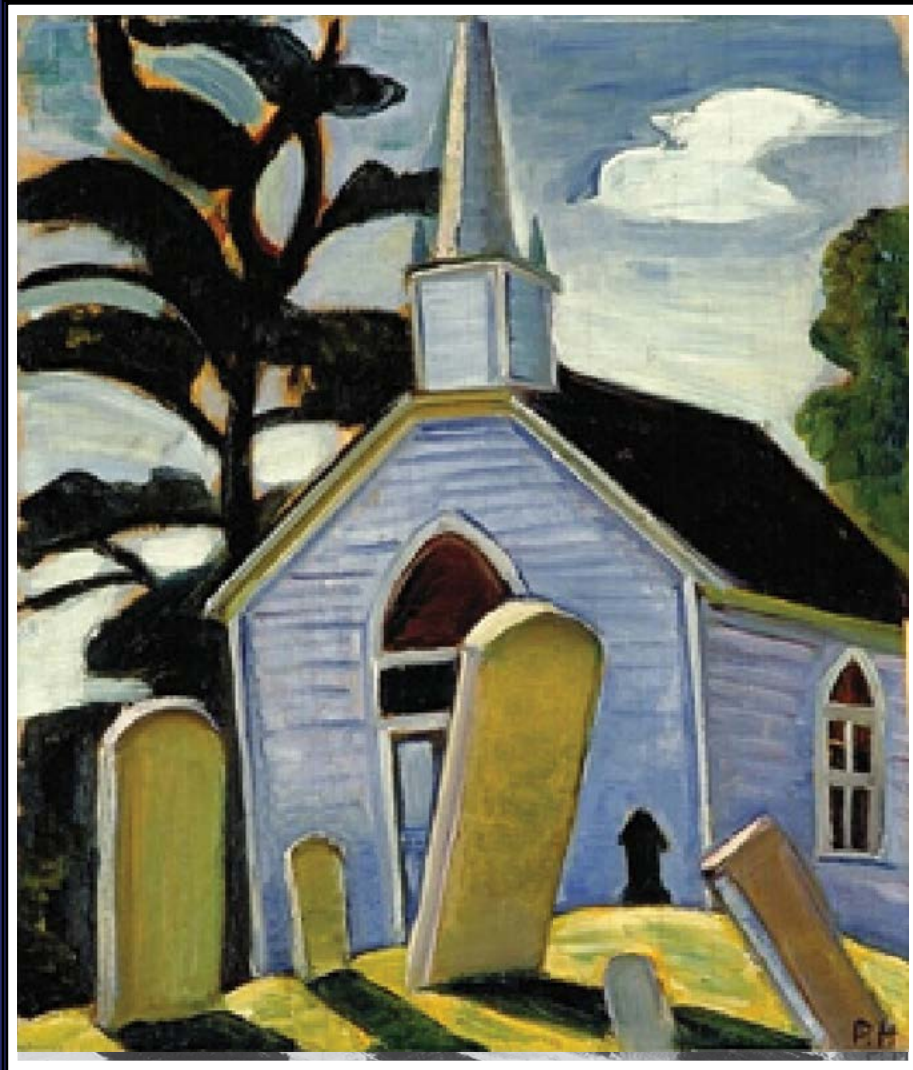


Landscapes of Memories



A Guide for
Conserving
Historic
Cemeteries

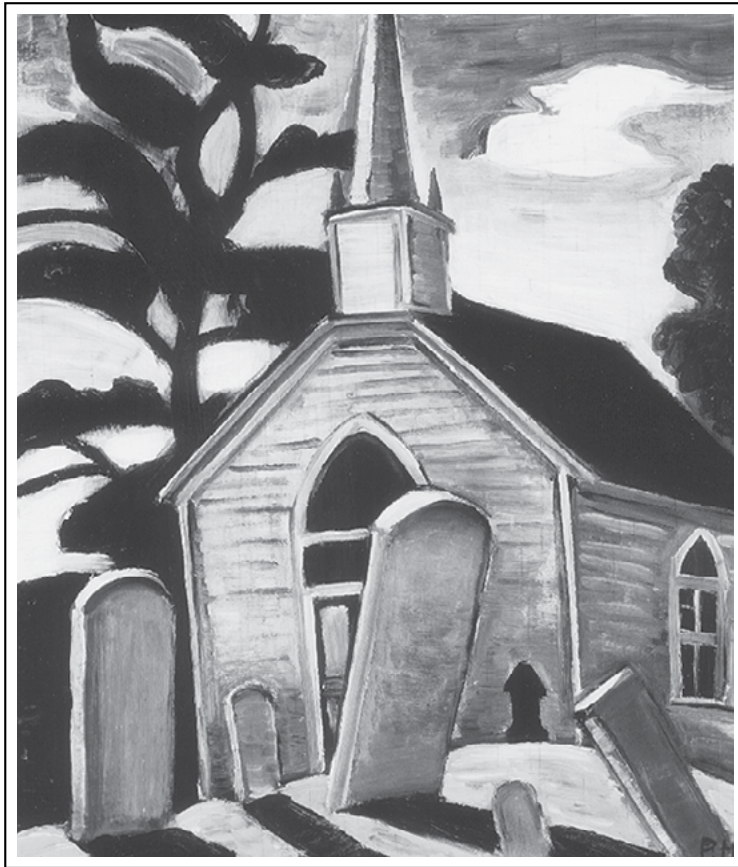
Repairing Tombstones

European immigrants settling in Ontario brought with them their burial customs to memorialize their loved ones. *Landscapes of Memories – A Guide for Conserving Historic Cemeteries* addresses the issues associated with the preservation and conservation of their cemeteries and tombstones. Cemetery trustees and genealogical societies have recorded the irreplaceable information of these tombstones, yet not enough has been written about the historical significance of Ontario's cemeteries or their contribution to the cultural landscape. Nothing is available that describes conservation techniques appropriate for the different types of grave markers found in Ontario. This publication will begin to fill this void.

The material in this publication reflects accepted conservation principles and addresses the needs of those who are responsible for, as well as those who have a general interest, in the care and maintenance of older cemeteries. It is especially intended for those who own and operate cemeteries, both private and municipal, and for monument builders and contractors who repair grave markers.

This guide has been written by specialists in the fields of heritage conservation, landscape architecture, and masonry conservation. It is divided into two volumes. *Planning for Conservation* explains how and why cemeteries are significant and the importance of planning for their preservation. This volume, *Repairing Tombstones*, provides technical and practical information that will be helpful in making decisions about conserving tombstones. The appendices contain information about designation of heritage cemeteries under the Ontario Heritage Act, relevant sections from the Cemeteries Act, a glossary for cemetery and masonry terms, and an extensive bibliography.

Landscapes of Memories



A Guide for
Conserving
Historic
Cemeteries

Repairing Tombstones

Compiled and edited by
TAMARA ANSON-CARTWRIGHT

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COVER: The Blue Church, 1933

Prudence Heward (1896-1947)

Oil on panel, 35.2 x 30.4 cm.

McMichael Canadian Art Collection, Kleinburg, Ontario

Gift of Dr. Naomi Jackson Groves

1984.18.3



WHERE DO THEY REST, THOSE HARDY MEN,

WHO LEFT THEIR NATIVE SHORE?

TO EARN THEIR BREAD IN DISTANT LANDS,

BEYOND THE ATLANTIC'S ROAR?

THEY SLEEP ON MANY A LONELY SPOT,

WHERE THE MIGHTY FOREST GREW,

WHERE THE GIANT PINE, AND STATELY OAK,

A DARKLING SHADOW THREW.

EXCERPTS FROM

THE GRAVES OF THE EMIGRANTS

BY CATHARINE PARR TRAILL

SOURCE: THE CANADIAN SETTLER'S GUIDE, 1854

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PREFACE

In researching and compiling this guide, I discovered that writers from around the world each use different names or terms for what are commonly known in Ontario as tombstones.

When reading this text, one will find references to monuments, grave markers, markers, tabletstone markers, gravestones, and flat slab markers. These can be interchanged with the term “tombstone.” I chose to keep this variety of terms to make the reader aware of and comfortable with their usage. It is important to know these different terms and to refer to them when searching for additional reference material and literature on cemetery, graveyard, churchyard, or burial ground preservation.

Many individuals have contributed to this guide. I would like to acknowledge and thank my Ministry colleagues for their support and hard work. I would also like to acknowledge the contribution of technical writers to this volume. Special thanks to Keith Blades, for his overall guidance and material on repairing markers, including the wonderful illustrations, and the mortars section. Thanks also to Martin Weaver and Eric Jokinen for their fine and detailed explanations of how to identify stone and what causes its deterioration, and to Per Neumeyer, whose skill and talent with stone repair are apparent in the many photographs of him at work in the Churchville cemetery.

I also want to express my appreciation to Gary Foster and the Board of the Ontario Monument Builders’ Association, who recognized the benefits of this project and

became our partners for the Churchville restoration project.

In compiling this guide, I sought photographs and images that could explain and simplify the text and provide visuals for the “how to” sections. In this effort, I am indebted to Glenn Lockwood and his extensive photographic collection of cemeteries in eastern Ontario; to the Aylmer and District Museum and its wonderful J.W. Hutchinson, Aylmer Monument Maker, collection; to the Archives of Ontario; to the Ontario Genealogical Society; and to Barbara Heward, who gave us permission to use *The Blue Church*, a painting that made this project complete.

Finally, I would like to thank John Parry for his excellent editing skills and his personal commitment to the project. His words of encouragement and support ensured the completion of this volume.

Tamara Anson-Cartwright
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and Recreation

INTRODUCTION

This guide examines conservation and repair treatments for historic monuments and tombstones, also referred to as markers. Often those responsible for conservation, restoration, or maintenance of cemeteries seek help from monument builders, who may have limited knowledge of current techniques and of materials for conserving or cleaning – especially for old, weathered, and deteriorated monuments. The Ontario Monument Builders Association (OMBA) is helping to remedy the situation and has recently begun offering certification courses for its members on such topics as “Repair Techniques for Historic Marble Slab Markers.”

Information about qualified monument builders and specialists and their organizations is available from the Ministry of Citizenship, Culture and Recreation. Groups such as the Canadian Association of Professional Heritage Consultants in Toronto (CAPHC) and the Canadian Association for Conservation of Cultural Property (CAC) in Ottawa are other sources of qualified help.

The first step in the conservation process should be preparation of a detailed inventory of all memorials, monuments, markers, mausoleums, and so on, including photographs and a scale plan that shows locations and orientations. The graveyard plan or inventory will record all the grave markers and monuments, their materials and structures, and all the landscape features. One can find many excellent articles on preparing such an inventory. We have included a simple, yet well described, method for “Drawing a Graveyard Plan” in Appendix B to this guide.

This inventory or plan in turn forms the framework for a record of conditions and associated treatment recommendations. Such documentation facilitates assembly and maintenance of conservation records for the whole cemetery and its contents – an exact parallel to the patients’ records kept by doctors and hospitals.

All research, testing, and conservation treatments must be documented and kept on record for future reference. Careful adherence to this process helps to ensure that treatments are as beneficial as possible and that harmful treatments are not carried out through ignorance.

A basic principle of conservation is that the conservator should always use the most gentle means possible to obtain the desired result. Another is that treatments should, as far as possible, be reversible. Ideally, a reversible material can be removed without causing any further harm to the original monument or its materials.

The *Venice Charter* of 1964 set the standards and principles for conservation for a new generation of practitioners and continues to be valid today. By 1983, however, the Canadian national committee of the International Council of Monuments and Sites (ICOMOS) had adopted the *Appleton Charter for the Protection and Enhancement of the Built Environment*

to reflect or encompass changes in conservation philosophy.

Within the *Appleton Charter*, there is a section regarding “Practice” which is an excellent framework for anyone considering conservation work or repairs within a historic cemetery.

The section is as follows:

Documentation

The better a resource is understood and interpreted, the better it will be protected and enhanced. In order to properly understand and interpret a site, there must be a comprehensive investigation of all those qualities which invest a structure with significance. This activity must precede activity at the site. Work on site must itself be documented and recorded.

Conjecture

Activities which involve the recovery or recreation of earlier forms must be limited to those forms which can be achieved without conjecture.

Distinguishability

New work should be identifiable on close inspection or to the trained eye, but should not impair the aesthetic integrity or coherence of the whole.

Materials and Techniques

Materials and techniques should respect traditional practice unless modern substitutes for which a firm scientific basis exists, which have been supported by a body of experience and which provide significant advantage can be identified.

Patina

Patina forms part of the historic integrity of a resource, and its destruction should be allowed only when essential to the protection of the fabric. Falsification of patina should be avoided.

Reversibility

The use of reversible processes is always to be preferred to allow the widest options for future development or the correction of unforeseen problems, or where the integrity of the resource could be affected.

Integrity

Structural and technological integrity must be respected and will require attention to performance as well as to appearance.

This guide is intended for the reader who will eventually perform the repairs in a historic cemetery. Our goal is to familiarize the monument builder, contractor, and cemetery trustee or volunteer with the theories of conservation and how they relate to a cemetery preservation program. We have written this volume assuming that the reader has a basic understanding of how to work with stone. This assumption allows us to get immediately to the business of stone identification and describing the specialized techniques for repairing historic tombstones in Ontario. Due to the technical nature of the volume and its limited readership, it will be available in English only.

This Ministry has long recognized the role of volunteers and their participation in preserving and conserving our cultural heritage in this province. The guide describes their role in repairing historic tombstones. Volunteers play an important part in ensuring that these historic cemeteries, our cultural legacies, survive for the next generation.

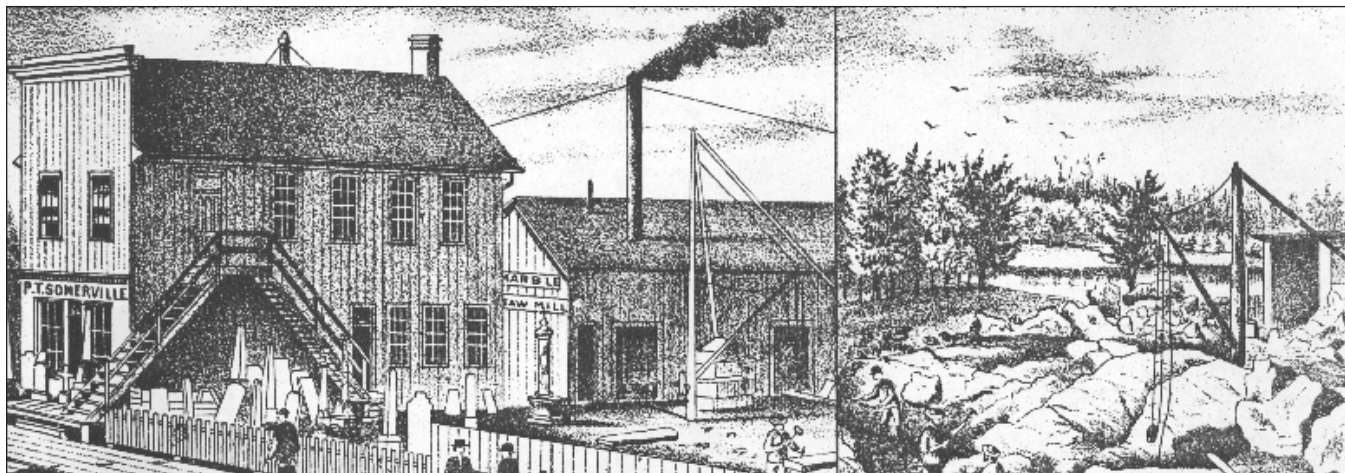
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CHAPTER 1:

IDENTIFYING STONE AND METAL



INTRODUCTION

As a result of a search for permanent materials, the first stone monuments were made from rocks lying where they had been dropped as glaciers receded across Ontario after the last ice age. Other rocks were found exposed in cliffs from which they could sometimes be taken in roughly rectangular blocks, ready for building or for memorials. By the mid-nineteenth century, Ontarians were using stone quarried in the province, the United States, and Europe for monuments and markers. Metals, too, began to find a place in monuments and surrounding structures.

Definitions

Sandstones, limestones, granites, marbles, slates, and all the other natural stones used in monuments are referred to as “rocks” when they are in the ground and have not been worked. When picked up, cut, or split from their matrix in the living rock and then worked on, they are termed “stones.” If cut to predetermined sizes and forms, they are termed “dimensioned stone” or “dimensional stone.” The dimensioned stone industry has a

somewhat confusing habit of describing all hard igneous or metamorphic rocks as “granites” and all acid-soluble, carbonate-based rocks that will take a polish as “marbles.” Thus, for example, some of the so-called granites are actually gabbros, and some “marbles” are dolomitic limestones.

Chemicals that may be used in conserving and repairing stones can react adversely with certain other chemicals and the physical structure of the stones. Therefore, it is necessary to identify correctly a rock, or stone, in terms of its structure, chemistry, and, more important, its durability in polluted and unpolluted environments.

THE ROCK CYCLE

Igneous Rocks

All rocks are formed as part of a cyclical process. The cycle begins with the rising of a mass of molten material or magma from the upper mantle, deep beneath the earth's crust. As it approaches the surface, the mass cools and solidifies as various minerals crystallize. Magma temperatures

range from 600°C to 1400°C. The slower the cooling, the larger the crystals formed. In its finally cooled and crystalline state,

seawater; their carbonate-rich bones and shells subsequently fall to the sea floor and become cemented together by

more carbonate material, resulting in limestones.

Types of rock	Names of rock		
Igneous	gabbro, syenites	granite	
Sedimentary	sandstone	shale	limestone
Metamorphic	gneiss	slate	marble

the mass forms an igneous rock (from the Latin *ignis*, meaning “fire”). Commonly used igneous rocks in Canada include *granite* and *gabbro*.

Sedimentary Rocks

If this igneous rock is then exposed to weathering and natural erosion over thousands or millions of years, it will be converted to sediments or solutions. The sediments range in size downward, from very coarse chunks of weathered granite, to sand, silt or clay particles 0.1 mm or less in diameter. Ions in solution may form into solid materials or be extracted by marine organisms and form part of their shell or bone remains within the rock.

The sediments may then be converted into sedimentary rocks by a process of lithification (literally being changed to stone, or petrified), which may occur in four ways:

- Pressure compacts buried sediments – for example, changing mud into shale.
- As water evaporates, minerals are left behind. Eventually the water becomes saturated, and minerals precipitate out; gypsum and halite (rock salt) are examples.
- Natural cements such as calcite, silica, iron, and clay may cement the particles of sediment together, forming rocks such as sandstone and millstone grit.
- Organisms extract minerals from

Geologists classify the sedimentary rocks first into clastic and non-clastic rocks: clastic are made up of large or small fragments of other rocks; non-clastic are either largely or completely of organic origin or were deposited chemically. Clastic rocks are further classified by particle size:

- rudaceous (coarse-textured) - for example, boulders, pudding-stones, conglomerates
 - arenaceous (medium-textured) – for example, sands and sandstones
 - argillaceous (fine-textured) – for example, clay, shale, and mudstone
- Non-clastic rocks include the following:
- evaporate deposits – for example, gypsum
 - ferriferous or ferruginous rocks – for example, sedimentary iron ores
 - calcareous rocks – for example, limestone and chalk
 - residual deposits – for example, clay with flints

Metamorphic Rocks

If sedimentary rocks or igneous rocks are subsequently subjected to heat, pressure, or chemically active solutions, they may change form and become metamorphic rocks. The older, or “parent” rocks may even have been metamorphosed before. Heat, pressure, and chemical solutions often result in new minerals, densities, or textures, which in their turn give clues as to the temperatures and pressures involved.

Metamorphic rocks are formed in regions of the earth’s crust near high heat sources, such as cooling magma or volcanic tubes, and at locations of high pressure, as in

subduction zones where the rocky shell of the earth plunges down into the molten rock in the upper mantle below. If the metamorphic rock actually melts, it returns to a magma and thus the cycle may begin again.

Metamorphic rocks used in monuments in Ontario include slate, which originates from shales or mudstones; marble, which originates from limestones and dolomites; and gneiss, which normally originates from granites but can be of sedimentary origin.

Identification of field stones may require the services of a trained geologist, but identification of dimensioned stones may be simpler. It is important that stones be identified because they cannot be cleaned or conserved without this geological information. A number of textbooks have fine colour photographs that can be used to identify rocks (See bibliography). Anyone wishing to specialize in stone conservation should start a collection of identified stone samples.

Selection and Durability

Stones for monuments have long been prepared from certain rocks according to carefully selected characteristics:

- Readily accessible or easily transported. This was an important factor when roads were bad or non-existent. As



Stone selection was often based on the workability or ease of carving and finishing.

we have seen, availability was usually critical in selection. Since stone is very heavy and may crack or break if dropped, it tends to be used as close as possible to its source, making transport cheaper, reducing wastage, and thus lowering the ultimate cost.

- Affordability.
- Workability or ease of carving and finishing – for example, certain soft sandstones.
- Durability – for example, gneiss or granite.
- Acceptability, socially and aesthetically – for example, Carrara marble (Carrara was often used for monuments exposed in the open air, though it was probably obvious at an early date that the stone was not suitable for such use in Ontario.)

Unfortunately, local stones were not always ideal for building purposes or for making monuments, particularly in a damp environment that would also be very cold for part of the year, causing freezing and even multiple freeze/thaw cycles. For example, a sandstone might have been selected because it was close to the cemetery and thus cheap, but its durability may have been poor. Similarly, shale might have been nearby but might have had very poor frost resistance. A shale might be used in a building where it could be protected by mortar and parging, but it could not be used by itself without some protection and would not be suitable for monuments. Clays and mudstones are also examples of sedimentary “rocks” that could not be used for monuments because of their poor durability.

SANDSTONES

Conservators classify sedimentary rocks by their natural “cements” – the materials that hold the sediments together. Some cements are very durable, while others may be easily removed by water, possibly causing local expansion.



An easy way to distinguish grey sandstone from limestone; rain washed surfaces of sandstones become very dirty, and limestones become cleaner looking, but eroded from acid rain.

Sandstones are composed of sand grains or particles held together with various types of binders. The binder has a profound effect on weathering and durability. Binders are classified as follows:

- argillaceous cement (clay)
 - soft, not durable, liable to swell when wet; rapid destruction possible in heavily polluted environments
 - liable to surface changes caused by clay enrichment when the clay minerals move with moisture to the surface
 - expanding surfaces then exfoliate or peel off
- calcareous cement (carbonates)
 - moderately hard, of medium density, relatively easy to work, and relatively durable
 - cement acid-soluble
- ferruginous cement (iron)
 - iron oxide cement
 - may change colour or rust
 - may be difficult to work
 - durability varies
 - may cause severe iron-rust staining in itself or on adjacent materials, particularly those affected by run-off
- siliceous cement or binder (silica-silicate)
 - hard, dense, may be hard to work and durable
 - cement not particularly acid-soluble

These cements may appear in combinations within a stone. For example, a calcareous cement stone can have bands of clay or argillaceous cement which can affect the durability of the stone.

Types

Sandstones used in Ontario monuments came from Ontario, the Maritime provinces, or the United States. Some sandstones were known as “freestones” – they could be freely worked in any direction and did not tend to split along any particular line or plane.

This province’s best-known sandstones were the red-brown, grey, and mottled Medina varieties of southern Ontario, especially from the Credit Forks or Credit Valley district; their most famous use was in the Legislative Buildings at Queen’s Park, Toronto. Other Canadian sandstones include the olive-grey Wallace sandstone from Nova Scotia and the Sackville red sandstone from New Brunswick.

The United States was a major sandstone source. Ohio sandstone from the famous Berea beds at South Amherst, near Cleveland, was enormously popular for monuments, mausoleums, chapels, and churches in the nineteenth century. The Berea sandstones are light grey or buff, medium-to-fine-grained protoquartzites, with silica and some clay cement. Also from Ohio came the medium-grained Briar Hill sandstone, popular for its variegated, often rusty colours; it is a Massilon sandstone and is also known as a Middle Pottsville sandstone. The Cuyahoga formation that lies just above the Berea is quarried for fine-grained, grey and buff sandstones in Scioto County, southern Ohio. The Scioto sandstone was very popular for interior and exterior building uses and “burial vaults.” Other U.S. sandstones used in Ontario in the nineteenth century included Red Potsdam sandstone from the Adirondacks, in New York state, and Medina Red and Grey



Contour scaling or the spalling of a stone surface is common to sandstones situated in urban areas with high levels of air pollution.

sandstones from Orleans County, also in New York.

Deterioration

Deterioration in sandstone memorials most often consists of the formation of a denser, less permeable, and more brittle surface crust that slowly blisters and then exfoliates or spalls, exposing a softer, crumbling inner core. This phenomenon is known as “contour scaling” and is particularly associated with pollution involving sulphur compounds.

Some sandstones and “bluestones” may also suffer from “face bedding,” in which the stone splits more or less cleanly along one or more bedding planes. This is a common problem because it is far easier to split a slab out of the stone matrix following a bedding plane than it is to cut a slab perpendicular to it. When the memorial slab is erected in the ground or set into a base block, the bedding planes are thus normally perpendicular and parallel to the broad faces. They then weather from the top, so that water penetrates along planes of softer, more permeable material. The entrapped water then freezes, and the face layers are wedged or split off.

Soluble Salts

Soluble salts affect all types of stones. These salts can cause severe deterioration by accumulating behind surface layers and forcing them off. Salts also build up in surfaces, pushing individual grains apart until the surface powders and crumbles. In cemeteries, water-soluble salts may include chlorides, nitrates, phosphates, and sulphates. Nitrates and phosphates may be produced by decomposition of organic matter. Nitrates can be particularly disruptive and damaging.

Salts that crystallize on stone surfaces are termed “efflorescence,” and salts below or

in the surface are termed “sub-florescence” or “crypto-florescence.” When individual grains or particles are forced out of the stone matrix, the process is termed “disaggregation.” The peeling off of the stone surface in thin layers or sheets is termed “exfoliation.”

LIMESTONES

Types

Limestone is composed of calcium carbonate in the form of calcite and is another member of the sedimentary stone classification. In the nineteenth century, Ontario produced a number of limestones that were used for memorial slabs and monuments. The most famous and most commonly used were Kingston, Ottawa, and Queenston varieties. Though production of the Kingston and Ottawa types fell off in the twentieth century, the famous Queenston limestone was produced in substantial quantities until well after the Second World War.

Kingston limestone, when quarried, is a hard, brownish-blue, calcium limestone of



Face bedding, or the setting upright of the bedding plane, is harmful to sandstone. Water penetrates the stone along the planes of softer material and washes it away.



Limestone and marble were the most popular types of stones for the earliest tombstones in Ontario. Limestone tombstones (two on the left) are usually grey or darker than marble. Fossils are found only in limestone and can be seen up close.



Marble and limestone erode with the effect of acid rain. The edges of carvings soften, and the inscriptions start to fade.

Ordovician age; normally it weathers to light silver grey or even white. An occasional bedding plane that contains microscopically fine pyrite crystals weathers to a yellowish cream. Kingston limestone is occasionally prone to cracking along and perpendicular to the bedding planes. This problem has sometimes been associated with gunpowder blasting in quarrying operations.

Ottawa limestone is a brownish-grey, high-calcium limestone of Ordovician age. Weathered surfaces of coarser varieties are characteristically spotted with white weathering calcite crystals and small fossil-shell fragments.

Queenston, currently termed Gull River Formation, is a stable, compact, silver-grey, magnesian limestone that weathers to a lighter silver or pearl grey. It often includes pinkish, circular fossil segments from crinoid or sea-lily stems.

Ontarians used three types of limestone from Quebec. Montreal limestones are of two types. The Chazy is a hard, medium-grained, blue-grey magnesian limestone, with sometimes as much as 23 per cent magnesium carbonate content. The magnesian material tends to be very permeable, and these stones may not weather well. The grey-blue Trenton is a relatively durable, high-calcium limestone. The Deschambault, from St-Marc-des-Carières, is still in plentiful supply. It is brown or greyish brown when quarried but weathers to a light grey. It is medium-grained, with high calcium content. Like the other Quebec limestones, it may contain fine veins, pockets, and even vugs or cavities filled with black bituminous matter. These flaws at best may be unsightly, but at worst may cause failure.

Deterioration

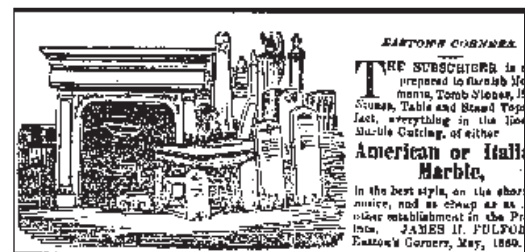
Limestones, like sandstones, can deteriorate (See soluble salts) for many

reasons, often because of penetration of acidic rain or moisture. This causes loss of carbonates, which dissolve in acids, giving off carbon dioxide gas. The surface may also react with sulphuric acid to form gypsum – calcium sulphate – or, less often, magnesium sulphate. Queenston, the so-called queen of magnesian limestones, tends to be dense and does not usually suffer from water penetration. The principal mineral component is dolomite. Though more resistant than pure limestones to weathering, they are vulnerable in polluted environments. In particular, magnesium sulphate crystals, once formed, expand four times more than those of calcium sulphate. The Chazy limestone from the Montreal region may suffer from this problem, when softer, more permeable bands and cracks penetrate the stone.

Some limestones, such as the Cobourg formation, are heavily faulted and have “trace” fossils or “bioturbation” in the form of burrows and tunnels of ancient molluscs and other creatures. The holes were filled with silt, often rich in clay minerals, which can cause some of these stones to have high water absorption and very poor resistance to frost.

MARBLES

In order to repair, conserve, and restore marbles, one must have a good



An advertisement for American and Italian marble appearing in the *Mirickville Chronicle*, June 15, 1860.

understanding of them, including identification of their types and sources and their chemical and physical natures. All of them have been used for monuments in interiors, and many have



Marble slab markers are the most common type of tombstone found in Ontario's historic cemeteries.

been used outside, though they frequently do not weather well in the open air and may have seriously deteriorated.

Marble was a fundamental material in monument construction in Ontario throughout the nineteenth century. Most of the marble used by Ontario firms came from Vermont, which was an especially good source of the blue marble. Locally quarried marbles such as Arnprior marble were quite popular for monuments. It was also common to find advertisements that publicized the availability of American, British, and Italian marbles.

Types

The American Standards for Testing Materials (ASTM) defines "marble" as follows: "Stone in this category comprises a variety of compositional and textural types, ranging from pure carbonate to

rocks containing very little carbonate that are classed commercially as marble (for example serpentine marble). Most marbles possess an interlocking texture and a range of grain size from cryptocrystalline to 5mm. All marble as here defined must be capable of taking a polish" (ASTM C 119-87a).

Further: "4.1 marble – a crystalline rock composed predominantly of one or more of the following minerals; calcite, dolomite or serpentine and capable of taking a polish" (ASTM C503-85).

Despite the geological facts, in Canada and the United States the term "marble" legally includes all crystalline calcium carbonate or calcium magnesium carbonate rocks that can take a high polish, including "cave onyx," travertine, and tufa, plus the non-carbonates alabaster and serpentinite. The limestones that may be polished are typified by the widely used "Tennessee marble" – a fossiliferous sedimentary limestone sometimes known as an orthomarlble, as in Holston orthomarlble, from the Knoxville district of eastern Tennessee.

The geologist's definition of a true marble is a metamorphic rock formed by extreme heat and pressure primarily from clay marls, dolomite, lime marls, and limestone and consisting of more or less compacted masses of calcite crystals (calcium carbonate). Compositions vary, but some marbles are made up of approximately 98 per cent calcium carbonate (CaCO_3), with traces of magnesium carbonate (MgCO_3), silica, and iron oxides. A fine statuary marble may be pure white, with more than 99 per cent calcium carbonate content.

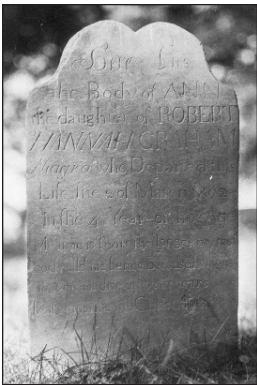
Additional materials may consist of both silicates and non-silicates. The chief silicates are chlorite, diopside, hornblende, mica, tremolite, and woolastonite. The chief non-silicates are



Marble will often have distinctive patterns or fine veins of colour.



Gypsum crust may form in protected areas such as in a deeply carved motif like a willow tree.



Slate markers are easily distinguished by their finely cut lettering and smooth grey appearance. Slate was not commonly used for monuments in Ontario.

graphite, hematite, limonite, and pyrite. Traces of oxides and other minerals give marbles their beautiful, distinctive colours and patterns, which may take a number of forms. The most usual patterns are, first, fine veins, lines, and/or clouds against a single-coloured background, and second, angular fragments of many colours, sizes, and textures cemented together in a matrix or ground of another colour and texture, with or without veins.

True marbles are metamorphic rocks that are soft enough to be carved quite readily. Marbles are acid soluble and not particularly durable in exterior environments in Ontario.

Deterioration

Marbles in polluted areas are usually dissolved by acid rain, snow, and fog. Marbles are particularly susceptible to a phenomenon called “sugar decay,” in which acid precipitation attacks along the joints or boundaries between the calcite crystals that comprise marble. The grains or crystals are ultimately loosened and can be brushed off like granulated sugar.

Marble may also have its surface converted to gypsum in reactions with atmospheric pollution containing sulphuric acid and acid gases such as sulphur dioxide.

The gypsum surface may also combine with carbon or soot to form a disfiguring and harmful black crust. Formation of gypsum crust will ultimately lead to conversion of more and more of the marble into unstable gypsum, which will blister and crumble away, resulting inevitably in loss of the entire surface, complete with all inscriptions, carved details, and finishes.

SLATES

Types

Slates have made fine gravestones and

memorial slabs, especially in New England, because they were easy to carve. Slate memorial slabs are usually easily distinguished by their finely cut lettering and smooth grey, blue-grey, grey-green,

or black, fine-grained appearance.

Occasionally, fine laminations may be visible in cross-sections. Slate typically came from the Eastern Townships of Quebec or from eastern U.S. areas such as the slate belt on the border between New York state and Vermont near Lake St Catharine.

Deterioration

Many slates are so durable and resistant to acid that they were once used for laboratory sinks. When slates do fail, they can delaminate or split apart in layers that vary from paper-thin to 5 mm or more in thickness. Often, failures occur because of the weathering out of softer patches of carbonates or clay minerals from the slate or as a result of chemical reactions leading to breakdown of nodules or inclusion of iron pyrites (fool’s gold). When the latter occurs, the pyrites’ remains are seen as crumbled, often rusty masses of particles, salts, and deep holes in the stone, possibly with localized, radiating crack patterns.

GRANITES

By the 1880s, in North America the trend was to more enduring stones for the monuments. Today, granite remains the preferred material for monuments, since igneous rocks, such as granites, and metamorphic rocks, such as gneiss, all tend to be hard, heavy, and durable. The building and monuments industry tends to describe “granites” as a wide range of hard, dense, and normally very durable, acid-resistant stones of igneous and metamorphic origin.

Types

Granites are usually divided into three



The design and style of monuments changed with the introduction of high polished stones like granite, gabbros, and syenites.

groups based on the sizes of their crystals:

- microgranites, or fine-grained granites, with small crystals
- medium-grained granites, with medium-sized crystals
- coarse-grained granites, with coarse or large crystals

Hard, lighter-coloured stones, typically with a salt-and-pepper appearance and medium-sized to large crystals, flakes of mica, and grains of black or dark minerals, such as hornblende, usually are granites.

Hard, darker brown or red stones with larger crystals, often found with highly polished surfaces in monuments, are usually gabbros. If such stones have smaller crystals and are slightly lighter in colour, they are probably syenites – such as Marathon Red, Canadian Red, or Coldwell Red, from Ontario – but may be medium to coarse-grained, such as the famous Sienna Red syenite from the Grenville district of Quebec. Polished hard

stones that are black or blue-black with shining, iridescent large crystals of feldspar are usually anorthosite, labradorite, or Norwegian larvikite, imported as Norwegian Blue or Norwegian Pearl.

Geologists classify igneous rocks as being “intrusive” if they cooled beneath the earth’s surface and “extrusive” if they cooled at the surface. They arrange igneous rocks into four groups according to their chemical composition and silica content:

- acid rocks (with more than 65 per cent silica)
- intermediate rocks (55-65 per cent)
- basic rocks (45-55 per cent)
- ultrabasic rocks (less than 45 per cent)

Light colours usually indicate acid rocks. Basic rocks are dark, with high proportions of dark, dense, ferro-magnesian minerals such as augite. The most common sources of granite for monuments were Vermont, from which comes a bluish-grey, medium-grained granite; Stanstead, Quebec, which yields light-grey granites with medium-sized, grey, clear, white crystals and black



By the late nineteenth century, granite had become the popular stone for monuments. The workshop yards such as the Marble Works of Aylmer were supplying more granite monuments than marble, as shown.

grains of biotite mica; and possibly the famous medium, coarse-grained Red Granite from the St George district of New Brunswick, or the similar and perhaps even more famous Aberdeen Red Granite from Scotland.

Red, dark pink, or brown stones with swirling patterns of veins of black were usually Cold Spring or Rainbow Granite from Cold Spring, Minnesota, but more recently may also be similar stones imported from India. Hard, polished black stones, with a fine or medium-sized crystal structure, might be diorite or anorthosite, such as the famous Nipissing Black Granite from the River Valley district northwest of North Bay, Ontario, or California Black "Granite." More recently, black diorites and anorthosites have included stones from

Uruguay and India.

Sources of granite in Ontario include Massey Black, a medium to coarse-grained gabbro (also known as Unique Black), and River Valley Black Anorthosite, a massive, medium to coarse-grained anorthosite. Quebec examples of black "granites" include Peribonka and Noir Albini. Anorthosites are made up of 90 per cent plagioclase feldspar (labradorite and Bytownite) and virtually no quartz. Blacks, blues, and dark colours, with large, iridescent feldspar crystals, are usually labradorite, larvikite, or Norwegian Blue.

Granites are usually light in colour, formed mainly of potash feldspar (about 60 per cent) and quartz (about 30 per cent), usually with mica and hornblende. The presence of feldspars may give the granite a reddish or pinkish appearance.

Measuring pH

The term "pH" is used to describe the hydrogen ion activity of a system, hence acidity or alkalinity of a substance. The greatest acid concentration is at pH0, and the greatest base or alkaline concentration is at pH14; pH7 is neutral. One may measure pH in the field in a number of ways, including through use of hand-held electronic pH meters and non-bleeding pH indicator strips with triple or quadruple colour-band indicators to facilitate accurate colour matching with reference strips. Indicator strips are used in conjunction with a small quantity of distilled water.

Studies on the deterioration of stone and subsequent cleaning and conservation treatments may often require a considerable amount of pH testing – for example, during use of acids or alkalis to clean masonry materials and to establish whether cleaning solutions have been properly removed and the surface and sub-surface left neutral.

Deterioration

In heavily polluted environments, however, even granites may be seriously damaged if they receive run-off from calcareous rocks such as limestone. In granites and slates, for example, inclusions of pyrites (fool's gold) or sulphide minerals such as iron or copper sulphide may react with sulphuric acid in precipitation and cause staining or, at worst, disintegration of the stone matrix. Some forms of mica such as biotite – a black or green, complex magnesium iron silicate – react with sulphuric acid and decompose, leaving thin scales of silica, possibly with rust staining as well. This decomposition can lead to serious surface damage.

Feldspars, an important group of complex, silicate, rock-forming minerals, are divided into the alkali varieties (orthoclase and microcline) and the plagioclase (soda-lime).

The deterioration of silicate minerals is highly complex, but it is believed that the following processes take place:

- Ions exposed on the rock surface hydrate readily in contact with water – very small acidic, positively charged hydrogen ions readily penetrate mineral grain surfaces and break down the silicate structure.
- Parent minerals break down, with a release of cations such as silica; the silica may retain its original atomic structure or may be dispersed.
- Metal alkalis become soluble and are removed as a result of the breakdown.
- The residues may re-form into new minerals in reactions with the more or less polluted environment.
- Water molecules enter spaces left vacant by leached metal cations; this process is called “hydrolysis” and leads to formation of clays. (Kaolinite is a typical clay mineral formed in this way from feldspar-containing rocks in the presence of heavy acidic precipitation.) Oxidizing conditions may produce much leaching and removal of calcium, iron, magnesium, potassium, sodium, and some silica ions.

In nature, the weathering process of silicate minerals from rocks is very slow, but at the low pH (acidic) values often found in acid precipitation in Ontario the processes are speeded up. In tests comparing leaching rates between distilled water and weak carbonic acid, the latter caused the leaching to double in speed for calcium, magnesium, potassium, and sodium. Orthoclase and muscovite (mica) are much more sensitive than other minerals to high carbon-dioxide contents in precipitation, as in acid-rain exposures in an urban environment. Ions are immobile between pH4.0 and 9.5 but are very soluble below and above that range. Temperature also influences leaching rates. Very moist surfaces exposed to high temperatures may have rates 20 to 40 times higher than those in cool, dry

exposures.

It is clear both from natural exposures of silicate rocks in deserts and from exposures in polluted environments that weathering rates may accelerate rapidly and disastrously once cracking and micro-cracking occur in the surface, particularly when gaps are created in the crystal lattice. Granites that were worked by mechanical bush-hammering to produce a flat surface may, in fact, be left with a damaged crystalline surface structure filled with micro-cracks. Granite blocks that were so treated in the opening decades of this century have often been subject to surface disintegration in polluted urban environments.

Silicate rock weathering also accelerates, particularly where acid-secreting and chelating bacteria and fungi are harboured in cracks in the surface. Stone exposed to polluted air and precipitation may show early signs of incipient weathering by undesirable discoloration, loss of lustre or polish, and loss of hardness of feldspars and ferromagnesian silicates such as biotite mica. Of all these processes, oxidation of ferrous iron is the earliest



Problems occur when marble or limestone is placed over sandstone. Look closely and you can see that the white carbonates from the marble have impregnated the sandstone (white marks on the dark stone).

evidence of deterioration. The surface zone in such cases changes colour from grey, greenish, or bluish, to various rusty hues of brown, yellow, and orange.

GENERAL DETERIORATION

In addition to harsh environmental conditions, atmospheric pollution, weathering, and incorrect conservation and repair techniques, several other factors can cause stone to deteriorate.

Mixing Stones

Problems occur where limestones or marbles are inserted into or are placed over sandstone and other permeable or semi-permeable stones so that run-off from calcareous stone gets into the surface of other stone. Surfaces of non-calcareous stones may thus be impregnated with carbonates and bicarbonates, which

are later converted by reactions with sulphuric acid in rain, snow, or fog. The affected surfaces will then blister, exfoliate, or crumble and be lost.

Improper Mortars and Setting Monuments in Concrete

Hard, dense, and impermeable Portland cement-based mortars are often used to repair and reset broken or loose stones in the mistaken belief that the harder and stronger mortar is better and that the repair will last longer. As a basic principle, all repair mortars should be designed to be slightly weaker than the original stone itself in its aged and weathered condition. When stones expand and contract with changes in temperature and humidity, the mortars that hold them together or hold them in place must be sufficiently soft, flexible, and permeable to accommodate movements and ensure that the masonry can dry out without damage

being caused to the original masonry units. The fragile edges of weathered stones are particularly susceptible to damage caused when a stone expands against a hard, incompressible mortar and where moisture carrying dissolved salts is forced out through the edges of the stones because of the impermeable nature of a mortar.

Vandalism

Vandalism is another major problem affecting stone monuments and memorials. The stones tend to be brittle and increasingly fragile as they become older and more weathered. If tablets, columns, or headstones are overturned, they may easily be broken into fragments or broken off their bases.

Removal of graffiti may require highly specialized attention from an experienced conservator, particularly when the underlying stone is fragile and permeable, as with old, crumbling marble.

Metal Corrosion

Corrosion of original or later iron or steel dowels, bolts, pins, and cramps leads to formation of expanding crusts of corrosion products, with substantial increases in volume. The resulting high pressures can shatter even the hardest granite if the metal is embedded in it.

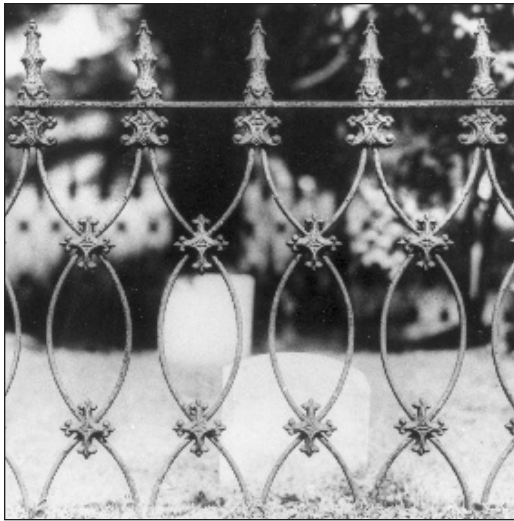
Unfortunately, broken stone tablets have often been repaired by drilling holes into the stone and bolting iron straps across the breaks. The iron straps would subsequently corrode and stain the stone surfaces. The bolts corrode, expanding and eventually splitting the stone in which they had been embedded.



Concrete can be harmful to the older, more fragile tombstones. This type of repair goes against the basic principle of reversible interventions.



Iron brackets used to hold broken marble slabs together detract from the appearance and lead to rust staining.



Cast iron was typically used for fencing of family gravesites.

METALS

In Ontario in the nineteenth century, iron, lead, zinc, copper, and bronze were added to the repertoire of materials used to fabricate complete monuments and statues and for railings, dowels, anchors, and other fittings for stone monuments.

Iron

Of the three metals iron, zinc, and lead, by far the most common in Ontario cemeteries is iron, either wrought or cast. Iron was frequently used for fences around graves and memorials and around the cemeteries themselves. Sometimes the iron was in the form of chains suspended from hooks or eyes set into posts or pillars of wood or stone. Today, many of the chains are missing completely, with the remaining hooks being the only traces of their existence. Simple details were usually fabricated in wrought iron, but by the second half of the nineteenth century complex balusters, piers, urns, planters, and even memorial statues were often made in cast iron.

Cast iron was often fabricated in sections that were bolted together. The screws, bolts, or threaded rods were of wrought iron or steel. Differences between the two metals sometimes caused, and can still cause, galvanic corrosion. Bolts of brass and bronze were also used, but they are usually comparatively easy to remove and have caused no particular corrosion problems.

Where hollow iron castings such as urns, planters, and statues trapped water, severe corrosion may have occurred, possibly accompanied by expansion of ice, causing shattering of the casting. Such problems are usually more severe in polluted environments, where chlorides are present.

Some cast-iron memorials may have been broken by accident or by vandalism, where the brittle, cast-iron sections were too thin.



White Bronze Company of St Thomas was famous for its zinc monuments.

Lead

Lead is most frequently found in lettering set into stone tablet surfaces. It was commonly used for settings for iron dowels and rails, as button and sheets to facilitate the even bedding of stones, or as a damp-proof membrane.

Occasionally, lead may be encountered as a material for hollow cast statues.

Lead is attacked by alkalis and by organic acids found in soils and rotting vegetation and in industrial pollution near pickle or vinegar factories. It is subject to plastic deformation under load, or “creep,” and heavy statues thus may have slumped or sagged under their own loads. When the surrounding stone is stained brown, red, or brilliant yellow, there may have been contact with incompatible stone-cleaning chemicals such as potassium hydroxide. Since lead is a soft metal, it may also suffer from vandalism.

Zinc

Also known as “white bronze,” zinc, the second most commonly used metal in Ontario, was employed extensively in

the nineteenth century for elaborate monuments that were usually cast in sections and bolted together. The White Bronze Company of St Thomas, Ontario, was one of the largest manufacturers of such monuments in Canada and exported them to the United States. Zinc memorials tend to be brittle and may be damaged

by vandalism. Corrosion may occur in severely polluted industrial environments with chlorides. Zinc corrosion is pH-dependent and is more common below pH4 and above pH9. Zinc corrosion products are generally white and usually consist of zinc hydroxide.

CHAPTER 2: CLEANING STONE

WHY CLEAN STONE?

Deterioration and soiling are most common with ornamental and carved stones, whether they are located in a building or are free-standing. As seen in chapter 1, a thorough understanding of a stone – its geology and the causes of soiling and decay – is essential before proposing any treatment or cleaning technique.

As we now know, the earliest tombstones in Ontario are made of limestone, marble, or calcareous sandstone. These carbonate stones are not only more susceptible to decay but are also capable of supporting organic materials such as algae and lichens, which contribute to their soiling.

The foremost reason for the existence of tombstones and monuments is to memorialize loved ones and ancestors. This means that the legibility and appearance – free of soiling – are even more important here than in any other type of ornamental stonework. Each year, as special occasions approach, monument builders and contractors are asked by people to improve the appearance of their family tombstones. Further, the increased popularity of genealogy has resulted in a greater desire to improve the legibility of inscriptions.

It is important to be sure about the motives for cleaning stone. Cleaning is expensive and can cause damage if it is not carried out with appropriate expertise. However, it can be essential if there is a risk that failure to clean will result in deterioration of a tombstone.

Light soiling is usually an aesthetic problem, but inscriptions may become

obscured, prompting visitors to scrape at surfaces and cause damage in the process.

The gentlest effective treatment may be simple washing with small quantities of clean water. This is often all that is needed and will cause no harm unless the stone is badly deteriorated. No cleaning with water should be attempted if there is a risk of temperatures falling low enough to cause freezing before the stone has dried out. Freezing of a water-saturated stone can cause severe damage or even total destruction.



Cleaning with warm water and a nylon brush can often remove much biological soiling.

For more serious situations of soiling and deterioration, it is best to hire only skilled stone masons and conservators with extensive professional experience and expertise in this specific area.

Removing Efflorescence

Where memorials are being affected by efflorescence and subflorescence of water-soluble salts (*See* soluble salts), these can be removed by means of poultices of clean water and diatomaceous earth, fuller's earth, or kaolinite, which form a thick paste. Such poultices are usually applied with wooden spatulas in a layer about 12 mm (1/2 in) thick. When dry, the poultices are carefully removed to avoid



Sandstone is susceptible to soiling caused by efflorescence (white staining), carbon buildup (black staining), or biological growth (also black staining).

getting any salts into the ground around the memorial. Most soiling on granites, marbles, slates, and limestones can be simply removed by washing with clean water and natural fibre or plastic brushes. *Wire brushes should never be used.* Soiling on sandstones may be in the surface, but superficial deposits may be removed with water. If the deposits are not easily removed, then progressively hotter water can be used, but the quantity of water should be kept to a minimum.

If the soiling on marble or limestone is heavy in protected areas, with some surface blistering, and the surface is powdering in rain-washed areas, then a more complex approach is called for. A poultice is prepared with deionized water mixed with kaolinite and so on, as described above. This is trowelled onto the surface, and then the whole poultice layer is wrapped in gauze bandages to keep it in place. The soiling will be pulled out and deposited in the poultice, which may be removed when dry. This process may also sufficiently soften dirt to loosen it and permit it to be removed with wooden toothpicks, or tools such as those used by dentists, sculptors, or carvers. Neutral soaps or detergents of pH6-7.5 may also be employed. If the deposits contain oily traffic exhaust-emission residues, a paint solvent such as Varsol may be mixed 1:1 with water and applied with swabs until the soiling can be removed. The process

may be assisted by means of wooden toothpicks.

Extremely heavy soiling may require use of a poultice based on the chelating agent ethylene diamine tetra-acetic acid (EDTA). Chelating agents are compounds able to combine with metallic ions that cause some stains. These ions are brought out of the stone in solution with the chelating agent and are deposited in a poultice, which is then removed. Staining caused by reactions between cleaning chemicals and lead in memorials can be removed by using chelating agents in poultices. EDTA should be used with caution since there are concerns within the conservation field that EDTA is not as selective as desired in locating these metallic ions. It is possible that in removal of stains some of the carbonate stone material will also be removed.

The poultice is a clear jelly, which is applied with a wooden spatula or a broad brush in a layer about 3-4 mm ($\frac{1}{8}$ in) thick. The poultice is then covered with a sheet of clear polyethylene, or plastic food wrap, to prevent it from drying out. Unlike other poultices, this one must not be allowed to dry out because it becomes very difficult to remove. It may be left on for as long as 24 hours and should be removed when still wet. Applications may be repeated as necessary. The poultice should not be used on fine, polished marbles, because the EDTA may remove calcium ions and damage the polish.

Removing Metal Stains

Stains from iron, copper, and bronze corrosion products may also be removed with poultices. For **iron stains**, make a solution of 1 part by volume sodium citrate, 6 parts water, and 7 parts glycerine. (The glycerine additives in poultices can cause subsequent soiling because the glycerine residue attracts

The Coat of Arms at the Ontario Legislative Building receives a poultice treatment to remove organic growth. (Detail of deer shown.)



dirt; some conservators therefore prefer to omit them.) Mix the solution with fuller's earth, kaolinite, or diatomaceous earth to form a stiff paste. Apply the paste to the affected surface with a trowel or spatula in a layer about 6-12mm ($\frac{1}{4}$ – $\frac{1}{2}$ in) thick and leave it to dry. When the layer cracks

up and cups, remove it with a wooden spatula or scrapers. You may need to repeat the treatment. **Very light rust stains** can sometimes be removed using a poultice with 30 gm (1 oz.) of oxalic acid powder and 285 gm (10 oz.) (by weight) of water. Add this mixture to fuller's earth or other inert poultice materials to form a stiff paste. **Very bad iron staining** can be removed using a sodium dithionite or sodium hydrosulphate poultice. ProSoCo, a Kansas-based manufacturer of masonry cleaning products, makes a sodium dithionite-based poultice kit. The stone should first be wetted with a sodium citrate solution using 1 part by volume sodium citrate and 6 parts water. ProSoCo also manufactures a prewash specifically for use with this poultice.

The literature on chemical safety cites some examples of spontaneous combustion occurring in laboratories where concentrated solutions of sodium dithionite have been splashed on cloth or paper and then have evaporated to dryness, forming crystals. Considerable heat is generated in this process, and a fire can result. It is recommended that any splashes be washed off immediately

with large quantities of water and that operatives or conservators wear plastic protective clothing to avoid the danger. The sodium dithionite is highly soluble and may be diluted with large quantities of water for safe disposal. Any treatments with the substance are likely to be on a very small scale, but prospective users would be well advised

to check with relevant environmental agencies to establish approved use and disposal techniques.

Copper and bronze stains may be removed with a poultice based on ammonium chloride. Mix one part by volume of ammonium chloride dry with 4 parts powdered talc, and then mix these to a stiff paste with 10 per cent ammonia water. Prewet the stained surface with clean water and then apply the poultice with a wooden spatula. Once the poultice has dried, remove it and thoroughly rinse the surface with clean water. Repeat the treatment as many times as necessary.



Highlighting the lettering on white marble monuments with permanent black ink/paint should be forbidden by cemeteries. This technique was used too often for recording and photographing epitaphs and is almost impossible to remove.

Removing Paint

You may remove paint from graffiti and from other means by applying an appropriate paint remover in a poultice of fuller's earth or other inert material. Most paints will respond to a poultice made with a methylene chloride-based paint remover. Spray lacquers may require use of a poultice with lacquer thinner instead. Carry out tests to establish solubility in various solvents on the least obvious areas before applying the poultice on a large scale.

You can usually obtain the best results by removing the paint as soon as possible after its application, using appropriate solvents in poultices. You should not apply paint solvents directly

to the stone surface because the paint may sink into the stone as soon as it is made soluble.

WARNING: The fumes or vapours from a wide range of organic solvents such as lacquer thinner and methylene chloridemay be extremely poisonous. They are highly flammable and even explosive when mixed with air. Use all such products with appropriate precautions and equipment.

In cases of severe soiling, you may use proprietary masonry-cleaning products such as ProSoCo. The products have as their base dilute acids, alkalis, or organic solvents, with admixtures of other compounds such as surfactants or wetting agents and chelating agents.

Please note: Each of these manufacturers' products is specifically designed for certain substrates and types of soiling. They may not be interchangeable and can cause hard-to-remove staining or much more serious damage if used improperly.

Micro-abrasive Cleaning

In recent years, with the enforcement of environment laws restricting the use of certain chemicals and regulating the disposal of others, many building masonry restoration companies have rediscovered micro-abrasive (wet or dry) cleaning methods. These systems of cleaning such as the JOS and Thomann-Hanry employ special nozzles that spray a little amount of water with an abrasive in a turbulent flow or use a nozzle with a vacuum system. These systems have the advantage of being environmentally safe. Again, it is essential that a skilled operator apply the system to ensure that there is no damage to the surface of the stone while the soiling is being removed.

Removing Organic Material

In urban cemeteries, while the "dirt" is often composed largely of sooty carbon deposits and dust adhering to the surface with traffic emission residues, some discoloration may also result from organic growths of bacteria, algae, and fungi. In rural sites, the "dirt" may be found to consist largely of organic material and can also include lichens, which may have difficulty in growing in more polluted, urban sites. "Soiling" that appears to be black may be seen under a microscope to be multicoloured and to consist of many organisms, with or without soot, grains of dust, and loose particles from the stone surface. A spot test may be applied with a cotton swab dipped in ordinary household bleach; carbon remains black, and organic material will be bleached to a light brown or may even be destroyed.

Tombstones in rural cemeteries are ideal hosts for algae and lichen because of the variety of stone types, which range in pH, texture, and water-bearing capacity.

Their carved surfaces and exposure to all orientations make tombstones ideal surfaces for lichen and algae colonization. It is important to understand that organic material removed from tombstones will return within a short period of time. In fact, many lichenologists or those dependent on lichens, such as weavers (wanting to create natural dyes from lichens for their wool), are thankful for the existence of historic cemeteries.

Generally, it is advisable not to remove lichens from tombstones, since more damage to the stone can occur during removal of lichens. Certain lichens are "lithophagous" – they can "eat" stones. They secrete organic acids that can destroy calcium carbonate – for example, as they are extracting nutrients from the stone. It is very difficult to remove these lithophagous lichens without removing



The black spots or "dirt" on tombstones are often organic growth and not pollution related.



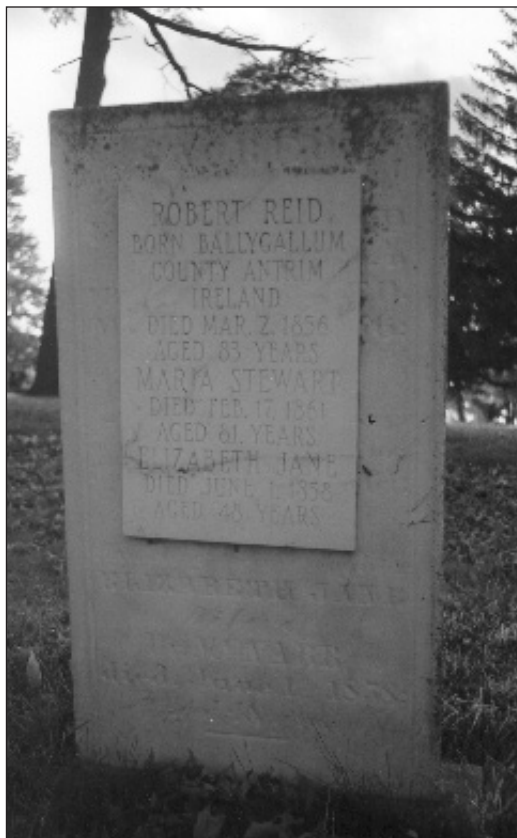
Lichens thrive on the tombstones found in rural cemeteries.

some stone. Rather it is best to try and control the accumulation of lichens on the surface of the stone by gently brushing off only loose material. Most types of lichens are harmless to stone other than being soil formers and, in time, assisting with the growth of mosses and small plants such as ivy and ferns. These plants and any soil should be removed by hand to prevent serious damage to a stone.

Conservators are occasionally asked to recommend herbicides and biocides to prevent growth of algae, fungi, mosses, lichens, grasses, and broad-leaved plants



A new granite marker is installed in front of the original tombstone.



As inscriptions become worn and faded, some families will request that the epitaph be recarved into the old stone or a new plaque be mounted on top. Both methods should be avoided, since they destroy the tombstone's original appearance.

on or around memorials. There is no single substance that can safely prevent regrowth of all these members of the plant kingdom. Some biocides are highly toxic to humans, domestic animals, and other mammals, fishes, and birds. Others – for example, borax – may be less toxic to animals but may cause crystal growth, which can destroy the stones of the memorials. Chlorine-based bleaches or hydrogen-peroxide washes (3 per cent in water) activated by a drop of ammonia may remove some algae and fungi and prevent regrowth for a short time at least. Copper-sulphate washes may also help but can cause staining in white or very light-coloured stones. Since the results of this type of cleaning are short term and since there is risk of damage to these fragile tombstones, we advise against the use of herbicides and biocides.

Recarving of Tombstones

Since some, if not all, of the motivation for cleaning tombstones comes from the desire to be able to read the weathered inscription, what does one do? There is

an unfortunate practice of recarving or relettering historic marble slab markers or tombstones when the inscription becomes very worn. *Recarving of tombstones can and should be avoided.*

Rather than altering the historic tombstone, one can install a new granite or bronze marker in the ground in front of the original tombstone. This new marker would then permit families to retranscribe the epitaph of the original tombstone into a more durable material without altering the integrity of the original one.

CHAPTER 3:

TEN COMMON REPAIRS

HOW TO START

The recommendations and procedures illustrated and the materials described

in this chapter provide a realistic and achievable approach to the repair of cemetery markers. All the procedures described here have been carried out either at cemeteries where restoration work is under way or at workshops organized by the Ministry of Citizenship, Culture and Recreation in conjunction with local monument builders.

It is quite common to find in the province historic cemeteries that now have historic slab markers set in concrete and memorial walls. In the past, there was a tendency to use strong materials in repairs, such as hard, dense, and brittle Portland cement in mortars, and concrete in which markers are set, either in the ground or in "cairns." These strong materials, while appearing to be beneficial in the short term, will, over time, speed deterioration because of their incompatibility with the markers themselves.



Setting tombstones in concrete will, over time, speed the deterioration of the stones. Unfortunately, the cemetery's appearance has greatly changed. Once a pastoral setting, it is now a highly regimented arrangement.



Participants in an Ontario Monument Builders' Association workshop learn how to use dowels and epoxy to repair broken monuments.

The materials and procedures described here are to a large degree traditional in nature, part of a common-sense approach, and follow established principles and practices of good conservation. What this means in practical terms is that people carrying out the work need to familiarize themselves with these materials and their correct use. Training programs that address these issues are becoming more common, and those responsible for cemeteries and repair work should seek out individuals and companies who have received this training.

Organizing the Repair Program

Once the decision is taken to carry out remedial work at a cemetery, the natural inclination is to "get going" as soon as possible, especially where public safety is an issue or where funds become available to assist with the work. However, a little time taken at the beginning of the project to develop a logical strategy can help prevent mistakes and, sometimes, irreversible decisions that may harm the work.

THE CONSERVATION PROCESS APPLIED TO A CEMETERY REPAIR PROGRAM

I DOCUMENTATION

- site survey
- recording – material type, historical data, photography
- condition survey – recording deterioration, determining and understanding failure mechanisms
- research – establish site and marker significance

II ANALYSIS AND CHOICE OF CONSERVATION APPROACHES

- additional research
- trial treatments
- determining repair strategies
- assessing skills required versus skills available
- finalizing treatment procedures on marker-by-marker basis
- presenting treatment recommendations

III IMPLEMENTATION

- carrying out treatments with appropriately qualified personnel – volunteers, contractors, monument builders, conservators
- documenting repair procedures – specifications, photography, written reports

IV CELEBRATION OF THE SUCCESSFUL WORK

- Because conservation is a long-term process, be sure to celebrate the milestones of achievement.
- Promote these achievements.
- Acknowledge volunteer and community support.

An ideal framework for this plan of action is the conservation process. The conservation team itemizes the various steps, such as:

- a site survey
- recording
- examination, and understanding of problems
- recommended solutions
- materials to be used
- methods of work

The conservation process provides a full understanding of the problems and issues involved prior to beginning of any remedial work. This approach, while general in principle, can be applied to a specific site, where conditions, priorities

for remedial action, and implementation will frequently relate closely to the funding and skills available.

Establishing Priorities

Where a cemetery has principally simple slab markers with only about 10 per cent obelisks and table tombs, and problems are limited to tilted slab markers, the strategy for repair will be very different from that in a cemetery with a more varied mix of markers and where extensive breakage and damage necessitate major interventions. Striking the balance between what is desirable and what is achievable can sometimes be difficult, especially when funds and skills are at a premium.

Where problems are relatively simple and easily dealt with, looking at the most serious of these first would be logical. Where repairs are extensive, complex, and sometimes expensive, it may be useful initially to address simple problems – of the type that volunteers can carry out – and thereby create both momentum for the project and interest in the community.

Repair procedures will vary. For example, simple supports in wood or metal to brace or stabilize a marker will look quite satisfactory if only two or three in a hundred markers are treated this way. However, if this technique is used in row after row at every other marker, the visual impact would be detrimental to the site as a whole.

Assessing Site Conditions

This is the critical, first phase of the work, where ideally the documentation process should lead to as comprehensive an understanding as possible.

- Survey the site to locate all markers, their orientation, and relevant landscape features.

- Survey markers to identify material, style, inscriptions, and condition.
- Where there is extensive deterioration or damage, a specialist may be needed to carry out an examination to determine deterioration mechanisms and make specific recommendations for the remedial work.
- Recommend treatment.

Implementing Programs

Supervisors must ensure that the repairs are fully recorded, with photographs taken before, during, and afterward and with a record being kept of who did the work, methods, and materials used. This is crucial for those who may have to carry out the repair program many years after it started, when key people may have moved away and memories start to fade of exactly what was done, when, and by whom.

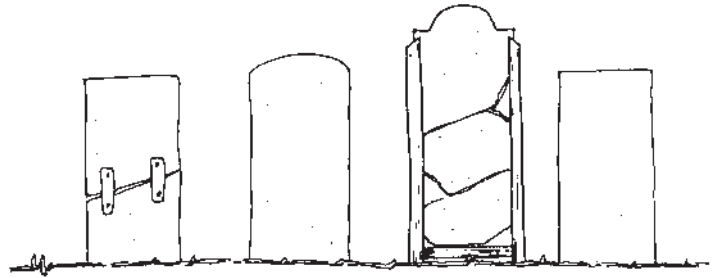
Skilled personnel are essential for most repairs (see Table 1). Training for monument builders and contractors is improving all the time, and there are increasing numbers who have experience and understanding of traditional materials and appropriate repair procedures. If advice has been provided by a specialist, he or she may be able to recommend suitable firms. Volunteers can carry out simple repairs.

It is usually better to work with a small, dedicated group; limit the work of the group to what is realistically achievable and leave complex repairs, which are best carried out by a specialist or conservator. A small team working under the direction of a conservator or monument builder can complete an impressive amount of work.

Preparation

When all the reports are completed and work is about to start on site, it is wise to run through a few last-minute checks “just to make sure.”

COMMON METHODS OF SUPPORTING BROKEN MARKERS



Metal or wooden frames can support the edges of markers but also obscure part of the stone, and the increased bulk and relative position of the stone can make these types of repairs really noticeable. An odd marker done this way may be acceptable, but row upon row cannot be recommended.

Metal straps and older repairs, if they are not causing an immediate problem, can be left and attended to later.

- Examine the marker once again for cracks, delaminations, spalling, or other weaknesses. • Photograph the “as found” condition before commencing any work.
- Treat all stones as fragile. Wet, saturated stone is far more susceptible to breakage than dry stone. If possible, allow a stone to dry out before handling it. This can take from a few days to up to a month or more; moisture evaporates very slowly from some stones.
- If, on a stone’s drying out, efflorescence appears on the surface, seek a specialist’s advice to determine if a poultice is necessary to absorb the salts and prevent further deterioration.
- Estimate a stone’s weight at about 160 or 180 pounds per cubic foot. A marker 6 ft high by 2 ft wide, 3 in thick, will weigh about 500 pounds.
- When using lifting equipment, ensure that belts are nylon and positioned to minimize pressure on the stone that would cause it to snap. If necessary,

provide additional support with lumber to help distribute loads. Trucks equipped with a gentle pneumatic lifting system such as the Hi-Ab boom are ideal.

- Never use metal pry-bars to move or lift stones, as these will damage friable edges of the stone.
- Once a stone is out of the ground or lifted, complete the recording form. Take photographs and measure the stone.
- Where buried portions of the stone become exposed, look for previously

concealed markings, staining, or features such as inscriptions, a maker's name, or thickening of the butt end.

This examination can help determine the depth to which a marker should be reset. Generally between one-third and one-half of a marker was set below grade, and a maker's mark should appear 1 to 2 inches above grade.

- Where bases exist, either with obelisks or simple markers, these are frequently tooled or finished differently between the portion meant to be seen and that hidden below grade.

TABLE 1

PERSONNEL SUITABLE FOR COMMON REPAIR WORK

Common repair no.	Task	Page no.	Contractor/volunteer	Monument builder	Conservator
1	Correcting minor tilting	25	Yes	Yes	Yes
2	Resetting simple slab markers	26	Yes	Yes	Yes
3	Resetting bases	27	Sometimes	Yes	Yes
4	Resetting markers into bases	28	No	Yes	Yes
5	Repairing snapped markers	29	No	Yes	Yes
6	Mortar filling of pinned repairs	30	No	Sometimes	Yes
7	Repairing markers with multiple breaks	30	No	Sometimes	Yes
8	Mortar filling of missing elements	31	No	Sometimes	Yes
9	Resetting obelisks	32	No	Yes	Sometimes
10	Repairing broken bases	32	No	Sometimes	Yes
	Cleaning, including poultices		No	Sometimes	Yes
	Stone consolidation		No	No	Yes
	Table tombs, box tombs		No	Yes	Sometimes

The ten common repairs listed in Table 1 and presented in this chapter, and the section on repairing table tombs, box tombs, and mausoleums that follows, are based on practical and sound knowledge of stone repair and respect the conservation principles for treatment. These principles state that repairs should maintain original design, repairs should use compatible materials, and any changes are to be reversible.

1 CORRECTING MINOR TILTING OF SIMPLE SLAB MARKERS

Simple stone slab markers without bases (sometimes known as tabletstones) are the most common type of marker. Typically, they are white marble or dense limestone, though markers exist of sandstone, other limestones, and slate. About one-third of the total height of the marker was intended to be set below grade. Over their 100-to-150-year life, many have moved out of alignment, usually as a result of changes in ground conditions or seasonal movements of the subsoil.

Thin, marble slab markers may have even started to bend and curve if they are leaning over and hence are acting as cantilevers. Curvatures may become surprisingly large, but when the slab is several inches out of true it will fracture. Correcting the tilt of the marker will reduce the load that is causing the curvature and remove the greater danger of the marker breaking.

Look carefully for unusual circumstances that may have contributed to mis-alignment. Apart from the ground conditions described above, the loss of a mature tree, for example, may change groundwater conditions, or the mis-alignment may relate to a sunken grave. These issues should be addressed.

Wherever possible, realign markers to their upright position, with minimal disturbance of the surrounding soil. Remove the marker completely only if it has sunk, risen out of the ground, or requires some other type of repair. The operation is simple and may be carried out by properly trained (and sympathetic)

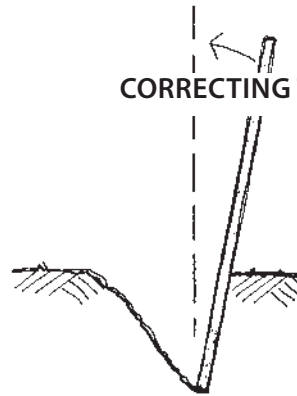
volunteers. The solution may not necessarily be permanent, and it should not be thought of as such. Sometimes movement may recur in a few years, but it is inexpensive and simple to correct and should be thought of as part of the ongoing maintenance and care of the cemetery.

- Lift sod around marker and set it aside for reuse. Excavate by hand down to the bottom of the marker on the side opposite the tilt. Work carefully, using small trowels when close to the marker.



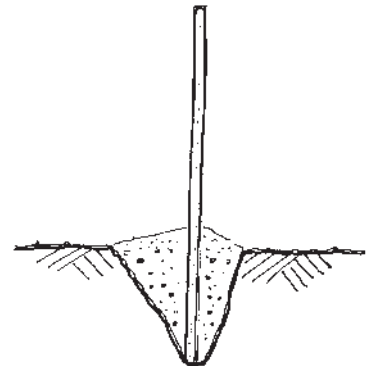
Tilted marker requires correcting before it

CORRECTING TILTED SLAB MARKERS

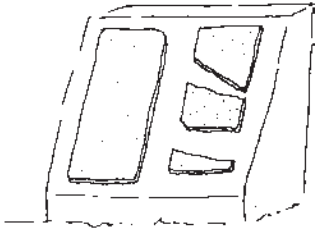


Excavate by hand with care on side opposite to tilt. Move marker to upright position.

Support marker while backfilling. Compact concrete sand in layers and ensure a positive slope, away from the marker's base. Return in one to two weeks and fill up any depressions resulting from settlement of soil.



INCORRECT MOUNTING OF MARKERS



Stones set in concrete bases or mounted in concrete cairns pose a more serious problem, as these stones will deteriorate more rapidly as a result of their contact with concrete. Seek specialist advice to help determine priorities and repair options.

If the presence of a base is suspected, some discreet and gentle probing with a pry bar will help locate it. The overall length of the marker will indicate whether a base was present or not.

- Carefully lift marker upright and either brace it or have a colleague support it.
- Ensure that the marker is plumb.
- **Backfilling:** Replace the soil around the marker, compacting it firmly in layers but without exerting any force against the marker. A baseball bat makes a good implement for compacting. Fill up both sides equally and where necessary add more topsoil to provide a positive slope away from the marker. Replace the sod, or seed, if necessary.
- Return to the site two weeks later and fill up any depressions that may have resulted from settling of the soil.

2 RESETTING SIMPLE SLAB MARKERS

If a marker is lying down or must be removed from the ground to be reset, then more extensive excavation and ground preparation are necessary. Assess the site and try to determine if any unusual circumstances have contributed to the conditions.

- If the marker remains set in the ground, proceed as in Repair 1, bringing the

marker upright.

- Support the marker and lift it out of the ground, using nylon lifting belts and appropriate hoisting equipment. Lay the marker carefully on supporting lumber (e.g., 2"x 4"s and thick plywood) to ensure even, firm, and continuous support. Leave room to slide nylon belts under the slab for easy lifting when you are ready to reset the marker.
- If the marker is lying in the ground, excavate around its perimeter and spaces beneath so that lifting belts may be slid from underneath. Lift the marker on to adjacent supporting lumber before attempting to reset it.
- Stones that have been lying in the ground for some years are likely to be saturated and are therefore very weak and prone to snapping. Such stones would typically require an entire summer to dry out sufficiently to allow for them to be safely handled and worked on. If they must remain outside, arrange clean tarpaulins so that air can circulate around the markers while they are protected from the weather.
- If additional work is not required and the marker is dry enough to be handled, prepare for resetting the marker. Photograph the stone and determine the depth to which the marker is to be reset.
- Flush surface dirt from the marker using clean water only and soft nylon or bristle brushes. Stubborn dirt may be loosened with wood or plastic scrapers. This process is not intended to remove heavy soiling, stains, or organic growth, any or all of which may be in the pores of the stone or bonded chemically with the surface. A stone specialist should be invited to review such conditions and make recommendations for cleaning procedures.
- At the intended location for the marker,



A marker that is lying in the ground can be set upright, again using simple methods.

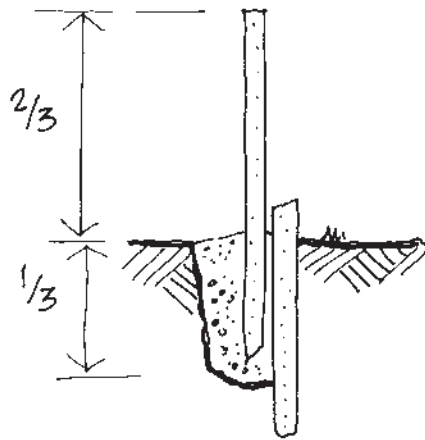
excavate a hole to the correct depth. Do not excavate below this point, as disturbed soil makes a poor base and increases the possibility of frost heave and/or settlement of the marker. Tamp the bottom of the hole to compact the soil fully.

- Many cemeteries are located on sandy knolls, where digging by hand is easy and the soil is well drained. In these conditions, the soil is often found to be poorly compacted and offers little support. Where such conditions occur, it is possible to provide a localized footing for the marker. Where large stones are not available, crushed stone or a concrete sand well compacted will be adequate. Avoid using brick, as it can disintegrate rapidly from frost action. A landscaping geotextile fabric, laid into the excavation prior to backfilling, can help prevent washout of the soil.
- Place the marker in the hole and ensure that it is plumb and correctly aligned in the row.
- Replace the soil around the marker as in *REPAIR 1*, above. If the existing soil is a light, sandy loam, a concrete sand makes a good alternative. Where heavy clay soils exist, a mixture of the clay and a lighter soil or sand will help prevent formation of a “swimming pool” in the excavation.
- Complete backfilling as in *REPAIR 1*.

3 RESETTling BASES

Markers set in stone bases are usually the second most common style of marker. Bases are often simply set on top of the ground or with the bottom portion just below grade. Many can be found out of plumb, damaged, or with the marker snapped off, leaving a short section still set in the base. In some instances, the marker is missing.

TEMPORARY PLACEMENT OF SNAPPED MARKERS

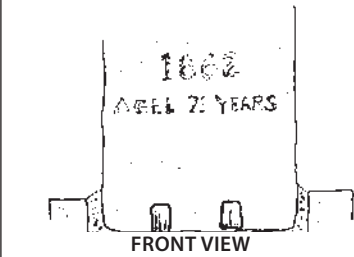


Set the upper portion of broken marker upright, adjacent to fragment surviving in ground. Use gravel to backfill to avoid staining face of marker.

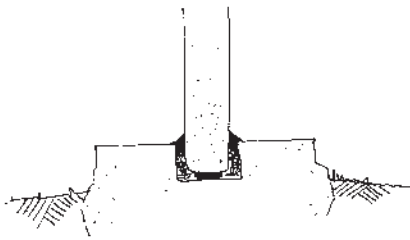
Instead of leaving markers lying flat in the ground, set pieces together as a temporary repair. This helps keep fragments together and is useful when resources are limited. Such a measure, while only temporary, does help provide a managed appearance to a cemetery.

This repair addresses the resetting of bases in the ground, and repair 4 considers the resetting of markers into bases. The procedures are applicable to other marker bases, such as obelisks.

- Where the base must be removed for resetting or for repairs, excavate carefully around the base and lift it onto a supporting lumber platform.
- Where the marker is firmly attached to the base and does not require resetting in the base, proceed with caution. Do not attempt to move or lift the assembly by the marker itself. Always support the marker while moving or lifting the base.
- Remove soil from around the base with clean water, as described in *REPAIR 2*.
- Carefully examine the base to determine if any repairs are necessary. Often, the stone forming the slot is cracked, or a portion is broken off. Carry out work as described in *REPAIR 10*.

RESETTING MARKER IN BASE**FRONT VIEW**

Bed marker on lead shims. Use lead wedges on each side to keep marker vertically aligned. Pack in mortar and finish with slightly sloped mortar pointing. Do no feather mortar on to top of base.

**SIDE VIEW**

After the marker is wedged securely, pack in lead wool, as a backing. Finish by hammering in a length of lead rope. Work lead to provide positive slope at base of marker and create a lip on top of base.

Caution: hammering of lead rope should not be used on limestone bases as this may cause cracking of the stone.

- Determine from inspection at what depth the marker was originally set. Usually tooling patterns did not extend more than an inch or two below grade. Sometimes the finishing or tooling fades out towards the bottom and is confirmation that the base was set into the soil. Examples would be the tooling on a margin or the quality of split-face work.

Preparing base for marker to be installed. The photo also shows the different types of brushes for cleaning stone.



- If the subsoil appears stable and capable of bearing the base, proceed as in *REPAIR 2*, adding concrete sand as necessary to improve the soil.
- Where the base is set on the side of a hill, a landscaping geotextile blanket laid into the excavation prior to backfilling can help prevent washout of the soil.
- In certain site conditions, a concrete foundation, poured to below the frost line (typically 4 ft 6 in), may be necessary. The top of the concrete foundation should be kept just below grade level (about 1 inch) and the foundation made slightly smaller (width and length) than the base.
- Place base on compacted fill or set it on the concrete, using mortar to provide a levelling bed and to accommodate the uneven underside of the base. The use of dowels here is not necessary.

4 **RESETTING MARKERS INTO BASES**

The procedures described here refer to the setting of markers into a base where the addition of pins is not necessary.

Generally markers 2 to 3 inches thick are set into a slot in the base that is slightly oversized and about 1 to 2 inches deep. Obtaining a seal between the marker and the base and sufficient rigidity to keep the marker upright may be difficult.

- Where the marker has an even base in good, sound condition, set it on lead shims and hold it in place in the slot in the base with lead wedges along its sides.
- Where the bottom, or butt end, of the marker is “sugary” (soft and liable to crumble easily) or part is broken off, set the marker on a bed of mortar. This

should be reasonably stiff in consistency to bear the weight. At the same time, set the lead wedges along the sides to hold the marker upright.

- Once the marker is set in place, fill the space between the marker and the edge of the slot with a mortar or with “lead wool” and “lead rope,” hammered in to provide a seal.
- Angle the mortar very slightly to help shed water, but avoid producing a large, triangular wedge of mortar between the marker and the base, as this is prone to failure.
- Pack the lead wool in as a backer for the lead to be finished on top of it. A blunt chisel makes a good tool to dress the lead down. Finish the surface at a slight angle, and the lead can just lip over the base to help provide a seal.

5 REPAIRING SNAPPED MARKERS

REPAIR 5 through *REPAIR 8* deal with the types of repairs that are common to the actual tombstone such as dowelling, mortar filling, and repairing of multiple breaks.

Dowelling procedures described are applicable to flat slab markers and to other types of markers, such as obelisks.

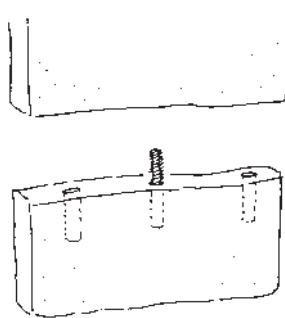
Typical failures involve markers that have snapped just above the top of a base or where a roughly horizontal break has occurred around mid-height.

- Lay slab markers on a flat, wooden bench that will support and keep the pieces aligned. Where a base is present, it must be securely positioned to prevent movement, particularly during drilling.
- Align the elements to be dowelled back together and determine dowel locations, length, and diameter. For a single break

in a 3-inch-thick marker, the use of threaded stainless steel dowels, 5 mm to 12 mm (3/8 – 1/2 in) in diameter, is ideal. Two or three dowels should be used and generally should extend 3 to 4 inches into each piece of stone.

- Holes need be only about 6 mm (1/4 in) oversized. Drill holes exactly parallel to the edges of the stone using a level or jig to ensure accuracy.
- Where a series of holes is drilled, offset the centre of each hole to help avoid creating a line of weakness.
- Retain stone dust from drillings. This can become part of the aggregate for mortar fillings to the stone.
- Ensure that holes are exactly matched by dry fitting the dowels and marker pieces together.
- Blow out dust from holes with compressed air (a turkey baster works nearly as well).
- Flush out holes with acetone, using a syringe.
- Prepare resin with a small amount of stone dust so that it is quite stiff and will not run. Using a spatula or popsicle stick, place a little resin in the hole. Coat the threaded dowel with the

REPAIRING SNAPPED MARKERS WITH DOWELS



When using three dowels, offset the centre hole slightly to avoid producing a line of weakness in the stone.

Resin should be used only to set the dowels. Use mortar on abutting stone surfaces.



Bad repairs detract from the design of the tombstone and obstruct the reading of the inscription.



A good repair of a snapped marker should appear only as a crack in the stone. The mortar fill should match the stone.

remainder of the resin and set it in the hole, turning the dowel to ensure proper sealing and filling between the stone and the dowel. Allow mixture to set fully.

- Another option is to use slow-setting gel resins which do not leak from holes and do not need to be set fully before the next step begins. This is the technique used at the Churchville cemetery project – see Appendix A. Either way, it is important that the dowels remain straight in the holes and do not tilt. There is a danger of using holes that are too oversized for the pins.
- Apply resin to holes on the piece to be mated and to the remainder of dowel. Carefully bring the two pieces together until they fit snugly.
- Resin that hardens can be removed only physically and will result in pieces of stone coming away with resin. Therefore, immediately remove any excess resin, using rags and, where necessary, some acetone.
- Properly support monument and allow repairs to set fully before proceeding with mortar repairs.

6 MORTAR FILLING OF PINNED REPAIRS

- Pinning repairs may be done in a workshop during the off-season. Markers can be re-installed during summer or when there is no threat of frost during the following 30 days.
- Mortar repairs should be done on site or after the marker is installed to avoid damage to mortar during transport to the cemetery.
- Fill up a crack along a junction, using a repair mortar that matches the marker in colour. Pack the mortar in, using fine tools to fill the joint completely. Where soft, rounded edges occur at the line of

the break, avoid filling flush and feathering the mortar. It is better to keep mortar very slightly back from the face of the stone.

- As the mortar sets up, stipple it with a short, stiff bristle brush to produce a lightly rough texture. Avoid tooling the mortar to a smooth finish, as this will cause it to dry very light in colour and will draw attention to the repair.
- Moist cure the mortar by lightly spritzing it with a water-spray bottle two or three times a day (more frequently in hot, sunny conditions) for two to three days. This helps the mortar set up and prevents shrinkage from rapid drying.

7 REPAIRING MARKERS WITH MULTIPLE BREAKS

Markers that have broken in many pieces are difficult and time-consuming to repair and should be worked on only by people who have experience with the procedures described here. It is a type of work best carried out indoors, where optimum working and environmental conditions exist.

- Gather up all the pieces and dry fit them together.
- Determine the sequence of pinning and mark stones for dowel positions. At major breaks joining large elements, employ the procedures described for snapped markers in *REPAIR 5*.
- Where smaller pieces are to be joined, reduce the size of the threaded, stainless steel dowels accordingly. A range of sizes from 12 mm (1/2 in) diameter down to 3 mm (1/8 in) should be on hand.
- The procedures for setting the dowels and joining the stone are the same as those in *REPAIR 5*. Large pipe clamps

and nylon belts that can be tensioned are useful for holding large stones together. Use wood spacers to protect the edges of the marker.

- It is best to use a pair of small-diameter pins for reattachment, but sometimes small fragments can only be reattached with a single dowel.
- Reattach the elements, working from the largest to the smallest pieces. Always allow sufficient curing time between each portion of the repair.
- Complete the repairs with mortar fills as described in *REPAIR 6*.

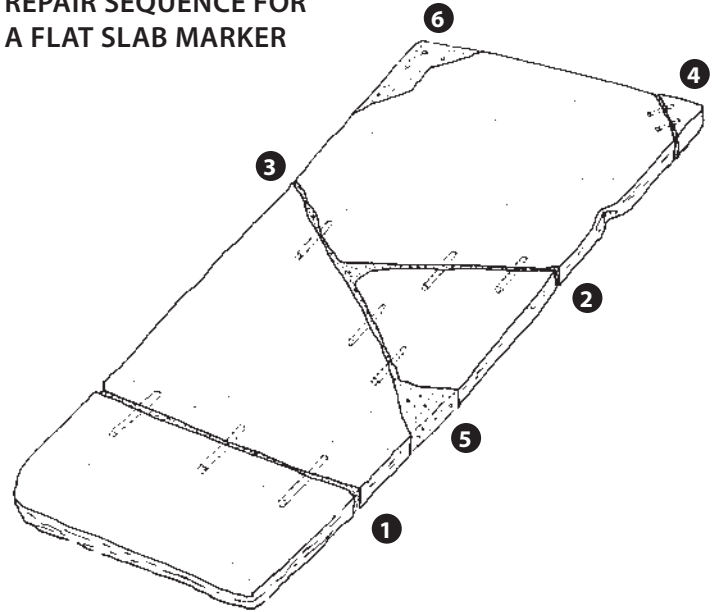
8 MORTAR FILLING OF MISSING ELEMENTS

Mortar fillings can replace missing elements effectively and for a long time if they are modest in scope and the work is carried out by experienced individuals.

Repair mortar must have similar characteristics to the stone on which it is being used. These types of repairs should be viewed as sacrificial: in conditions of stress, it is the mortar that will fail, rather than the stone. These characteristics are usually obtained with mortars mixed from lime, a variety of graded aggregates, and a small amount of white Portland cement. There is also considerable scope for use of hydraulic limes, which are increasingly available again, as the binder, instead of the combination of white Portland cement and ordinary lime. Mortars and their constituents are explained in detail in chapter 4.

Proprietary patching materials are not appropriate here, as they are designed primarily for concrete repair and are not compatible with marbles and other stones. The exception is where missing portions of a base prevent resetting of a slab marker. Here, a patching mortar, which

REPAIR SEQUENCE FOR A FLAT SLAB MARKER



1. Dowel together two bottom pieces of marker.
2. Dowel top of stone to triangular fragment.
3. Dowel top to bottom of stone.
4. Pin on fragment with a smaller dowel.
5. Pack in mortar on both sides of stone to fill cracks and complete mortar fills at missing portions.
6. This mortar fill is in a very vulnerable location and may not survive long here. While it would "complete" the stone, it is probably best omitted.

can be matched exactly to the stone colour and characteristics, can be employed. This procedure permits reuse of the base rather than replacement in new stone or casting in concrete.

- Installing mortar fills is very similar to filling cracks, (see *REPAIR 6*), except that these should be built up in stages and at least an initial set allowed before successive layers are applied.
- Moist curing is critical in these thicker fills; keep damp, absorbent towels in contact with the surface for the first day. Occasional spritzing with water should continue for two more days.
- To obtain a textured finish, lightly stipple the surface just after the initial

setting. Do not attempt to provide a smooth finish or one that matches the sawn surface of the stone.

9 RESETTING OBELISKS

Obelisks, because they tend to be tall and slender, are particularly vulnerable to tilting out of alignment. Frequently, the topmost element of the assembly, such as a ball or finial, is broken, has fallen off, or is missing.

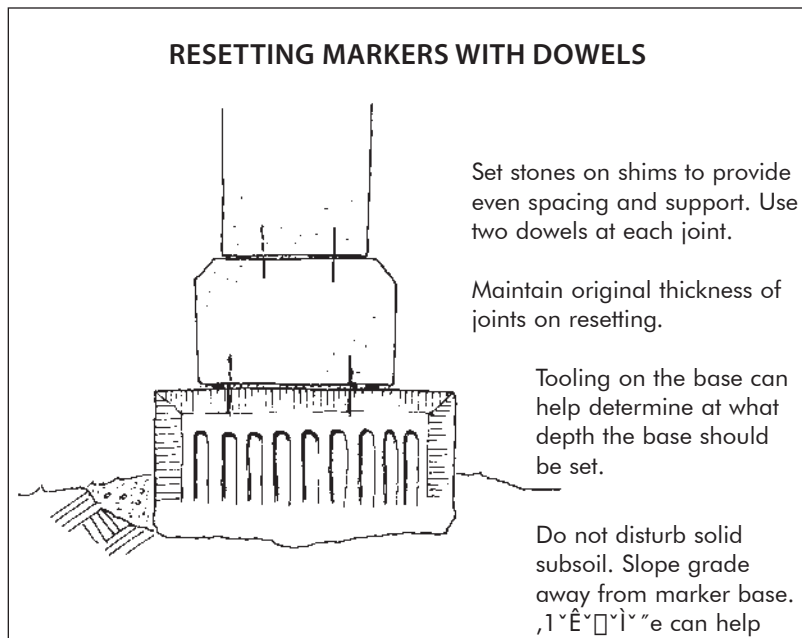
The repair procedures for slab markers described above that deal with resetting and repairs are effective for obelisks made of limestone, sandstone, and marble.

- The disassembly of obelisks is best handled by a firm equipped with proper lifting equipment. This is not a procedure for volunteers.
- Lift stones vertically to ensure that they clear any existing dowels. Remove any surviving ferrous dowels by coring out the stone. New dowels should be stainless steel, and, if they are not set in the existing locations, fill old holes with mortar.

- Carry out repairs to damaged stones as described above.
- Reset obelisk base on newly compacted fill or a concrete footing poured to just below grade, as described above.
- Reassemble the obelisk, dowelling between the elements. The use of two opposing dowels will prevent twisting. Employ slate, lead, or plastic shims to set stones. Pack the beds with mortar and point up to the surface. For very thin joints, apply a bed of mortar just prior to bedding the next stone. Rake back the bedding mortar and point up all the joints together to obtain a consistent pointing mortar.
- Maintain the original joint thickness when reassembling stones, particularly where fine joints are present, and resist the temptation to fatten joints to more workable tolerances.

10 REPAIRING BROKEN BASES

A base that contains a slot in which a marker sits may be broken or eroded to the point where it can no longer retain the marker.



- Wherever possible, reuse the existing base and repair, rather than replace, the base.
- Proprietary restoration mortar such as Jahn mortar can be placed and formed very simply to profile and tooled to match the adjacent stone. It sets up nearly as hard as the stone and can, if allowed to cure fully, perform in the same way as the stone.
- Repair with restoration mortar requires particular skills and should be carried out only by individuals who have completed the training program introduced by the product manufacturer. The technique should generally be limited to relatively minor

and straightforward repairs. Major repairs should be carried out with a matching stone or a new base prepared either in stone or in a high-quality, cast-stone material. Avoid crude concrete bases.

- Slots are vulnerable to frost damage, as they can fill with water. Bases left without a marker should have their slots filled with mortar. Bases repaired with restoration mortar can incorporate a discreet weep hole to allow moisture to escape. If bases are sound and performing well, a weep hole is probably unnecessary.

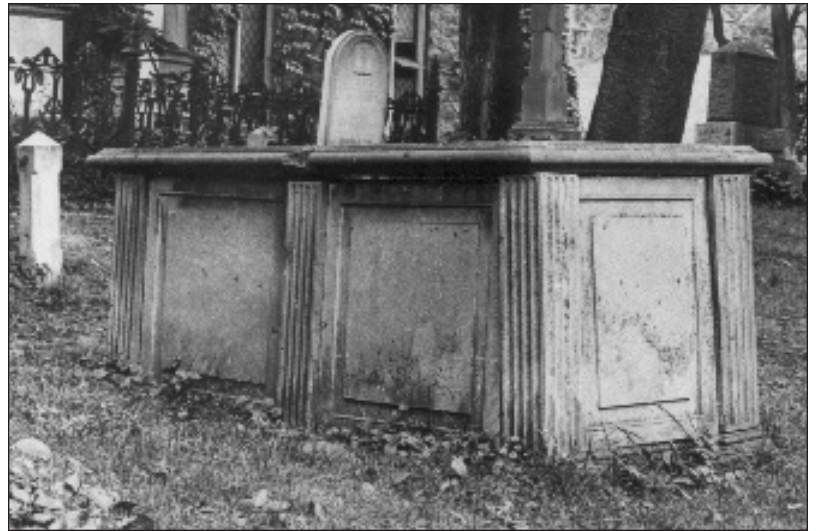
REPAIRING TABLE TOMBS, BOX TOMBS, AND MAUSOLEUMS

Stone slabs that span between columns, as in table tombs, may have sagged, taking on a pronounced curvature. In table tombs, which have a stone slab supported by stone columns or posts just like a table, conservators can sometimes take the slabs to a laboratory, turn them face down in a large bath of clean, filtered, potable water with a variable support system, and, over a period of weeks, relax the stone back to its original, level surface. The stone slab will then require careful drying and can sometimes be repositioned with some additional supports to prevent recurrence of the problem.

In most cases with a table tomb, one is concerned when the slab and supporting



A table top tomb which has collapsed because of the corroded iron pins.



Box tombs are similar to table top tombs, but have panels that fit into the supporting columns.

columns become loose due to the corrosion and failure of the iron rods and fasteners at the corners. The slab then becomes very vulnerable to breakage as the columns start to tilt and the fasteners are put under greater stress. It is critical that action be taken immediately, since

the tomb can collapse at any moment, especially during a winter when there is the certainty of extra load because of snow or the possibility of ice forming.

Box tombs and mausoleums must be treated like small masonry buildings and may even require very careful dismantling and re-erection using suitable lime-based masonry mortars and non-corroding cramps and dowels. A box tomb usually has four large stone slabs forming its sides and a large slab on top for a lid. More elaborate versions can have corner posts with grooves or rebates for the side slabs or panels. The various stone units are usually joined together with iron dowels and cramps, many of which may have corroded.

Often expansion of corrosion products on iron dowels and cramps joining stones together cracks the stone. If the iron dowels and cramps were set in molten lead, they may have survived intact.

A core drill is used to remove corroded pins.



However, if they were set in mortar, they are usually corroded, particularly where the iron was set in molten sulphur – a practice that can lead to disastrous corrosion but still surfaces occasionally when architects and others search through old specifications looking for “good old crafts practices.”



Sandstone monument in St Andrew's cemetery, Grimsby, which suffers from delamination. See Pinning Technique from Ashurst's Practical Building Conservation Series.

Carefully remove corroded iron dowels and cramps, saving the stone fragments, where possible, for the restoration and repair of the stone. Remove all iron and corrosion products, if necessary using water-cooled, diamond-tipped masonry saws and coring bits to cut out anchors, clamps, bolts, and fragments stuck in the stone. New dowels and cramps should be of non-corroding materials, such as stainless steel, bronze, titanium, or solid nylon or Teflon.

AISI Type 316 stainless steel normally prevents further corrosion. It is often convenient to use 12-mm (1/2-in)–diameter threaded rod, which can be cut to length as required. The new cramps and dowels are usually set in a moisture-insensitive, epoxy resin-based grout as previously described in the ten common repairs.

ADVANCED TECHNIQUE FOR STONE CONSOLIDATION

One can conserve delaminating stone (most often sandstone) memorial slabs that are suffering from face-bedding problems by drilling carefully on a slight downward angle across the planes of separation and then setting in short pins of threaded nylon or stainless-steel rods. Set the pins in moisture-insensitive epoxy resin with their heads set down below the surface of the stone. Patch the remaining hole with a stone plug set in tinted mortar or a lime/stone dust mortar composite. This is an advanced technique and should be applied only by those who have received training in the method.

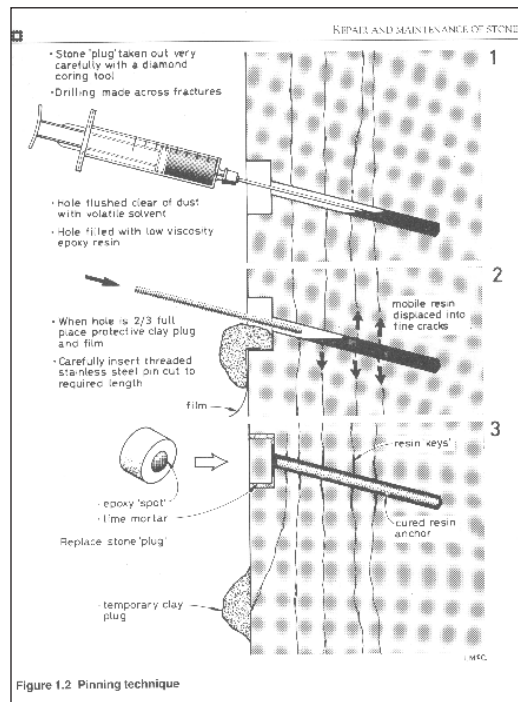


Figure 1.2 Pinning technique

Pinning Technique

Source: *Practical Building Conservation Series: Volume 1: Stone Masonry*, John and Nicola Ashurst, Aldershot, England: Gower Technical Press Ltd., 1988, p 15.

CHAPTER 4: MORTARS

CONSTITUENTS

All the mortars recommended in this book for repair work are based on lime. While lime traditionally was used in all types of building work, today it tends to be limited to work on historic buildings and monuments. As a result, it is not as readily available as it once was, and contractors may not be very familiar with its use. Some may need time to familiarize themselves with its properties, correct mixing procedures, and applications.

Aggregate (Sand or Stone Dust)

All mortars are combinations of a binder (lime) and an aggregate. The aggregate is usually sand, which acts as a filler and contributes to the durability of the mortar. The sand should be clean, washed, angular, and well graded – that is, a selection of grain sizes from a powder to about 3 mm (1/8 in). Most builder's sands consist of very fine grains only, and these should be avoided.

Sometimes, stone dust can be used as part of the aggregate to give colour to the mix. This is preferable to using pigments, which are prone to fading over time.

Limes (Binders)

Limes do not set in water. They are derived from high-calcium lime – limestone that has a high amount of calcium carbonate – or from dolomitic limestone, which contains both calcium carbonate and magnesium carbonate. The lime is fired in kilns to produce quicklime, which can be purchased. Slaking – mixing quicklime with water – produces lime putty suitable for use in mortar.

Alternatively, building-material suppliers sell a powdered lime called hydrated lime

– quicklime that has been commercially slaked with just enough water to produce powdered lime.

Lime putty produced from quicklime or hydrated lime may be kept indefinitely, in an airtight container, if protected from frost.

Hydraulic limes do set in water. They are also derived from limestones, but ones that contain clay in addition to the calcium and magnesium carbonates found in non-hydraulic limes. They set when their hydraulic components react with water. They were well known and extensively used in Roman times, rediscovered in the eighteenth century, and reintroduced for conservation work in limited quantities recently.

The speed of a hydraulic set depends on the amount of clay present in the limestone. At one end of the scale, where the proportion of clay exceeds about 35 per cent, the material is known as a natural cement. At the other end of the scale are pure limes, which will slake vigorously but will not set under water. Natural cements will not slake, but will set rapidly under water. In between are hydraulic limes, and they are categorized as follows: feebly hydraulic (setting in 15-21 days); moderately hydraulic (5-15 days); and eminently hydraulic (1-4 days).

Hydraulic lime is similarly fired in kilns and is usually supplied as a dry, ground hydrate in airtight containers. It should be fresh and used within one or two months. The hydraulic limes currently available are moderately and eminently hydraulic and are imported from the United States and Europe.

White Portland Cement

Portland cement may be thought of as eminently hydraulic lime. It is produced artificially when limestone and clay are burned together twice, and gypsum is added to retard the setting characteristics. Portland cement usually sets in about 45 minutes. Because the grey variant contains soluble salts, only white Portland cement should be used in mortars.

Pure limes can take many weeks to harden fully. It is possible to produce a more rapid set by adding Portland cement to the lime as part of the total binder content or by using other materials known as setting aids that will impart a hydraulic set.

Setting Aids

The hydraulic setting action may be imitated by mixing with pure lime those materials that contain reactive clay constituents, known as pozzolans. Pozzolans are named after the volcanic ash from Pozzuoli, Italy, which the Romans exploited. These can be found in fired clays, such as crushed pottery and low-fired brick.

Choose pozzolans carefully, since some contain soluble salts. The reactivity of pozzolans can vary. It is important to check the product data sheet to learn its particular characteristics.



Lime putty should have the consistency of yoghurt.

PREPARING MORTARS

During the off-season, one can produce enough lime to supply projects for the upcoming busy on-site repair season. Lime putty can, however, be kept indefinitely and, in fact, improves with age.

Creating Lime Putty from Slaking Quicklime

- Half fill a galvanized container, such as a plasterer's trough, with water.
- Carefully add the quicklime so that it does not project above the water.
- Stir continuously with a hoe as the reaction develops through generation of heat, emission of gas (carbon dioxide), and breakdown of the quicklime.
- The water may reach the boiling point.
- Continue to add more water and lime, stirring continuously until the process is complete.
- The lime should be thick and creamy.
- Allow mixture to cool, then pass it through a no. 16 mesh (1.18 mm) screen into plastic drums. Cover it with water and seal and date container. Allow it to mature or "fatten up" for a minimum of two weeks before using.
- As the lime matures it should develop a consistency similar to stiff yoghurt or cream cheese.
- Before using the lime, strain off excess water. If lime is still runny, place lime in cheesecloth to drain excess water.

Warnings

- Quicklime is corrosive, and the slaking process can be dangerous. Spitting can occur, and excessive heat is produced. Keep children and animals well away.

- Keep clean water, an eyebath, and barrier cream on hand. Lime burns can be serious; deal with them immediately.
- Wear full protective clothing – a rubber suit, boots, gloves, and head protection with goggles.
- The process inevitably causes a mess. Carry out slaking in an out-of-the way location.

Creating Lime Putty from Hydrated Lime Powder

- In a similar manner to preparing lime putty from quicklime, add hydrated lime powder to water in a metal plasterer's trough.
- The process is not as dangerous as when quicklime is used; little heat is produced, and the hydrated lime powder is not as corrosive. The process is messy, however, and similar precautions should be taken.
- The putty should achieve a stiff, creamy consistency
- Leave it for a minimum of 48 hours before use. Strain off excess water and place the lime in cheesecloth, if necessary, to produce a stiffer consistency.
- Lime putty produced in this way will stiffen, but it will not achieve the same plastic properties as well-matured lime putty produced from quicklime.



Mixing coarse stuff.

Coarse Stuff (Mixing Lime and Sand)

- The longer the lime and the sand are in contact, the better the eventual mortar will be. So mix them together as early in the process as possible. Small quantities are then available without the need for any mechanical mixing.
- Only accurate batching of the constituents can ensure consistent colour and performance of the mortar.
- Keep sand dry or barely damp. Do not use wet sand.
- Mix lime and sand thoroughly. A mechanical mixer is ideal for this procedure, though it can be done by hand.

The traditional specification of “beating, chopping, and running” to ensure good contact between lime and sand requires additional work. Use of a baseball bat to compact mortar in the bottom of a pail will produce a good, workable mortar. A stiff, “crumbly” mix can be reworked to a plastic state by this method in five to ten minutes.

- Cover the coarse stuff with damp burlap and seal it in plastic containers. If it is protected from frost, it can be stored indefinitely.
- Note: Both lime putty prepared from quicklime and pre-mixed coarse stuff can be purchased in small quantities. Refer to list of materials and suppliers below (page 39-40).

Additions to Coarse Stuff

- Take out sufficient coarse stuff for use and rework it with a baseball bat to a plastic consistency.
- Add the white Portland cement or other pozzolan in the correct proportion to the coarse stuff. (See mix proportioning)

- Ensure thorough and even distribution. Avoid the temptation to add more water to make mixing easier.
- Use the mixture within 45 minutes. Do not rework it or add water to it.

Use of Hydraulic Limes

- Because experience with use of these limes is limited and they can be unpredictable in their performance, only experienced practitioners should work with them.

Mix Proportioning

- When preparing a 1:3:9 mix, one mixes the following:
 - one part white Portland cement
 - three parts lime putty
 - nine parts aggregate
- If, however, one uses coarse stuff, then one would prepare the mix as follows. The coarse stuff, which has been previously mixed in the proportions of three parts lime putty to nine parts of aggregate, is stored until a mortar is required for repairs. To prepare the 1:3:9 mortar mix, nine parts (not twelve) of coarse stuff is mixed with one part white Portland cement.
- The important concept to understand when using coarse stuff (lime/aggregate mix) in mortar is that lime fills up the spaces between the aggregate particles without adding to the overall bulk. This means that the volume of coarse stuff is equal to the aggregate volume.

Placing and Curing

- Lime mortars require carbon dioxide from the air to help them harden. Even when mixed with cements or pozzolans, they continue to cure for a long time, usually up to several months.
- Keep freshly placed mortars moist and protect them from sun, wind, and heat, all of which will dry them out too

rapidly, causing shrinkage and cracking. Heavy rain can wash out fresh mortars.

- To help the curing process and to reduce the likelihood of shrinkage, keep mortars dampened for the first two or three days by lightly spritzing them with spray bottles at regular intervals, or covering them with damp burlap. Sometimes damp, absorbent paper towels work well.
- Place mortars with small tools to keep repairs neat and well compacted.
- Plan repairs so that mortars have as much time as possible to cure before they are exposed to frost. One month is the absolute minimum; two or three months is preferable.

TYPES OF MORTAR

Mortars are used when setting stones, for pointing joints and cracks, and for fillings or adhesions in repairs. Where very soft and weak stones are encountered, a 1:3:9 mortar of white Portland cement with lime putty and aggregate is more suitable for bedding, pointing, and repairs.

Mortars for repairing tombstones and carved stone require some customization, as shown.

Bedding and Pointing Mortars

- Markers with thinly bedded joints of about 3 mm (1/8 in) can be fitted with a mortar mix of one part white Portland cement and two parts lime putty. Where joint widths permit, add fine, clear quartzes and/or stone dust to about seven parts in this mix (i.e., 1:2:7).
- A typical all-round mortar for bedding or pointing is the 1:2:7 mix referred to above. Up to 1.5 parts of fired brick dust can form part of the total aggregate content. It will produce a light, buff-coloured mortar. This mix can be used for repairing sound, durable stones. An

alternative can be obtained by mixing hydraulic lime in dry powdered form with a blend of aggregates at a ratio of 2:5. The aggregate portion should be made up of two to three parts stone dust blended with a sharper, quartzitic aggregate. Depending on the colour of the lime, a light-grey to light-buff mortar will be produced.

Patching and Filling

Repair mortars for patching and filling will be custom mixed to match the permeability of the tombstone being repaired. Typically, mixes are similar to the pointing mortars. Sometimes, numerous trial mixes need to be prepared to produce a truly compatible mortar. Repair mortars are well suited to the repair of bases.

Generally, it is not recommended to use repair mortars for fillings and repairs to soft marbles and other stones. Rather there are a number of proprietary materials that can be used for filling. Most experience to date has been with the Jahn Restoration mortars (See materials and suppliers).

MATERIALS

This section summarizes the ingredients (lime, cement, and sand) of mortars for repair of cemetery markers.

Limes

Preparation of mortar may involve use of quicklime, hydrated lime, or hydraulic lime:

- *Quicklime*, slaked and run to putty, is preferred and recommended because of its superior working and handling properties (plasticity).
- *Hydrated lime* may be considered as an alternative to slaked quicklime; type “S” dolomitic finishing lime performs better than a type “N” high-calcium

lime.

- *Hydraulic lime* will provide a set without use of a cement and is appropriate for mortar fills and repairs. A selection of hydraulic limes from mildly to eminently hydraulic is available from Europe and distributed in Toronto.

Setting Aids (Cements)

White Portland cement affects the strength and permeability of lime/aggregate mortars. Always use white Portland (type-10) cement. Unlike grey cement, it has a very low soluble alkali content, significantly reducing the risk of salts forming, producing efflorescence, and damaging stone.

Brick dust can be used as a setting aid and as porous aggregate helping to entrap air in the mix. It is incorporated into mixes as part of the total aggregate content.

Aggregate (Sand and Brick Dust)

Generally, a well-graded blend of aggregates is recommended. Proprietary “standard” sands are rarely suitable without some screening and blending – for repairs and for pointing, aggregate for mixes will be produced from graded sands, stone dust, and brick dust.

For brick dust not affecting the strength of mortar, one would choose ordinary, fired-crushed brick dusts. Use buff rather than red brick for the brick dust.

Proprietary Restoration Mortars

Restoration mortars can be ordered pre-bagged and colour matched to samples of stone. Only people who have received training in mixing and application procedures of the product are able to order materials, and only they should use the product.

SUPPLIERS

The following supplies are available from the suppliers indicated; a key to the abbreviations of suppliers is provided.

Limes

- Quicklime or lime putty
BL, LR, TSC
- Hydrated lime (type “S”, dolomitic finishing lime)
FWC, LR, TSC
- Hydraulic lime
LR

White Portland Cement

FWC, LR

Aggregates

Sand: Agg, LR, BBS
Concrete sand: LR, BBS
Stone dust (small quantities): LR
Coloured marble dust: KP
Brick dust: LR
Coarse stuff: LR

Prepared Mortars

Jahn Mortar: CSP

Dowels

Threaded, stainless steel rod, type-304 minimum, 316 preferred 1/2”, 3/8”, 5/16”, 1/4”, 3/16”, 1/8”
Loc, LR

Lead

Lead wool, lead rope, lead wedging
HLL

Conservation Tools

Absorbent towel, acetone, basters, brushes, burlap, pointing keys, rasps, spatula, syringes, trowels, water bottles,
Loc, AS

Epoxy Resin

SC

Abbreviations

Agg	local aggregate pits
CSP	Jahn Restoration Mortar is available pre-bagged and colour matched to qualified users. Cathedral Stone Products Inc. Jessup, Md., USA; tel.: (301) 317-4658 Ontario distributor of Jahn Restoration Mortars: Daubois Inc. Cambridge, Ont.; tel.: 1-800-565-9025
BL	Beechvillime P.O. Box 190 Ingersoll, Ont.; tel.: (519) 423-6283
FWC	Federal White Cement Ingersoll, Ont.; tel: (519) 485-5410
HLL	Heather & Little Ltd. Toronto, Ont.; tel.: (416) 465-5491
KP	Kremer Pigments New York, NY; tel.: (212) 995-5556
Loc	local building material/hardware/specialty suppliers.
LR	Liner Rolpanit (North America) Inc. Toronto, Ont.; tel.: (416) 532-3078
TSC	Toronto Salt & Chemicals Ltd. Toronto, Ont.; tel.: (416) 259-9647
BBS	Bernardi Building Supply Weston, Ont.; tel.: (416) 741-0941 www.bernardibuildingsupply.com
AS	Active Surplus Toronto, Ont.; tel.: (416) 593-0909 www.activesurplus.com
SC	Smithcraft Toronto, Ont.; tel.: (416) 259-6946

APPENDICES

- A CHURCHVILLE CEMETERY PROJECT
- B DRAWING A GRAVEYARD PLAN
- C ONTARIO CEMETERIES ACT
- D ONTARIO HERITAGE ACT
- E DESIGNATED CEMETERIES IN ONTARIO
- F ORGANIZATIONS INVOLVED IN HISTORIC CEMETERIES

CHURCHVILLE CEMETERY PROJECT

The Churchville cemetery project was sponsored in the summer of 1994 by the Ontario Monument Builders' Association and the Ontario Ministry of Citizenship, Culture and Recreation. Churchville Cemetery is west of the city of Brampton, on Steeles Avenue. Conserving the tombstones of the Church family plot has demonstrated how stone repair techniques traditionally used in building and monument conservation can be successfully adapted for repairing historic tombstones. In this photo sequence, we show you the most important stages of the project. Refer to chapter 3 for details on materials and methods used.

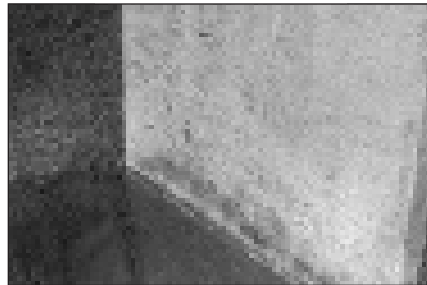


Church family plot.

REPAIR SEQUENCE NO. 1



1.1 Tilting slab marker could snap if not set upright.



1.2 Dig soil away at the backside of slab marker. Slab markers typically have no base, but check to be certain.



1.3 Marker set upright again.

REPAIR SEQUENCE NO. 2



2.1 Broken monument about to be repaired.



2.2 Drilling slightly oversized holes for pins that will hold broken pieces together.



2.3 Testing the length and alignment of stainless steel pins.



2.4 Checking to see that pieces fit properly. It is important to remove stone dust from pin holes and any loose stone fragments along edges.



2.5 Fill all holes with epoxy. Use gel-type epoxy that will not run and leak to the surface of stone.



2.6 Place pins immediately into epoxy. Place upper section on to lower stone.



2.7 Ensure that edges align and no ledge is created.



2.8 Support tombstone while epoxy sets.



2.9 Broken pieces successfully pinned together. Additional pin installed through top of cracked piece to ensure against breakage.



2.10 Artist's clay pressed into crack prevents epoxy leaking to surface.



2.11 Artist's clay removed once epoxy is set.



2.12 Pieces fit together.



2.13 Mortar should fill only cracks and not be used to fill chipped areas. Patching chipped areas is unnecessary and will often crack later.



2.14 Fill pin hole with mortar and sponge clean surface to remove excess mortar.



2.15 Wet paper towel placed on mortar can help slow rapid drying of small repairs on hot and windy days.



2.16 Filling cracked area that has been pinned.

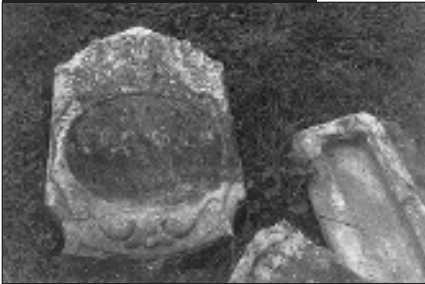


2.17 Dentistry tools can do a good job of filling small cracks.



2.18 Repair of tombstone completed.

REPAIR SEQUENCE NO. 3



3.1 Fitting pieces together for repair of another tombstone.



3.2 Hand cleaning the edges of pieces to be joined together.



3.3 Drying the cleaned edges of any excess water. Choose natural air drying when possible.



3.4 Pin locations are measured and marked with pencil. Pins are staggered in shape of a triangle, one pin forward and two back.



3.5 Measuring length of stainless steel pins.



3.6 Epoxying pins in place. (Note plastic gloves.)



3.7 Support tombstone until epoxy sets. Work bench and generator are essential when working on site.



3.8 Begin with filling larger side of crack. Apply light spray of water on crack before applying mortar.



3.9 Final scraping to create a concave surface of the mortar joint.



3.10 This repair should stand up almost as long as the marble.



3.11 Grouting is required to fill the inside of this crack. Build a small wall of clay around area to be filled.



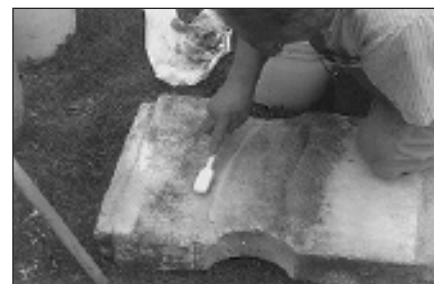
3.12 Stirring the grout to encourage flow into crack.



3.13 Remove clay and excess grout material.



3.14 Clean stone surface area thoroughly.



3.15 Continue cleaning until all grout is removed from surface. Grout can stain surface if not removed immediately.



3.16 Removing bases that have sunken into ground.



3.17 Cleaning out slot in base to accept upright marker. Must be good fit.



3.18 Prewetting slot before bed of mortar placed inside.



3.19 Subsoil replaced with well-draining gravel or sand.



3.20 Levelling base and adding sand for proper height of base to sod.



3.21 Applying lead to joint. Trimming lead and ensuring that there are no gaps.



3.22 Applying tapered lead rope.



3.23 Tamping lead into place.



3.24 Completed section after lead has been installed.

APPENDIX B: GRAVEYARD PLAN

INTRODUCTION

An important part of recording gravestones and other features is knowing how to prepare a scaled plan.* With a little practice and minimal equipment, anyone can make a plan. Steep slopes do, however, require specialized techniques and equipment, to ensure accuracy.

Determining the scale of a plan depends on the size of the graveyard and the number of grave markers. While metric measurement is now standard, it is important to use a system of measurement that is familiar to those carrying out the

survey. 1:100 or 1:200 is probably the most suitable metric scale (approximately equivalent to $1/8'' = 1'-0''$ and $1/16'' = 1'-0''$ respectively in imperial scales). 48 1:10 or even larger scales are better where there are a large number of markers, particularly if they are close together. A larger scale (such as 1:50) may be helpful for the sketch plan made in the graveyard, where field notes are shown.

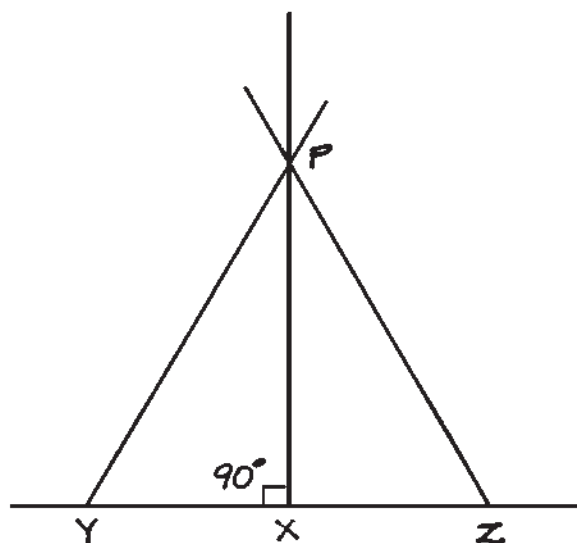
PREPARING THE PLAN

Number the Grave Markers

For example, use a number marked on white cardboard with 'permanent ink' felt-tip pen, taped to stones with drafting tape.

Lay out a Grid

- Select area free of obstructions.
- Lay down a base-line using a 30-metre (100-ft) tape:
 - Line up the tape in a straight line, by eye, and mark the base-line with wooden stakes driven into the ground at even intervals (e.g. every 10 metres or every 25 - 30 feet). Subsequent measurements will be greatly simplified if this base-line is laid parallel to the majority of the grave markers.
 - Attach string to nails driven into the tops of the stakes, to mark the base-line.



- = the point from which a 90° offset is required.
- = points equidistant from X on a straight line.
- = a point at which two measuring tapes attached to Y and Z cross at the same length.

Constructing the Perpendicular

* Adapted from Jeremy Jones, *How to Record Graveyards*, London: Council for British Archaeology and RESCUE, 1984.

- Lay off lines at 90° to this base-line, at regular intervals along it (e.g., every 10 metres), (Figure 1).
- Complete the grid by laying off lines at right angles to one another at regular intervals (e.g., 10 metres), marked by wooden stakes (Figure 2).
- Number the wooden stakes, beginning in one corner of the graveyard as shown below. Mark the numbers on the stakes. Draw the stakes on the graveyard plan, with their numbers. Each square on the grid is then identified by the number of a particular stake - e.g. always the stake in the lower left-hand corner.
- Take a compass reading along the base-line, and/or measurements from the base-line to a permanent feature such as a fence, to record the position of the base-line that was used for the survey.

Measure and Record the Grave Markers and other Features

- Marking the graveyard off with a grid allows different teams to record different squares. Starting at one corner of the graveyard (e.g., A1), record the features in each square, as follows.
- Secure lengths of string along two opposite sides of the grid square, fastened to nails in the top of the wooden grid stakes.
- Lay a measuring tape across the square at 90° to the strings, and at the same distance along both strings from the grid line. Position this tape as close as practical to a row of grave markers, and where it will not touch any grave markers, bases, fences, etc. Fasten the measuring tape into position on wooden stakes.
- Measure the positions of the grave markers relative to this tape. Measure along the tape in one direction. Ensure that the hand tape is 90° to the

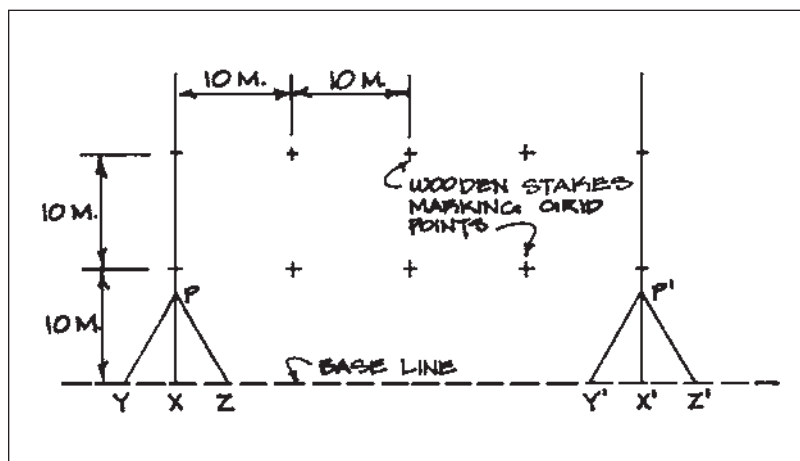


Figure 2 Constructing the Grid

measuring tape on the wooden stakes. Measure to both corners for headstones or footstones, and to all four corners for markers such as box tombs, cairns, or slabs laid flat on the ground. Also measure the plan dimensions of markers at this time. Show curbstones, walls, fences, trees, and other major plantings, as well as grave markers.

- Record the locations and measurements on a sketch plan, drawn in pencil. Show

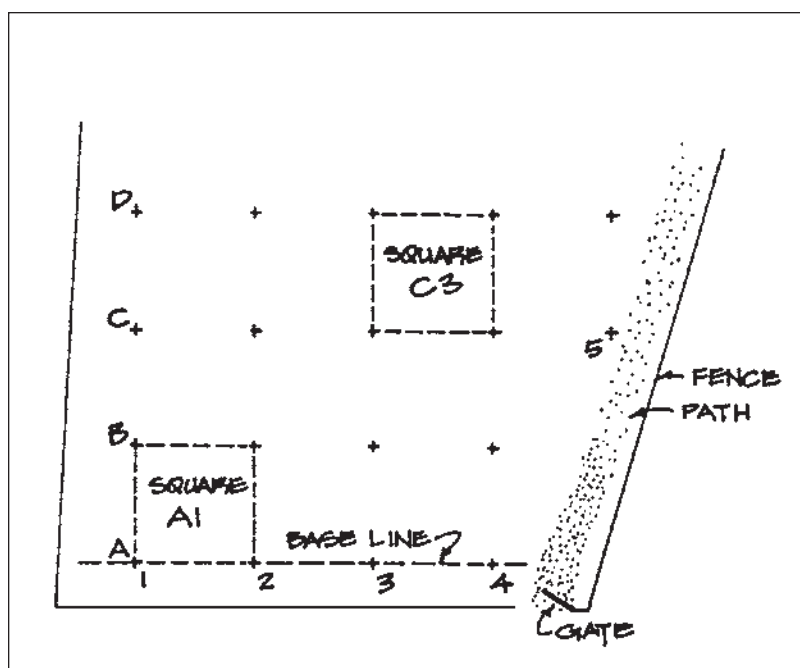


Figure 3 Numbering the Grid

the number of each grave marker. It also helps to show the family name from the marker on this sketch plan, to avoid confusion. Draw markers in plan; many will show as a thin rectangle. For others that lie on the ground, the plan view will show the shape of the marker. Otherwise, if you wish to show the shapes of the markers in elevation, you could make a border of these on the drawing.

- Be sure to show the distance of the tape line from the grid line – otherwise, the measurements taken do not relate to anything.

EQUIPMENT REQUIRED

- tape measures: two 30-metre (100-ft) tapes, preferably fibreglass (can be rented) and one 5-metre (16 ft.) hand-held metal tape.
- small hatchet (or hammer and hand-saw) for cutting and placing wooden stakes
- compass
- hand level: for sloped sites only to keep tapes horizontal for accurate measurement
- wooden stakes: from 1" x 2" stock, approximately 24" long, cut on an angle at one end only
- nails: 1 1/2"-2" common nails
- waxed twine
- cardboard or similar numbering tags (for grave markers)
- permanent ink felt-tip marker
- drafting tape
- drafting paper or film (e.g., mylar)
- drafting pencils and sharpener
- squared/grid paper (e.g., quad paper) to use as underlay for sketches, or a smooth-faced sheet of plywood
- drawing surface (e.g., clip-board for small field sketches, or a smooth-faced sheet of plywood)
- drafting scale (metric or imperial)

APPENDIX C:

ONTARIO CEMETERIES ACT

The following excerpts from the *Cemeteries Act (Revised)*, R.S.O., 1990, C.4. ISBN 0-7729-9668-7, are relevant to the preservation of historic cemeteries. It is advised that one consult the complete text of the legislation prior to performing any conservation work within a cemetery. For further information on the legislation, contact the Cemeteries Registrar's Office at the Ministry of Consumer and Commercial Relations, 250 Yonge Street, 32nd Floor, Toronto, tel.: (416) 326-8393. One can purchase a copy of the legislation through the Ontario Government Bookstore at 1-800-668-9938.

CONSENT TO ESTABLISH CEMETERY OR CREMATORIUM

2. No person shall establish, alter or increase the capacity of a cemetery or crematorium without the consent of the Registrar. 1989, C.50, S.2.

3.(1)(a) An applicant for consent shall apply to the Registrar and,
(b) submit the prescribed documents showing the layout of the cemetery and the location of existing or proposed plots, lots, structures and fixtures; and
(2) If the cemetery or crematorium is proposed to be established or already exists in an area with municipal organization, the applicant, before applying for the consent of the registrar, must obtain the approval to the proposal of the appropriate municipality.

5. (1) A municipality, upon receiving a request for approval, shall
(2) In considering a request for an approval, the principal factor shall be the public interest.

(4) The applicant, Registrar or any person with an interest therein may, within fifteen days after publication of the notice of the decision, refer the decision of a municipality to the Ontario Municipal Board for a hearing.

6. (1) The Ontario Municipal Board may reverse the decision appealed from and substitute its own decision.

CLOSING CEMETERY

8. (2) The Registrar may order a cemetery closed if the closing is in the public interest.

9. (1) In an order to close a cemetery, the Registrar may,

(a) declare a cemetery or a portion thereof closed;

(b) require the owner to disinter all human remains therein and specify the manner of disinterment and the manner and place of reinterment or dealing with the remains;

(c) require the owner to remove any markers and relocate them to a specified place; and

(d) require the owner to provide or acquire equivalent interment rights for all holders of interment rights with respect to unused lots in the cemetery.

10. A person with an interest therein may appeal, to the Tribunal,

(a) an order to close a cemetery any time before the order comes into force; or

(b) refusal to order a cemetery

closed.

LICENCES

14. No person shall own a cemetery or crematorium unless licensed under this *Act* to own the cemetery or crematorium. 1989, c. 50, s. 14.

CEMETERY AND CREMATORIUM OPERATIONS

44. (1) Every cemetery owner shall maintain, without charge to interment rights holders, the grounds of the cemetery, including all lots, structures and markers, to ensure the safety of the public and to preserve the dignity of the cemetery.
- (2) Despite subsection (1), an owner of a non-commercial cemetery may charge interment rights holders, at a rate approved by the Registrar, for the maintenance of lots and markers that were sold before 1955 if there were no trust funds collected for that purpose. 1989, c. 50, s. 44.
48. If a marker in a cemetery presents a risk to public safety because it is unstable, the owner of the cemetery shall do whatever is necessary by way of repairing, resetting or laying down the marker so as to remove the risk. 1989, c. 50, s. 48.

Neglected Cemetery

59. (1) A municipality may order a cemetery owner who does not keep the cemetery in good order and repair to restore it to good order and repair.
- (2) An owner may appeal, to the Registrar, an order to restore within fifteen days after receiving the order.
- (6) If an owner does not restore a cemetery as specified in an order given under subsection (1) within

such reasonable time as is set out in the order, the municipality may have the required work done and recover the costs thereof from the owner. 1989, c. 50, s. 59.

Abandoned Cemeteries

60. (1) An application to declare a cemetery abandoned may be made to a judge of the District Court if the owner of the cemetery,
- (a) cannot be found or is unknown;
 - (b) is unable to maintain it;
 - (c) was a corporation that was dissolved; or
 - (d) is not licensed as an owner under this *Act*.
- (2) An application to declare a cemetery abandoned may be made by the owner of the cemetery, the municipality or the Registrar.
- (9) Plan an application being made to declare a cemetery abandoned, the municipality within which the cemetery is situated is responsible for the maintenance of the cemetery until the application is disposed of. 1989, c. 50, s. 60.
61. The Registrar may require any owner who has an interest in a cemetery that appears to be abandoned or neglected to maintain that cemetery as a condition of retaining a licence to own a cemetery or crematorium. 1989, c. 50, s. 61.

ADMINISTRATION

63. (1) The Registrar may appoint inspectors to carry out inspections for the purpose of determining whether there is compliance with this *Act* and the regulations.

64. (1) For the purpose of ensuring compliance with this *Act* and the regulations, an inspector may,

- (e) conduct such tests as are reasonably necessary to determine the integrity of a structure, fence or marker in a cemetery; and

BURIAL SITES

68. No person shall disturb or order the disturbance of a burial site or artifacts associated with the human remains except,

- (a) on instruction by the coroner; or
- (b) pursuant to a site disposition agreement. 1989, c.50, s.68.

69. Any person discovering or having knowledge of a burial site shall immediately notify the police or coroner. 1989, c.50, s.69.

71. (1) As soon as the origin of a burial site is determined the Registrar shall declare the site to be,

- (a) an unapproved aboriginal peoples cemetery;
- (b) an unapproved cemetery; or
- (c) an irregular burial site.

1989, c.50, s.71(1)

(3) An unapproved cemetery is land set aside with the apparent intention of interring therein, in accordance with cultural affinities, human remains and containing remains identified as those of persons who were not one of the aboriginal peoples of Canada.

75. (1) No person shall alter or move the remains or marker of a Canadian or Allied veteran or a Commonwealth War Burial without the agreement of the Department of Veterans Affairs (Federal), the Commonwealth War

Graves Commission or such other persons and associations as are prescribed.

Regulations

76. (1) The Lieutenant Governor in Council may make regulations,

6. prescribing requirements and standards for the placing and spacing of interments, markers, fixtures, fences or other structures in a cemetery;

9. governing mausolea, columbaria and other structures on or in a cemetery and establishing construction standards;

36. prescribing standards for the construction, installation, stabilization and preservation of markers and other cemetery supplies and requiring compliance with the standards;

78. (1) Any person who, in a cemetery, damages or moves any tree, plant, marker, fence, structure or other thing usually erected, planted or placed in a cemetery is liable to the cemetery owner and any interment rights holder who, as a result, incurs damage.

(2) In an action under subsection (1), the amount of damages shall be the amount required to restore the cemetery to the state that it was in before anything was damaged or moved by the person liable.

- (3) Any person collecting damages under this section shall use the full amount collected to restore the cemetery. 1989, c.50, s.78.
- 82. (1) If there is an appeal under this *Act* to the Tribunal, it shall appoint a time for and hold a hearing.
(2) After holding a hearing, the Tribunal may by order direct the Registrar to take an intended action or to refrain from taking an action or to take such action as the Tribunal considers that the Registrar ought to take and for such purposes the Tribunal may substitute its opinion for that of the Registrar.
- 87. This *Act* prevails over Part VI of the *Ontario Heritage Act*. 1989, c.50, s.87.

CEMETERIES ACT (REVISED)

ONTARIO REGULATION 130/92

ESTABLISHING, OPERATING AND CLOSING CEMETERIES AND CREMATORIA

- 2. (1) For the purposes of clause 3(1) (b) of the *Act*, the following
(5) If the cemetery or crematorium or any part thereof is designated under the *Ontario Heritage Act*, a copy of the designation by-law.

STANDARDS FOR THE CONSTRUCTION, INSTALLATION, STABILIZATION AND PRESERVATION OF MARKERS AND SUPPLIES

- 20. The owner of a cemetery shall comply with the standards for constructing, installing, stabilizing and preserving markers and other cemetery supplies that are set out in sections 21 and 22. O. Reg. 130/92, s.20.
- 21. (1) The owner may remove a marker only if it cannot be preserved using income from the Care and

Maintenance Fund or funds from other sources.

- (2) The owner shall use only reversible processes to preserve and stabilize a marker if the cost of doing so can be paid out of the income received by the Care and Maintenance Fund or out of funds from other sources. O. Reg. 130/92, s.21.

- 22. If money from the Care and Maintenance Fund has been spent on stabilizing or restoring a marker or site, the owner of the cemetery shall record the particulars of the work done and money spent and make the information available for inspection in accordance with section 38.

O. Reg. 130/92, s.22.

CLOSING A CEMETERY

- 49. (1) For the purposes of clause 8(3)(a) of the *Act*, an owner who wishes to obtain an order closing a cemetery shall give notice, in accordance with this section, of the owner's intention to apply for the order.
(2) The notice shall be published,
(a) once in *The Ontario Gazette*; and
(b) once a week for two consecutive weeks in a newspaper with general circulation in the locality in which the cemetery is located.
(3) The notice shall be sent by registered mail to,
(a) each interment rights holder whose lot is situated in the portion of the cemetery subject to the order, mailed to the rights holder's last address known to the owner;

- (b) the municipality in which the cemetery is located;
 - (c) the Local Architectural Conservation Advisory Committee, if any, established under the *Ontario Heritage Act* for the locality in which the cemetery is located;
 - (d) the Archives of Ontario, the Ontario Historical Society, the Ontario Archaeological Society and the Ontario Genealogical Society; and
 - (e) the Minister of Culture and Communications.*
- (4) The notice shall be conspicuously posted on a sign at the entrance to the cemetery before publication of the first notice under clause (2)(b) and shall remain posted until the Registrar makes, or refuses to make, the order sought by the owner. O. Reg. 130/92, s.49.

(3) Once the obligations described in subsection (2) are fulfilled, the owner may use any remaining income from the Fund to maintain, secure and preserve other cemeteries, owned by the same owner, their grounds and buildings and the equipment used for purposes of maintenance, security and preservation.

(4) The owner shall use income from the Fund on money deposited into it under section 38 of the Act only to maintain, stabilize, secure and preserve markers in the cemetery and, once this work is complete, to maintain, stabilize, secure and preserve markers in other cemeteries owned by the same owner.

(5) The owner may use income from the Fund to pay the wages and benefits of workers engaged in maintenance and preservation, and of their supervisors, but not to pay the wages and benefits of salespersons or office staff.

ONTARIO REGULATION 132/92

TRUST FUNDS – PART I – CARE AND MAINTENANCE FUND

4. (3) If a marker is being installed in a cemetery to replace a marker that has been damaged and cannot be repaired, a person is exempt from subsection 38(1) of the *Act* and an owner is exempt from subsection 38(3) of the *Act*.
- USE OF MONEY IN THE FUND**
6. (2) Subject to subsections (3), (4) and (5), the owner shall use the income from the Fund to maintain, secure and preserve the cemetery, its grounds and building and the equipment used for purposes of maintenance, security and preservation.

* Now known as: Minister of Citizenship, Culture and Recreation.

APPENDIX D:

ONTARIO HERITAGE ACT

The Ministry of Culture has made changes to the Ontario Heritage Act as part of the Government Efficiency Act, which received Royal Assent on November 26, 2002. The Government Efficiency Act amends legislation across government to clarify, update, streamline and improve provisions.

The following excerpts are included as basic reference for those who might perform repairs to tombstones located in a cemetery designated under the Ontario Heritage Act.

The Act enables municipalities to designate property and acquire heritage easements on property of "cultural heritage value or interest" (replacing "historic or architectural value or interest") to reflect the broader meaning of heritage ("cultural heritage" will be defined by regulation), or to designated heritage conservation districts (Part V).

Designation not only is a recognition of the significance of a property or district but also provides a measure of protection from demolition and unsympathetic alteration.

For further information on the legislation, consult the Ministry of Culture's web site: www.culture.gov.on.ca

PART IV - CONSERVATION OF PROPERTY OF CULTURAL HERITAGE VALUE OR INTEREST

Designation of Properties by Municipalities

29. -(1) Subject to subsection (2), where the council of a municipality intends to designate a property within the municipality to be of cultural heritage value or interest, it shall cause notice of intention to designate to be given by the clerk of the municipality in accordance with subsection (3).

(2) Where the council of a municipality has appointed a Municipal heritage committee, the council shall, before giving notice of its intention to designate a property under subsection (1), consult with its Municipal heritage committee.

(3) Notice of intention to designate under subsection (1) shall be,

- (a) served on the owner of the property and on the Foundation; and
- (b) published in a newspaper having general circulation in the municipality.

(4) Notice of intention to designate under subsection (1) shall contain,

(a) an adequate description of the property so that it may be readily ascertained;

(b) a short statement of the reason for the proposed designation, including a description of the heritage attributes of the property; and

(c) a statement that notice of objection to the designation may be served on the clerk within thirty days after the date of the first publication of the notice of intention in a newspaper having general circulation in the municipality.

(5) A person who objects to a proposed designation shall, within thirty days after the date of first publication of the notice of this intention in a newspaper having general circulation in the municipality, serve on the clerk of the municipality a notice of objection setting out the reason for the objection and all relevant facts.

33.-(1) No owner of property designated under this Part shall alter the property or permit the alteration of the property

where the alteration is likely to affect the property's heritage attributes, as set out in the description of the property's heritage attributes that was required to be served and registered under subsection 29 (6) or (14), as the case may be, unless the owner applies to the council of the municipality in which the property is situate and receives consent in writing to the alteration.

- (2) An application under subsection (1) shall be accompanied by a detailed plan and shall set out such information as the council may require.

PART V - HERITAGE CONSERVATION DISTRICTS

40. - (1) The council of a municipality may by by-law define the municipality or one or more areas thereof as an area to be examined for future designation as a heritage conservation district and the council may, after such examination is completed, prepare official plan provisions with respect to such designation.

41. - (1) Where there is in effect in a municipality an official plan that contains provisions relating to the establishment of heritage conservation districts, the council of the municipality may by by-law designate the municipality or any defined area or areas thereof as heritage conservation district.

- (2) A property that is designated under Part IV may subsequently be included in an area designated as a heritage conservation district under this Part, and a property that is included in an area designated as a heritage conservation district under this Part may subsequently designated under Part IV.

42. - (1) If a by-law passed under section 41 designating a heritage conservation district is in force, no owner of property located in the heritage conservation district shall erect, demolish or remove, or permit the erection, demolition or removal of, any building or structure on the property or alter, or permit the alteration of, the external portions of any building or structure on the property, unless the owner applies to the council of the municipality in which the property is situate and is given a permit for the erection, demolition, removal or alteration.

- (4) Within 90 days after the notice of receipt is served the applicant under subsection (3) or within such longer period as is agreed upon by the applicant and the council, the council may give the applicant,
- (a) the permit applied for;
 - (b) notice that the council is refusing the application for the permit; or
 - (c) the permit applied for, with terms and conditions attached, in the case of an application for a permit to erect, or alter the external portions of, a building or structure.

* The Board refers to the Conservation Review Board as described in Part III of *The Ontario Heritage Act*.

APPENDIX E:

DESIGNATED CEMETERIES IN ONTARIO

Ontario has over two thousand five hundred designated heritage properties. Approximately 120 cemeteries have been designated under the Ontario Heritage Act for historic or architectural value or interest.

A review of available designation notices for cemetery properties in Ontario shows cemeteries to be valued repositories of vital information on early settlement and familial history. They often contain built heritage features such as chapels, mausoleums, dead houses, cenotaphs, and grave markers associated with well-known people or groups. Contextually, cemeteries may also be important municipal features as managed open space.

The following is a list of cemeteries designated in the province under the *Ontario Heritage Act*.

Municipality	Property Name
Ancaster	Shaver Family Cemetery
Augusta	Blue Church Cemetery
Aurora	The Keeper's House, Aurora Cemetery
Bastard & South Burgess	St Peter's Anglican Church Vault
Belleville	Dundas Street Burying Grounds
Brampton	Churchville Cemetery
Brant	St John's Lutheran Church Cemetery
Brock	The Old Stone Church
Burlington	Union Burying Grounds
Cambridge	Pioneer Pergola
Caledon	Boston Mills Cemetery
Caledon	Laurel Hill Cemetery
Caledon	Melville White Church and Cemetery
Caledon	St Andrew's Presbyterian Church and Cemetery
Caledon	Salem United Church
Chatham	Maple Leaf Cemetery
Cornwall Twp.	St Andrew's West Convent
Douro	St Joseph's Cemetery
East Gwillimbury	Sharon Burying Ground
Elizabethtown	Fulford Pioneer Cemetery
Eramosa	Eden Mills Presbyterian Church
Eramosa	Rockwood Cemetery
Flamborough	Rous-Howard Cemetery
Fort Erie	Memorial Ridge Mausoleum
Haldimand	Academy Hill Cemetery
Haldimand	Gilliland Pioneer Cemetery
Haldimand	Russ's Creek Cemetery
Municipality	Property Name

Haldimand	St Andrew's Church
Halton Hills	Boston Presbyterian Church and churchyard
Hamilton	Barton Stone United Church Cemetery
Hamilton	Church of the Ascension
Hamilton	St George's Cemetery
Hearst	Monseigneur Pierre Grenier Cemetery
Hearst	Riverside Cemetery
Hope Twp.	St Paul's Anglican Church
King Twp.	King Immanuel Baptist Church
Kitchener	German Evangelical Lutheran Church Cemetery
Kitchener	Mausoleum, Woodland Cemetery
Lakefield	Christ Anglican Church
Lincoln	St John's Anglican Church and Cemetery
Lansdowne	The Union United Church and Cemetery
London	Brick Street Cemetery
Markham	Grace Anglican Cemetery
Markham	Ramer (Mount Joy) Cemetery
Markham	St Patrick's Roman Catholic Cemetery
Markham	St Vladimir Ukrainian Catholic Church and Manse
Markham	Thornhill Community Cemetery
Mississauga	Britannia United Church
Mississauga	Dixie Union Cemetery and Chapel
Mississauga	Port Credit War Memorial (Cenotaph)
Mississauga	Streetsville War Cenotaph
Nanticoke	Upper Farm Cemetery
Nepean	Bells Corners Union Cemetery
Nepean	Merivale United Church
Nepean	St John's Cemetery
Nepean	St Patrick's Church and Presbyterian
Newcastle	16 Church Street East (formerly Presbyterian Church)
Newmarket	Hicksite Friends Burying Ground
Newmarket	Quaker Meeting House
Niagara Falls	Lyons Creek United Church
Niagara-on-the-Lake	St Vincent de Paul, 93 Picton Street
Niagara-on-the-Lake	Warner Cemetery
North Easthope	Knox North Easthope Presbyterian Church – Pioneer Cemeteries
North York	Elia Church and Cemetery
North York	St John's Anglican Church
North York	Zion Primitive Methodist Church
Oakville	Bronte Cemetery
Oakville	Cox Estate Pioneer Cemetery
Oakville	Merton-Mount Pleasant Pioneer Cemetery
Oakville	Munn's Pioneer Cemetery
Oakville	Oakville/St Mary's Cemetery
Oakville	St Andrews Church
Oakville	St Jude's Anglican Church

Municipality	Property Name
Oakville	Walton Memorial United Church
Penetanguishene	St James-On-The-Lines Church
Perth	Old Burying Ground/ Craig Street Cemetery
Peterborough	Confederation Square
Picton	Glenwood Cemetery Chapel (Chapel and Receiving Vault)
Picton	Macauley House
Pittsburgh	Milton Cemetery
Port Hope	Union Cemetery Chapel
Port Stanley	Christ Church
Port Sydney	Christ Church, Anglican
Ramsay	Auld Kirk
Rear of Leeds and Lansdowne	Soperton Cemetery
Richmond Hill	Richmond Hill Presbyterian Church Cemetery
Richmond Hill	St John the Baptist
St Thomas	Old St Thomas Church
Sarnia	Devine Street
Saugeen	Old Southampton Cemetery
Sault Ste. Marie	Bishop Fauquier Memorial Chapel Cemetery
Sault Ste. Marie	Queen Street Cemetery
Scarborough	Christie Cemetery
Scarborough	Knox United Church
Scarborough	St Andrew's Presbyterian Church and Cemetery
Scarborough	Secor Family Burial Plot
Scarborough	Tabor Hill Native People Ossuary
South Crosby	Brier Hill Cemetery
South Crosby	Clear Lake Cemetery
South Crosby	Knowlton Cemetery
South Crosby	Ripley Cemetery
South Dumfries	Paris Plains Church and Maus School
Stratford	St James Anglican Church Cemetery
Stoney Creek	Fifty United Church
Sydenham	Leith United Church and a portion of the cemetery
Thorold	Beaverdams Church (c. 1832)
Toronto	Davenport-Perth United Church
Toronto	St Michael's Cemetery Deadhouse
Tuckersmith	Harpurhey Cemetery
Vaughan	Maple Cemetery Vault
Williamstown	United Church
Wingham	War Memorial
Woodstock	Old St Paul's Church
York	St John's on the Humber Cemetery

APPENDIX F: ORGANIZATIONS INVOLVED IN HISTORIC CEMETERIES

CANADIAN ORGANIZATIONS

Architectural Conservancy of Ontario Inc.
Suite 204
10 Adelaide Street East
Toronto, Ontario M5C 1J3
tel.: (416) 367-8075; fax: (416) 947-1066

Archives Association of Ontario
P.O. Box 46009, College Park Office
444 Yonge Street
Toronto, Ontario M5B 2L8
tel.: (416) 778-0426; fax: (416) 778-8362

Canadian Association for Conservation of
Cultural Property (CAC)
P.O. Box 9195
Ottawa, Ontario K1G 3T9
tel./fax: (819) 684-7460

Canadian Association of Professional
Heritage Consultants (CAPHC)
P.O. Box 1023
Station "F"
Toronto, Ontario M4Y 2T7

Heritage Canada
Ontario Regional Office, #202
29 Dickson Street
Cambridge, Ontario N1R 1T5
tel.: (519) 622-3036; fax: (519) 622-1132

ICOMOS Canada
Scientific Committee for Stone
P.O. Box 737, Station B
Ottawa, Ontario K1P 5R4
tel./fax: (613) 749-0971
<http://www.icomos.org/canada/>

Ontario Archaeological Society
126 Willowdale Avenue
North York, Ontario M2N 4Y2
tel.: (416) 730-0797; fax: (416) 730-0797

Ontario Association of Cemeteries Suite
318, 900 The East Mall
Etobicoke, Ontario M9B 6K2
tel.: (416) 621-1277; fax: (416) 621-9230

Ontario Black History Society

Ontario Heritage Centre
10 Adelaide Street East, #202
Toronto, Ontario M5C 1J3
tel.: (416) 867-9420; fax: (416) 867-8691

Ontario Genealogical Society
40 Orchard View Blvd., #102
Toronto, Ontario M4R 1B9
tel.: (416) 489-0734; fax: (416) 489-9803

Ontario Historical Society
John McKenzie House
34 Parkview Avenue
North York, Ontario M2N 3Y2
tel.: (416) 226-9011; fax: (416)-226-2740

Ontario Monument Builders Association
39 Delaware Avenue
Toronto, Ontario, M6H 2S8
tel.: (416) 534-9511; fax: (416) 537-2545

Ontario Museum Association
George Brown House
50 Baldwin Street
Toronto, Ontario M5T 1L4
tel.: (416) 348-8672; fax: (416) 348-8689

Société franco-ontarienne d'histoire et de
généalogie
30 Wellington Street East, #2002
Toronto, Ontario M5E 1S3
tel.: (416) 861-0165; fax: (416) 861-0165

AMERICAN ORGANIZATIONS

Alliance for Historic Landscape
Preservation
852 Wall Street, Suite 1105
New York, NY 10005, USA

American Culture Association
Cemeteries & Gravemarkers
Bowling Green, OH 43403, USA

Association for Gravestone Studies
278 Main Street, Suite 207
Greenfield, MA 01301, USA
tel.: (413) 772-0836
e-mail: ags@javanet.com

GLOSSARY OF COMMON CONDITIONS

Bedding: The manner or direction in which bedding planes (layers, stratification or direction in which a stone is formed) are laid when a stone is in use. Bedding is a condition that is typically seen in sedimentary stones such as sandstone and limestone. Stone monuments have bedding planes that are either horizontal (naturally bedded), vertical and parallel (face bedded), or perpendicular (edge-bedded) to the exposed surfaces. Most historic slab grave markers have a bedding that is vertical and parallel to the face; it is easiest to split a stone along the natural bedding planes and turn it upright to create a grave marker.

Biological activity: Evidence of plants (such as algae, bushes, grasses, lichens, mosses, trees) or animals (such as bird droppings and groundhog tunnelling) that are affecting the grave marker.

Blistering: Swelling and rupturing of a thin, uniform layer of stone are usually found on sandstone, but also on granite. It is generally caused by salts and/or moisture and can occur either across or parallel to bedding planes.

Cracking: Narrow fissures or fractures in the stone.

Delamination: Separation of layers of stone along the bedding planes, which eventually results in breaking off of those layers. It is generally seen in slate and sandstone grave markers, less commonly in other stones. It results from exposure of vertically laid bedding planes to weathering – water penetrates and freezes, prying the bedded layers apart. Early stages appear as thin cracks along the top edge of the grave marker and are recorded

as “cracking.” Major detachment of layers of stone through delamination is recorded under “losses.”

Efflorescence/subflorescence: Deposits of white, crystalline salts on the surface of masonry materials. These salts may result from (1) water rising through the masonry from the soil (for example, bringing salts caused by de-icing salts, fertilizers, or weed-killers); (2) air or water pollution; (3) grey (“normal”) Portland cement used in concrete, mortars, and so on; or (4) cleaning compounds. The salts are water-soluble and move through the masonry in solution, eventually being deposited as salt crystals when the water evaporates at or near the surface of the stone. These salt deposits are called “efflorescence” when they occur on the surface of the stone and “subflorescence” when beneath the surface, within the pores of the stone. While efflorescence itself does not cause damage, it is an important danger sign, indicating that damage may soon result from excessive moisture or harmful subflorescence salts. The causes of the efflorescence (the sources of excessive moisture or salts) should be identified and eliminated. Subflorescence salts may need to be drawn out of the stone (for instance, through poulticing).

Erosion: Gradual wearing away of the surface, resulting in rounded, blurred edges and damage to carved details (such as lettering). Erosion is caused by natural abrasion (as by wind or wind-blown particles) or dissolution (for example, by acidic rainfall) of the surface.

Flaking: Detachment of small, flat, thin pieces of a stone’s surface. It is usually caused by freeze-thaw cycling of moisture within the masonry. Coatings such as

water-repellents that trap moisture within a stone can result in flaking.

Metal corrosion: Deterioration of a metal through a chemical or electrochemical reaction between the metal and oxygen (oxidation) or other substances (acids, salts, water, different metals in contact, and so on). Corrosion is indicated by formation of corrosion products (for example, rust on ferrous metals) or by loss of metal (pitting, and so on).

Mower scars: Abrasion of a stone's surface, near the ground, caused by grass-mowing equipment.

Scaling: Advanced loss of stone, to a variable depth.

Soiling: Fine particles deposited on the surface of a marker, changing or obscuring its appearance. Soiling may consist, for instance, of soil thrown up by mowers or of sooty, carbonaceous deposits resulting from air pollution.

Spalling: Breaking off or peeling away of the outer layer or layers of masonry products. Spalling is a more general term than "blistering," "flaking," or "scaling." Unlike those terms, it applies to stone and other masonry materials (such as brick, concrete, and terra cotta). Spalling is usually caused by (1) the pressures exerted by salts and/or moisture (during freeze-thaw cycling) within the masonry; (2) improper bedding of stone; or (3) improper repointing of masonry with hard, cement-rich mortars. Chipping caused by mechanical abrasion or other forces external to the masonry is not included in spalling.

Sugaring: A granular, sometimes powdery condition that is characteristic of some stone, particularly fine-grained marbles and other carbonate stones, such as limestone. Sugaring indicates gradual surface disintegration, generally caused by dissolution of the binder within the stone.

Surface crusts: Hard crusts that develop through movement of moisture towards the surface and outer edges of stone and deposition of dissolved material in those areas. Dark-coloured crusts on sandstone result from a chemical reaction of the stone to airborne pollutants and often indicate disintegration of the stone behind the crust.

BIBLIOGRAPHY

The following is a selected list of sources to supplement this publication. Every effort has been made to ensure that the information is correct at the time of publication. The International Standard Book Number (ISBN) is noted for publications that are currently available. Please send any corrections and additions to the Ministry of Citizenship, Culture and Recreation, Cultural Programs, 77 Bloor Street West, 2nd Floor, Toronto, Ontario M7A 2R9; fax: (416) 314-7175; e-mail address: ansonct@mczcr.gov.on.ca

GENERAL SOURCES, STATUTES, MANUALS, AND DIRECTORIES

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Ontario Heritage Act, R.S.O., 1990, c. O.18. ISBN 0-7778-0297-X

Architectural Conservation Technology. 1994. Seven Volumes. Ottawa: Minister of Supply and Services. ISBN 0-660-14657-6 (Set)

Vol. I Project Management

Vol. II Heritage Recording

Vol. III Historic Site Analysis

Vol. IV Historic Site Design and Development

Vol. V Conservation Maintenance

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Ontario Monument Builders Association, Update

The guide is clearly written with many photographs and line drawings complementing the text. Response to this guide has been very positive; clearly there is a need for this information.

Ontario Association of Cemeteries, The Journal

Local Architectural Conservation Advisory Committees (LACAC) are always looking for easy-to-use technical resources to help us preserve the built heritage of our community. And as volunteers, LACAC members appreciate information in easy-to-understand language. *Landscapes of Memories* qualifies beautifully in both criteria.

*Sandy Tomlin, Heritage Planner,
City of Owen Sound, Ontario*

May I say how delighted I was to receive a copy of your excellent publication. We are in the early stages of writing such a guide on the care of Scottish Graveyards. Your publication is of considerable benefit to us at this very formative stage of our investigation.

Ingval Maxwell, Historic Scotland

My experience has shown there is an information gap between the masons – those who are actually doing the work – and the conservators. Your book is an invaluable step in bridging this gap.

*Meg Winslow, Curator of Historical Collections,
Mount Auburn Cemetery, Cambridge, Mass.*

The Ministry is to be congratulated for preparing such a user-friendly publication. We are pleased to have added your publication and web site information to our cemetery guidance material.

*Bernadette Castro, Commissioner
Office of Parks, Recreation and Historic Preservation,
New York State*