desirable location for the DPC is below all floor timbers. This is because the purpose of the DPC is not only to keep the masonry dry but also to keep the floor timbers dry. Unfortunately, in many Australian houses the DPC was not carried through under the floor plates; instead, the latter often sit directly on masonry, which may be quite damp.

Inserting DPCs in internal walls

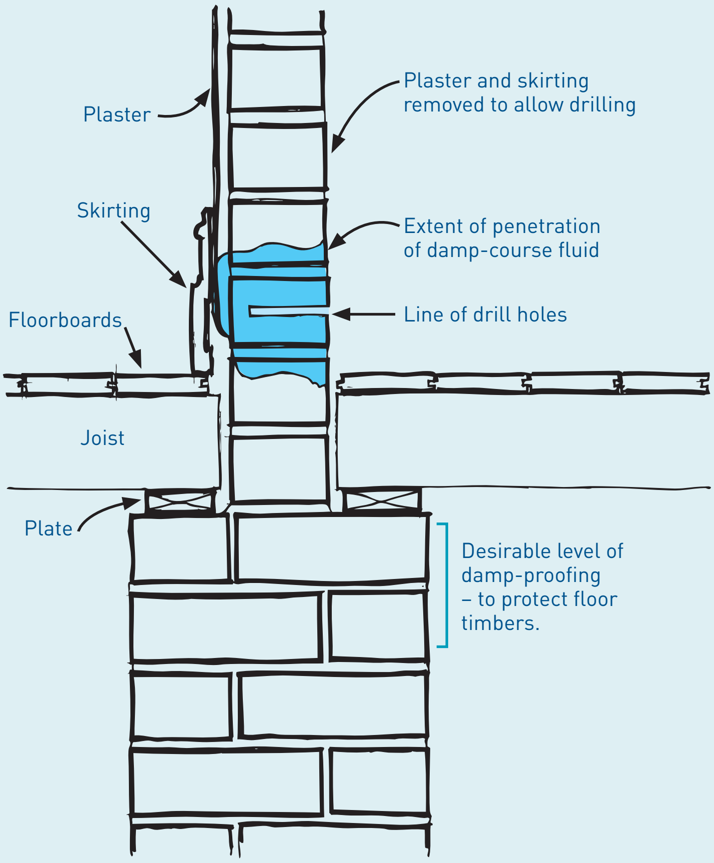
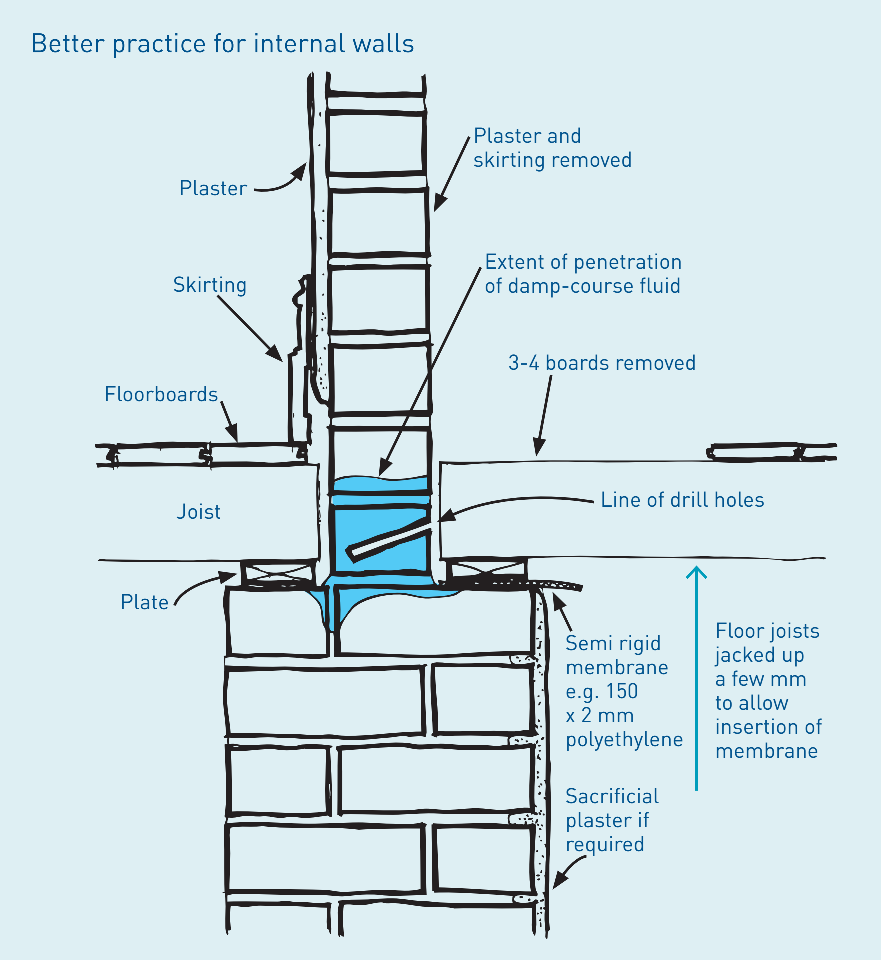


Figure 47 A common practice when installing chemical dampcourses into internal walls is to drill and inject the course of bricks shown. This produces a water repellent zone that may protect the wall above but does not protect the floor timbers, which remain at risk of fungal rot and termite attack.

Best practice DPC insertion would therefore require the removal of sufficient floorboards to enable working access to the wall so that it can be injected (or slot sawn) below floor level. This will obviously add to the expense and disruption of the job. (Note that there are practical difficulties with injecting the upper course or slot sawing in the first mortar joint below the floor plate, as the upper course of bricks will be loosened by vibration. Drilling, or slot sawing, would need to be in the second or third course or joint, respectively.) There may be additional complications if the wall below floor level is not made of regular brickwork but of dense stone such as bluestone or granite, which may make DPC insertion difficult. A less expensive alternative, but one which would still provide protection to both masonry and timber, is explained below.

Three or four floorboards are removed to enable the drilling and injection of the course of bricks immediately above the floor plates as shown in Figure 48. Dampcourse fluid will penetrate up into the course above and downwards into the top of the wider masonry below.

Figure 48 Proposed method of achieving damp-proofing of interior walls and of floor timbers using a combination of chemical impregnation and insertion of a semi-rigid membrane beneath the floor plates. The membrane, which might be 2–3 mm thick polyethylene, such as is used for root barriers and lawn edging, is pushed in hard against the newly created DPC. Removing floorboards, which is a skilled activity requiring a carpenter, may not be necessary if there is access and working room beneath the floor.



The mortar joint immediately above the wider masonry (and directly below the brick being drilled) is where we would expect to find a DPC. A partially effective DPC (e.g. of tar and sand) at this joint will limit downward penetration of the fluid. Drilling and impregnating an existing tar and sand DPC would be counter-productive and should never be undertaken. Impregnation adjacent to a tar and sand DPC creates the risk of staining as solvents in the fluid dissolve components of the tar, although this shouldn't be an issue for interior walls that are to be replastered.

Protection of the floor timbers is achieved by jacking floor joists up a few millimetres to enable insertion of a new membrane beneath the plates. The membrane can function as both a DPC and as a partial termite shield, though it could not be considered as termite shielding within the meaning of Australian Standard AS 3660—2000: *Termite Management*.

Appropriate materials might be stiff plastic such as is used for root barriers and lawn edging. Normal DPC material, whether 0.5 or 0.75 mm thick, would not be suitable, as it would not resist the abrasion of dry insertion, nor have sufficient rigidity to enable it to be forced into place. A material of the order of 2–3 mm thick would be more suitable. Standard termite shield materials, such as galvanised steel and other metals, are not recommended, as they may corrode in the damp saline environments that are commonly encountered in old walls.

Floor plates on dwarf walls should also be protected with a membrane.

Instead of chemical impregnation, internal walls might be treated by undersetting, in which case it is important that the new DPC be carried through under the floor plates.

Whichever treatment is used, it may be desirable to apply a sacrificial plaster to the face of the wall below the new membrane. More thorough desalination will be required for very salty walls, such as that shown in Figure 50.

20

Out of sight, out of mind: the need for improvements to practice

Figure 49 The photograph at right is looking beneath a floor against a damp wall, and shows a wet zone on the timber joist and plaster debris on the floor plate, which is wet and rotten. The diagram below is a sectional view showing how the plaster debris drops behind the floorboards and sits on the floor plate. The debris provides a path or bridge around the DPC. Even though the DPC may have been only partially effective, the newly created bridge will add to the rate at which damp rises. And the salt that caused the first plaster to fail is being recycled into the wall where it will cause more damage. Furthermore, the plaster debris holds moisture against the floor timbers, increasing the risk of fungal rot and insect attack.

The risk for many walls and timbers in underfloor spaces is that they are unseen and ignored, as these photographs show. Figure 49 was taken through a floor trap near a damp wall and shows a wet zone on the floor joist. Of particular concern is the pile of debris sitting on the floor plate to the left of the joist. The debris is from the previous plaster on the wall above, plaster that decayed with salt attack, some of it falling behind the skirting board and onto the plate. Most of the debris on the plate would have landed there during the last round of repairs when the damaged plaster was hacked off the wall, some of it falling through the gap between floorboards and the wall itself as the diagram shows. Being salt-laden (and hence hygroscopic) the debris attracts moisture and spreads it to the timber plate and the joist. After removing the debris, the wall plate beneath was found to be mostly rotten, with little sound timber remaining. As well as promoting fungal rot, high moisture levels in timber significantly increase the risk of borer and termite attack.

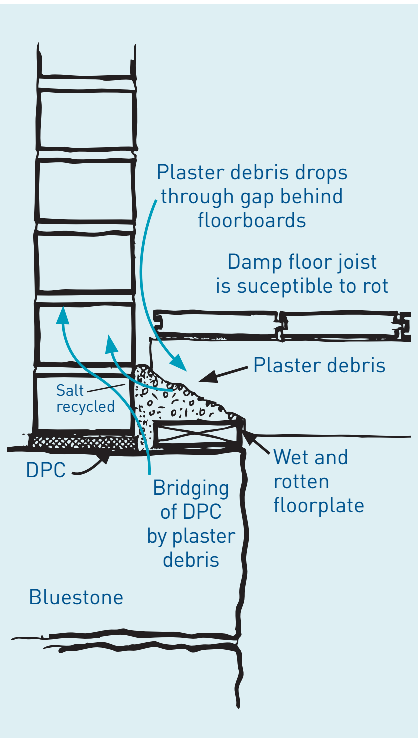


Figure 50 shows a similar view beneath the floor of another house. Salt attack is decaying the brickwork and the debris is accumulating on the damp floor plate. The brick debris overlies previous plaster material which has fallen onto and behind the plate, thereby making a bridge across the DPC which is located out of sight, directly behind the floor plate. Unfortunately the plate is not isolated from the damp masonry below, a situation that is common in Australian buildings. Note the extensive salt efflorescence on the face of the bluestone rubble.

Figure 50 Looking beneath a floor at the edge of a debris-covered floor plate. There are water stains on the end and base of the joist. Salt attack is damaging the bricks at the rear, which are slowly crumbling onto the floor plate. Dense salt crystals encrust the surface of the rubble bluestone in the foreground. The lack of a membrane beneath the floor plate means that the floor timbers are at greater risk of fungal rot and termite attack.

The problem of accumulation of plaster debris on floor plates is widespread and is likely to be encountered wherever repairs to plasterwork have been undertaken.

The message from these photographs is that plaster repairs to the walls above are endangering the floor timbers below — timbers which may be out of sight and out of mind to the damp-proofing contractor. There is a need to change the work practices of specifiers and contractors to recognise and deal with these risks. There are five key points to keep in mind:

- all investigations of buildings for salt attack and rising damp should include an underfloor inspection to assess the condition and risks to floor timbers, in addition to the state of the walls, and any dwarf walls that support the floor
- all debris accumulating on floor plates should be removed (e.g. by industrial vacuum cleaner) which will mean access to the floor plate — either from under the floor where headroom is sufficient; or by lifting floorboards against the wall; or from the other side of a wall that is being opened up for undersetting
- membranes should be inserted beneath the floor plates to protect them from dampness coming directly from the wet wall below — see Section 19: *Inserting chemical DPCs in internal walls)*
- replastering work should include additional measures to prevent debris from dropping through the gap behind floorboards and to retrieve any that does
- certification of completed works should include underfloor inspections to confirm that debris has been removed from floor plates and that all floor timbers are suitably protected from rising dampness.

21 Repairs to interior plasterwork

Figure 51 Discoveries on removing plaster from interior walls. On the left, the brick-on-edge is a partial undersetting of the inner part of a solid wall, leaving the outer part untreated — a total waste of effort. On both walls, but more apparent on the right, are remnants of a dense hard cementitious material containing milled iron that was designed to rust and block pores, making it impermeable. Its removal proved extremely difficult.

Figure 52 A thick film of salt that crystallised beneath a hard render, which was in turn finished with a high-build (thick) paint coating. For evaporation (and hence salt crystallisation) to occur the render must first have become partially detached from the brickwork. Thermal cycling would then drive air movement, allowing evaporation. The salt was chiselled off and the brickwork poulticed before re-rendering.

Repairs to interior plasterwork are commonly required when dealing with a damp problem, whether its origin is rising, falling or penetrating. In each case it will be important to cut off or minimise the source of moisture and to remove any salts prior to replastering. This section expands on some of the issues with interior plasters and rising damp.

Prior to undertaking the insertion of a damp-proof course (by whatever method), plaster is removed from interior walls up to at least 300 mm above the upper limit of elevated salt and damp readings, as measured with a moisture meter — used with informed caution as explained in Section 11.2.

This is when some unhappy discoveries may be made. The building may have been previously treated for salt damp and the discoveries may include corroded remnants of copper wire electrodes from a passive electro-osmotic treatment, replacement masonry from a partial undersetting of the walls, and hard impervious renders trapping moisture and salt within the walls (Figure 51). The hard render may have delaminated in places, leaving a film of salt crystallising in the space between render and wall (Figure 52). The render, which may have been formulated to be waterproof and may be an extremely hard mix of almost neat cement, will need to be removed to allow desalination.

Desalination can begin straight away and need not wait for DPC insertion. Indeed, beginning the desalination before treatments such as chemical impregnation has some advantages, including protecting the wall above from a sudden flushing of salt that may be displaced by the injection of dampcoursing fluid (see Section 16.3: *Chemical impregnation*).

Some contractors claim that the old plaster acts sacrificially, making poulticing unnecessary. While there is some truth in this, the overall effect will be slight, particularly as paint coatings will slow the drying while multiple coats may stop it altogether. Where there is a lot of salt, it is better to remove the old plaster and to poultice the underlying masonry.

After thorough desalination and insertion of a new DPC, the walls can be replastered. So that the new plaster will be compatible with the wall, its materials should be similar to those of the original. The replacement plasters for old walls of flexible masonry should also be soft and flexible and made of lime, whereas a stronger cement-lime plaster may be appropriate for newer and stiffer walls on rigid footings. The amount of gypsum (plaster of Paris) in the final (set) coat will be determined in the same way: less for old flexible walls and more for younger stiffer walls.

Figure 53 Damaged plaster on a damp wall; the dampness is indicated by green algae and white salts crystallising on the stonework and fill below. The recent plaster is decaying because it contains gypsum.

Gypsum plasters should not be used where there is any risk of continuing dampness. This is because gypsum, which is calcium sulphate ($CaSO_4 \cdot 2H_2O$) is a slightly soluble salt and any moisture will trigger salt attack within the new plaster (Figure 53). Use only lime or lime-cement plasters where walls may be subject to continuing dampness. Portland cements contain gypsum and other salts which may add to a damp problem. Specify low-alkali cements to keep salts to a minimum.

After replastering comes thorough drying, not only of the construction water introduced with the plaster, but of any residual dampness from deep in the wall. Depending on the climate this may take 3–6 months, or even up to 12 months for wet thick walls in cooler damp climates. Without thorough drying before repainting, bubbling paint films are almost guaranteed.

Whereas in the past prolonged drying was accepted as a necessary part of constructing masonry buildings with solid plasters, such understanding is less evident today. The demands to complete the job and to quickly tidy up someone's living or working area has meant that some contractors offer alternative approaches to the best practice method described above. These alternatives generally include the addition of waterproofing additives to the first plaster coat (the render coat) with the aim of preventing moisture damage to new paint coatings. To make these work, the render coat is made with a rich cement-sand mix which will be too strong for old walls.

Depending on the nature and amount of the additive, the render coat can be made moderately or strongly hydrophobic (waterproof). Strongly hydrophobic treatments will prevent evaporation from any continuing rising damp and may be being used as a belts-and-braces approach in case DPC insertion has not been adequate. However, in twenty or thirty years the damp will have risen above the hard render and will once again break out (Figure 20), requiring a new round of treatment. Less strongly hydrophobic additives (such as some salt retarders) will allow the wall to breathe and dry, but will not prevent active rising damp from damaging the plaster. At least these are more honest, as any failure of the DPC will become apparent relatively quickly. However, there remains the potential incompatibility of the hard and brittle cement render on what may be soft and flexible walls.

While the desire to complete repairs quickly may lead some to accept the use of hard render coats that contain additives to control or prevent drying, these treatments are not best practice and should not be used in buildings of considerable heritage value. **Good practice requires the removal of as much salt as possible and thorough drying before repainting.**

22 Repainting

The choice of paint type is important in situations where walls are damp, particularly when salts are present. As walls get older and accumulate salts, the need for good breathing increases. Unfortunately, many modern paints are less vapour-permeable than traditional coatings; they don't allow the wall to breathe as effectively as the older ones.

Acrylic (water-based) paints are more vapour-permeable than alkyd (oil-based) paints; the latter should not be used where walls remain damp or are still drying out after DPC insertion. Even the acrylics can be too impermeable for old walls (Figure 54). In these circumstances alternative coatings such as cement-based paints and traditional limewashes should be considered. Limewashes are more vapour-permeable than cement-based paints.

Figure 54 Failure of an acrylic paint coating due to salt damp. The bottom part of the wall is rendered in cement, which has contributed to the damp rising further due to its relative (but not total) impermeability. Decay of the brickwork is focussed where the paint film fails because that's where salt crystallises as moisture evaporates. The paint and the render should be removed and replaced with a more vapour-permeable coating such as limewash.

Buildings of heritage value that were traditionally painted in limewash should be repainted in limewash, not only because it is the authentic finish, but because it has the greatest breathing capacity of all coatings.

Be aware that some modern 'limewashes' (and cement-based paints) contain acrylic or other resins and their breathing capacity may be no better than normal paints. Look for limewashes that have a minimum of organic resin binders, or alternatively, make your own from lime putty, water and pigments.

23 Cellars and basements

Cellars and basements present particular problems because of the risk of groundwater penetrating horizontally through the walls, causing salt attack on the inside faces, and creating damp internal environments. Flooding of cellars is common where groundwater tables are shallow, or where the subsoils are heavy clays which form temporary watertables, diverting some of the water through the cellar. The internal lining of cellar walls with impervious membranes is often proposed. While it may limit water inflow, it will simply drive the damp higher up the walls and is not recommended.

There are several approaches to cellars with salt damp. One is to keep the cellar tightly closed, thus reducing evaporation and the rate of decay. Under such conditions, salts may crystallise relatively benignly on the face of the walls as efflorescence, rather than just beneath the wall surface where they do damage. This option will only be viable if the damp does not rise further in the walls. Often a better alternative is to add some (but not too much) ventilation, and seek to manage salt attack decay with sacrificial plasters and limewash coatings. Both these approaches may limit the future uses of cellars: the latter may lead to unsightly crumbling plaster, and the former to very high humidity levels, which will preclude even normal storage functions.

Making cellars and basements habitable may require more substantial treatments including excavation along the outside of the cellar or basement walls and the installation of a drainage system with vertical moisture barriers against the wall surfaces (tanking). This is expensive and often difficult to achieve in an existing building (geotechnical engineering advice may be required — see Section 12.2: *Site drainage*). The installation of a DPC in the base of the walls might then be considered, together with removal of salts from the wall surfaces. Floors may also need to be made impervious, and in practice this is expensive, with few examples of success.

24 Old treatments

Over the years there has been a range of different treatments for rising damp, many of which have proved to be unsatisfactory. Some of the more common include hard cement renders, damp-proof mortar additives, Knapen tubes, and passive electro-osmosis. These methods should no longer be considered.

24.1 Hard cement renders

A rich cement render along the base of walls can be seen disfiguring many buildings (Front cover). Because these renders are relatively impermeable, they prevent evaporation of rising damp. At best this is a short term solution, for (as explained in Section 13: *Sacrificial treatments*) the damp will eventually rise and cause decay above the render. Alternatively, the damp may cause damage by evaporating through wall cavities or the inside faces of solid walls.

The remedial treatment of hard-rendered walls should begin with an assessment of the thickness of the render and of the extent of original wall material lost prior to the application of the render. By carefully hammering across the face of the render, it may be possible to break it into small pieces, which can then be removed with minimal damage to the original masonry. Because of the quite different mechanical properties of the render and the wall, many renders will be found to be partially detached, often with salt crystallising at the interface. Remove any surface salt by brushing, vacuuming or light chiselling and desalinate the wall as explained in Section 14.

Decisions then need to be made about the desirability of a damp-proof course and the finished appearance of the wall: whether it can be returned to its original face brickwork or stonework, or whether the extent of decay and costs of repair mean that it needs to be re-rendered. If re-rendering, seek to make the render compatible with the underlying masonry. If the wall is soft and flexible, make the render the same. If there's any likelihood of salt remaining in the wall, the new render should act sacrificially. Incorporate porous particulates in the render mix to provide storage space for the salt and prolong the render's life (see Section 13.1: *Sacrificial mixes*). Finish with limewash to allow it to breathe.

24.2 Atmospheric syphons

Atmospheric syphons, also known as Knapen tubes, are lightly fired ceramic tubes that were mortared into holes drilled in walls with plastic or metal covers over the exposed ends. They were intended as drying aids, based on the principle of drawing moisture into the small pores of the ceramic and then encouraging it to evaporate into the hollow tube and then to pass into the atmosphere. However, tests have shown that an empty hole is just as effective in drying the surrounding wall. Further, when the natural rate of evaporation from the wall surface is greater than is possible from the tube or empty hole (and this is the norm) they will not add significantly to the drying of a wall. In high salt conditions the ceramic tube is rapidly destroyed by salt attack.

25 The future

Although most Australian buildings are less than 200 years old, we want those of heritage value to last many hundreds more. Many will now be at a critical stage in their salt damp history, and many more will reach this stage in the coming decades, particularly those with ineffective damp-proofing. The long term management of these buildings will require regular maintenance, attention to good housekeeping, and periodic inspection of wall cavities and underfloor spaces to check the condition of normally unseen parts of walls.

Accurate diagnosis is critically important; there is no substitute for a thorough understanding of a building's behaviour and its response to changes over time. Minor changes can have a significant impact, both positive and negative. Make small changes first, then assess their effectiveness before deciding on more expensive treatments like the insertion of damp-proof courses.

There is a need for the damp-proofing industry to also become salt-removalists, and to recognise that removing salt is as important as damp-proofing. There is also the need for the damp-proofing and pest control industries to come together and overlap to the extent that pest inspectors checking for termites should be able to comment in an informed way on the condition of walls beneath floors. Equally, damp-proofing contractors should undertake works in such a way as to minimise timber decay and, where needed, should install suitable protection for floor timbers.

Finally, those who commission, specify, fund and live with salt damp remedial works should do so knowing that the business is as much about salt as it is about damp, and in full knowledge of the ongoing need for maintenance and of the limitations and risks associated with partial treatments that deal only with the more obvious symptoms.

The slate doorstep

In recent years several examples have come to light of replacement slate doorsteps failing after only a few years in service. The following case study provides a valuable insight into an important aspect of salt damp.

A brick house built in about 1900 had a slate front doorstep. Mild damp affects parts of the house particularly near the front door, causing the doorstep to delaminate and become powdery on the surface due to salt attack. The badly worn step was replaced in the mid-1980s with a new piece of slate from the same quarry. Within five years the new step began to decay in the same manner (Figure 55, below). What happened? Why did the first step last eighty-odd years and yet the second need replacing after ten? Perhaps the slate is not what it used to be?

The answer to the last question is a definite no: the slate is the same sound, relatively durable material it always was. So why did the second one fail in such a short time?

The explanation is that it took eighty years for rising damp to draw salts from the soils up into the walls to a concentration sufficient for it to cause decay in the first step (see Figure 17 in Section 9.4). The second step was built into this already salt-laden environment and so it began to decay shortly afterwards.

The dense layered nature of slate contributes to its demise — its very fine pore structure has a high suction along the layers, while being relatively impermeable across the layers. Thus the slate will draw any available moisture in from its edges — edges which are butted against salty brickwork.

The third step, which is now doing fine after ten years, had its edges sealed with slate sealer prior to installation (several coats of siloxane dampcourse fluid would be an alternative). The new step is bedded on a plastic DPC and on weak mortar that will decay sacrificially in preference to the adjacent brickwork.

Box 9, Figure 55

Glossary

Aggregate Hard and generally inert material used as a filler in mortars and concrete: coarse aggregate = gravel; fine aggregate = sand.

Bluestone Hard, dense, dark coloured stone, occasionally bluish. In Victoria, volcanic basalt; in New South Wales, includes granite-like metavolcanics; and in South Australia, sedimentary rocks such as siltstones and shales.

Capillarity Capillary action: suction of fine tubes, related to surface tension, drawing water sideways or against gravity in fine-pored materials.

Captive-head washing Cleaning system with a water jet within an enclosed hood which is equipped with a powerful vacuum to capture the dirty wash water.

Case hardening Hardening of the outer skin of sandstones, limestones and some other types due to solution and re-precipitation of some of the natural cementing material within the stone. Retaining its case hardening can be critical to a stone's durability.

Contour scaling The loss of a thin scale (commonly the case-hardening) from the surface of a stone, often (but not always) caused by salt attack.

Coping Capping of the top of a wall in stone, brick or concrete.

Cornice On exteriors the cornice is the horizontal or near horizontal projection from the base of the parapet at the top of the building; designed to shed water and protect the walls below.

Damp-proof course (DPC) A layer of impervious material (e.g. polyethylene) built into walls to prevent the upward migration of water. Also called a dampcourse. Remedial damp-proofing may include chemical DPCs.

Damp-proof membrane (DPM) As for a DPC but generally used to describe the thinner sheet material used beneath concrete slab footings.

Deliquescence Deliquescent materials are those which absorb water vapour from surrounding air and dissolve into it, forming a solution.

Desalination The removal of salt, in this case from masonry materials.

Dew point The temperature at which water vapour in air condenses as liquid droplets (condensation).

Diatomaceous earth A natural deposit of fossil 'skeletons' of tiny organisms (diatoms).

Efflorescence Crystallisation of white powdery salts on the surface of masonry.

Electro-osmosis Movement of liquid under an applied electrical field.

Evaporative front Line within masonry at which evaporation from liquid to water vapour takes place. The front may move with changes in weather.

Evaporative zone Zone of a wall through which evaporation occurs, often 0.5–1.2 m above ground level when DPC is absent or ineffective.

Falling damp Dampness in buildings resulting from water entering at upper levels and percolating downwards; as distinct from rising damp.

Flashing A strip of impervious material such as lead or other metal fitted into walls to provide a barrier to the movement of moisture.

Footing The widened base of walls that spreads the load to the ground beneath; traditionally of stone or brick, now of reinforced concrete.

Header A brick laid with its long dimension across the plane of a wall so that its end is visible in the wall face (see stretcher).

Hydrophobic Water repellent material.

Hygroscopic Materials that attract moisture from air. Some are also deliquescent.

Impervious A material that does not permit water or other fluids to pass through; one that is impermeable (see permeability).

Masonry Bricks, concrete bricks or blocks, stone and terracotta laid in mortar to form walls or other structures.

No-fines concrete Concrete made without fine aggregate (sand) so as to be porous and permeable.

Osmotic pressure Pressure required to stop the flow of a dilute salt solution towards a more concentrated salt solution across a semi-permeable membrane.

Parapet Low wall projecting above the line of a roof.

Penetrating damp Horizontal penetration of dampness into walls.

Permeability The property of a porous material that allows fluids such as water to pass through it. Impermeable materials don't (see impervious).

Plaster Lining of internal walls or ceilings (see render).

Porosity The void (or pore) space in a material, expressed as a percentage.

Rainwater head A box-like fitting at the top of a downpipe that collects and discharges rainwater from roof gutters.

Render Covering of external walls in mortar-like materials. The term is also for the first coat of plasters.

Repointing The replacement of the outer part of the jointing material in brick and stonework. Usually includes the weatherproof surface "pointing" and some of the softer mortar behind it.

Rising damp Upward capillary migration of water in masonry.

Salinity Soluble salts in soils, natural waters and the environment.

Salt attack Decay of masonry materials due to the crystallisation of soluble salts within the pores of the material; see also salt weathering.

Salt damp A term originating in South Australia that neatly combines the two discrete phenomena of salt attack and rising damp.

Salt weathering The same process as salt attack, but applied more broadly, e.g. in geomorphology, to the weathering of landforms.

Saturated solution A solution containing the normal maximum amount of salt.

Solute suction The osmotic pressure of a salt solution — drawing less saline water towards the more saline, so as to dilute it.

Stretcher A brick laid with its long dimension horizontally along a wall.

Subflorescence Crystallisation of salts within the pores of masonry. Sometimes referred to as crypto-efflorescence, meaning hidden.

Suction The negative force exerted by the capillarity of porous materials. It draws water into walls and aids in adhesion of plaster and mortar.

Supersaturation A salt solution which is over saturated in salt which has not yet crystallised out.

Termites Commonly called white ants, termites belong to a different order of insects; their food consists of cellulose in trees, grass and timber.

Urban Salinity Recently coined term encompassing the combined impact of water and salt on the urban environment, including buildings, roads and other infrastructure. Includes salt attack and salt damp.

Undersetting Salt damp treatment in which sections of the base of a wall are progressively rebuilt in new materials, incorporating a DPC.

27 Further reading

27.1 General references

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27.3 Internet links

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